

KEMENTERIAN PENGAJIAN TINGGI JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI







# e-Proceedings NCTS 2022 NATIONAL CONFERENCE ON TVET FOR UNDERGRADUATE STUDENTS



## E-PROSIDING NATIONAL CONFERENCE ON TVET UNDERGRADUATE STUDENTS 2022

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## PRODUCT LIBRARY AS A LEARNING PLATFORM FOR NEW EMPLOYEES IN PURCHASING DEPARTMENT

Amirthavalli A/P Govindan<sup>1</sup>, Mohd Hadzrin Almi Bin Ismail<sup>2</sup> <sup>1,2</sup> Ungku Omar Polytechnic, Malaysia <sup>1</sup>amirtha@puo.edu.my <sup>2</sup>hadzrinismail@gmail.com

#### Abstract

Training is an essential part of adapting a new employee to a company's work environment. Technological advancements have expanded the delivery mode of training in companies ranging from internship, job rotation, lecture, mentoring, apprenticeship and in some cases self-study via online platform provided by the company. In this study research is done to analyse the user satisfaction of an online learning platform in the form of Product Library as a training source. The Product Library is developed to assist new employee in the company's purchasing department as the company has a high staff turnover rate. The product library is also developed to assist new purchasers who are not from engineering background during ordering process as it is found that they have difficulty dealing with suppliers when buying engineering-based materials, tools or equipment. The employees involved in this study were given 2 sets of Likert scale-based questionnaires to measure their satisfaction level regarding the Product Library implemented. The mean score average as stated in the first questionnaire analysis proved that the product library is a helpful platform for them to solve their problem and shorten the time taken for them to study the common engineering equipment before placing order with the supplier. Furthermore, the mean average score as per stated in the second questionnaire analysis shows that all the employees in purchasing department are satisfied and agreed that the Product library is a useful learning platform for them, and they are willing to recommend the Product library to other colleague.

Keywords: Product Library, new employee, purchasing department, user satisfaction

#### INTRODUCTION

Purchasing department is an integral part of a company that handles request from other departments and act as buyers while finding the best prices for material or product needed by company. The department also work as budget controllers to make sure that the company budget is followed. In order to have an efficient purchasing department it is crucial that all the employees within are qualified and are properly trained. One of the factors that can disturb an efficient working department is high staff turnover. According to Al-Suraihi et al (2021) one of the reasons that causes high turnover is because there is very little training and feedback from companies. Employee turnover is costly because



in addition to new employee replacement fees, there are hidden costs such as productivity loss, workplace safety issues, and morale damage. Malek et al (2018) study found that proper management training and management style has direct impact on employee turnover intentions. This research indicates that if companies invest in management training, then there will be a reduction in employee turnover intention. Studies also shows that company spending for internal training promotes interpersonal and organizational learning practices, which, in turn, increase resourceful performance among employees (Sung & Choi,2014).

The following study is done in a Malaysian manufacturing company's purchasing department with a high number of staff turnover. Most of the new employees or the buyers in this case are fresh graduates with no prior experience in the field of engineering. The buyers face difficulty when placing order as it is hard for them to figure out what kind of engineering equipment or part they need. For some engineering equipment the buyers need to know the exact size and dimensions of the parts, which is hard for a first-time buyer to do. Buyers also need to find and access different files, hardcopy manuals and seek senior buyers help each time a new order must be made. Because the company does not give the buyers any specific training or resources for them to get information, some of them take a long time to learn about the equipment and parts thus slowing down the ordering process or place wrong orders which in turn can create delay in production or monetary loss. This case is similar to a study by Bals et al (2019) that finds companies tend to adopt on-the-job training for purchasing employee but lacks in an efficient training approach for their employee.

To overcome this problem a Product Library is developed as a one-stop learning platform for new employees to access relevant parts and equipment information needed before placing order. Product library is a platform that will be added to SharePoint, which is the company's official portal. All employees in the purchasing department, especially the buyer, will have access to the product library. An analysis is done after the implementation of the Product Library to measure the user satisfaction and the efficiency of the platform in assisting new and existing employees within the company's purchasing department.

#### METHODOLOGY

This study is done in four stages; stage one involves clarifying the problem statement that has been identified, stage two is the development and implementation of Product Library to new employees, stage three is of conduct a survey to measure the effectiveness, satisfaction and agreement level of the new employee testing the Product Library developed and finally conduct a survey to measure the effectiveness, satisfaction and agreement level of measure the effectiveness, satisfaction and agreement employee testing the Product Library developed and finally conduct a survey to measure the effectiveness, satisfaction and agreement level of all purchasing department employee testing the Product Library developed.

For stage one, three and four of the study different sets of questionnaires were given to relevant group of respondents in the company's purchasing department to assess their agreement and satisfaction level. The questionnaires were given in a Google form using a 4-point Likert scale. Likert scales are a common methodological tool for data collection



used in quantitative or mixed method approaches in multiple domains (Pescaroli et al., 2020). Table 1 shows the indicator which represent the level of agreement and satisfaction of the respondent. This table is used to indicate the agreement level of respondent which are measured using Likert scale method (Education Planning and Research Division (EPRD), MOE, 2006).

Mean Score Representation of Mean Score	
3.26 – 4.00 Very High	
2.51 – 3.25	High
1.76 – 2.50	Low
1.00 – 1.75	Very Low

Table 1: Agreement level of respondent using Likert scale method

The Google Forms were used as it creates and analyse surveys with no special software. Google forms also enable us to obtain instant results as results come in and summarize survey results immediately with charts and graphs (Parinata & Puspaningtyas ,2021).

For stage 2 of the study an online learning platform is developed in the form of Product Library. This Product Library consists of all the commonly used tools and equipment in the company's production line. The product library will have detail catalogue on tools and equipment related to machining, piping, safety & environment, maintenance and raw materials. This is in tandem with study by Hudrasyah et al, 2019 where it is found that most governments and businesses all over the world use electronic platforms like E-catalogue to run their businesses these days . Hudrasyah et al (2019) and Nawi et al (2016) states that suppliers believe that e-catalogues make the buying and selling process easier for buyers. The platforms with the most up-to-date information helps the buyer make a better decision about what to buy (Naeem, 2019).

#### **RESULT and DISCUSSION**

#### 1. Set Questionnaire: Before Implementation Survey

Before making the decision to implement the product library in the purchasing department, a questionnaire was given to the targeted user. The goal of this survey also to clarify the problem statement that has been identified. Table 2 shows the content of the first questionnaire sent to the targeted respondent.

No	Product library for purchasing department	Mean	Level
1	Newcomers in the purchasing department take a long time to study certain equipment and processes before dealing with the supplier.	3.5	Very High
2	What do you think it is necessary that the purchasing department have a learning platform that explains the common equipment and processes used in the company (example : A Product Library)	3.5	Very High



3	Newcomers in the purchasing department who are not from an engineering background are unable to define the equipment that is related to engineering.	3.4	Very High
4	Implementation of a product library in the Purchasing department will assist newcomers to study the equipment that they are not familiar with.	3.7	Very High
5	The Product Library's implementation will shorten the time it takes us to find or study details about a piece of equipment.	3.7	Very High
	Average	3.56	Very High

Table 2: Mean score analysis for each question in questionnaire 1

This questionnaire is used to find verify our problem statement in the purchasing department. Table 2 shows that the average mean score is 3.56 for questionnaire 1. The results shows that the new employee really have issues regarding learning about engineering equipment and there is a need for a learning platform to be created in the purchasing department.

#### Page Break

## 2 Set Questionnaire: Effectiveness Survey After The Implementation Of Product Library

After Product library has been published and implemented in the company portal for a period of one month, an effectiveness survey on the implementation of product library is done. This survey is sent to employees with less than 3 months of experience. The survey is conducted to measure the effectiveness, satisfaction and agreement level of the users regarding the Product Library. Table 3 shows the result of the survey conducted.

No	Product library for purchasing department	Mean	Level
	Do you enjoy using Product Library? if no please state what aspect do you feel need improvement.	3.5	Very High
2	Product library is a useful platform	3.6	Very High
3	The use of a product library platform for learning platform promotes study flexibility.	3.5	Very High
4	The Product Library platform is easily accessible to users.	3.4	Very High
5	Because of my use of the Product Library, I can effectively manage my study time.	3.6	Very High
6	I appreciate the no-hassle learning experience provided by the Product Library platform.	3.7	Very High
7	I like the Product Library's ability to create a customizable learning environment.	3.6	Very High
8	Using product library helps reduce time taken to fill in order with the supplier	3.5	Very High



9	My motivation to learn about the company's common 9 technical equipment has increased after the establishment of the Product Library.		Very High
	Average	3.56	Very High

Table 3: Mean score analysis for each question in questionnaire 2

The goal of this questionnaire is to find out how satisfied the employees are with the Product Library developed. Mean results for each question are all above 3,5 which is the very high level. This shows that the employees are very satisfied with the Product Library developed. The respondents agree that the Product Library serves them as a useful learning platform that is easy to navigate and helps them learn at their own pace which in turn motivates them to learn. Survey also shows that the Product Library helps reduce time taken for employees to learn about a product before placing order or a supplier before doing business with them.

## 3 Questionnaire: Effectiveness Survey To All Staff In Purchasing Department Top Glove

The third set of questionnaires were distributed to all purchasing department employee of the company. The demography of the survey shown that 71.4% of the respondent are not from the engineering background. The respondent of this survey is Executive (52.4%), Trainee (23.8%), Manager (14.3%) and Researcher (9.5%) with 71.4% of them having work experience of 3 years and below while 28.6% of them already work for 3-6 years with the company. Out of this respondent 52.4% of the respondent have actively used the Product Library and 95.2% of them are aware about the Product Library implementation in the purchasing department of the company. Table 4 shows the mean score analysis for each question in questionnaire 3.

No	Product library for purchasing department	Mean	Level
1	The product library is a useful tool for non-engineering background staff to learn about engineering equipment before placing an order with a supplier.	3.3	Very High
2	Do you think that the product library is a useful platform?	3.1	High
3	The common product that company purchases from the supplier is the content of the product in the product library.	3.3	Very High
4	Share Point makes it simple to access the product library platform.	3.4	Very High
5	Using the product library improved your motivation to learn about common products and processes in the company	3.4	Very High
6	How would you rate the product library?	3.8	Very High
	Average	3.38	Very High

Table 4 : Mean score analysis for each question in questionnaire 3



Based on the survey results in Table 4 it is found that the employees agree that the Product Library is a useful and relevant learning platform that is easily accessible via the company SharePoint Platform. The mean average also shows the employees are highly satisfied with the Product Library.

#### CONCLUSION

Results from the surveys conducted shows that the employees are very satisfied with the Product Library developed. It has shortened the time taken in buying, dealing and studying process and improve the productivity of the staff in purchasing department. The Product Library has proven useful not only to new employees but also to others in the purchasing department. Survey results have also proven that the Product Library has all the relevant information needed by employee to place orders. All This shows that the purchasing department of the company can continue to use the Product Library as a learning platform for their employees and implement it as training mechanism. The researcher's recommendation for this project is to include more equipment in the product library platform and to publish it to all the other department in the company.

#### REFERENCES

- Al-Suraihi, W. A., Samikon, S. A., Al-Suraihi, A. H. A., & Ibrahim, I. (2021). Employee turnover: Causes, importance and retention strategies. European Journal of Business and Management Research, 6(3), 1-10.
- Bals, L., Schulze, H., Kelly, S., & Stek, K. (2019). Purchasing and supply management (PSM) competencies: Current and future requirements. Journal of purchasing and supply management, 25(5), 100572.
- Hudrasyah, H., Yusuf, M., Nugraha, C., Fatima, I., Rahadi, R. A., & Nugraha, C. (2019). e-Catalogue Attractiveness Study to Increase Suppliers Participation. Int. J. Accounting, Financ. Bus, 4(20), 14-31.
- Malek, K., Kline, S. F., & DiPietro, R. (2018). The impact of manager training on employee turnover intentions. Journal of Hospitality and Tourism Insights.
- Nawi, M. N. M., Roslan, S., Salleh, N. A., Zulhumadi, F., & Harun, A. N. (2016). The benefits and challenges of E-procurement implementation: a case study of Malaysian company. International Journal of Economics and Financial Issues, 6(7), 329-332.
- Naeem, M. (2019). Uncovering the role of social media and cross-platform applications as tools for knowledge sharing. VINE Journal of Information and Knowledge Management Systems.



- Parinata, D., & Puspaningtyas, N. D. (2021). Optimalisasi Penggunaan Google Form terhadap Pembelajaran Matematika. *Mathema: Jurnal Pendidikan Matematika*, *3*(1), 56-65.
- Pescaroli, G., Velazquez, O., Alcántara-Ayala, I., Galasso, C., Kostkova, P., & Alexander, D. (2020). A likert scale-based model for benchmarking operational capacity, organizational resilience, and disaster risk reduction. International Journal of Disaster Risk Science, 11(3), 404-409.
- Sung, S. Y., & Choi, J. N. (2014). Do organizations spend wisely on employees? Effects of training and development investments on learning and innovation in organizations. Journal of organizational behavior, 35(3), 393-412.



#### **PROJECT MONITORING APPLICATION**

Siti Hajar Binti Amiruddin<sup>1</sup>, Sunitha V. Doraisamy<sup>2</sup> Civil Engineering Department, Politeknik Ungku Omar, Ipoh, Perak *http://www.puo.edu.my* 

> Civil Engineering Department, Politeknik Ungku Omar, Ipoh, Perak *http://www.puo.edu.my*

#### Abstract

The use of systematic and proper document management at the site office and construction site is one of the most essential components in the success of a construction project. Construction sites will not be able to survive unless construction papers are organized and managed properly. The fundamental issue is that many construction projects will face a variety of issues, particularly in terms of project monitoring, resulting in unorganized progress work and project delays. The study's goal is to create a Project Monitoring Application and assess its' efficacy. The success of the Project Monitoring Application was broken down into further three sections sustainable practice, userfriendliness and communication capabilities. Almost all respondents from Building Department in Prima Reka Kounsultan agree and strongly agree that the Project Monitoring Application contributes to sustainable practices and user friendly. In addition, a survey was conducted to measure the effectiveness of the Project Monitoring Application. They also strongly agree that this application is accessible. Future studies, therefore, are recommended to obtain accurate results, especially on the effectiveness of all conveniently of this application. Cooperation from the staff was essential to increase the number of responses and samples.

**Keywords:** Project Monitoring Application (PMA), Mobile Application, Sustainable Construction, User-Friendly, Document Management.

#### 1. Introduction

Malaysia's building industry is one of the most important contributors to the country's economic growth. Through the formation of industries such as education, financial services, manufacturing, and service, the industry functions as a catalyst for our economy (Wesam, 2021). The primary parties will gather a significant volume of records on most building sites, and the records will cover a variety of characteristics of the construction operation (Abraham, 2016). It is acknowledged that the engineers and clerks of works



keep a very significant source of information regarding the status of the job on a daily basis as the work progresses.

For a variety of reasons, including satisfying auditors' requirements, paying creditors, and pursuing debtors, all companies must preserve records of their actions (Aditya, 2017). The records kept by parties on building sites, on the other hand, serve a variety of critical purposes, most notably quality, finance, and progress. Construction site reporting relies heavily on project progress. They're used to keep track of daily site development and ensure that any project snafus

The term "green construction" refers to the construction industry's responsibility to attain sustainability. The term "sustainability" has come to be seen as a panacea for change and progress (Abidin, 2021). The process of achieving long-term sustainability in construction is known as sustainable construction. Purvis (2019) proposes that the notion of sustainability be used to the construction sector in order to influence how projects are carried out in order to find a balance between environmental conservation and the continuation of economic prosperity. Obtaining sustainability does not imply removing negative impacts, which is currently an unattainable goal, but rather lowering them to a manageable level (UNEP,2011).

The rise of electronics in the 1970s ushered in the Third Industrial Revolution. The Digital Revolution refers to the evolution of technology from analogue electronic and mechanical devices to today's digital technologies. The Industrial Revolution (IR) 4.0 aspires for a viable and sustainable manufacturing system, with a higher level of complexity for integrating production and product processes so that they become part of a sustainable system. All three components of sustainability, social, economic, and environmental, are valued in the building of sustainable industry through Industry 4.0 and used for long-term competitiveness (Wesam, 2018).

#### 2. Background Of The Study

In this part, the researcher will provide an overview of the background of the study to be completed. An ongoing study has been conducted to establish existing research expertise. Apart from that, it is also appropriate to foresee a better solution to the problem. The researcher may also find a better approach from a previous case study using the other researcher. It also recognizes the value of documentation technology in the process of project implementation and in the phase of construction.

#### 2.1 Project Monitoring

Monitoring project time is one of the many challenges faced by the project manager. Time monitoring seeks to assess the extent to which the project adheres to the planned timetable over a period. There are several ways in which a construction schedule can be presented. The most common types of construction schedules include the Gantt chart, arrow activity, priority network, and balance line. Bar charts or Gantt charts are a powerful



communication tool and an extremely useful visual and graphical medium for building scheduling. In this construction sector, therefore, there will be a technology application with an advantageous impact in which efficiency can be improved and time saved. Moreover, by applying technologies such as apps or systems, it can be opened anywhere and simplifies everyday work with just a fingertip (Abidin, 2009). Project monitoring is the process of keeping a close eye on the entire project management life cycle and ensuring project activities are on the right track. Project monitoring is all about comparing actual performance to the goals you set. If you're not hitting milestones (e.g., delivering a prototype within a specified time), the project has a high chance of failure(Mondy,2020).

#### 2.2 Progress Report

Construction progress reports are prepared regularly (often monthly) by the contract administrator during the construction phase and are forwarded to the client. In general, they will be a summary of the reports received and the discussions held at the progress meetings on construction (Samir and Osama 2010). Construction progress reports can be a combination of minutes of construction progress meetings and reports received during those meetings, with key issues highlighted in the accompanying cover note. Alternatively, a re-written version of that information may be prepared specifically to meet the requirements of the client.

#### 2.3 Data Base Management System

In the field of computer science, the sub-field of database systems is dedicated to examining the problems of handling large volumes of information, with "massive" informally defined as a feature of the computing power and garage capability to be available at a given point in time. From its roots in business information processing.

Database-gadget research has advanced to one of the incredible fulfillment memories of computer science in phrases of enormous theoretical effects (e.g., relational model and transaction version) and in terms of high realistic industrial costs (Henry and Abraham, 2001). These achievements are documented in and in technical shows on the fate of database studies (Thomas,2010). Here we provide a more conceptual view of the databases and their function within the state-of-the-art information revolution (Kerssens,2018)

#### 2.4 Android Development

Android software development is the process of creating new applications for devices running the Android operating system. Android mobile app development is ongoing in the industry, with new mobile applications and other products being released on a daily basis. There was a time when we didn't have a choice but to code an application from graze for each stage. With the constant advancement of technology, it is now possible to code your own Android mobile application efficiently and quickly using a variety of Android Development Tools. There are application development tools available, such as Android



Studio, Visual Studio Xamarin, and Phone Gap (Android Developer Fundamental, 2016). Figure 1 shows android development for devices running.



Figure 1 : Android Development

Source: Android Develop Fundamental. (2016)

#### 3. Research Design

Research design is very important for planning and observation. The implementation steps should be monitored to identify problems that will arise during implementation. Changes need to be made when there is a critical problem that is a major cause of job implementation failure. Control measures must be taken to maintain a constant flow. Figure 2 show the details of data analysis methodology are illustrated.



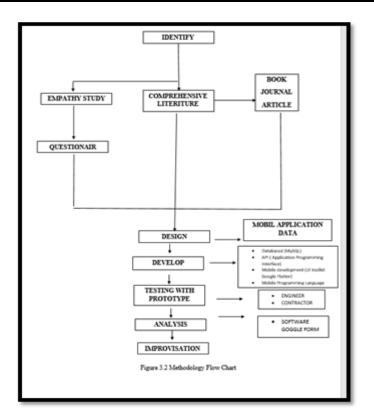


Figure 2 : Development of Research

Prototype provides visualization solutions. Various methods are involved, such as sketches, quick prototypes and more. Whichever method you choose, the main goal of this phase remains the same: to come up with a draft solution to decide whether it will be beneficial to the problem (Lauff, 2018). There is no decision yet on what software to use for this prototype, but some software to use has been studied such as, Database, API (Application Programming Interface), Mobile Development such as UI toolkit Goggle Flutter) and Mobile Programming Language. The software selected is very affordable and easy to use. Figure 3.2 below, show the flowchart of design prototype for main menu the Project Monitoring Application



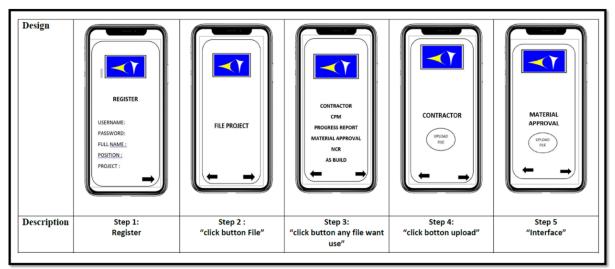


Figure 3 Prototype Design

The prototype is tested with the customer to see if they are satisfied with the solution. Any available improvement can be made to update the prototype. The questionnaire should be distributed to construction workers such as the site manager, engineer and supervisor. The implementation would make observations as the task was completed to determine the effectiveness of the application. In order to add value to the project, feasibility studies were carried out using primary and secondary sources. It was carried out with questionnaires and observation for the main source. The aim of the distributed questionnaire is to find out people's perceptions and knowledge of our project. In addition, collect feedback that can be used to improve the app. The purpose of this questionnaire is then to collect user feedback on whether or not they agree with the concept of the application.

Table 1: Feedback Mean Score						
Mean Score Representation of Mean Score						
4.20- 5.00	Very High					
3.40 - 4.19	High					
2.60-3.39	Medium					
1.80 – 2.59	Low					
1.79	Very Low					

Source: Education Planning and Research Division (EPRD), MOE, 2006.



Table 2 : Level of mean score on each question           Effectiveness of the developed system         Level					
Is the Project Monitoring Application helpful in dealing with progress reports?	High	3.43			
<ul> <li>Sustainable practices: Project Monitoring Application is in line with the sustainable construction problem solving</li> <li>a) Environmental: Using a Website Platform (can assist in reducing the use of paper in the production of schedule forms)</li> <li>b) Economic: Minimize Activity Delay and Less Cost</li> <li>c) Time: Are aligned with sustainable construction in terms of time savings</li> </ul>	Very High	4.5			
User friendly: it will not take long to create a document form using Project Monitoring Application a) Time: Can reduce the time to fill out the form b) Simple: Facilities c) tate the user	High	3.39			
Communication abilities: Project Monitoring Application allows for smooth communication, and users can easily obtain information a) Easy to access: can be accessed at any time and from any location	High	3.37			

#### 4. Conclusions

This study's major goal was to figure out which construction papers should be organised using Project Monitoring Application. The majority of respondents experienced concerns with the use of irregular documents, according to the findings of the analytical questionnaire, which caused numerous projects to be delayed.

The study's second purpose is to develop a mobile app-based site monitoring solution. The main focused on the design of an application for site monitoring development, the approach utilised throughout the study was discussed. A form of site log, as well as numerous irregular and unstructured building progress reports, make up the majority of the records in this system.

In order to assess feedback on the Project Monitoring Application's effectiveness, a survey is issued to the intended responder. According to the data, respondents strongly agree that the Project Monitoring Application Mobile is especially valuable for document management at the Kompleks Pendidikan AI-Ummah project site.

Overall, based on the findings of the observations and questionnaires, it is possible to conclude that they have roughly challenges during the document management process. According to all of the respondents, the problems at the site office have an impact on their work. The Project Monitoring Application Mobile was evaluated and found to be successful in document management at the site office in Kompleks Pendidikan Al-Ummah. The Project Monitoring Application Mobile, according to the majority of respondents, is beneficial.



#### References

- United Nations Environment Programme (2011). UNEP Year Book 2011: emerging issues in our global environment. https://wedocs.unep.org/20.500.11822/8276.
- Alaloul, Wesam & Liew, M.s & Wan Abdullah Zawawi, Noor Amila & Mohammed, Bashar. (2018). Industry Revolution IR 4.0: Future Opportunities and Challenges in Construction Industry. *MATEC Web of Conferences*. 203. 02010. 10.1051/matecconf/201820302010

Abraham Silberschatz, H. F. (2001). Database system concepts.

- UNESCO. (2017). Sustainable Engineering. Retrieved from Natural Sciences: unesco.org/new/en/natural-sciences/science-technology/engineering/sustainableengineering/
- Zainul Abidin, Nazirah. (2009). Sustainable Construction in Malaysia Developers' Awareness. World Academy of Science, Engineering and Technology. 53.
- Android Develop Fundamental. (2016). Learn To Develop Android Application. Android Develop Fundamental Course, 6-9. <u>https://google-developer-training.github.io/android-developer-fundamentalscourse-concepts/en/android-developer-fundamentals-course-concepts-en.pdf</u>
- AppFutura. (2016, September 27). Sustainable apps for a better future. Retrieved from <u>https://www.google.com.my/amp/s/www.appfutura.com/blog/sustainable-apps-for-a-better-future/amo/</u>

Sustainable apps for a better future . (2016, September 27). Retrieved from <u>https://www.google.com.my/amp/s/www.appfutura.com/blog/sustainable-apps-for-a-better-future/amo/</u>



#### IMPROVEMENT IN BEEHIVE SEPARATOR MACHINE WHEN IMPLEMENTING AUTONOMOUS MAINTENANCE (AM)

Husni Nazra Abu Bakar<sup>1</sup> and Muhammad Adib Mohd Saber<sup>2</sup>

<sup>1</sup>Mechanical Engineering Department, Ungku Omar Polytechnic, Ipoh, Perak husninazra@polycc.edu.my

<sup>2</sup>Mechanical Engineering Department, Ungku Omar Polytechnic, Ipoh, Perak adeepsaber@gmail.com

#### Abstract

Autonomous maintenance (AM) is a maintenance approach in which machine operators continually monitor, modify, and conduct small maintenance chores on their machines. The first pillar of the entire productive maintenance plan is autonomous maintenance. It has been 2 years beehive separator machine being using breakdown maintenance method for repairing their machine. The purpose of this project is to reduce the downtime and improve machine operator and production technician knowledge on controlling the machine by giving training. Various tools used for this project including questionnaire, pareto chart and bar chart. The tools used has been helpful in identifying the major root cause for certain breakdown. The project successfully perform improvement on the availability of the machine showed decrease values from 55 hours breakdown to 0 hours breakdown. Knowledge on machine operator and production technician was also showed a good improvement after training was given.

**Keywords:** Autonomous maintenance, Beehive Separator Machine, Downtime, Breakdown maintenance, Productive Maintenance.

#### 1. Introduction

Autonomous maintenance (AM) is a maintenance method in which machine operators monitor, adjust, and conduct small maintenance chores on their machines on a continuous basis. The first pillar of a whole productive maintenance approach is AM. An operator who has been trained in AM has a thorough understanding of basic activities such as cleaning, lubricating, and inspecting. It necessitates that operator accept responsibility for their equipment and its surroundings. This starts with cleaning the machine to a "like new" quality and maintaining it, as well as ensuring that operators are



trained in the right technical abilities for conducting routine inspections and establishing a consistent inspection plan (Praveen et al., 2014).

AM follows two core principles. To prevent equipment deterioration through proper operation, and bringing equipment to, keeping it at, "like new" status through restoration and proper management. There's a reason that autonomous maintenance comes first, with the ultimate goal of total productive maintenance being to improve organization's overall equipment effectiveness. It frees up skilled maintenance employees from having to worry about simple, routine maintenance activities, allowing them to focus on more complex projects. This has a number of benefits, including increasing the understanding of operators about their equipment, maintaining equipment in a "like new" condition by keeping it clean and oiled and the ability to spot potential problems before they turn into failures. Overall Equipment Effectiveness (OEE) is further increased by allowing machine operators to perform these normal maintenance checks and duties, which reduces breakdowns and equipment deterioration (Praveen et al., 2014).

AM method which was done on the machine at the company being selected in this reserach is the important procedure to prevent breakdown during production as well as to prevent production output demand. According to Praveen et al. (2014) and Nakajima (1989), AM method was the main procedure done before and after production in order to reduce breakdown during production, thus improve the OEE. Without a proper autonomous maintenance, the potential machine breakdown will increase, hence affectted the output production. The output is important for company's planning production which it needs to meet order demand.

Before the implementation of AM, the company was using breakdown maintenance where maintenance was performed on an equipment that has broken down, failure or cannot be operated. The past maintenance method involves engineering department team who supports the production's technician team in performing repair. This method will increase the downtime due to the time taken for engineering teams to arrive and diagnose the problem occurs. Shortage in labor man power for doing the maintenance process was also identified where maintenance teams need to take care for urgent maintenance action which will affect with other maintenance plans. Furthermore, there was also problem in machine operators who have lack of skill and knowledge on how to handle the machine.

reseracn)						
Date Start	Date Finished	Time Start	Time Finished	Total Downtime	Issues	Root Causes
9/2/2021	9/2/2021	4:55:00 PM	7:35:00 PM	2:40:00	Drive chain broken	Wear and tear
9/14/2021	9/14/2021	10:00:00 AM	1:28:00 PM	3:28:00	Loud sound from machine	Bolt damage causing motor loose
9/21/2021	9/23/2021	10:00:00 AM	10:00:00 AM	48:00:00	Abnormal sound from machine	Beehive being damage

Table 1: . The downtime on beehive machine (Source: Company being selected in reserach)



10/6/2021	10/6/2021	12:00:00 PM	12:32:00 PM	0:32:00	Abnormal sound from chain	Beehive machine tensioner loose
10/23/2021	10/25/2021	3:00:00 PM	10:32:00 AM	43:32:00	Auger stucked and cannot be opened	Bearing and seal damage

The downtime for beehive machine is a minor frequently happen but when the downtime occurs on the machine, it will take a few days to rectify. During this downtime it will impact on the production output and also on the demand order. Table 1 illustrates the breakdown on beehive separator machine before the improvement of AM which shows the time start and finish of the machine breakdown as well as the total downtime of the machine. It indicates that, the unexpected machine (equipment) breakdown that disrupt production and lead to loses (Gosavi, 2006). From the table, it defines that there is no early detection and action after the abnormalities on the machine. The root causes and issues of the machine is on mechanical part where the part need to be monitor regularly to prevent it from worn out.

In addition, questionnaires may be used to acquire information on customer attitudes and behavior in a variety of scenarios. The willingness of participants to participate in questionnaire surveys is very important. To optimize response rates, a significant amount of work must be put in from the beginning to ensure that the questionnaire is acceptable to the target demographic. This document outlines the processes to take while conducting a questionnaire survey and explores strategies for increasing response rates. Processes must be summarized while creating the questionnaire which firstly by defining the research question and study population followed by deciding on how the questionnaire will be administered, then formulate the questions. After that, the next process includes formulating the responses followed by designing the layout and doing the pre-pilot towards the questions and layout. Then, pilot study–test validity, reliability, and acceptability will be conducted followed by designing the questionnaire and lastly the questionnaire will be printed to be given to the respondants (Williams, 2003).

As said by Williams (2003), it is important to determine the research project, respondents of the study, and research objective at the start of the research. People are more likely to respond to questionnaires that include issues that are important to them, according to previous research. As a first step in questionnaire research, qualitative approaches like as focus groups and unstructured interviews are increasingly being used to discover topics of concern to operators [4]. Questionnaires can be used as the foundation for a structured interview conducted by a skilled interviewer, or they can be completed independently by the subject. When deciding how to administer a questionnaire, ones must strike a balance 25 between practical concerns, such as the study's timeframe and funds, and the topics that being investigated (Williams, 2003).

The way questions are phrased has a significant impact on the replies that are offered. The fundamentals of question selection are summed up by using simple language, avoid jargon and keep questions short and specific. The most crucial guidelines for conducting



a questionnaire survey is the stages involved in creating and testing a questionnaire, as well as concerns surrounding data processing, have been covered (Williams, 2003).

Improvement of AM is to improve knowledge on machine's operators and production's technicians in which on how to handle the machine beehive separator which output concerns are related to questionnaires given . Thus the paper aims to reduce beehive downtime with improvement in AM and to identify the improvement of knowledge for machine's operators and production's technicians with AM.

#### 2. Methodology

This chapter explains about the planning and the flow of the project research in order to achieve the objectives stated.

#### 2.1 Improvement of knowledge

As the first line defense of beehive separator machine from breakdown, machine's operators and production's technicians should have skills and knowledge about the machine that they are handled. Thus, a proper training on how the machine components work and what is the critical part of the machines need to be given to them in order to enhance their skills and knowledge on beehive separator machine. The method that has being use is one point lesson (OPL) and training class. In brief, machine's operators and production's technicians can improve their skill such as detect abnormalities, correcting and restoring basic maintenance and maintaining machine in an optimum condition.

#### 2.2 One Point Lesson (OPL)

One-point lesson (OPL) is a simple, visual and of the pointwise description of a task. An OPL consist pictures, symbols, simple texts and is a short tasks. The main objective of the OPL is to give information about specific problems and improvements such as safety, basic knowledge, trouble and improvement. Safety is the object lesson related to ensures the safety gap which creates the awareness of potential risk. Basic knowledge is about the removing of the knowledge gap which lesson on how to gives the basic knowledge information. Furthermore, trouble is a lesson which gives actual examples of breakdowns, defects and other abnormalities to illustrate how to identify and avoid a work place problem. It is the most effective when presented immediately after the problem occurs. Moreover, improvements that result from team activities. It helps teams in other areas to create similar improvements.

#### 2.3 Machine training

The main objective of machine training is to improve machine's operators and production's technicians related to the functions of the machine and on how to control the machine along with the cleaning process and the critical part of the machine.



#### 2.4 Machine function

The function of the machine is mechanically regulated, self-feeding processor used to process poultry, red meat, seafood and certain types of fruits and vegetables. The separator is a twin-motor design with separate control of the feed-screws and separator head assembly for maximum product control. The auger, chamber, and ring valve have been specifically designed for maximum product quality and production following the specific processing requirements.

#### 5. Critical part

Critical part of the machine is an important part of the process where machine's operators and production's technicians need to do an inspection before and after the production in order to detect any abnormalities and early prevention from breakdown to happen. The critical part for beehive machine includes control panel, auger, feed screw, head bearing and the rotation of auger and feed screw.

#### 6. How to operate machine

The step on how to operate the beehive separator machine are starting with installing the auger and head bearing, followed by checking the machine for any leakage or loosen part. The next step is to turn on the machine, afterwards doing checking for any abnormalities, then adjust the position of the ring valve to get the desired yield. Subsequently, the production is starting by putting product in infeed chamber and to finish with waiting until the product come out at feed.

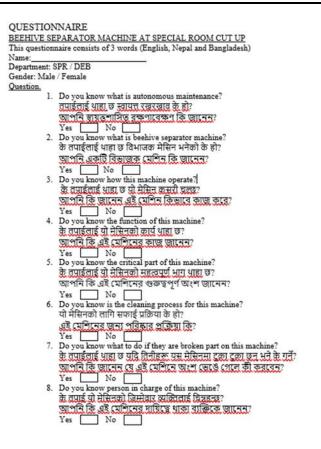
#### 7. Cleaning Process

Cleaning process on the beehive separator machine must be initially done with removing and cleaning the part of head housing slinger/spacer head gasket pump housing auger ratchet ring, feed-screws chamber auger nut hopper seals ring valve ring clamp and adapter bracket. Secondly, cleaning the chamber followed by remove as much product from the chamber as possible. Next process is to immerse the chamber in the cleaning solution then allow the chamber to soak overnight. After soaking was done, the chamber is rinsing inside and outside with high pressure hot water and lastly cleaning and sanitizing the chamber.

#### 2.7 Questionnaire

A questionnaire is a research tool that consists of a sequence of questions (or other sorts of prompts) designed to collect data from respondents in a survey or statistical study. Although questionnaires are frequently created for statistical analysis of the responses, they can also be used for other purposes.





# Figure 1: Questionnaire on beehive separator machin at special room cut up given to the respondents

#### 3. Results and Discussion

In this chapter the data obtained from questionnaire and downtime trend will be discussed and analyses with respect to the objective of the study.

#### 3.1 Reduction of breakdown downtime.

With kickstarting improvement in beehive separator machine in September. The time frame of monitoring this improvement was start from September. Based on Figure 2, the month of September and October had the higher duration downtime compare to the month of November and December. This is due to the machine's operators are still learning and adapting the new job scope. Hence, the high downtime indicates at beehive separator machine which are 55 and 44 hours respectively. Also, in the month of September operator detected early abnormality at machine auger resulting in plan downtime in servicing the machine for 55 hours. In October with the result of increasing machine's operators and production's technicians doing sharing knowledge, the downtime was still high but slightly reduce compare to the month of September. This is due to the machine's operators detected early abnormalities on gearbox issue which resulted in planned downtime to repair the machine. In November and December both



months demonstrates promising result compared to the first 2 months. Operator have the senses of machine ownership. During this time machine's operators conducted regular cleaning, oiling, tightening and inspection (COTI) supervised by production technician. Hence the machine downtime reduces to 24 and 12 hours respectively. Thus, it shows that the percentage decreasing hours in downtime covers about 78.2% from September 2021 to December 2021, hence shows a better transition with the improvement of AM.



Figure 2: Duration downtime during improvement

Figure 3 illustrates the downtime data from January to March 2022 that there was no downtime recorded through out the first 3 months. This shows that by improving machine operator and production technician knowledge prove that operator is the first line of defense of AM concept



Figure 3: Duration downtime after improvement

Figure 4 tabulates the comparison of the project during 7 months duration which is from September 2021 to March 2022. The time frame shows the reduction of downtime and



the availability of the machine has increase. A sharp decline of downtime had a great positive result where the availability of the machine is 100% during January until March. It also improves the OEE of the beehive separator machine.

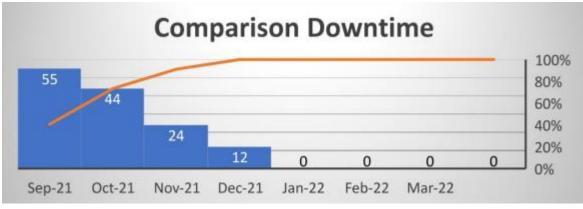


Figure 4: Comparison downtime

Figure 5 shows the questionnaire results before and after knowledge sharing session with machine's operators and production's technicians that covers all machine aspects including machine function, operate machine, cleaning process and critical part of the machine. The machine function is to make minced meat from the raw material in the chicken poultry for future process in making nugget, minced meat and sausage. Operate the machine is where the machine operator learns a proper step to start up and run the machine. Cleaning process is to train the machine operator to clean their machine in a proper way. During this process will keep them to inspect any leak, loose bolt crack or contamination on the machine. Sharing knowledge about critical part will improve machine operator on their visual inspection on the machine it also can detect for any abnormalities. It can be seen that 7 out of 8 or 87.5% of operators and production, cleaning process and critical part while all of the machine operator and production technician have full knowledge in operating the machine after improvement autonomous maintenance was applied.



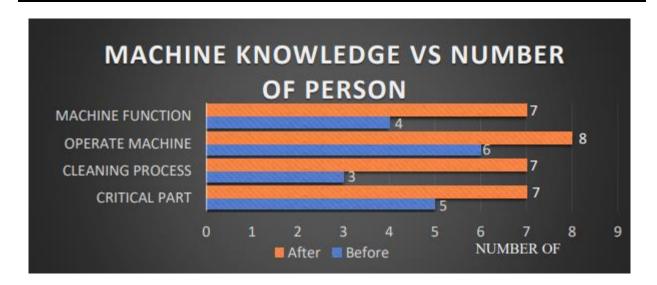


Figure 5: Graph on machine knowledge vs. number of person

#### 4. Conclusion

AM technique, which may become a significant part of intelligent quality management system, has a heavy focus on knowledge management and improvement through organizational learning in the domain of maintenance. The result of the improvement of implementing autonomous maintenance by improving machine operator and production technician knowledge help to reduce the downtime of beehive separator machine from 55 hours breakdown time to 0 breakdown.

An improvement knowledge for machine operator and production technician is successfully. This improvement helps the understanding for operator and technician to perform easy daily maintenance and checking activities such as focusing on major and critical part of the machine. It also helps them to know the abnormalities on the machine. Other than that, it gives them responsibility and encourage as a machine owner to keep their machine in best condition during production. Therefore, thru this improvement knowledge had lead to reducing the downtime of beehive machine.

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#### References

- Praveen, S. S, Mushtaq, P. & Vivek, B. (2014). A Literature Review on Overall Equipment Effectiveness. International Journal Of Research In Aeronautical And Mechanical Engineering. 2. 35-42.
- Nakajima, S. (1989). *TPM Development Program: Implementing Total Productive Maintenance (1<sup>st</sup> ed.).* Productivity Press, Inc. Cambridge, MA.
- Gosavi, A. (2006). A risk-sensitive approach to total productive maintenance. *Automatica*. *42*. 1321-1330.
- Williams, A. (2003). How to ... Write and analyse a questionnaire. *Journal of Orthodontics.* 30. 245-252.



# INTERACTIVE E-SITE PREPARATION USING AUGMENTED REALITY

<sup>1</sup> Muhamad Aqlan Amir & <sup>1</sup>Seri Bunian Mokhtar

Civil Engineering Department, Politeknik Ungku Omar, Ipoh, Perak muhdaqlanamir17@gmail.com

Civil Engineering Department, Politeknik Ungku Omar, Ipoh, Perak mseribunian@gmail.com

#### Abstract

A severe lack of planning is one of the most common issues that contractors face when embarking on a site preparation project. Every site is distinct, including the slope, topography, and overall land layout. Every preparation task, regardless of how experienced a professional, will invariably present new challenges. Poor planning is the direct cause of inefficiency. Therefore, this study aims to design and develop an Interactive e-site preparation using Augmented Reality that allows users to access information on the details of planning for site preparation. This research started by designing and developing the interactive e-site preparation using augmented reality(esite) system using BlippAR, and lastly analysing the data using questionnaire. This product were tested among 10 members of the project team for Gamuda Berhad Sdn Bhd employees consist of engineer, site supervisor, project manager. The effectiveness of the product was evaluated using paired t-test, analysed by Social Science Statistics online website. The paired t-test result showed that Interactive E-Site Preparation has a significant different compared with existing method. This mean that Interactive E-Site Preparation was more effective in term of usability compared with the existing method. This product was highly recommended to be used in managing site preparation for construction site.

**Keywords:** Industrial Revolution (IR) 4.0, augmented reality, construction site, site preparation



#### 1. Introduction

Project management has evolved to plan, coordinate, and control the complex and diverse activities of modern industrial, commercial, and management change, as well as information technology (IT) projects (Lock, 2007). All projects have one thing in common: the transformation of ideas and activities into new ventures. Because of the ever-present element of risk and uncertainty, the events and tasks leading up to completion can never be predicted with absolute certainty. There are numerous examples of projects that have vastly exceeded their budgets, finished late, or even been abandoned before completion. Such failures are all too common in all types of projects in industry, commerce, and (apparently, especially) the public sector. The goal of project management is to anticipate or predict as many hazards and problems as possible, as well as to plan, organize, and control activities so that projects are completed successfully despite all risks. This process should begin before any resources are committed and should continue until all work is completed. The primary goal of the project manager is for the end result to satisfy the project sponsor or purchaser, as well as all other major stakeholders, within the timeframe promised and without using more money or other resources than were originally set aside or budgeted.

Construction is an important and productive sector in Malaysia for economic growth in order to improve the quality of life and living standards of Malaysians (Ali Khan, et al., 2014). According to the Malaysian Department of Statistics, the value of construction works increased by 1.3 percent in the first quarter of 2019. The main type of activity is civil engineering works, followed by non-residential buildings, residential buildings, and finally special trade activities. In the fourth quarter of 2019, the Civil engineering sub-sector increased by 7.9 percent, followed by the Special trades activities sub-sector by 3.8 percent. After contracting since the first quarter of 2018, the residential building sub-sector increased by 2.7%. Meanwhile, the non-residential building sub-sector fell by 10.3% (Mahidin, 2020).

Finally, as the construction industry prepares for the fourth industrial revolution (IR 4.0), construction technology innovation has accelerated. Technology succession planning has not been well managed in the construction industry. According to Woodhead et al.(2018) believes that the construction industry must make a pivotal shift to digitised processes in order to make project delivery more cost-effective. Companies that do not embrace this shift will struggle to maintain long-term business growth due to significant productivity losses. The digitalization process has improved many areas, including productivity, agility, innovation, consumer experience, quality, costs, and revenue. Despite significant advancements in construction techniques, materials, worksite automation, scheduling techniques, and collaborative platforms such as BIM, concerns have been raised about the construction sector's resistance to adopting such technology. IoT applications are widely spread across all domains. Although other industries are incorporating it into their daily processes, the construction industry is lagging behind in adopting an IoT eco-system. A recent study identifies several areas for construction tool



and equipment tracking, equipment servicing and repair, remote usage monitoring, augmented reality (AR), Building Information Modelling (BIM), predictive maintenance, progress monitoring, construction safety, and quality monitoring (Burger, 2018). Furthermore, the Malaysian construction industry is currently developing IoT applications related to building information modelling (BIM), augmented reality, cloud computing, and big data analytics. However, the implementation is still in its early stages and requires further improvement as well as more expertise in managing IoT implementation in Malaysia (Alaloul et al., 2018).

One of the most common issues that contractors face when embarking on a site preparation project is a severe lack of planning. Every site is unique, including the slope, topography, and overall layout of the land. Every preparation task, no matter how experienced a professional, will invariably present unique challenges. Inefficiency is the direct result of poor planning. Even if the contractor you hire has a team of professionals wearing matching uniforms, there is a problem if they simply arrive on site and want to get started right away. When you hire the right team, they will want to come out and do some sort of consultation. They will not simply arrive and begin site preparation because they cannot predict which machines will work best or what approach will be best until they have seen the site.

Poor site management can lead to project delays and decreased productivity. Based on (Acharya, et al., 2004) all construction projects in the world may have completed projects with time overruns, such as the Asian Development Bank project, which was awarded the "Outstanding Award" but is still facing a 9-month project delay. Every construction project should have a high rate of productivity. When a construction project is faced with a construction constraint, it has an impact on three major elements of the project: time, cost, and quality, resulting in a low productivity rate (Sambasivan, et al., 2007). According to (Acharya, et al., 2004) poor planning during the early stages of the project will result in delays at various stages throughout the project. As a result, an experienced contractor and labour are required, especially for large and mega projects. Good planning and management are essential for accelerating the project plan and overcoming time burn during delays. A few steps are taken by the researchers to improve the problems that causes the overrun causes which have leads to many problems to the contractors and to the others parties as well. To avoid variations (additions and omissions) comprehensive site investigation should be carried out at the design phase of the project which is compromises all aspects of possible changes must be considered thoroughly before construction begins to avoid undue changes and delays.

From the previous researches, it can be concluded that there were many researched that have been done regarding planning of the project. Based on (Ibrahim et al, 2021) Site monitoring is an essential part of the construction process to ensure the progress of the project development and the environment of the construction site is smooth, and maintain on track all the time. Construction site monitoring is divided into two parts: tracking of human (track worker) and machinery (track machinery) activities on site (Boje, et al., 2020). The use of IoT for monitoring is to assist the project team in staying on track



and automatically recording the massive volume and variety of data throughout the entire project lifecycle, which cannot be handled manually by the project team. Furthermore, information from human tracking and machinery is recorded using GPS, RFID, sensors, and drones via IoT. The information from these devices can be accessed by the project team via mobile, tablet, and computer, which is beneficial in managing the time and cost of the project at each development stage, as well as improving the monitoring system to be more effectively and efficiently (Boje, et al., 2020).

Next, in project management, the primary key indicators for project success are time, cost, quality and the scope of the project. Previously, most projects encountered difficulties with those key indicators in completing a project within the time frame specified with a limited budget because they lacked efficient management at the time. However, with the IoT application, project management is made more manageable by digitally monitoring the entire project progress through the visualisation of the 3D model. The digitalization of 3D models enables project management to better utilise project resources, monitor vehicle equipment, track project progress, detect errors and clashes earlier, provide real-time reporting, and manage project scheduling and costs (Enegbuma, et al., 2014). From previous research, it can be concluded that there were many researches that have been done. However, none of the previous research use application BlipAR in their design. Therefore, this study aims to develop e-site preparation stage using Augments Reality.

## 2. Method

## 2.1 System design and Development

Blippar WebAR SDK is a software development kit that allows to create and run AR Experiences on mobile web browsers. It can easily create AR experiences that interact realistically with objects and environments using WebGL-based 3D content and/or operable HTML elements using WebAR SDK and A-Frame or PlayCanvas. WebAR SDK is also a library of classes that interact with various application programming interfaces (APIs) to create a unique set of augmented reality and plane detection features that can be integrated into third-party applications. It also makes use of device motion sensors to track and fix an object on any surface. WebAR SDK enables developers to create and publish augmented reality content in their web environment. While augmented reality allows for the rendering of virtual objects in the real world, WebAR SDK allows for the accurate placement and tracking of those objects in order to create an immersive web experience. It works with web content standards that support 2D and 3D graphics, such as HTML and WebGL. It can implement AR on mobile web browsers that adhere to web standards by utilising various JavaScript-based library and framework features in AR applications (Chrome, Safari, etc.) Figure 1 show the development of Interactive E-Site Preparation



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Figure 1: Design and development process of Interactive E-Site Preparation.



#### 2.2 Materials Used

Material	Function
1. Power Point, Word and GSite	To make an animation, note, site plan and all site preparation information that can be access using AR.
1. Blippar	
blippar.	A software for easier people to scan and gain information on site preparation.

#### Table 1: Material used in developing of Interactive E-Site Preparation

#### 2.3. Testing

The end product was tested using online questionnaire. This product was developed using BlippAR and were tested among 10 Gamuda Sdn Bhd employees consist of engineer, site supervisor, project manager. The questionnaire was adapted from Technology Acceptance Model by Davis (1989). Technology Acceptance Model (TAM; Davis, 1989) has been one of the most influential models of technology acceptance, with two primary factors influencing an individual's intention to use new technology: perceived ease of use and perceived usefulness. TAM most familiar variables being measured in this study which is Perceived Ease of Use, Perceived Usefulness, Attitude Towards Using Technology and Behavioral Intention to Use. The sample size was determined using Krejcie and Morgan Table (1970) whereby for population of 10 respondents, 10 samples were adequate. Therefore, all population were involved in this study. The simulation study done by De Winter (2013) showed that there is no fundamental objection to using a regular t-test with extremely small sample sizes. He emphasized that even a sample size as small as 2 did not pose problems.



## 3. Results

3.1 The end Product of Interactive E-Site Preparation

Figure 2 shown the end product of Interactive E-Site Preparation using AR. The AR will possess contents such as documents, site plan and other related site preparation in just one scan.



Figure 2: Interactive E-Site Preparation Marker

## 3.1 Usability Level of Interactive E-Site Preparation

Table 3 shows respondent level of usability toward using existing method whereby analysis shows for all variables tested the mean score were less than 2.00 meaning that the usability level of existing method were low. Whilst Table 3 shows respondent level of usability toward using Interactive E-Site Preparation whereby analysis shows for all variables tested the mean score were more than 4.00 meaning that the usage of Interactive E-Site Preparation much more easier compare with the existing method.



Variables	Mean	Interpretation
Perceived Ease of Use	1.88	Very Low
Perceived Usefulness	2.03	Low
Attitude Towards Using Technology	1.80	Very Low
Behavioral Intention to Use	1.43	Very Low

I able 3 : Usability Level of Intera	active E-Site Preparation among respondants

Variables	Mean	Interpretation
Perceived Ease of Use	4.38	High
Perceived Usefulness	4.33	High
Attitude Towards Using Technology	4.07	High
Behavioral Intention to Use	4.13	High

3.2 Significant diffirences between Interactive E-Site Preparation compare with the existing method.

In order to evaluate the effectiveness of Interactive E-Site Preparation in the project, a paired sample t test was performed. Results as shown in Table 4, respondent preferred using Interactive E-Site Preparation whereby all variable measured Perceived Ease of Use (Mean = 4.38), Perceived Usefulness (Mean = 4.33), Attitude Towards Using Technology (Mean = 4.07) and Behavioral Intention to Use (Mean = 4.13) were more higher compared with existing method Perceived Ease of Use (Mean = 1.88), Perceived Usefulness (Mean = 2.03), Attitude Towards Using Technology (Mean = 1.80 and Behavioral Intention to Use (Mean = 1.43). A paired sample t-test found this difference to be significant for all variables being measured. The value of t of Perceived Ease of Use is 17.32 and the value of p is < .00001. The result is significant at p < .05. The value of t of Perceived Usefulness is 31.65 and value of p is < .00001. The result is significant at p < .05. The value of t of Attitude Towards Using Technology is 20.87 and the value of p is <.00001. The result is significant at p < .05. The value of t of Behavioral Intention to Use is 30.08 and the value of p is < .00001. The result is significant at p < .05. This suggests that using Interactive E-Site Preparation was much easier and resourceful compared with existing method. This mean that Interactive E-Site Preparation was more effective compare with the existing method.

Table 4 : Paired sample t-test			
Pair	Paired Different Mean	t	Significant (two tailed)
Perceived Ease of Use - Existing Method	2.25	17.32	.000
Perceived Usefulness - Existing Method	2.30	31.65	.000



Attitude Towards Using Technology- Existing Method	2.27	20.87	.000	
Behavioral Intention to Use- Existing Method	2.70	30.08	.000	

## 4. Conclusions

The result showed those respondant which consist of employees of Gamuda Sdn Bhd employees consist of engineer, site supervisor, project manager were agreed that Interactive E-Site Preparation system is more effective compare to existing method. The current method that has been used on site is they use paper as their reference and submission. This method was obsolete and hard to manage. Higher mean (> 4.00) were agreed with Interactive E-Site Preparation easy to use and they have the intention to use it to gain information of site preparation. The effectiveness of the Interactive E-Site Preparation was evaluated using paired t-test, analyzed by Social Science Statistics online website. The result shows that Interactive E-Site Preparation has a significant different compare with existing method. This mean that Interactive E-Site Preparation was more effective and easy to use compare with the existing method. This product was highly recommended to be used in gaining all information for construction site.

In addition, this Interactive E-Site Preparation also can be access as mobile application which it will also ease the user and ready plus easy to use by all employee. The conclusion that researcher can make is technology in construction sector is important to produce the best quality and product for the project. Interactive E-Site Preparation can cut the cost of paper using, save time, and the organization become more systematic. Hence, the usage of technology in the company also can attract more clients to choose company service. By applied the technology in managing construction activities may also help to bring Malaysia parallel with other success countries in the world. Technology in construction sector is important to boost of a nation's economy.

## References

- Acharya N K, Yong Kim S and Dai Lee Y. (2004). Factors affecting timely completion of construction projects Proceedings of the Fifth Asia Pacific Industrial Engineering and Management Systems Conference 2004. p 22.4.1-13.
- Alaloul, W. S., Liew, M., Zawawi, N. A. W. A., & Kennedy, I. B. (2020). Industrial Revolution 4.0 in the construction industry: Challenges and opportunities for stakeholders. *Ain Shams Engineering Journal*, 11(1), 225–230. https://doi.org/10.1016/j.asej.2019.08.010



- Ali Khan R, Shahir Liew M and Ghazali Z. (2014). Malaysian Construction Sector and Malaysia Vision 2020. *Developed Nation Status Procedia Soc. Behav. Sci*, 109 507–13.
- Boje, C., Guerriero, A., Kubicki, S., & Rezgui, Y. (2020, March). *Towards a semantic Construction Digital Twin: Directions for future research.* Retrieved from https://doi.org/10.1016/j.autcon.2020.103179
- Burger, R. (2018, may). Retrieved from How "The Internet of Things" is Affecting the Construction Industry: https://formworkdokauk.com/2017/12/04/how-the-internet-of-things-is-affecting-the-construction-industry/
- Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly*, *13*(3), 319–340. https://doi.org/10.2307/249008
- Enegbuma, W. I., Aliagha, U. G., & Ali, K. N. (2014). Preliminary building information modelling adoption model in Malaysia A strategic information technology perspective. *Construction Innovation*, 408–432.
- Ibrahim, F. S. ., Binti Esa, M., & A. Rahman, R. (2021). The Adoption of IOT in the Malaysian Construction Industry: Towards Construction 4.0. International Journal of Sustainable Construction Engineering and Technology, 12(1), 56–67.
- Krejcie, R.V. & Morgan, D.W. (1970). Determining Sample Size for Research Activities. Educational and Psychological Measurement. 30. 607-610.

Lock, D. (2007). Project management. – 9th ed. USA: Gower Publishing Company.

Mahidin, D. M. (February 2020). *Quarterly Construction Statistics, Fourth Quarter 2019.* DEPARTMENT OF STATISTICS MALAYSIA.

- Sambasivan M and Soon Y W. (2007). Causes and effects of delays in Malaysian construction industry. *Int. J. Proj. Manag*, 25 517–26.
- Woodhead R., Stephenson P., and Morrey D. (2018). "Digital construction: From point solutions to IoT ecosystem." *Autom. Constr., vol.* 93,, pp. 35–46.
- De Winter, J.C.F. (2013) "Using the Student's t-test with extremely small sample sizes," *Practical Assessment, Research, and Evaluation*, 18(10). DOI: https://doi.org/10.7275/e4r6-dj05



# E-MACHINERY ORGANISER WITH CLOUD STORAGE APPLICATION

<sup>1</sup>Thurairaj A/L Kumar & <sup>1</sup>Seri Bunian Mokhtar

Civil Engineering Department, Politeknik Ungku Omar, Ipoh, Perak *thurai.9748@gmail.com mseribunian@gmail.com* 

#### Abstract

Usage of Industrial Revolution (IR) 4.0 in all economy sectors were increasingly widespread including construction sector all around the world. The current method of identifying location of machineries through WhatsApp and messages are not relevant according to the digital era. Furthermore, it is clearly not beneficial based on the survey and interviews done. Therefore, the aim of this project was to develop an E-Machinery Organiser application with cloud storage using latest technology which was parallel with Industry Revolution 4.0 (IR 4.0) technology. This product was developed using Adalo app and the product were tested among 30 members of the project team for the Kota Elmina Business Park project. The effectiveness of the product was evaluated using paired t-test, analysed by Social Science Statistics online website. The paired t-test result showed that E-Machinery Organiser has a significant different compared with existing method. This mean that E-Machinery Organiser was more effective in term of usability compared with the existing method. This product was highly recommended to be used in managing machineries for construction site.

**Keywords:** Industrial Revolution (IR) 4.0, application, construction site, machinery management

#### 1. Introduction

Construction is a field of industry which is always relevant and is still important to be carried out as the world's population grows from ancient times to the present. As the world progresses into the most advanced technologies, all industries, including construction, must adhere to the Fourth Industrial Revolution (IR4.0) requirement in order to provide the best results to all parties involved, including developers, clients, consultants, main contractors, subcontractors, and others. IR 4.0 is all about using digitalization to propose new ideas and improvements in the construction industry, whether it's through project initiation (planning), project planning (preconstruction), project execution (construction), project monitoring and control, or project closing (close-out). According to Haron et al.



(2017), rapid economic expansion has raised demand for infrastructure and facilities across the world, the construction industry has become increasingly important. The building industry also contributes to the long-term viability and development of human existence on the planet. Construction projects are in high demand and activities are booming in many countries to cope with an ever-increasing population, land pressure, and growing economic activity. Furthermore, programmes and initiatives are launched to safeguard the nation's economy's long-term viability and to build vast economic ties. From the planning stage to the finish, an effective project management technique must be used to ensure that these projects are implemented successfully and that the functional goals of the projects are met within the project's service period. According to Magsoom et al. (2018) the second highest reason that causes time and cost overrun in a construction project is poor site management and supervision by contractor. Poor site management and supervision comes in many forms and machinery management is one of them. Therefore, it is clear that machinery management is one of a serious issue that has to be tackled on site for a smoother workflow. According to Ramli et al. (2021), the construction industry is critical to the country's economic prosperity. Construction is an important and productive sector in Malaysia for economic growth and improving the guality of life and living standards of Malaysians. However, Malaysia is suffering challenges in construction industry in such of poor performance of time and budget, wastage of construction, low productivity and over-reliance on foreign labours. Despite from all challenges, project delay is categorised as major component of construction management process and has become the key factor to gain success in a project.

Finally, as the construction sector prepares for the fourth industrial revolution (IR 4.0), construction technology innovation has grown at an exponential rate. The internet of things (IoT) is recognised as one of the main aspects to assist the sector in enhancing their productivity output, according to the nine (9) pillars of the fourth industrial revolution (Alaloul et al. 2018). Due to that, the integration of IoT and the other pillars in the fourth industrial revolution such as advanced robotics, additive manufacturing, augmented reality, simulation, system integration, cloud computing, cyber-security and big data analytics is important to optimise computerisation and digitalisation usage by the construction players for the purpose of monitoring and controlling the whole project lifecycle. With high encouragement from the government and other construction agencies worldwide, IoT has become the central topic among the construction industry players, including Malaysia, especially regarding the readiness towards Construction 4.0 by using digitalization and IoT in construction industry (Ibrahim, et al, 2021). By using the IoT, the project lifecycle become more manageable, especially in monitoring and controlling the machinery, materials and labour usage, as well as the project sequence being more flexible in terms of which part needs to be done first or next or at the same time (Ibrahim, et al, 2021). Additionally, the Malaysian construction industry is currently working on the application of IoT that is connected to building information modelling (BIM), augmented reality. cloud computing, and big data analytics (Alaloul et al. 2018). Construction industry is an industry involving lots of heavy machinery, and previously it was operated manually by the human. In order to mange the the machinery, an involvement of technology will assist the process. Multiple kind of technology such as



BIM, Big Data, Sensor, Augmented Reality, Remote Operation, waze, GPS can be use to monitor and transfer the information from the machineries to the operators (Ibrahim, et al, 2021). The adoption of IoT helps in reducing the cost of the project and the project will effectively managed before the project commences. This would save cost and time of the project as well as enhance the construction quality.

Researchers	Study Technology
Yuan Shien et al, (2021)	This study seeks to identify the effectiveness of Radio Frequency
	materials tracking at the congestedIdentification
	construction site with the potential(RFID)
	implementation of RFID technique
Amine (2007)	Real-time construction project progressRadio Frequency tracking: a hybrid model for wirelessIdentification technologies selection, assessment, and(RFID), mobile implementation integrating informationcomputing technologies such as radio frequencydevices, and identification (RFID), mobile computingwireless devices, and wireless technology into buildingtechnology projects can greatly improve the efficiency and convenience of information flow.
Goustouridis et al. (2021)	Creating an Intelligent Logger system has theInternet of Thing distinctive features that provide successful fleet(IoT) management of heavy-duty vehicles and machines. Intelligent Logger is based on a custom design of a versatile IoT sensor node for the collection of vehicle/machinery-related data in real time, as well as advanced data handling and AI models for the detection of irregular operations, and finally business intelligence (BI) models for the production of reports, dashboards, and alerts.

#### Table 1: Previous Study On Technology Usage In Machinery Management

From the previous researches in Table 1, it can be concluded that there were many researched that have been done regarding this machinery management issue. Most of the research uses Radio frequency Identification or real time tracker and sensors to indicate the location of such machineries. However, none of the previous researches have implemented operator detail, maintenance date and task carried out on site. RFID trackers sensors tends to provide issues as time passes by due to the wear and tear of the sensors. On the other hand, Real time tracking solutions is dependent on GPS positioning and will not function steadily during bad weather conditions. Therefore, the aim of this project was to develop and test the usability of E-Machinery Organiser with cloud storage application that will provide location of machineries on a site layout plan



together with details of operators, tasks and maintenance status of machineries using Adalo.

## 2. Method

#### 2.1 System design and Development

The Adalo development tool was used to construct the E-Machinery Organiser application. Adalo is a user-friendly visual programming environment that allowed anyone, including children, to create fully working Android and iOS apps. Those new to Adalo may be able to create a simple first app in less than 30 minutes. In addition, the blocks-based tool made it easier to construct complex, high-impact programmes in a fraction of the time required in traditional programming environments. Figure 1 show the design and development process of E-Machinery Organiser.

Step 1. Adalo's Blank Page interface	Step 2. Method to add components to
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established your blank mobile app in Adalo	o, such as a After that, you must assign properties to
signup page, a login page, and your first scre	
	first thing a categorised pieces of data that must
	or log in. Aexist in your app in order for your
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component' or search for a component if you	u know what location, image, and so on are
you're searching for. Click, hold, and drag this	s componentexamples of these. Select what you
to your home screen. Then, above the list cor	nponent yourequire from the drop-down menu by
have created, choose a text component a	
drag it into the home screen the visual and	behavioural
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Step 7. The edit location interface enables administrator	Step 8. In the user interface, the
to move the location of machineries according to needs at site.	
	Step 10. The cloud storage will possess contents such as operator documents, machinery service documents and other related machinery and operator documents.
Image: Control of the control of th	

Figure 1: Design and development process of E-Machinery Organiser.



## 2.2 Materials Used

# Table 2: Material used in developing of E-Machinery Organiser

Materials	Function		
Computers/Laptops	To create application and store data		
	To test functionality of application		
Smartphone			
	To link the computer and internet connect to develop a website.		
Internet/WIFI			
Adalo	To provide a software for application development		



My Account My Account VouTube VouTube Drive Drive Translate	G Search Play Play Calendar Calendar Photos	Maps Maps Gmail Google+	To register for software and cloud storage
	Number         Numer         Numer         Numer <td></td> <td>To obtain list of machineries at the construction site</td>		To obtain list of machineries at the construction site

## 2.3. Testing

The end product was tested using questionnaire. This product was tested among 30 members of the project team for the Kota Elmina Business Park project. These 30 members consist of employees of Pembinaan Tetap Teguh Sdn Bhd, Khairy Consultant Sdn Bhd, Sime Darby Development and Sub-Contractors. The questionnaire was adapted from Technology Acceptance Model by Davis (1989). Technology Acceptance Model (TAM; Davis, 1989) has been one of the most influential models of technology acceptance, with two primary factors influencing an individual's intention to use new



technology: perceived ease of use and perceived usefulness (Neil Charness, 2016). TAM most familiar variables being measured in this study which is Perceived Ease of Use, Perceived Usefulness, Attitude Towards Using Technology and Behavioral Intention to Use. The sample size was determined using Krejcie and Morgan Table (1970) whereby for population of 30 respondents, 27 samples were adequate. However all population were involved in this study.

#### 3. Results

3.1 The end Product of E-Machinery Organiser

Figure 2 shown the end product of E-Machinery Organiser using Adalo. The cloud storage will possess contents such as operator documents, machinery service documents and other related machinery and operator documents in just a click.



Figure 2: E-Machinery Organiser

## 3.1 Usability Level of E-Machinery Organiser

Table 3 shows respondent level of usability toward using existing method whereby analysis shows for all variables tested the mean score were less than 2.50 meaning that the usability level of existing method were low. Whilst Table 4 shows respondent level of usability toward using E-Machinery Organiser whereby analysis shows for all variables tested the mean score were more than 4.00 meaning that the usage of E-Machinery Organiser much more easier compare with the existing method.



#### Table 3 : Usability Level of existing method among respondents

Varaibles	Mean	Interpretation
Perceived Ease of Use	2.20	Low
Perceived Usefulness	2.00	Low
Attitude Towards Using Technology	1.90	Very Low
Behavioral Intention to Use	2.00	Low

Table 4 : Usability Level of E-Machinery Organiser among respondants

Varaibles	Mean	Interpretation
Perceived Ease of Use	4.40	High
Perceived Usefulness	4.50	High
Attitude Towards Using Technology	4.30	High
Behavioral Intention to Use	4.40	High

# **3.2 Significant Diffirences Between E-Machinery Organiser Compare With The Existing Method**

In order to evaluate the effectiveness of E-Machinery Organiser in the project, a paired sample t test was performed. Results as shown in Table 5, respondent preferred using E-Machinery Organiser whereby all variable measured Perceived Ease of Use (Mean = 4.40), Perceived Usefulness (Mean = 4.50), Attitude Towards Using Technology (Mean = 4.30) and Behavioral Intention to Use (Mean = 4.40) were more higher compared with existing method Perceived Ease of Use (Mean = 2.20), Perceived Usefulness (Mean = 2.00), Attitude Towards Using Technology (Mean = 1.90 and Behavioral Intention to Use (Mean = 2.00). A paired sample t-test found this difference to be significant for all variables being measured. The value of t of Perceived Ease of Use is 12.73 and the value of p is < .00001. The result is significant at p < .05. The value of t of Perceived Usefulness is 15.99 and value of p is < .00001. The result is significant at p < .05. The value of t of Attitude Towards Using Technology is 13.53 and the value of p is < .00001. The result is significant at p < .05. The value of t of Behavioral Intention to Use is 16.15 and the value of p is < .00001. The result is significant at p < .05. This suggests that using E-Machinery Organiser was much easier and resourceful compared with existing method. This mean that E-Machinery Organiser was more effective compare with the existing method.



Pair	Paired Different Mean	t	Significant (two tailed)
	2.20	12.73	.000
Perceived Ease of Use - Existing Method			
Perceived Usefulness - Existing Method	2.50	15.99	.000
Attitude Towards Using Technology- Existing			
Method	2.40	13.53	.000
Behavioral Intention to Use- Existing Method			
	2.40	16.15	.000

# Table 5 : Paired sample t-test

## 4. Conclusions

The result showed those respondant which consist of employees of Pembinaan Tetap Teguh Sdn Bhd, Khairy Consultant Sdn Bhd, Sime Darby Development and Sub-Contractors were agreed that E-Machinery Organiser system is more effective compare to existing method. The current method that has been used on site is they use paper as their reference and submission. Everything is depended on the paper which is produced a lot of paper usage. Higher mean (> 4.00) were agreed with E-Machinery Organiser easy to use and they have the intention to use it to monitor machinery. The effectiveness of the E-Machinery Organiser was evaluated using paired t-test, analyzed by Social Science Statistics online website. The result shows that E-Machinery Organiser has a significant different compare with existing method. This mean that E-Machinery Organiser was more effective compare with the existing method. This product was highly recommended to be used in monitoring machinery for construction site.

In addition, this E-Machinery Organiser also can be change as mobile application which it will also ease the user because the mobile application is easy to install by all employee. The mobile application also can download and save the information from this system. This depends on the company which they would be more comfortable to use the system. The conclusion that researcher can make is technology in construction sector is important to produce the best quality and product for the project. E-Machinery Organiser can cut the cost of paper using, save time, and the organization become more systematic. Hence, the usage of technology in the company also can attract more clients to choose company service. By applied the technology in managing construction activities may also help to bring Malaysia parallel with other success countries in the world. Technology in construction sector is important to boost of a nation's economy.



#### References

- Alaloul, W. S., Liew, M., Zawawi, N. A. W. A., & Kennedy, I. B. (2020). Industrial Revolution 4.0 in the construction industry: Challenges and opportunities for stakeholders. *Ain Shams Engineering Journal*, 11(1), 225–230. https://doi.org/10.1016/j.asej.2019.08.010
- Amine, G. (2007). Real-Time Construction Project Progress Tracking: A Hybrid Model For Wireless Technologies Selection, Assessment, And Implementation. Unpublished Doctor of Philosophy Theses.
- Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly*, *13*(3), 319–340. <u>https://doi.org/10.2307/249008</u>
- Goustouridis, D., Sideris, A., Sdrolias, I., Loizos, G., Tatlas, N., Potirakis, S. (2021). 'IntelligentLogger: A Heavy-Duty Vehicles Fleet Management System Based on IoT and Smart Prediction Techniques'. World Academy of Science, Engineering and Technology, Open Science Index 176, International Journal of Mechanical and Industrial Engineering, 15(8), 336 - 340.
- Haron, N. A., Devi, P., Hassim, S., Alias, A. H., Tahir, M. M., & Harun, A. N. (2017). Project management practice and its effects on project success in Malaysian construction industry. *IOP Conference Series: Materials Science and Engineering*, 291, 012008. https://doi.org/10.1088/1757-899x/291/1/012008
- Ibrahim, F. S. ., Binti Esa, M., & A. Rahman, R. (2021). The Adoption of IOT in the Malaysian Construction Industry: Towards Construction 4.0. International Journal of Sustainable Construction Engineering and Technology, 12(1), 56–67.
- Krejcie, R.V. & Morgan, D.W. (1970). Determining Sample Size for Research Activities. Educational and Psychological Measurement. 30. 607-610.
- Maqsoom, A., Khan, M. U., Khan, M. T., Khan, S., Naeemullah, & Ullah, F. (2017). Factors Influencing the Construction Time and Cost Overrun in Projects: Empirical Evidence from Pakistani Construction Industry. *Proceedings of the 21st International Symposium on Advancement of Construction Management and Real Estate*, 769– 778. <u>https://doi.org/10.1007/978-981-10-6190-5\_69</u>
- Ramli, M. Z., Malek, M. A., Hanipah, M. H., Lin, C. L., Mahamad Sukri, M. F., Zawawi, M. H., Zainal Abidin, M. Z., & Mohamad Fuad, N. F. S. (2018). Study of factors influencing construction delays at rural area in Malaysia. *Journal of Physics: Conference Series*, 1049, 012017. <u>https://doi.org/10.1088/1742-6596/1049/1/012017</u>
- Yuan Shien, L. ., Kasim, N., Zainal, R. ., Shareh Musa, S. M., & Mohd Noh, H. (2021). Study on Radio Frequency Identification (RFID) Implementation for Effective Materials Tracking at Congested Construction Site. *Research in Management of Technology and Business*, 2(1), 711–721.



# IMPROVE EXISTING KANBAN SYSTEM AT TRIMMING, SQUEEZING, PACKING AND WAREHOUSE DEPARTMENT

Woo Tze Keong<sup>1</sup>, Ahmad Naqiuddin Bin Rainizamani<sup>2</sup>

<sup>1</sup>Mechanical Engineering Department, Polytechnic Ungku Omar, Ipoh, Perak kenz78@gmail.com

<sup>2</sup> Mechanical Engineering Department, Polytechnic Ungku Omar, Ipoh, Perak naqiuddinahmad65@gmail.com

#### Abstract

Taiichi Ohno is a Japanese engineer who designed the Just In Time (JIT) production method, also known as the "Toyota Production System." The original objective of the Just in Time (JIT) production system is to reduce and eliminate waste of any aspect. The Kanban system's application at this industry is necessary since it has increased the company's efficiency and production flexibility in response to consumer requests. The Kanban method ensures good output at a given rate and at a set time. Kanban system are one manufacturing technique that allows you to optimize production by only making what you need. Kanban system controls production by supplying the item, at the right time, in the right quantity, and at the right location. The Kanban system is used in automotive industries to arrange all production processes and ensure that they are completed in according with customer needs. Many manufacturers are now under customer pressure to give a high-quality, better product to satisfied customers and prevent customer complaints in order to reduce losses.

**Keywords:** JIT (Just In Time). KANBAN system, automotive industry, Toyota Production system, application of Kanban system;

#### 1. Introduction

Signboard is another term for the Kanban card. Kanban is a scheduling or planning framework for lean manufacturing. Just-in-Time production, or JIT, is another term for Kanban. Kanban was created by Taiichi Ohno, a Toyota industrial engineer, to improve manufacturing productivity. The system is developed by the cards that pass through the production line. In the vehicle and automotive industries, Kanban is also known as the Toyota nameplate system. The basic purpose of the JIT manufacturing method is to reduce and eliminate all waste. Based on this idea, Japanese companies manage extremely low inventories while achieving great quality and productivity. JIT focuses on the "zero concept," which includes achieving zero faults, zero inventory, zero breakdown, and other objectives. At company, Kanban cards divided into several cards. Every card has their MRF code, for example, the part the code is S1/45, E2/12 and others. For other



customers, the code is F2/12a, R2/10 and others, all of this items and parts is automotive part.

Kanban pull system working process is when one department request an item from another department. For example, warehouse department will make request from trimming and packing department to produce goods for preparation to customers.

Kanban system is an inventory management system that triggers signals to produce products based on the needs of actual customers. Working system by Kanban is when Kanban card placed on Heijunka board based on board's sign, for example, Normal, Warning and Critical. When Kanban card placed at normal board, the production will be hold and focus on warning and critical board. This system is running in automotive manufacturing for many years. A common problem associated with Kanban is that cards are often lost due to employee negligence. This caused the company to experience slow production of items. Due to production delays, the company suffered losses and customers did not want to take the goods at the company.

#### 2. Literature review

#### 2.1 Kanban system

Kanban is a Japanese word for a visual record or card. Cards are required in the Kanban system to allow for the manufacturing process or movement of certain quantities of goods. This system is used to process data. Kanban is a part-pulling system that may also be used to monitor and control production stock. To manage production, Kanban may record the inventory levels in the system. The system is ordered to stop producing when the buffer increases capacity. in addition ,Kanban is one of the methods used by JIT to manage flows, inventory, and other factors. It also involves the arrangement of raw material, as well as the amount of production.

Kanban is a Japanese word that means "card," and it refers to a card that includes all of the information that manufacturing need. The Kanban card will efficiently control production from raw materials to finished items, avoiding inventories and reducing production time and work in progress (WIP). Based on the most recent Sendir Kumar and Panneerselvam's study, there are various methods to achieve Just In Time (JIT) goals, including Kanban, Conwip, and supply chain management.

There are a variety of tools and methods commonly used to define efficient production systems. The Kanban system is just one of the tools and technologies used in Lean Manufacturing, among other technologies, 4M method, Why Why analysis, Ishikawa diagram (fishbone) and many others. Lean is a set of tools that help identify and eliminate waste that can improve quality and production time and cost.



This allows a company to improve productivity while reducing waste. When the item is ready, Kanban must be generated. The Kanban method is widely used in Japan because it reduces costs by eliminating overproduction and allowing for more flexible development Workstation, Station, Waste Reduction Minimizes waiting times and logistics costs. This also reduces inventory levels and overhead costs.

## 3. Methodology

#### 3.1. Flow chart of the Whole Project

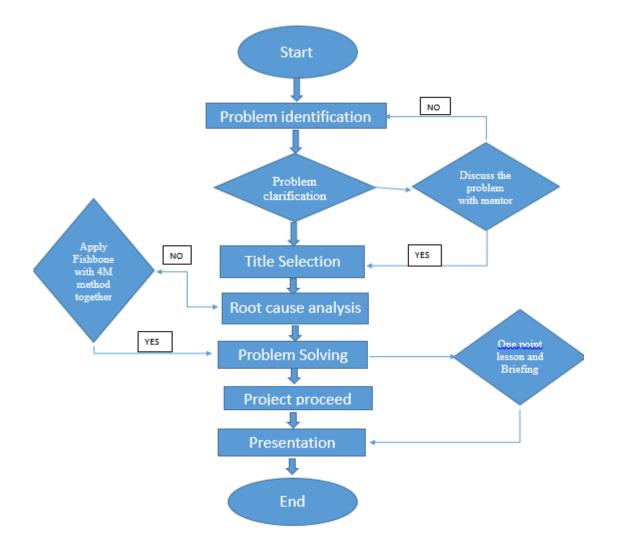


Figure 1: Flowchart of the Project Process

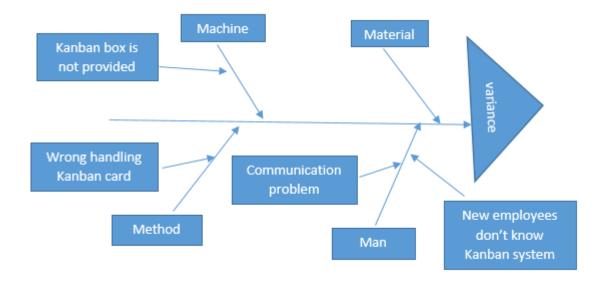


#### 3.2. 4M Method and Fishbone Diagram

Combining 4M method and fish bones diagram to get more efficient and accurate results. There are several factors that can be detected during this step, for example, man, machine, material and method. The function of applying 4M method and fish bones diagram is to prevent the observing from overlooking all aspects so that the project can runs smoothly.

For "Man", the problem that was founded, new employees do not know about the Kanban card, they just assume the Kanban card is an unimportant piece of card and just to be thrown away. Moreover, problems that occur for man are also problems in communication between employees and supervisors, for example, foreign workers do not understand what the supervisor is saying. For method problem, the operators did not know how to handle the Kanban card and it is causes the Kanban card is placed with different items MRF Code.

Lastly, the problem that was founded from machine, the department's did not provided a storage area to keeping the Kanban card during Kanban card in work in progress. This condition causes Kanban card always misses and have been put at random area.



## Figure 2: 4M method and Fishbone Diagram of Project



#### 3.3 "WHY WHY" Analysis

Why why analysis is a technique of analysing and identifying the problem's root causes. Why? is the main question created during the analysis, as the method's name. The "Why Why" analysis is necessary in this project since it includes the proper individuals. They may be well in both the problem and the procedure. They must be in various departments if at all allowed. Inside a group, there must be no supervisors or employees. It is sometimes beneficial to include people who are unfamiliar with the process or problem. They have the ability to provide a new look. Avoid putting the blame on the issue. The purpose is to solve the problem, not to detect the problem. Stop any disagreement which goes to someone blaming someone else right away. The "Why Why" analysis refers to the Toyota Production System (TPS), which is applied in the automobile industry to develop the predictive maintenance plan.

Factor	Problem	Why 1	Why 2	Why 3	Root cause	Problem solving
Man	New employees	Do not understand the work concept	Not enough training	Supervisor did not have a time	Non-fixed operator	Set a schedule to briefing for new employees
	Communication problem	Do not understand what is being taught	Different language	Foreign workers cannot speaking	Supervisor cannot explain in different language	One point lesson in various language
Machine	Do not have a proper Kanban box to keep Kanban card	there no observation from department superior	Did not have time	Too many work	Packing department did not have a proper Kanban box	Build a proper Kanban box at packing department
Method	Handle Kanban card in wrong ways	the position of the Kanban card on the item is not in the right place	Employee did not know how to handle it	Did not have a right training	Kanban card movement is scattered	Give a training to employees
Material	-	-	-	-	-	-

## Figure 3: "Why Why" Analysis for searching Project Root cause



### Page Break 3.4 One Point lesson and Kanban Box

One point lesson is one of the quality tools that use to improve the knowledge. One point lesson is the alternative method for manufacturer to train the employees. One point lesson means, information about specific problem and improvement. The main objectives of one point lesson is safety, basic knowledge, trouble and improvement. One Point Lesson it as method for reducing and improving work. One Point lessons have been used as a technical aid by operators

Lessons are one-page instructions that contain information and a picture of the general concept or technique that is being discussed. They are operational instructions, whose purpose is to ensure the accuracy of conducted activities, provide operators with the relevant information, standardize that knowledge, and train in the optimal solutions. The procedures to follow in order to overcome the issue in the best known way are determined by the instructions. Their simple text and accompanying image or photo make the established method of functioning easy to understand.

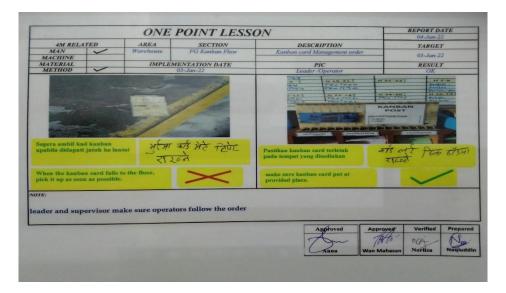


Figure 4: One Point Lesson for Improvement the Kanban system

## 3.4.1 Kanban Box

Kanban box is important thing that use for Kanban card. The function of Kanban box is to storage Kanban card when card in progress to avoid the Kanban card move freely. This box usually tagging with sign to make the employees understand and separate the cards according process. by created Kanban box the company can save space from providing a special area for the Kanban card during Work In Progress (W.I.P). The creation of the Kanban box can also save costs as the Kanban box can be produced using recycle items.





Figure 5: Kanban box for Project Improvement

# 4. Analysis and Discussion

## 4.1 Tables and Figures

Figure 6 shows combining graph between amount of card, undetected card and variances of card for every month. From this graph we can see every month the company produces so many kanban cards to avoid slow production and keep the inventory in optimal condition. In figure 6 shows the percentage of variance exceeding 10%. In September, a total of 5381 were produced, at the end of September, the Kanban Card Audit would be held and the card found was only 2317. A total of 3064 cards not found. This led to a high variant in September by 43.06%. The number of missing cards has led to the company forced to make a high cost to produce a new card for the next month's use.



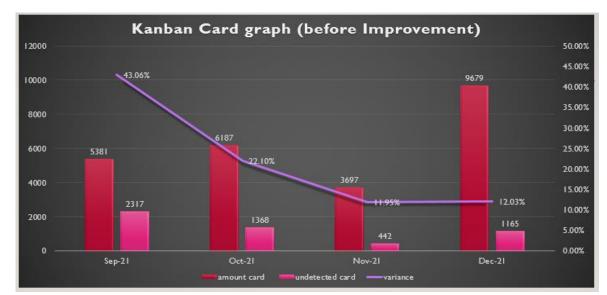


Figure 6: Kanban Card graph (Before Improvement)

At the table below, we can see the cards produced by the company in September, October, November, and December. The number of cards issued in the four was 24944 and the company suffered a loss of 5292 cards. This causes the company to bear the high variants of the month and spend a lot of money to produce a new card.

l able 1: R	Table 1: Result and Data collection (Before improvement)					
Month	Total card	Variances%	Total card undetected			
September 2021	5381 pcs	-43.06 %	2317 pcs			
October 2021	6187 pcs	-22.1 %	1368 pcs			
November 2021	3697 pcs	-11.95%	442 pcs			
December 2021	9679 pcs	-12.03 %	1165 pcs			

The graph below shows the data of combined graph after the improvement on the Kanban system. The improvements made have successfully lowered the Kanban card variance by 18.3% per month. This result shows that the improvements made successfully change the percentage of variations from critical point to normal point and the rate of variance decreased to a point below 10% which is the rate considered normal. The percentage of card loss will occur because the Kanban card is always in movement, but it can be reduced to a minimum rate. The percentage rate that is considered normal is below 10%.



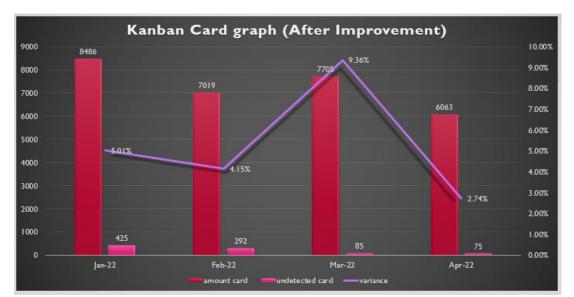


Figure 7: Kanban Card graph (After Improvement)

After improvements made on January 2022, February 2022, March 2022 April 2022, the company has successfully reduced variants at normal rates. The number of cards in the 4 months was also higher than 4 months before the improvement was made by 29273 cards. In addition, the average of loss card is also lower, which is only 877 cards is undetected.

Table 2: Result and Data collection (After improvement)					
Month	Total card	Variances%	Total card undetected		
January 2022	8486 pcs	-5.01 %	425 pcs		
February 2022	7019 pcs	-4.15 %	292 pcs		
March 2022	7705 pcs	-9.36%	85 pcs		
April 2022	6063 pcs	-2.74%	75 pcs		

#### 4. Conclusions

As a conclusion, I hope this project will help trimming, squeezing, packing and warehouses department to decrease variances (lost) Kanban card as long as reduce the cost, time and energy. This will give a great advantage to avoid delay items and excess inventory in warehouse department. I hope this improvement can the company to achieve their mission to developing a competent workforce with care and Conducting their business with the Highest Level of Integrity and Corporate Social Responsibility as long as to be world class manufacturer in their core product.



#### References

Kumar, C. S., & Panneerselvam, R. (2007). Literature review of JIT-KANBAN system. *The International Journal of Advanced Manufacturing Technology*, 32(3-4), 393-408.

Rahman, N. A. A., Sharif, S. M., & Esa, M. M. (2013). Lean manufacturing case study with Kanban system implementation. *Procedia Economics and Finance*, 7, 174-180.

Mojarro-Magaña, M., Olguín-Tiznado, J. E., García-Alcaraz, J. L., Camargo-Wilson, C., López-Barreras, J. A., & Pérez-López, R. J. (2018). Impact of the Planning from the Kanban System on the Company's Operating Benefits. *Sustainability*, *10*(7), 2506.

Matzka, J., Di Mascolo, M., & Furmans, K. (2012). Buffer sizing of a Heijunka Kanban system. *Journal of Intelligent Manufacturing*, 23(1), 49-60.

Mrugalska, B., & Wyrwicka, M. K. (2017). Towards lean production in industry 4.0. *Procedia engineering*, *182*, 466-473.

Favi, C., Germani, M., & Marconi, M. (2017). A 4M approach for a comprehensive analysis and improvement of manual assembly lines. *Procedia Manufacturing*, *11*, 1510-1518



# DEVELOPMENT OF ADVANCED LOGSHEETS FOR INSPECTION ITEMS AND DEFECT BLOCKS

Nur Nasrin Sabrina Omar<sup>1</sup> and Rosmawati Mat Jihin<sup>2</sup>

<sup>1, 2</sup>Mechanical Engineering Department, Politeknik Ungku Omar, Ipoh, Perak <sup>1</sup>nasrinomar5076@gmail.com <sup>2</sup>rosmawati@puo.edu.my

#### Abstract

Poor data/information quality in the company can cause a negative impact on the economic and social aspects of the organization, such as less customer satisfaction, increased running costs, inefficient decision-making processes, lower performance, and lowered job satisfaction. To maintain the quality and overall performance, improvements in terms of data and document management are required. The lack of up-to-date standardized information turns out to be the most critical cause of delay in accessing the information. Therefore, the purpose of this study is to present a structured investigation of the problem in the documentation of the data management system that is currently applied in one of automotive company as a case study. Initially, group interviews and semi-structured interviews with Quality Control Department executives (inspection engineering) are conducted, to identify the individual steps and the parties involved in order to access the reliable information. A comprehensive digitalize solution is proposed by developing the excel-based application denoted as advanced Logsheet to address the document management issues, especially for inspection items and defect blocks. Among the key features of this Logsheet is the ability to ensure that all users have access to the current and compliant content, perform automatic compliance checks, and notify users when a file is outdated. The Logsheet development process is carried out by extracting data from the original document, designing the application interface and layout of control elements, loading the data into the program, simulation and test runs, and evaluating the performance. Based on the evaluation results, the implementation of this Logsheet able to improve the quality of company data management and easily facilitate the tasks of the designated personnel for more effective operation performance.

Keywords: Logsheet, data management system, digitalize solution

#### 1. Introduction

Nowadays, majority of businesses, however, fall behind when it comes to properly managing their digital files or making sure that their templates are consistent with their brand. While most businesses are rather adept at organising their tangible, physical



assets in storage closets and filing cabinets. Almost all corporate action begins with a digital document, whether it is a new file being created or an old template being changed. Companies often employ documents including correspondence, contracts, plans, and presentations that contain crucial information(Kavelaars et al., 2009). Documentation is the key to good manufacturing practices compliance and ensures traceability of all development, manufacturing, and testing activities(Murthy et al., 2015). Documentation provides the route for auditors to assess the overall quality of operations within a company and the final product.

Due to the enormous amount of labour required to store, manage, and transport the enormous amounts of material involved in a company's business activities, firms may have previously refrained from implementing efficient document management systems. According to the research and observation, some businesses have failed to keep up with the most recent software developments and new technologies that can aid in automating their content management procedures by merely accepting document anarchy as a necessary component of a digital workplace(Fung, 2020). However, when papers are incorrectly classified or outdated, dealing with the ensuing mess is more than just a pain. Failure to invest in efficient document management techniques may have long-term effects on a business' operations, profits, and productivity.

Another noticeable problem by some companies is the time consumed to access the information or data. They need to search for the supporting documents one by one just to get the data and information that is required. Plus, there will be more time spent on activities like filing and documentation. Poor documentation or data management system can be seen when paper-based documents have likely experienced to get misfiled, misplaced, or accidentally thrown away(Denkena et al., 2019). While in terms of data accessibility, only an authorized person who has been given access can get access to the information and that too is limited to staff that is separated geographically. This means if the staffs from other departments need to access the document, they need to present it at the document controller office. But if it goes digital, they can simply get access through logsheet which can be accessed by everyone, everywhere, and anytime without limitation.

Therefore, in this work, the concern is given to the documentation and allocation of responsibilities, authority, and resources of Complete Vehicle Inspection Standard (CVIS) items during the different phases of the in-plant inspection process. This documentation is crucial since it will specify quality standards, practices, resources, specifications, and the sequence of activities relevant to a particular part. Poor allocation of CVIS can cause the excessive time to gain the required information. With excel sheet services, solutions like Logsheets can address a company's document management issues. There are several laborious document management procedures that may be automated (De Wilde et al., 2013). This Logsheet will carry out automated compliance checks, ensuring that all users have access to up-to-date, compliant information, and even notify users when a file is outdated.



The objectives of this project are to investigate the problem in the documentation of the data management system that is currently applied in the company, to develop an advanced Logsheet for inspection items and prevent defect occurrence (defect block), and to evaluate the performance of Logsheet implementation in the company. This project is to be implemented at Quality Control Department (QCD), for inspection items of custom-made Vios and Yaris models only. The focus is on inspection data for various parts in that vehicles and as a preventive way to detect defect occurrence. The next section will briefly describe the background of logsheet development, followed by the methods that have been implemented to realize the solution idea. Then, evaluation in terms of Logsheet performance is highlighted in the results and discussion section. Finally, the conclusion is given.

#### 2. Project Background

#### 2.1 Manufacturing Logbook

A manufacturing production log is an excellent way of recording the 'stage-by-stage process of manufacturing a product. In its simplest form, it is a series of photographs accompanied by notes. A complex form will be several sheets of photographs, with detailed notes. It is important that the notes refer to health and safety, practical skills, environmental issues, and economic viability.

The log is an excellent way of explaining the complexities of the manufacturing process, to a potential customer, a client, or even an investor/bank manager. The production log should explain the damage to the environment during the manufacturing process, and has been minimized (Alkali et al., 2009). This could include the use of recycled materials and the use of sustainable materials. This evidence may be vital when persuading environmentally aware customers to purchase your product. A production log also allows the manufacturer to record problems and their solutions, which leads to a safer and more profitable production line.

In the manufacturing sector, logbooks are used for a number of purposes to help with the recording of data related to machine operation or batch records. The GMP standards for the traceability of data, events, and communications specify the necessary logbooks. First, a Register Logbook for each region is required, in which all manufacturing batches handled there are listed sequentially. The logbook must be formatted using the example provided in point. the Finishing Line Logbook, second. These logbooks are a valuable source of data and must be kept for future use. The creation and appropriate upkeep of the logbook are under the purview of the Team.



#### 2.2 Digitize paper-based logbooks and forms

Manufacturing operations are facing various challenges such as long cleanups & changeovers, unpredictable downtimes, variable labor performance, and ever-changing production schedules. Manual and incomplete data collection, and limited and cumbersome performance tracking are further preventing decision-makers from taking the right actions at the right time. In this era of 4.0 technologies evolution has emerged advanced analytics which helps manufacturers quickly and cost-effectively digitize their performance tracking, production scheduling and log keeping activities via integrated solutions like OEE Tracker, Scheduler, Digital Logbook, and Labor Tracker(McAlpine et al., 2017).

Digital Logbook helps address difficult and costly processes for maintaining hundreds of logbooks and forms to comply with Good Manufacturing Practices (GMP) requirements. Digital Logbook replaces any kind of paper-based logs or forms with digital counterparts while complying with GMP(Aremu et al., 2018). With secure, audit-ready, and easy-to-maintain digital logs, you can access & analyze your data instantly, save time, and achieve better security.

#### 2.3 Manual maintenance of logbooks

The usage of logbooks is not just limited to the production unit. They are extensively used in QA, QC, warehouse, packing, engineering, and other departments. In QA, the logbooks are used for the issuance of batches, batch records, or maintenance of other essential information. QC logbooks are used to maintain details of instruments, samples, etc. Details of inventory can be stored properly using logbooks by the warehouse department. In packing, information about when the packing started and stopped, what materials were used, etc. can be recorded. The engineering department uses logbooks predominantly for schedules such as calibration schedules, preventive maintenance, and others (Jain & Lad, 2017). The humble logbook in fact plays a significant role in maintaining the relevant data of every department of the organization.

#### 2.4 A cost-effective movement

As production has a direct impact on costs, digitalization of logbooks should be an effective move to increase profitability given that many companies end up spending a good sum annually on logbooks(Chan et al., 2005). It also ensures a good foundation for the current necessity of complete digitalization of the manufacturing process. Data can be retrieved easily, and it can also empower teams to attend to e-audits. Any potential changes in format, design and issuance issues can also be tackled effectively with electronic logbooks.



#### 3. Methodology

This section will further discuss the data collection procedure, the development process, and the analysis used to evaluate product performance. The methodology consists of three stages which begin with problem identification, development and implementation, and performance evaluation.

#### 3.1 Project Workflow

Figure 1 below represent the flow process of Logsheet development which begins from start and ends with the finish. The figure below shows the current process on how to develop Logsheet.

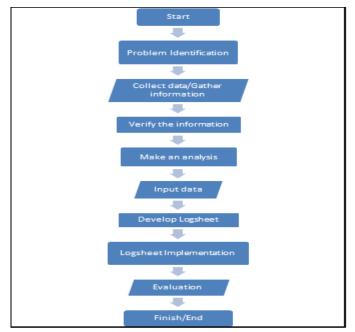


Figure 1: The flow Process of Logsheet Development

#### 3.2 Logsheet User Guideline

As the process of Logsheet development is done, there are some guidelines that need to follow to ease the usage of this Logsheet.. Figure 2 shows the Logsheet user guideline. The first step is to open the Logsheet folder, then identify the searched part and confirmed the part. Next, the user needs to filter the CVIS code and sub-code according to the following searched part. Finally, for the last step, filter the supplementary column for the checking item and done. All information will appear.



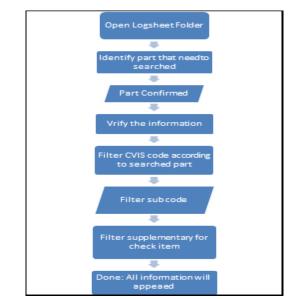


Figure 2: Flow Chart of Logsheet Implementation

# 4. Results and Discussion

This Logsheet performance evaluation and user satisfaction survey was handed out to the Quality Control Department and the targeted respondent was an Inspection Engineer (IE) who was frequently in need of a data management system. The amount of female and male respondents are unequal, as most of the leading users in the department are male. Thus, only 26 % of all the respondents are females, the rest 74% belong males. The reason for this gap might be that males, usually, are the most employed in this department due to they might need to perform some heavy tasks sometimes. Most Females are usually employed in other departments like Assembly shops, Welding shops, and Paint shops. Figure 3 below represents the number of Logsheet users at the Quality Control Department followed by gender.

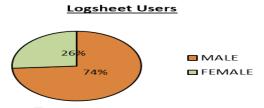
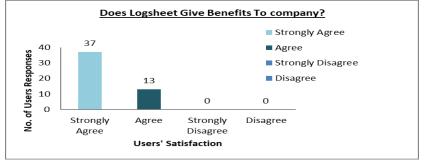


Figure 3: Number of Logsheet Users

The first element of the survey deals with "Does this innovation (Logsheet) give benefits to company organization?", the total of respondents that took part in the survey is 50 respondents. From the data gained, it is shown that 60% of the respondents state that they strongly agree that this Logsheet has given great benefits to the company organization. This can be seen when they gave good feedback that this Logsheet has eased their searching of the CVIS information and reduced the time of searching (if still using paper documentation). While 30% of them stated that they agree with the



statements and only a few say that they strongly disagree. Figure 4 below shows the responses of users towards Logsheet benefits to the company.



# Figure 4: Survey result for Logsheet benefit towards company

The second element of the survey deals with, "Logsheet users' experience" The QC Department and IE users says that they are very satisfied with the services of the Logsheet, as indicated in the chart with a percentage of 76%. While the remaining respondents answered satisfied with the percentage of 18%. This implies that the Logsheet can provide sufficient and outstanding information to QC and IE users. However, only 6% of the respondents that has uncertain thoughts regarding Logsheet experience. This is due to a lack of understanding of the scope and purpose of the Logsheet and maybe because they were not familiar with the Logsheet yet. This is because Logsheet focuses on appearing inspection data for various parts in a vehicle and as a preventive way to detect defect occurrence. Figure 5 below represents the survey results for Logsheet users' experience.

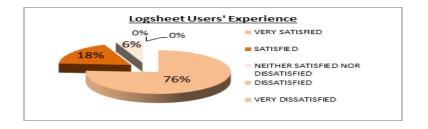


Figure 5: Survey Results for Logsheet Users's Experience

The continuity from the survey results for Logsheet users' experience can be followed by the gender types. 32 male respondents answered very satisfied and 5 of them answered satisfied. While for female respondents, 11 of them had answered very satisfied and the remaining 2 respondents answered satisfied. As we can see the number of male respondents is larger than female respondents. The reason for this gap is due to males being the most employed in the Quality Control Department. This is due to their job scope which requires them to perform some heavy tasks that can't be conducted by females. As for females, most of them are employed in other departments like Assembly Shop, Paint Shop, and Welding Shop. So, basically, both males and females have agreed that Logsheet gave them the best experience as they don't need to search for many



documents anymore. Figure 6 represents the survey results for Logsheet users' experience which is categorized by the gender types.

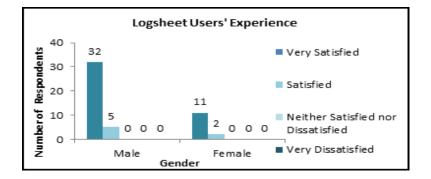


Figure 6: Logsheet Users' Experience For Gender Types

The next element of the survey then goes with respondents being asked either if Logsheet has an impact on reducing defects or not. From the survey collected, 46 respondents answered 'Yes' that this Logsheet has contributed to reducing defects and 3 respondents answered 'Not Really'. Only 1 respondent has anwered 'No'. We can see that majority has claimed the statement was true. This is because Logsheet focuses on appearing inspection data for various parts in a vehicle and as a preventive way to detect defect occurrence. So, no doubt that most of the respondents reacted so. For those who answered no and not really maybe because they don't really understand Logsheet and are still not familiar with it. Figure 7 below shows the survey result of Logsheet has an impact on reducing defects.

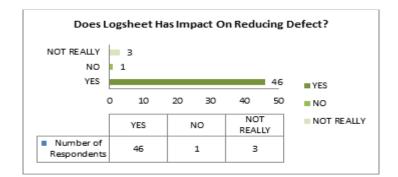


Figure 7: Logsheet Reduce Defect

The fourth element of the survey deals with, "Logsheet provide details information with the easiest way". All respondents who participated in the survey agreed that logsheet does contribute to reducing defects. This can be seen through the results of the survey, 45 out of 50 respondents said they are very satisfied with the percentage of 90%. However, there is a minority of respondents with the thoughts of 'satisfied' which is 5



respondents with a percentage of 10%. This proves that this Logsheet really does help them to gain whatever information they need in the easiest way. This is because Logsheet serves as a summary reference of QC/IE checking item allocation and revision detail info for any CVIS revision. This can be done with only a few clicks, and all the information that they need will appear on the screen. What they need to do is just open the Logsheet folder, confirmed they searched part, verified the information, and use the filter indication to ease the searching and finally all the information will appear. In this way, there will be less time-consuming searching. They won't have to look for one-by-one documents to find what they need. Plus, the major benefit is there will be no clutters of papers and automatically it will reduce the amount of carbon footprint which can save environmental health and support green environment program. As this was part of the purpose of the Logsheet invention. Thus, Figure 8 below represents the results of the element of this survey.

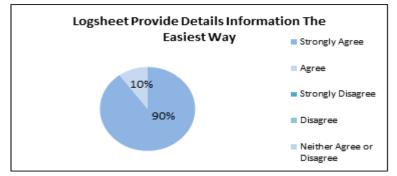


Figure 8: Logsheet Provide Details Information With The Esaiest Way

The other survey question that has been asked to respondents is "Leveraging log data helps teams optimize root cause analysis". 43 out of 50 respondents are 'very satisfied' that this Logsheet does help QC/IE to optimize root cause analysis while the remaining, 7 of the respondents was 'satisfied'. This is as a result of their realisation that a successful incident response strategy depends on good root cause analysis. So, log data helps to reduce another important incident response measure by being a useful tool for identifying the underlying cause. When issues arise with an application, log data might be useful for identifying the underlying reason. For instance, the application's error log often contains useful details such as the whole stack trace when the system throws an exception. This information makes it easy to investigate the issue and duplicate the problematic circumstance by allowing us to track down the method calls that caused the issue and pinpoint the precise line of code that caused the exception. Responders are able to identify the issue as a result, which helps them find a comprehensive remedy. Figure 9 below shows the results of leveraging log data which can helps teams to optimize the root cause analysis.



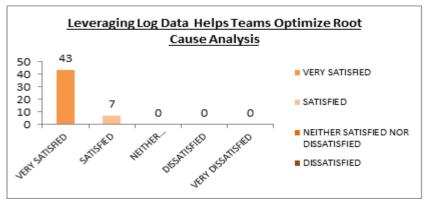


Figure 9: Leveraging Log Data Helps Teams Optimize Root Cause Analysis

# 5. Conclusions

In conclusion, an advanced Logsheet for the management of inspection and defect data has been built using Microsoft Excel and successfully meet the desired objectives. It provides a convenient way and accurate method for staff to get information or data related to the part standards and to trace the cause of the defect quickly. This will eventually prevent defect outflow toward customers. It will also shorten searching durations for the related documents and there will be no paper clutters too. By using a Logsheet, all the information regarding the documents is readily available and accessible. According to the survey, 90% of the respondents strongly agreed that this Logsheet really helps in finding whatever information they need such as CVIS number, part standard, vehicle specs and etc. This is because Logsheet is a summarized form of reference of QC/IE checking item allocation and detail of info for any CVIS revision. Hence, in terms of Logsheet effectiveness, 76% of the respondents were very satisfied with the experience of using the Logsheet. It is proof that advanced Logsheet can really benefit companies in improving the performance of data inspection management.

# References

- Alkali, B. M., Bedford, T., Quigley, J., & Gaw, J. (2009). Failure and maintenance data extraction from power plant maintenance management databases. *Journal of Statistical Planning and Inference*, *139*(5), 1766–1776. https://doi.org/10.1016/j.jspi.2008.05.037
- Aremu, O. O., Palau, A. S., Parlikad, A. K., Hyland-Wood, D., & McAree, P. R. (2018). Structuring Data for Intelligent Predictive Maintenance in Asset Management. *IFAC Proceedings Volumes (IFAC-PapersOnline)*, 51(11), 514–519. <u>https://doi.org/10.1016/j.ifacol.2018.08.370</u>
- Chan, T., Corlett, D., Sharples, M., Ting, J., & Westmancott, O. (2005). Developing Interactive Logbook: A Personal Learning Environment. *IEEE International Workshop on Wireless and Mobile Technologies in Education (WMTE'05)*, 1–3.



- De Wilde, P., Martinez-Ortiz, C., Pearson, D., Beynon, I., Beck, M., & Barlow, N. (2013). Building simulation approaches for the training of automated data analysis tools in building energy management. *Advanced Engineering Informatics*, 27(4), 457–465. <u>https://doi.org/10.1016/j.aei.2013.05.001</u>
- Denkena, B., Nyhuis, P., Bergmann, B., Nübel, N., & Lucht, T. (2019). Towards an autonomous maintenance, repair and overhaul process: Exemplary holistic data management approach for the regeneration of aero-engine blades. *Procedia Manufacturing*, 40, 77–82. https://doi.org/10.1016/j.promfg.2020.02.014
- Fung, A. W. S. (2020). Utilizing connectivity and data management system for effective quality management and regulatory compliance in point of care testing. *Practical Laboratory Medicine*, 22. <u>https://doi.org/10.1016/j.plabm.2020.e00187</u>
- Jain, A. K., & Lad, B. K. (2017). Dynamic optimization of process quality control and maintenance planning. *IEEE Transactions on Reliability*, 66(2), 502–517. https://doi.org/10.1109/TR.2017.2684709
- Kavelaars, A. T., Bloom, E., Claus, R., Fouts, K., Tuvi, S., & Linear Accelerator, S. (2009). Electronic Logbook for Space System Integration & Test Operations. *IEEE Transactions on Aerospace and Electronic Systems*, 45(1), 167–178.
- McAlpine, H., Cash, P., & Hicks, B. (2017). The role of logbooks as mediators of engineering design work. *Design Studies*, *48*, 1–29. <u>https://doi.org/10.1016/j.destud.2016.10.003</u>
- Murthy, D. N. P., Karim, M. R., & Ahmadi, A. (2015). Data management in maintenance outsourcing. *Reliability Engineering and System Safety*, *142*, 100–110. https://doi.org/10.1016/j.ress.2015.05.002



# AUGMENTED REALITY TECHNOLOGY AT THEME PARK ELEVATE TOURIST EXPERIENCE

Suhaili binti Ishak<sup>1</sup> and Dr. Nurul Azhani binti Mohd Azmin<sup>2</sup>

<sup>1</sup> Department of Tourism and Hospitality, Politeknik Ibrahim Sultan, Pasir Gudang, Johor suhailiishak.si@gmail.com

<sup>2</sup> Department of Tourism and Hospitality, Politeknik Ibrahim Sultan, Pasir Gudang, Johor nurul\_azhani@pis.edu.my

#### Abstract

Theme parks are increasingly popular travel destinations for travellers all around the world these days. Theme parks also give tourists a variety of experiences. One of the well-known theme parks in Malaysia is LEGOLAND Malaysia. At LEGOLAND Malaysia, they provide a ride that makes use of augmented reality (AR) technology to satisfy visitor satisfaction. The purpose of this study is to measure the satisfaction of tourists with the AR technology and investigate the relationship between tourist satisfaction and tourist revisit intention. It is crucial to understand the functional of the AR technology and tourists' experiences at the LEGOLAND Malaysia since experience is an important factor that is related to intention to revisit. In this study, 200 respondents who have been to LEGOLAND Malaysia within the past three years took the online survey. The data was collected by using quantitative method. Statistical Package for Social Sciences (SPSS) was used for data analysis. The result of the study indicates that functional and experience has a significant impact on satisfaction and revisit intention at LEGOLAND Malaysia. Therefore, there is a need for LEGOLAND Malaysia to apply AR technology to encourage revisit intention. The results of this study can be used by the management of theme parks to design and carry out marketing initiatives that will enhance the services provided by the theme parks.

Keywords: Augmented Reality, Theme Park, Satisfaction

#### Introduction

Theme parks are an important part of the tourist sector in many parts of the world and have significant economic value since they demand significant financial investment and include some very big organisations. Even while it is less developed areas of Asia, the industry is thriving there due to the region's economic growth, which is boosting travel and leisure spending and making it easier to access funding. Numerous customer satisfaction and service quality studies have been conducted before this, but it has rarely



been applied to theme park industries. Furthermore, in prior studies on service quality, most researchers concentrated on consumer perceptions in retrospect rather than actual customer satisfaction. As a result, the research focus shifted to investigating the relationships between service quality and customer satisfaction at LEGOLAND Malaysia.

The lack of attention paid to visitors' requirements and wishes, along with poor service guality, has a significant impact on visitor satisfaction and the likelihood of returning. The theme park management must ensure that their clients are satisfied with the items and services they provide. Malaysia become the major theme park hub in the Asian region. There are now 20 theme parks and water parks in Malaysia, with more on the way. Twentieth Century Fox Studios, Ubisoft video game theme park, Matta Fair, LEGOLAND, Sea Life Malaysia, The Malaysian Reserve, and the Desaru Coast Adventure Waterpark are among these attractions. Understanding the impact of atmospheric experience on visitor satisfaction would improve the parks' ability to favourably influence visitor pleasure and, as a result, create visitor loyalty, allowing them to remain competitive. The happier memories visitors have from their tourism experience, the more likely they are to return and share their great experience with others. To recognising the types of technological advancements that emotionally touch guests, improving the facilities and providing a choice, or variety, of games in the theme park will lead to visitor retention and possibly inspire new visitors to attend. As a result, there is an obvious need to investigate what types of technological advancements can affect visitor pleasure and loyalty at LEGOLAND Malaysia.

Finding of this study will helps evaluate the operations and business environment related to Augmented Reality technology as to what aspects that the management will take corrective action. This research would offer trustworthy and practical information on the management, which was crucial in guaranteeing that the requirements and desires of the customers would be appropriately met. This would assist them in producing cutting-edge concepts that may form the core of their marketing campaigns to draw in more clients. Those this study aim is to identify the tourist satisfaction of augmented reality technology to increased the intention to revisit at LEGOLAND Malaysia. Numerous customer satisfaction and service quality studies have been conducted before this, but it has rarely been applied to theme park industries. Furthermore, in prior studies on service quality, most researchers concentrated on consumer perceptions in retrospect rather than actual customer satisfaction. As a result, the research focus shifted to investigating the relationships between service quality and customer satisfaction at LEGOLAND Malaysia.

#### 2. Literature Review

#### 2.1 Technology Acceptance Model

Davis, an American researcher, proposed the Technology Acceptance Model (TAM) in 1989. The rational behaviour theory proposed the technology acceptance model to analyse the user's adoption of the information system. It was originally intended to provide an explanation of the critical aspects that computers accepted. Two primary determinants



are proposed in the technology acceptance model. The first is perceived usefulness, which refers to a person's willingness to use a system to improve his job performance. Second, perceived simplicity of use, which reveals how simple a system is to operate in the eyes of the user. According to TAM, the cognitive goal of the activity determines the actual use of technology, while the user's attitude toward usage and perceived utility determines the behavioural intention. The usefulness of perception is decided by the ease of use of perception and external variables, whereas the utility of perception is determined by the ease of use of perception and external variables. External factors have an impact on perceptual ease of use. Cognitive psychology is a sort of tourist identification. Cognition is part of the attitude category, which is tied to behavioural intent. As a result, tourist identity, attitude of usage, and behavioural intention are all related, according to TAM theory.

#### 2.2 Tourist satisfaction resulting in Intention of Revisit

The level of satisfaction may be used as a metric to assess the quality of the products and services provided at the location. Satisfaction is a post-usage phenomena that is entirely subjective and the outcome of comparisons. Loyalty is a key idea in the area of repercussions of satisfaction. Repeat visitors are more likely to share positive word-of-mouth, which has been effective as a free marketing technique (Som and Badarneh, 2017). Destination marketers are being encouraged to concentrate more on boosting travellers' desire to return to tourism or rural tourism locations as the tourism business gets more competitive (Choo, Ahn, and Petrick, 2016). Tourist satisfaction is crucial for effective destination marketing since it affects the decision to travel, the consumption of products and services, and the likelihood that they will return (Lee et al., 2019). According to several research, there is a high correlation between customer satisfaction and the possibility that they will return (Hutchinson, Lai, and Wang, 2009; Orel and Kara, 2014). As a result, the cognitive and affective viewpoints contend that an individual's cognitive assessments and the feelings they receive from their consumption experience have an impact on their level of satisfaction.

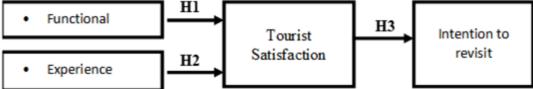
#### 2.3 Augmented Reality in Tourism Industry

Since being brought to the consumer market through gadgets like the Oculus Rift, Google Cradboard, or Magic Leap Lightwear, Augmented Reality (AR) has drawn a lot of interest. But according to Bonetti, Warnaby, and Quinn (2018), AR has already been used in a variety of business settings. The definition of Augmented Reality (AR) is the overlaying of electronic information that is projected into the user's field of vision via devices like smartphones, tablets, and wearables like AR glasses (Rauschnabel & Ro, 2016). A number of theme park operators have tried to use augmented reality to improve guest experiences and draw in more visitors. Recent technologies are frequently essential for visitor engagement, therefore they have improved their visitor experiences with innovations ranging from virtual upgrades to stay attractive for tourists. Positive reviews noted a more engaging experience in terms of enjoyment, interaction, and visual and



figurative appeal. These more complex solutions are being envisioned and implemented for end-user advantages in the tourism and hospitality industries as a result of the growth of AR technology, whose implementations continue to impress consumers and investors. A person's sentiments of pleasure or disappointment as a consequence of evaluating a product's perceived performance in accordance to visitor expectations are referred to as satisfaction. Figure 1 represents the study framework schematically. Understanding the factors that influence quality of AR technology and tourist loyalty results in intents of recommendation and return visits to LEGOLAND Malaysia. As a result, a conceptual framework was created as a foundation for the investigation. The literature research was then used to identify a set of quality of service dimensions specific to LEGOLAND Malaysia.





#### 3. Methods

For this study, researcher used primary and secondary data to collect the information. Quantitative method was used to collect primary data. A pilot study was conducted on 30 tourists visiting Legoland Malaysia using Statistical Package for the Social Sciences (SPSS). A total of 30 visitor voluntarily participated in the pilot study. A systematic sampling approach was employed in this study. Specifically, the total respondent target population consisted of 200 individual who have visited to Legoland in the past 3 years during the period of data collection. Data collection was proceeded using a selfadministrated questionnaire, consisting of both scaled variables which were functional and experience, tourist satisfaction and demographic enquiries. A screening question was asked to secure that the tourists had visited the Legoland Malaysia, to prevent response error. Respondents were asked to indicate their level of agreement based on a Likert scale of 1 to 5 (from very disagree to very agree). Researchers focus with respondents that are 18 years old and above to ensure this study was relevant. The method needs to consequently be applicable and related to the objective of this research and as the result will be decided through the method used. Hence, the objective of this research can be done through proper procedures. Proportionate Stratified sampling method to obtain the generalization of the results.



# 4. Result and Discussion

#### 4.1 Realibility Analysis

The Cronbach's Alpha Coefficient was used to determine the dependability of each item in the instruments. To make it easier to understand, each dimension of the questionnaire was calculated independently. The dependability analysis is then used to determine a measuring instrument's consistency in measuring the concept it is measuring. The term "reliability of measure" refers to the consistency and stability with which an instrument implements a concept and aids in determining a measure's "goodness."

As rules of thumb, values which were above 0.6 were considered acceptable and 0.8 is the most appropriate and acceptable stated by Pallant (2011). Based on the table appended all variable that addressed in the questionnaire achieved reliability of close to 0.8 or above to the fact that the item in the questionnaire is reliable because had already been used and tested by other researchers in the same field of study. This result also showed that the questionnaire is understandable and align with the situation.

Table 1: Reliability Coefficients for Each Variable					
Variables	No. of Items	Item Deleted	Cronbach's Alpha		
Functional	6	-	0.911		
Experience	5	-	0.898		
Tourist Satisfaction	3	-	0.911		
Intention to Revisit	3	-	0.925		

#### 4.2 Descriptive Analysis

Descriptive analysis was carried out with the aims of explaining tourist satisfaction of respondent with Augmented Reality (AR) technology with their trips. The statistical tests used were frequency, percentage, mean and standard deviation. Table 1 shows in this study 53.5% of the respondents were female and 46.5% of respondents were male. 52% of the respondents were married and 48% of the respondent were single. According to the age group, most of the respondents were from the age group of 18 - 29 years old with percentage of 48% followed by the age group of 30 - 39 with a total number of percentages of 43% and the least number of respondents were in the age group of 40 and above with only percentage of 9%. Therefore, this study can conclude that there is no bias in this study.



Table 2: Profile of respondents					
Demography Frequency Percentage					
Gender	Male	93	46.5		
	Female	107	53.5		
Marital	Single	96	48.0		
status	Married	104	52.0		
Age	18 – 29	96	48.0		
	30 – 39	86	43.0		
	40 and above	18	9.0		

Table 2 shows the descriptive statistics for the Functional variable. Overall, the functional of AR technology at LEGOLAND Malaysia is at a high level (Mean=4.53). The item that highest level of functional is item on the "The AR imagery that occurred was clear" (Mean=4.53). "The AR system at LEGOLAND Malaysia provide high quality of information about the Lego character" and "It was comfortable to use this AR glasses at LEGOLAND Malaysia" has the lowest level item (Mean=4.51).

Table 3: Descriptive Statistics for Functional (N=200, Mean=4.53)					
Items	Mean	SD	Level		
1. The AR system at LEGOLAND MALAYSIA worked	4.56	0.624	High		
smoothly					
2. The AR system at LEGOLAND MALAYSIA provide	4.51	0.634	High		
high quality of information about the Lego character					
3. It was comfortable to use this AR glasses at	4.51	0.694	High		
LEGOLAND MALAYSIA.					
4. LEGOLAND MALAYSIA AR system provided	4.53	0.641	High		
authentic audio setting					
5. The AR imagery that occurred was clear	4.57	0.597	High		
6. The AR imagery that used was detailed	4.53	0.649	High		

Table 3 shows shows the descriptive statistics for the experience variable. Overall, the experience of visitor at LEGOLAND Malaysia with AR technology is at prominent level (Mean=4.56). The highest level of experience is item on the "I was able to block out most other distraction from outside during AR ride" (Mean=4.58).



Table 4: Descriptive Statistic for Experience (N=200, Mean=4.58)					
Items	Mean	SD	Level		
1. Time period for the ride that using AR technology at LEGOLAND MALAYSIA very suitable	4.55	0.671	High		
<ol> <li>I was able to block out most other distraction from outside during AR ride</li> </ol>	4.58	0.588	High		
3. I was absorbed in the AR environment	4.57	0.598	High		
<ol><li>I had fun during the ride that using AR system</li></ol>	4.56	0.599	High		
5. I felt the AR ride at LEGOLAND MALAYSIA was very interesting	4.57	0.606	High		

Table 4 shows the descriptive statistics for tourist satisfaction variable. Overall, the tourist satisfaction with the AR technology at LEGOLAND Malaysia is at a high level (Mean=4.57). The item that has the highest level of tourist satisfaction is item on the "A trip to LEGOLAND MALAYSIA to experience AR technology was worthwhile" and "A trip to LEGOLAND MALAYSIA was as good as I expected" (Mean=4.57).

Table 5: Descriptive Statistics for Tourist Satisfaction (N=200, Mean=4.57)			an=4.57)
Items	Mean	SD	Level
1. A trip to LEGOLAND MALAYSIA to experience AR technology was worthwhile	4.58	0.621	High
2. A trip to LEGOLAND MALAYSIA was as good as I expected 3. A trip to LEGOLAND MALAYSIA is satisfying	4.58 4.57	0.599 0.614	High High

#### 4.3 Hypothesis Testing

In testing the hypothesis of this study, the critical the ratio associated with each parameter was examined. The process involved inspecting whether the path coefficients were significant and in the hypothesized direction. The hypothesis outlined in this study suggest that the model has two dimensions in measuring the quality of AR technology value. Thus, visitors will aggregate their satisfaction with the quality of AR technology of the two dimensions, which in turn will influence the tourist satisfaction value. Tourist satisfaction value has an impact on future behavioural intentions.

Table 6: Summarized Results for Direct Relationship				
Hypothesis tested	Std. Beta	Std. Error	t- value	Decisions
H1 Functional has a positive relationship with tourist satisfaction	0.771	0.046	4.502	Supported
H2 Experience has a positive relationship with tourist satisfaction	0.798	0.044	4.259	Supported



positive relationship with intention 0.759 0.49 3.828 Supported to revisit	H3 Tourist satisfaction has a positive relationship with intention	0.759	0.49	3.828	Supported
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The direct relationship demonstrated that all hypothesis showed significant effects. The verdict indicated two quality value of AR technology which are functional, and experience were significant to tourist satisfaction. In addition, the relationship between the tourist satisfaction and intention to revisit were also found significant.

#### 5. Conclusion

This study found that the usefulness of AR technology and the user experience had a beneficial impact on tourists' pleasure. Establishing significant tasks and immersing people in intriguing worlds are two main aspects that should be emphasised simultaneously for the optimal experience and enthusiasm. The results of the current study are also corroborated by Chen (2013), who came to the conclusion that the system quality and experience, as well as the three quality dimensions, have an impact on the behavioural intention. System and information quality are significant, according to Kim et al. (2013) who evaluated the desire to implement a ubiquitous tour information service. As a result, system quality is crucial in both the general business environment and the tourist industry.

The findings of this study indicate that visitor functional and experience had a higher impact on satisfaction that resulting intention to revisit. Users' total satisfaction is influenced by system design and functionality, therefore developers of AR applications should concentrate largely on interaction and on personalised data, images, and videos. When employing AR apps to conserve theme park, personal information, photographs, and videos become vital, along with the quality of the material and the system. The research's findings contribute to the body of knowledge on managing and marketing tourist destinations. This study may be repeated at theme park or in other leisure-related industries.

In conclusion, the study's findings suggest that theme parks should give and improve the overall park experience by providing a range of attractions and value by giving tourists engaging, beautiful, and entertaining experiences in order to raise visitor satisfaction and tendency to return. Understanding and managing visitor satisfaction is crucial to creating an environment and an experience that will encourage visitors to consider of returning. The management of theme parks is responsible for creating and providing the emotional experiences that encourage visitors to use the attractions.



#### Reference

Bonetti, F., Warnaby, G., & Quinn, L. (2017). Augmented Reality and Virtual Reality in Physical and Online Retailing: A Review, Synthesis and Research Agenda. Augmented Reality and Virtual Reality, 119-132. <u>https://doi.org/10.1007/978-3-319-64027-3\_9</u>

Choo, H., Ahn, K. and Petrick, J. F. (2016). An integrated model of festival revisit intentions. Theory of planned behavior and festival quality/satisfaction. International Journal of Contemporary Hospitality Management, 28(4), 818-838.

Chin, W. W. (1998). The partial least squares approach to structural equation modeling. In G. A. Marcoulides (Ed.), Modern methods for business research (pp. 295-336). Mahwah, NJ: Lawrence Brlbaum Associates

Dewi, D., Hajadi, F., Handranata, Y. W., & Herlina, M. G. (2021). The effect of service quality and customer satisfaction toward customer loyalty in service industry. Uncertain Supply Chain Management, 9(3), 631–636. <u>https://doi.org/10.5267/j.uscm.2021.5.007</u>.

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: indeed a silver bullet. Journal of Marketing Theory and Practice, 19(2), 139-151

Henderson, J.C, Chua P.T., Liu, H.J. & Ngiam, J (2013). Theme Parks in Southeast Asia: A Case Study of LEGOLAND® Malaysia. Asia-Pacific Journal of Innovation in Hospitality and Tourism, 2(2), 227-242.

Ko, D. G., Kirsch, L. J., & King, W. R. (2005). Antecedents of knowledge transfer from consultants to clients in enterprise system implementations. MIS Quarterly, 29(1), 59–85.

Krejcie, R.V., & Morgan, D.W., (1970). Determining Sample Size for Research Activities. Educational and Psychological Measurement.

Lee, S., Jeong, E., & Qu, K. (2019). Exploring Theme Park Visitors' Experience on Satisfaction and Revisit Intention: A Utilization of Experience Economy Model. Journal of Quality Assurance in Hospitality & Tourism, 21(4), 474–497. https://doi.org/10.1080/1528008x.2019.1691702.

Mansori, S., & Chin, J. H. (2013). Shopping Mall Attributes: Tourist Satisfaction and Loyalty. Management Dynamics in the Knowledge Economy, 7(4), 571–590. <u>https://doi.org/10.25019/mdke/7.4.08</u>.

Ranjbarian, B. and Pool, J. K. (2018). The impact of perceived quality and value on tourists' satisfaction and intention to revisit Nowshahr City of Iran. Journal of Quality Assurance in Hospitality & Tourism, 16(1), 103-117



Rauschnabel, P. A., & Ro, Y. K. (2016). Augmented reality smart glasses: an investigation of technology acceptance drivers. International Journal of Technology Marketing, 11(2), 123. https://doi.org/10.1504/ijtmkt.2016.075690

Resort, L. M. (2020). Awesome Awaits. LEGOLAND® Malaysia Resort. Retrieved November 1, 2021, from <u>https://www.Legoland.com.my/</u>.

S. Sutton, Health Behavior: Psychosocial Theories, Editor(s): Neil J. Smelser, Paul B. Baltes, International Encyclopedia of the Social & Behavioral Sciences, Pergamon, 2001, Pages 6499-6506,

Som, A. and Badarneh, M. (2017). Tourist satisfaction and repeat visitation: Toward a new comprehensive model. International Journal of Human and Social Sciences, 6(1), 38-45.

Statista. (2021, October 22). Legoland park attendance worldwide 2011–2020. https://www.statista.com/statistics/663955/merlin-entertainments-Legoland-parks-visitor-numbers/.

Sun, P. and Zhang, M. (2019) Chinese Theme Park Technology Intervention and Tourist Identification Research: A Case Study of Liuzhou OCT Visionland. Journal of Service Science and Management, 12, 293-314. doi: 10.4236/jssm.2019.123020.

Van Nuenen, T., & Scarles, C. (2021). Advancements in technology and digital media in tourism. Tourist Studies, 21(1), 119–132. <u>https://doi.org/10.1177/1468797621990410</u>.

Yuen, E., Chan, S, (2019). The effect of retail service quality and product quality on customer loyalty. J Database Mark Cust Strategy Manag 17, 222–240. <u>https://doi.org/10.1057/dbm.2010.13</u>.

Zhang, Y. (2019). Why Customer Perception Matters and How to Improve It. https://hapticmedia.fr/blog/en/customer-perception/.



# THE RELATIONSHIP BETWEEN SERVICE QUALITY AND TOURIST SATISFACTION AT TAMAN NEGARA, NATIONAL PARK, KUALA TAHAN, PAHANG

Khairiah Izmira Binti Rosli<sup>1</sup> and Dr Nurul Azhani Binti Mohd Azmin<sup>2</sup>

<sup>1</sup> Department of Tourism and Hospitality, Politeknik Ibrahim Sultan, Pasir Gudang, Johor *miraworks*359@gmail.com *nurul\_azhani*@pis.edu.my

#### Abstract

One of Malaysia's key economic areas is ecotourism. Ecotourism has been advocated as a tool for managing and conserving the ecological and cultural legacy of deserts. Despite the expanding significance of protected area tourism, insufficient focus has been placed on tourist satisfaction as measured by their assessment of the features' quality. Service quality is thought of as an important indicator to the growth of ecotourism. Achieving high levels of tourist satisfaction may result in a loyal customer with a lot of positive returns. Service quality is an important part for a national park which is they can lead them to become friendlier between the local people and tourists. This study attempts to examine the level satisfaction of tourist that had visited Taman Negara, National Park, Kuala Tahan, Pahang (TNNPKT). A survey of 150 respondents was used to measure the satisfaction and the data was collected using the quantitative method. Meanwhile, Statistical Package for the Social Sciences (SPSS) was used for data analysis. In conclusion, it is recommended that there is a need to Taman Negara, National Park, Kuala Tahan, Pahang (TNNPKT) to acknowledge the relationship between service guality and tourist satisfaction in order to increase the local visitors at Taman Negara, National Park, Kuala Tahan, Pahang.

Keywords: Service Quality, Tourist Satisfaction, National Park.



#### 1. Introduction

Many developing nations successfully promote tourism in protected and unprotected areas by utilising the natural charms. To achieve sustainable tourism, effective management of visitors is necessary to avoid negative impacts on the environment, the host community, and visitor satisfaction. The focus on managing conflicts and promoting sustainable development is based on the conscientious use of resources, particularly in light of planning, commitment, and the participation of both the management and the interested stakeholders. The main focus of this study is Taman Negara National Park, which is a one of the World Heritage Site. Taman Negara or National Park in Pahang, Malaysia is among the popular ecotourism destination in Malaysia. Their management has became more difficult over the last few years as a result of an increase in tourists, a lack of facilities, and changes to the natural environment. To avoid negative consequences on the environment, the host community, and visitor happiness, it is important to address and carefully manage the conflict of interest and values amongst the various tourism sector stakeholders.

The researcher chooses to study about eco-tourism in Taman Negara, National Park, Kuala Tahan, Pahang. Kuala Tahan, Pahang is the main entrance to the Taman Negara, National Park in Malaysia and it is by far the most established, with all of the amenities and visitor accommodations (Yng, 2015). The aim of this study is to increase the tourist at TNNPKT by upgrading their service quality that can contribute to the customer satisfaction when tourists visit TNNPKT.

Based on the data given by Malaysia Tourism Key Performance Indicators (2020), the visitor's arrival in 2019 at TNNPKT had recorded significant changes among the national parks. As stated in the data, TNNPKT domestic visitors had decreased from 34,346 to 29,898. Khairuddin & Rahman (2020) had declared that, in order to ensure better quality of experience to tourists, the interaction between tourists and local authorities in TNNPKT needs to be enhanced which can be seen as responsiveness. For a past years, since the national park received many critisms and encounter many issues regarding service quality (UKEssays, 2018). Therefore, the purposes of this study was to assess the relationship between tourist's satisfaction and service quality at TNNPKT which could contribute to the upgrading the levels of services and facilities provided by TNPPKT.



### 2.0 Literature Review

# 2.1 Service Quality

Aseres & Sira (2019) stated that service quality has been established in a variety of educational and economic organizations. Hence, Yusof et al. (2019) announced that tourist satisfaction is rely on the quality of the services provided, especially in ecotourism destinations but academia author, Frochos and Hughes stated to determine the service quality for a tourism destination is quite challenging due to the heterogeneous, inseparable, and intangible qualities of services. Lai et al. (2014) mentioned, since then, service quality in the hospitality and tourism industries has remained a hot topic that has garnered a lot of research. Even though the model has been used widely by academic authors, according to Adil et al. (2013) mentioned that the model also received many criticisms. The researcher also stated that criticisms have mainly revolved around right from its dimensional structure to the interpretation and implementation of the instrument.

# 2.2 SERVQUAL Model

According to Puri & Singh (2018) mentioned that SERVQUAL is developed to evaluate service quality as perceived by the consumer, and customer expectations are perceived when analysing overall service quality. As stated by Yusof et al. (2014), Parasuraman, Zethaml and Beryl had introduce the SERVQUAL model in the first place, they recognizes ten dimensions of service quality which is tangibility, reliability, responsiveness, competency, communication, credibility, security, access, courtesy and understanding of the customer. But then, Parasuraman and other academia authors specify into five dimensions which is the tangibility, reliability, responsiveness, assurance, and empathy. Civility and knowledge of the employees is defined by assurance, trustworthiness and precise performance is explained by reliability, swift and enthusiastic response towards the customer service is laid under responsiveness, tangibles explains the things which are physical like the materials, facilities and the personals, lastly dedicate attitudes towards customers come under the empathy (Khan et al, 2017). According to Rodrigues (2011), the SERVQUAL model by Parasuraman Model is describing service quality as the difference between consumers' perceived performance and expectations.

# 2.2 Service Quality at National Park

Sira & Aseres (2019) had commented that park authorities should recognise measuring the SERVQUAL in national parks to improve ecotourism competitiveness and visitor satisfaction. Measuring the SERVQUAL obviously need management implications



because it facilitates in the development of knowledge of the level of service quality and visitor satisfaction, lack of consistency and in the development of service recovery strategies.

# 2.3 Tourist Satisfaction

Abdalla et al. (2015) stated that service quality and tourist satisfaction are increasingly being recognised as critical factors in the combat for competitive differentiation and tourist retention. Zaibaf et al. (2013) also mentioned that in the context of services, satisfaction can be defined as an affective tourist condition that results from a detailed understanding of all aspects of the tourist's relationship with the service provider. According to Kobylanski (2012), consumers who are satisfied with their goods or services are more likely to make long-term commitments to the product or service provider, as well as have fewer negative feelings that could lead to a change of service provider which can be seen tourists' satisfaction levels are negatively related to consumer complaints. If customer high expectations are met, high customer satisfaction is likely (Ellis & Vogelsong, 2003). As a result, it can lower costs associated with resolving issues with low-quality services. Higher level of satisfaction is most often achieved through the continuous improvement of the quality of service (Atabeb, 2019).

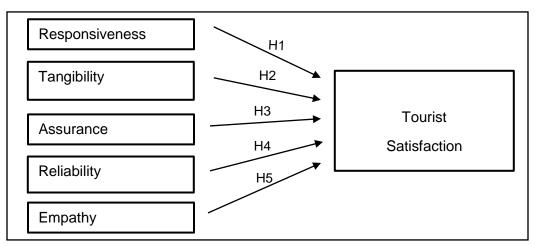


Figure 1: Conceptual Framework of Study

#### 3.0 Method

Researchers are focus on data collection in order to get the information throughout the respondent's opinions about service quality and tourist satisfaction at Taman Negara, National Park, Kuala Tahan, Pahang by both methods which are primary data which consists questionnaire and the other method is secondary data which may include by previous articles and journals. Total of 150 respondents were participating in answering



the questionnaire. The population included the tourist that had visited TNNPKT. The data is analyze by the use of the Statical Packages for the Social Science (SPPS). The questionnaire consisted three sections, which includes: Section A (Demographic), Section B (Responsiveness, Tangibility, Assurance, Reliability and Empathy) and Section C (Tourist Satisfaction).

The tourist satisfaction towards service quality provide at TNNPKT were measured using the Likert Scale. The responses of respondents were categorized into five groups and given them weight from minimum 1 to maximum 5; then assigned point 1 for the response "strongly disagree", 2 for "disagree", 3 for "neutral", 4 for "agree" and 5 for "strongly agree". If one is strongly agreed with particular statement that indicates he is sighly satisfied with that particular criterion. On the flip side, if one is strongly disagreed with particular statement that indicates he has negative attitude or dissatisfaction with that particular criterion.

#### 4.0 Result and Discussion

The purpose of the descriptive analysis was to explain tourist satisfaction with the service quality at TNNPKT.

Demography		Frequenc y	Percentage
Gender	Male	68	44.2
	Female	86	55.8
Age group	< 20	8	5.2
	20 - 29	117	76.0
	30 - 39	23	14.9
	40 - 49	6	3.9

Table 1 shows the demographic information. The statistical tests for demographic information used were frequency and percentage. In this study, according to gender, the number of respondents is almost equally distributed 44.2% male respondents and 55.8% for female respondents. According to age group, most of the respondents are from the age group of 20 until 29 years old with 76% of respondents. This is followed by the age group of 30 until 39 years old with 14.9% respondents. The next age group is below 20



years old with a total percentage 5.2% respondents. The least number of respondents is followed by the age group of 40 until 49 years old 3.9% respondents.

# Table 2: Level Satisfaction among tourist

Tourist_satisfaction			
Gender / Jantina	Mean	N	Std. Deviation
Male	3.9088	68	.99817
Female	4.0000	86	.93154
Total	3.9597	154	.95941

Tourist satisfaction at TNNPKT varied depending on the gender's sector, the group of female are more satisfied when visiting the TNNPKT with mean score 4.0.

Table 3: Level of Responsiveness towards Tourist Satisfaction (N=150,
Mean=3.90)

Items	Mean	SD	Level
1. The staffs at TNNPKT show their effort to answer the customer's question.	3.94	1.011	High
2. The staffs at TNNPKT are able to response to all customer's question within a short time.	3.88	1.048	High
3. Availability to respond to customer's request.	3.92	.987	High
4. Flexibility in order to fulfill the needs of the customer.	3.90	.985	High
5. Staffs at TNNPKT are able communicate.	3.95	.992	High
6. Staffs at TNNPKT have some knowledge to answer a question from customer.	3.86	1.081	High

Table 3 shows the level of responsiveness towards the tourist satisfaction at TNNPKT. Overall, the responsiveness level towards tourist satisfaction at TNNPKT is at high level with mean score 3.90. Mostly tourist satisfied with how the staff at TNNPKT communicate with mean score 3.95.



Items	Mean	SD	Level
1. Accessibility and transportation to TNNPKT is easy.	3.79	.990	High
2. TNNPKT has an adequate parking space.	3.82	.978	High
3. The park's facilities at TNNPKT do not give a negative impact	3.79	1.008	High
to the environment.			
4. TNNPKT has a sufficient signages around the park.	3.84	1.038	High
5. TNNPKT provides convenient recreational facilities.	3.88	1.022	High
6. I satisfy with the food and beverages facilities that provided by the TNNPKT.		1.023	High
7. The brochure and guides at TNNPKT are noticeable.	3.86	1.004	High
8. The staffs at TNNPKT have a neat appearance.	3.84	1.038	High
9. TNNPKT has an availability of information resources.	3.87	1.014	High

#### Table 4: Level of Tangibility towards Tourist Satisfaction (N=150, Mean= 3.83)

Table 4 shows the level of tangibility towards the tourist satisfaction at TNNPKT. Overall, the tangibility level towards tourist satisfaction at TNNPKT is at high level with mean score 3.83. Mostly tourist satisfied with the availability of information resources at TNNPKT with mean score 3.87.

 Table 5: Level of Assurance towards Tourist Satisfaction (N=150, Mean= 3.89)

Items	Mean	SD	Level
1. Staffs and travel guides at TNNPKT are consistently polite.	3.90	.982	High
2. The guide at TNNPKT is well prepared with their occupational	3.88	1.029	High
skills.			
3. I trust the staffs at TNNPKT and feel safe while interact with	3.91	.979	High
them.			

Table 5 shows the level of assurance towards the tourist satisfaction at TNNPKT. Generally, The assurance level towards tourist satisfaction at TNNPKT is at high level with mean score 3.89. Mostly tourist trust the staffs at TNNPKT and feel safe while interact with them.



Items	Mean	SD	Level
1. The staffs at TNNPKT always willing to help.	3.88	1.022	High
2. The staffs at TNNPKT are dependable.	3.88	.986	High
3. The staffs at TNNPKT always available for care and aid when I	3.94	1001	High
am facing the difficulties.			
4. The staffs at TNNPKT are understanding and reassuring.	3.89	1.007	High
5. Services at TNNPKT are delivered on time as promised.	3.87	1.001	High

Table 6: Level of Reliability	v and Tourist Sati	sfaction (N-150	Mean- 3 89)
	y and rounst Saus	Siaction (11-130	, IVICALI = 5.03)

Table 6 shows the level of reliability towards the tourist satisfaction at TNNPKT. The reliability level towards tourist satisfaction at TNNPKT is at high level with mean score 3.89. Mostly tourist satisfied with the staffs' availability when they facing the difficulties with mean score 3.94.

Table 7: Level of Empathy towards	Tourist Satisfaction (N=150, Mean= 3.86)
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Items	Mea	SD	Level
	n		
1. I experience a personal attention from the staffs at TNNPKT.	3.81	.995	High
2. The staffs at TNNPKT are easily approach.	3.88	1.016	High
3. The staffs at TNNPKT understand what customer's needs.	3.89	.994	High

Table 7 shows the level of empathy towards the tourist satisfaction at TNNPKT. The empathy level towards tourist satisfaction at TNNPKT is at high level with mean score 3.86. Mostly the staffs at TNNPKT understand what customer's need with mean score 3.89.

Hypothesis Tested	Std. Beta	Std. Error	t-value	Decisions
H1 Responsiveness has a positive relationship with tourist satisfaction.	0.305	0.102	3.029	Supported
H2 Tangibility has a positive relationship with tourist satisfaction.	0.045	0.108	0.437	Not supported



H3 Assurance has a positive relationship with tourist satisfaction.	0.123	0.097	1.278	Not supported
H4 Reliability has a positive relationship with tourist satisfaction.	0.282	0.106	2.702	Supported
H5 Empathy has positive relationship with tourist satisfaction.	0.219	0.81	2.765	Supported

Table 8 shows the results of direct relationship between service quality an tourist satisfaction. The direct relationship demonstrated that 3 out of 5 hypotheses showed significant effects. The verdict indicates three service quality which can be seen as responsiveness, reliability and empathy significant to tourist satisfaction at TNNPKT. Meanwhile, there are two variables that not significant to tourist satisfaction which can be seen as seen as tangibility and assurance.

#### 5.0 Conclusion

The findings of this study show significant relationship on the influence of service quality towards customer satisfaction at TNNPKT. The quality of responsiveness at TNNPKT satisfied the tourist that had visited TNNPKT. From the analysis, it was found that this study is contradict with the other researcher findings. From the findings "Evaluating the quality experience of ecotourist in Taman Negara Pahang" from Khairudin & Rahman (2020), in order to provide tourists with a better quality of experience, the interaction between tourists and local authorities in TNNPKT must be improved, which can be referred as responsiveness. The findings use the eco tourist as their main respondents. Meanwhile, this study found that the TNNPKT did not have any issues related to responsiveness. This study used tourist that had visited TNNPKT as the study's sample population. TNNPKT is a popular destination due to the uniqueness of its characteristic as an ecotourism destination. Therefore, TNNPKT is a destination that can give the tourists adifferent kind satisfaction that can meet tourist expectations.

#### References

Adil. et.al (2013). SERVQUAL: A Review of Measurement in Service Marketing Research.

Global Journal of Management and Business Research Marketing, Volume 13 Issue 6.

Aseres, S. A., & Sira, R. K. (2019). An exploratory study of ecotourism services quality (ESQ) in

Bale Mountains National Park (BMNP), Ethiopia: using an ECOSERV model. Annals of Leisure Research, 23(3), 386–406.



Atabeb, H. A. (2019). *Customer satisfaction in tourism industry*. International Journal of Scientific and Research Publications (IJSRP), 9(1), p8566.

Ellis, C. L., & Vogelsong. H. (2003). Assessing indicators relating to overall tourist

satisfaction of ecotourism developments in eastern North Carolina. Department of Agriculture, Forest Service, Northeastern Research Station. 52-57.

Khairudin. A. D., & Rahman. N. H. A. (2020). Evaluating the quality experience of

ecotourist in Taman Negara Pahang. IOP Conference Series: Earth and Environmental Science. 447. 012014.

Lai. I. K.W., Hitchcock. M., Yang. T., and Lu. T. W. (2018). Literature review on

service quality in hospitality and tourism (1984-2014): future directions and trends. International Journal of Contemporary Hospitality Management, Vol. 30 No. 1, pp. 114-159.

Puri, G., & Singh, K. (2018). The Role of Service Quality and Customer Satisfaction in Tourism

*Industry: A Review of SERVQUAL Model.* International Journal of Research and Analytical Reviews 2018. VOLUME 5. ISSUE 4. pp. -745-751

Rodrigues. L. L. R., Barkur. G., Varambally. K. V. M., & Golrooy. M. F. (2011).

Comparison of SERVQUAL and SERVPERF metrics: an empirical study. The TQM Journal, Vol. 23 No. 6, pp. 629-643.

Yusof, N., Abd Rahman, F., Che Jamil, M. F., & Iranmanesh, M. (2014). Measuring the Quality

of Ecotourism Services. SAGE Open, 4(2), 215824401453827.

Zaibaf, M., Taherikia, F., & Fakharian, M. (2013). Effect of perceived service quality

on customer satisfaction in hospitality industry: gronroos' service quality model development. Journal of Hospitality Marketing & Management, 22(5), 490–504.

#### Website:

DWNP. (2014). Pahang National Park, Kuala Tahan. Department of Wildlife and

National Park. Accessed 25 November 2021, from https://www.wildlife.gov.my/index.php/en/11-info/158-pahang-national-park-kuala-tahan

UKEssays. (2018, November). Case study of taman negara malaysia tourism essay.

UKEssays. Accessed 2 December 2021, from https://www.ukessays.com/essays/tourism/case-study-of-taman-negara-malaysia-tourism-essay.php?vref=1



# **BIM AUGMENTED REALITY TO YOU (AR2U)**

Asyraf Hafiffuddin Abd Rahim<sup>1</sup>, Samikhah Muhammad @ Munir<sup>2</sup>

<sup>1</sup>Civil Engineering Department, Politeknik Ungku Omar, Ipoh, Perak Ar.Asyraf95@gmail.com

<sup>2</sup>Civil Engineering Department, Politeknik Ungku Omar, Ipoh, Perak samikhah@puo.edu.my

#### Abstract

Construction drawings should be providing a graphic representation of what is to be built and it also should be concise and coordinated to avoid, wherever possible, ambiguity and confusion. However, at MINT Modernization Project for Bank Negara Malaysia, the usage of construction drawing is beyond count. The outcome is numerous paper waste has been produced. MINT Modernization Project also depending on the user ability to imagine from 2D drawing, consequence to this the user unable to retrieve enough information. The study aim is to innovate an Augmented Reality application that can generate 3D model using Building Information Modelling (BIM) and Augmented Reality (AR). The BIM AR2U application able to help the user to visualize and gain more information from 2D drawing. Respondent preferred using AR2U application whereby all variable measured Perceived Usefulness (Mean =4.78), Perceived Ease of Use (Mean = 4.68), and impact of trust towards intention to use AR2U (Mean = 4.74). Needless to say, BIM AR2U offers key benefits to the construction industry as it able to help user to get sufficient data that ensures both accuracy and speed as well. BIM AR2U also gives them the chance to navigate each project phase and to see any errors before they surface later.

Keywords: Construction Drawing, Paper waste, Augmented Reality, BIM, Envisioned.

# 1. Introduction

Although the construction industry contributes to the development but at the same time this is not an environmental friendly activity because a lot of problems may exist if the progress and development of this industry are not well planned. Construction industry is not by nature an environmentally friendly activity and it is a major contributor to environmental impacts, which are typically classified as air pollution, noise pollution, water pollution and paper waste.



One of the crucial part in construction industry is proper planning where the most important before any construction works started is to provide the construction drawing. Construction drawing is the general term used for drawings that form part of the production information that is incorporated into tender documentation and then the contract documents for the construction works. This means they have legal significance and form part of the agreement between the employer and the contractor. However, the construction drawing tends to be used for single use only the consequences to this number of paper waste has been produced. Not only that construction drawing also required the user to self-visualize in order to get the end picture of the building. Therefore, Building Information Modelling been implemented in construction industry.

Building Information Modelling (BIM) is an intelligent 3D model-based process that provides AEC professionals with every detail need to plan, design, construct, and manage buildings and infrastructure. BIM allows design and construction teams to work more efficiently, while enabling them to capture the data they create during the process. This data benefits operations and maintenance activities, and informs planning and resourcing on the project. BIM can be used in a number of industries, but in architecture it is used to make better design decisions, improve building performance, and collaborate more effectively throughout the project lifecycle. Other industries using BIM include civil engineering, construction, plant, MEP (mechanical, electrical, plumbing), and structural engineering.

#### **1.1 Paper Impact on Environment**

(Dennis Kempner, 2016) Paper alone accounts for 40% of all waste in the United States. That adds up to about 71.6 million tons per year. What many hope to reduce, reuse, and recycle, unfortunately and overwhelming ends up being dumped into a landfill. Waste from paper is a big issue. It's easy to forget that production of paper also has a devastating impact on the world we live in. Deforestation has increased at an alarming rate. Paper manufacturing used up to 40% of all global wood. The process of manufacturing paper releases nitrogen dioxide, sulfur dioxide, and carbon dioxide into the air, contributing to pollution such as acid rain and greenhouse gases. Furthermore, the US consumes more than 30% of all paper products globally, despite being only 5% of the world's population.

#### **1.2 Problems with 2D drawing**.

User are required to be skilful in a visualization method as a reference to prepare a prototyping process (Lothrop, 2012). Diraso et al. (2013) asserted that poor engineering drawing becomes one of the main reasons the graduates had difficulty in getting a jobs in technical drawing fields. This was because they could not interpret and read the engineering drawing accurately (Abdullah, 2015). In other words, 2D drawing rely on the user ability to imagine or visualize the end product.



## **1.3 Building Information Modeling**

Azhar, S. (2011). Building information modeling (BIM) is one of the most promising recent developments in the architecture, engineering, and construction (AEC) industry. With BIM technology, an accurate virtual model of a building is digitally constructed. This model, known as a building information model, can be used for planning, design, construction, and operation of the facility. It helps architects, engineers, and constructors visualize what is to be built in a simulated environment to identify any potential design, construction, or operational issues. BIM represents a new paradigm within AEC, one that encourages integration of the roles of all stakeholders on a project. In this paper, current trends, benefits, possible risks, and future challenges of BIM for the AEC industry are discussed. The findings of this study provide useful information for AEC industry practitioners considering implementing BIM technology in their projects.

#### 1.4 Augmented Reality

Carmigniani, J., & Furht, B. (2011) define Augmented Reality (AR) as a real-time direct or indirect view of a physical real-world environment that has been enhanced/augmented by adding virtual computer-generated information to it. AR is both interactive and registered in 3D as well as combines real and virtual objects. Milgram's Reality-Virtuality Continuum is defined by Paul Milgram and Fumio Kishino as a continuum that spans between the real environment and the virtual environment comprise Augmented Reality and Augmented Virtuality (AV) in between, where AR is closer to the real world and AV is closer to a pure virtual environment.

#### 2. Methodology

The approaches and procedures used in a research study's design will depend on the researcher's point of view about their ideas about the nature of knowledge and reality, which are frequently shaped by the discipline fields the researcher belongs to. Figure 1 shows the research design implemented in this project.



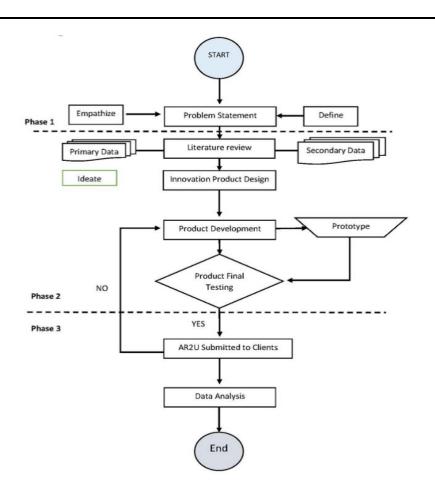


Figure 1: Research Design of the study

## 2.1 Questionnaire

The aim of the post questionnaire being distributed and being analyse is to answering the objectives number 3, which is to evaluate the effectiveness of AR2U application. A total number of 30 respondents being selected by the researcher to answer and give their perception regarding the application effectiveness. The selection of respondent is to obtain the absolute data and valid perception. These respondent been selected because of their professionalism background and their designation in Mint Modernisation for Bank Negara Malaysia (BNM) project.

## 2.2 Design Development

The innovation of AR2U is mainly to ensure the user able to visualize the end product through 2D drawing. This means, 2D drawing is still will be used as it is a major component in construction industry. This application being develop by using several open sources software such as Unity, Vuforia, Firebase, Visual Studio and Android studio. Due to all the software that been used is open sources software hence the development of



this project is free of charge. Figure 2 show the process of developing the AR2U application.

1. Registering Image Target in Vuforia.	2. Insert image target to Unity
3. Convert RVT file to FBX file	
5. Design and Create AR2U interface in Unity	6. Assign all button using Visual Studio
7. Create Security Data Base using FireBase	8. Build and Run to convert to APK file

Figure 2: AR2U Development Process



## 3. Result





The BIM AR2U is installed with security system where only registered people will allowed to use this application. This action able to secure the construction information. After registering to the apps the profile will be saved on a data base called firebase. To used this augmented effect the user only need the layout of the building and scanned the layout to generate 3D Model with augmented reality effect and on this study is support building for Mint Modernisation Project for Bank Negara Malaysia (BNM). The application is installed with 3 model which is architectural, structural and mechanical & electrical model.



Due to this application act as support application to 2D drawing, a folder contain 2D drawing was created. Hence, the construction able to reduce the usage of paper. Not only that this application also is installed with others notes regarding the structural element to ensure the user obtain much information to perform work on site.

A valid perception regarding the effectiveness of the product, the product than be tested by professional such as Engineer, Architect, Modeler, Draughtsman and Site supervisor. A questionnaire than being distributed to obtain the professional opinion regards the AR2U usefulness. The purpose of this questionnaire also to obtained the professional recommendation that can be implemented to improve the BIM AR2U application.

Table 1 shows result obtained by the developer regarding the effectiveness of BIM AR2U application from the professional overview.

Table 1: Level of mean score on each question					
AR2U Effectiveness	Level	Mean Value			
AR2U would help user visualize the end product of building design.	Very High	4.83			
Using AR2U application able to reduce the usage of paper in construction industry	Very High	4.77			
AR2U has adequate features to protect construction information.	Very High	4.63			

Table 1 shows the evaluation of the BIM AR2U effectiveness in the project, the study recorded that the professional strongly agree that by using BIM AR2U application the user able to visualize the end product of the building design and able to retrieve more information (Mean= 4.83). The study also recorded that by using the AR2U application construction industry able to reduce the usage of paper (Mean= 4.77). Hence this allow the construction able to reduce the number of paper waste.

The study also recorded that the professional believes that BIM AR2U application has an adequate feature to protect the construction information (Mean= 4.63). Respondent preferred using AR2U application whereby all variable measured Perceived Usefulness (Mean= 4.78), Perceived Ease of Use (Mean = 4.68), and impact of trust towards intention to use AR2U (Mean= 4.74).

 Table 2: One-Sample Test

		Test Value = 0								
t		t df		cance	Ance Mean Difference		95% Confidence Interval of the Difference		Std. Error	
			One- Sided p	Two- Sided p	Difference	Lower	Upper	Deviation	Mean	
Perceived Usefulness	84.263	29	<.001	<.001	4.77500	4.6591	4.8909	.31038	.05667	



Perceived Ease of Use	60.336	29	<.001	<.001	4.68333	4.5246	4.8421	.42514	.07762
Impact of trust towards intention to use	85.346	29	<.001	<.001	4.74167	4.6280	4.8553	.30430	.05556

Table 2 shows one sample t-test found this difference to be significant for all variables being measured, the value of t of Perceived Usefulness is 84.263 and the value of p is < .001. The result is significant at p < .05. The value of t of Perceived Ease of Use is 60.33 and value of p is < .001. The result is significant at p < .05. The value of t of Perceived interval. The value of t of impact of trust towards intention to use BIM AR2U is 85.35 and the value of p is < .01. The result is significant at p < .05. This conclude that by using BIM AR2U application able to overcome the problem occur regards of 2D drawing. This mean that BIM AR2U was more effective compare to be used as support application for 2D drawing.

## 4. Conclusions

In conclusion, construction industry will keep on evolving every day. However, it is unpractical if the industry stagnant rely of conventional way either in work or planning. This study aims to innovate the augmented reality effect to be fully used in construction industry.

This application able to support the conventional system which is 2D drawing to be fully functioning and minimize the contradiction. As 2D drawing is depending on the user ability to visualize a human error possible to occur. Moreover, by using this BIM AR2U application the usage of paper able to be reduced. As this application generate architectural model, structural model and mechanical & electrical model. 2D drawing is a major component in construction industry, hence this BIM AR2U did not oppose the usefulness of 2D drawing but this application is a support application to reduce the human error.

The result shows the professional in the study area is strongly agree with mean value from 4.63 to 4.78. This show this application will bring many benefit to the construction industry. Needless to say, BIM AR2U offers key benefits to the construction industry as it able to help user to get sufficient data that ensures both accuracy and speed as well. BIM AR2U also gives them the chance to navigate each project phase and to see any errors before they surface later.



#### References

- Ahn, S., Han, S., & Al-Hussein, M. (2019). 2D drawing visualization framework for applying projection-based augmented reality in a panelized construction manufacturing facility: Proof of concept. Journal of Computing in Civil Engineering, 33(5), 04019032.
- Alaloul, W. S., Liew, M. S., Zawawi, N. A. W. A., & Mohammed, B. S. (2018). Industry revolution IR 4.0: future opportunities and challenges in construction industry. In MATEC web of conferences (Vol. 203, p. 02010). EDP Sciences.
- Azhar, S. (2011). Building information modeling (BIM): Trends, benefits, risks, and challenges for the AEC industry. Leadership and management in engineering, 11(3), 241-252.
- Bossink, B. A. G., & Brouwers, H. J. H. (1996). Construction waste: quantification and source evaluation. Journal of construction engineering and management, 122(1), 55-60.
- Carmigniani, J., & Furht, B. (2011). Augmented reality: an overview. Handbook of augmented reality, 3-46.

FURNITURE, D. P. A. (2017). A Case Study of Autocad 2D Engineering Drawing Performance Among Furniture and Product Design (BFPD) Students. In Proceedings of 3 rd International Conference on Education 2017 (ICEDU-2017) (Vol. 3, pp. 49-57).

- Lin, J. P. (2021). Augmented Reality Use in Construction-A Case Study of the Industry.
- Mawalagedara, R., & Oglesby, R. J. (2012). The climatic effects of deforestation in South and Southeast Asia. Deforestation around the World, 3-20.
- Oztemel, E., & Gursev, S. (2020). Literature review of Industry 4.0 and related technologies. Journal of Intelligent Manufacturing, 31(1), 127-182.
- Tam, W. Y. V., Tam, C. M., Tsui, W. S. and Ho, C. M. (2006). "Environmental indicators for environmental performance assessment in construction." Journal of Building and Construction Management, 10(1). 45-56.



# FACTOR AFFECT EVENT VISITOR'S REVISIT BEHAVIORAL INTENTION AT ANIME FESTIVAL, PARADIGM MALL, PETALING JAYA

Wan Muhammad Akmal Che Azman<sup>1</sup> and Siti Nurhafizah Ahmad<sup>2</sup>

Department of Tourism and Hospitality, Politeknik Ibrahim Sultan, Pasir Gudang, Johor arissa.qw@gmail.com sitinurhafizahahmad@graduate.utm.my

#### Abstract

The festival is a celebration of a theme to which the public is invited during a season. Festivals had changed over time: before the festivals were small and only the citizens of that territory attended them, today the festivals are organized to celebrate important events. This research aims at what factors influence visitors to attend and revisit behavioral intention to attend the Anime Festival that was held at Paradigm Mall, Petaling Java. Researchers will then focus on data collection in order to get information about the respondent's opinions about Factors Affecting Event Visitors' Revisit Behavioral Intentions: Anime Festival, Paradigm Mall, Petaling Jaya. by both methods which are primary data which consists of questionnaires and the other method is secondary data which may include by previous articles and journals. Through the questionnaire, researchers will be providing questions and information to the respondents and giving some period of time to answer all the research questions. this study employed 170 samples to reach significance. Results revealed that the relationships between motivation and revisit behavioral intentions were highly significant. Findings further provide specific implications for both theoretical insight and marketing practice in the context of the festival Anime held at Paradigm Mall, Petaling Jaya.

Keywords: Revisit Behavioral Intention, Festival, Anime, Motivation.

#### 1. Introduction

Nowadays, festivals are considered to be a fundamental pillar within the tourism industry. Festivals are valued, among other characteristics, for their ability to create an image in destinations and for being a tourist offering themselves (Rao, 2016). Festivals have played an important role in human history. It depicts the prevailing norms and traditions of the region. It is a platform that brings people together, increases interactions and dependence in society, and breaks people's monotony. Due to the competitive nature of tourism and the ongoing public funding required to keep them running, festivals must



ensure the satisfaction of their visitors in order to avoid factors that could lead to their demise.

Anime tourism has received limited access and attention in tourism research (Kirillova, Peng, & Chen, 2018; Tung et al., 2017) The existing literature on anime tourists focuses more on their communication and behavioral patterns (Okamoto, 2015; Sabre, 2016) and is rather descriptive. Motivation, as an essential factor explaining anime tourist behavior, is under-researched. Kirillova et al. (2018) conducted exploratory research on anime consumers' motivations for anime tourism. Although the study demonstrates three motivational factors (i.e. blurring reality and fantasy, social belonging, and self-development) for anime consumers to travel novelty, as a primary motivational factor for travel (Oviedo García, Castellanos Verdugo, Trujillo García,& Mallya, 2014), is not included in the initial item pool, thereby making the motivational factors seemingly incomplete (Kirillova et al., 2018).

The finding of this paper is how is the relationship between Motivation (exploration, family, novelty, escape, and socialization) influence visitor towards behavioral intention and visitors' revisit intention towards Anime Festival, Paradigm Mall, Petaling Jaya.

#### 2. Literature Review

#### 2.1 Events

An international event refers to an event that attracts a considerable number of international participants and spectators, and generates significant short-term and long-term economic, social, and cultural benefits for the host country, providing international media coverage for tourism (Majorevents.govt.nz, 2016).

#### 2.2 Motivation Theory

Motivations for pleasure travel have been found to include "socio-psychological motives (escape, exploration, relaxation, regression, prestige, kinship relationships, and socialization) and cultural motives (novelty and education)" (Crompton, 1979, p. 408).

#### 2.3 Behavioral Intention

Behavioral intentions have been defined as an assertion of the likelihood of initiating a certain action (Oliver, 2010). When discussing behavioral intentions, Zeithaml, Berry, and Parasuraman (1996, p. 34) noted that "customers are indicating behavioral that they are bonding with the company when they praise the firm, express preference for the company over others, increase the volume of their purchases, or agreeably pay a price premium."



## 2.4 Revisit Intention

The intention to revisit a tourism destination can be seen as a type of post-consumption behavior (Cole & Scott, 2004) and has been defined as a visitor repeating an activity or revisiting a destination (Baker & Crompton, 2000). It also relates to the visitor's judgment about the likeliness or plans to revisit the same destination (Khasawneh & Alfandi, 2019; Stylos et al., 2016) or the willingness to recommend the destination to others (Chen & Tsai, 2007; Khasawneh & Alfandi, 2019).

## 3. Methodology

The researcher uses a quantitative technique for findings and the outcome are easier to develop. The researchers are focused on data collection in order to get the information about the respondent's motivation factors that influence visitor behavior and revisit intention to attend Anime Festival held at Paradigm Mall, Petaling Jaya by both methods which are primary data which consists questionnaire and the other method is secondary data which may include by previous articles and journals. The instrument that the researcher used is a questionnaire that contains motivation variables (exploration motivation, family togetherness motivation, novelty motivation, escape motivation, and socialization motivation) and behavioral intention as dependent variables for this research.

#### 4. Result and Discussion

The analysis of quantitative data required the use of the Statistical Package for the Social Science (SPSS) data system application, which aided in the screening, editing, and inputting of data, as well as the coding and categorization of the results by generating descriptive and inferential statistics.

Demographics are population characteristics. Gender, Age, Marital Status, education level, occupation and household income and status are all examples of demographics that are commonly used in surveys.



	Table 1: Table of Demog		
Demographic Variable	Category	Ν	%
Gender	Male	98	58
	Female	71	42
	Total	169	100
Age	Less than 18 years	15	8.9
<b>U</b>	old	81	47.9
	18 – 25 years old	64	37.9
	26 – 35 years old	8	4.7
	36 – 45 years old	1	0.6
	46 years old and	169	100
	above Total		
Marital Status	Single	124	73.4
	Married	45	26.6
	Total	169	100
Education Level	High Schoolers	26	15.4
	Secondary	91	53.8
	Tertiary	52	30.8
	Total	169	100
Occupation	Student/Unemployed	64	37.9
	Government Sector	31	18.3
	Private Sector	48	28.4
	Self-employed	26	15.4
	Total	169	100
Household Income	Less than RM1000	59	34.9
	RM1000 – RM3000	56	33.1
	RM3001 – RM5000	47	27.8
	RM5001 and above	7	4.1
	Total	169	100

Normality is also included in the assumption of the correlational analysis. Therefore, the data must be tested for normality in order to know the shape of its distribution. The shape of its distribution should be normality distributed about the predicted dependent variables scores.



Table 2: Normality Results: Values for skewness and kurtosis (n = 154)							
	Mean	Std Dev	Min	Max	Skewness	Kurtosis	
Independent Variables							
Exploration	4.7419	.40833	3.33	5.00	-1.365	.671	
Family	4.5656	.61414	2.33	5.00	-1.501	1.626	
Novelty	4.7548	.38002	3.33	5.00	-1.362	.804	
Escape	4.7591	.41183	3.33	5.00	-1.570	1.394	
Socialization	4.7828	.38850	3.33	5.00	-1.634	1.453	
Dependent Variables							
Behavioral Revisit Intention	4.7935	.37465	3.33	5.00	-1.852	2.750	

Based on the result, the researcher found that most of the respondent who attends the Anime Festival that held at Paradigm Mall, Petaling Jaya are mostly influence to attend the event are by socialization motivation which the highest Mean, which 4.7828 following by escape motivation = 4.7591, novelty motivation by = 4.7548, exploration motivation = 4.7419 and last is family togetherness by = 4.5656.

Ranking	Mean	Standard Deviation
1. Socialization	4.7828	.38850
2. Escape	4.7591	.41183
3. Novelty	4.7548	.38002
4. Exploration	4.7419	.40833
5. Family Togetherness	4.5656	.61414

#### Table 3: Ranking of motivation that influences respondent

#### 4. Conclusions

The results of this research also provide practical implications for event organizers and tourism marketers of mega-events. One key implication is that socialization was found to play an important role in forming behavioral intentions to revisit the festival. It also can see that people are living in a stressful life and need to escape from a daily routine in order to relieve stress. It was further found that quality was highly related to perceptions of value, which in turn led to visitors' behavioral intentions to revisit the event. As a result, events should be planned to improve the ambiance, be clean and well-maintained, have an impressive appearance, and be developed with safety in mind, according to the results of the current study.



This research evaluates anime tourists as a whole, turning a blind eye to their level of involvement; anime tourists' motivations may vary depending on their level of involvement. Finally, this study looks at anime tourists who have taken part in a variety of anime tourism activities, though the reasons behind them can vary. The scale development of anime tourists' reasons for visiting expands the area of research and lays the groundwork for further study.

Further contrasting anime tourism trends with other types of tourism would be useful. Applying the ATMs in exploring the relationships between online involvement, travel motivations, and tourist experiences would be a logical extension given that anime tourism involves the online interactions of the tourists and given the growing dependence on the Internet under the current situation of the COVID 19 pandemic.

#### References

- Baker, D. A., & Crompton, J. L. (2000). Quality, satisfaction and behavioral intentions. Annals of Tourism Research, 27(3), 785–804. <u>https://doi.org/10.1016/s0160-7383(99)00108-5</u>
- Chen, C. F., & Tsai, D. (2007). How destination image and evaluative factors affect behavioral intentions? Tourism Management, 28(4), 1115–1122. https://doi.org/10.1016/j.tourman.2006.07.007
- Crompton, J. L. (1979). Motivations for pleasure vacation. Annals of Tourism Research, 6(4), 408–424.
- Cole, S. T., & Scott, D. (2004). Examining the mediating role of experience quality in a model of tourist experiences. Journal of Travel and Tourism Marketing.
- Majorevents.govt.nz. (2016). Definition major events. Retrieved February 25, 2018, from http://www.majorevents.govt.nz/new-zealand-major-events/definition.
- Okamoto, T. (2015). Otaku tourism and the anime pilgrimage phenomenon in Japan. Japan Forum, 27(1), 12–36. <u>https://doi.org/10.1080/09555803.2014.962565</u>
- Oliver, R. L. (2010). Satisfaction: A behavioral perspective on the consumer (2nd ed.). New York: ME Sharpe.
- Oviedo-García, M. N., Castellanos-Verdugo, M., Trujillo-García, M. A., & Mallya, T. (2014). Film-induced tourist motivations. The case of Seville (Spain). Current Issues in Tourism, 19(7), 713–733. <u>https://doi.org/10.1080/13683500.2013.872606</u>

Parasuraman, A., & Grewal, D. (2000). The impact of technology on the quality-value-loyalty chain : A research agenda.



Rao, V. (2016). Celebrations as social investments: festival expenditures, unit price variation and social status in rural India. Journal of Development Studies, 71–97.

Stylos, N., Vassiliadis, C. A., Bellou, V., & Andronikidis, A. (2016). Destination images, holistic images and personal normative beliefs: Predictors of intention to revisit a destination. Tourism Management, 53, 40–60. <u>https://doi.org/10.1016/j.tourman.2015.09.006</u>

Khasawneh, M. S., & Alfandi, A. M. (2019). Determining behaviour intentions from the overall

destination image and risk perception. Tourism and Hospitality Management, 25(2), 355– 375. <u>https://doi.org/10.20867/thm.25.2.6</u>

- Kirillova, K., Peng, C., & Chen, H. (2018). Anime consumer motivation for anime tourism and how to harness it. Journal of Travel & Tourism Marketing, 36(2), 268–281. <u>https://doi.org/10.1080/10548408.2018.1527274</u>
- Sabre, C. (2016). French anime and manga fans in Japan: Pop culture tourism, media pilgrimage, imaginary. International Journal of Contents Tourism, 1 (1), 1 19.
- Tung, V. W. S., Lee, S., & Hudson, S. (2017). The potential of anime for destination marketing: fantasies, otaku, and the kidult segment. Current Issues in Tourism, 22(12), 1423–1436. <u>https://doi.org/10.1080/13683500.2017.1368462</u>



# E-FINAL ACCOUNT DOCUMENTS TRACKING SYSTEM (E-FATs)

Mak Hoi Yin<sup>1</sup>, Noraziah Hamid<sup>2</sup> Civil Engineering Department,

Politeknik Ungku Omar, Ipoh, Perak Christymak.hoiyin@gmail.com

Civil Engineering Department, Politeknik Ungku Omar, Ipoh, Perak aziahhamid1965@gmail.com

#### Abstract

In construction contracts, Final Account (FA) is generated to represent the final cost of the project that has been completed by a contractor. FA is an agreed-upon account of the amount of money to be paid by the employer to the contractor due to contract and that lead up to the agreement of the FA between the contract's parties. At Pembinaan Tetap Teguh (PTT) Sdn. Bhd, contract department still using the manually method to keep and store the FA documents in hardcopy. The process to track the document for FA preparation become slow and delay in preparing closing of FA due to missing document frequently happen. Therefore, this study aims to develop the Electronic Final Account Document Tracking System (E-FATs) for efficient FA preparation. There are three objectives to be studies, first is to identify the need of E-FATs by mobile application secondly is to develop the E-FATs by mobile application and finally is to evaluate the effectiveness of E-FATs by the construction site management team members. For objectives 1 and 3, this study employs a quantitative method in the form of a survey, with data analyzed using SPSS. For objective 2, develop a mobile application for E-FATs using the Flutter App. The results showed that 100% respondents not agree in category 6; efficient final account preparation and >90% disagree in all 6 categories in usage of existing method. The mean interpretation is very low. Therefore, the E-FATs by mobile application need to be developed. Meanwhile, evaluate the effectiveness of E-FATs resulted in av. mean >4.5; interpretation very high in E-FATs usage. Paired T Test, show that the category 6, is 3.8 in differences mean; highest among the six (6) categories. Hence, this E-FATs is efficient and able to avoid delay in FA preparation due to missing documents.

**Keywords:** Final Account, Delay, Document Tracking system, Final Account preparation, Flutter App



#### 1. Introduction

A quantity surveyor (QS) is a construction industry specialist who is well-versed in construction prices, finances, and contracts. They are experts in the cost and administration of construction projects, whether they are for a building, a civil engineering project, or a heavy engineering project. Moreover, Malaysia's building sector is primarily dependent from local economic activity. Nonetheless, the building industry's potential is impeded by delays, and not just during the planning stage. Delays can occur during the post-contract stage of a building project. The cause and effect of these delays are marvelous and are observed by this paper like the egg-and-chicken situation, which initially caused or eventually diputes between owners and contractors, increased costs, productivity loss and revenue, as well as contract termination. It will have a negative impact on project management as well as the construction industry's performance. (Tumi et al., 2009).

When a construction project is suggested, it is critical that the cost involved be known ahead of time. These include site preparation expenses, construction, labor, material, and plant costs, professional fees, taxes, and other charges, as well as the new building's expected operating and maintenance costs. The Quantity Surveyor is qualified to assess these expenses and provide recommendations on alternate options. Furthermore, from a project management approach, project charter or project scope is clearly linked to project charter or project scope that may be defined in writing by outlining the work to be completed, including the final account deadline. During this phase, a team should prioritise the project, create a budget and timeframe, and determine which resources are needed. It is all while identifying important variables for final account closing processes.

Beside that, final account closing that includes the cost of the defect liability term, any additions, changes, and deductions resulting from project revisions, and any other connected payments mentioned in the contract. (Zakaria et al, 2012) is described as a verified declaration of final cost that is effectively closed by systematic project management processes by Ismailet al. (2014). Before the final account can be properly closed, issuance of a Certificate of Practical Completion (CPC) and a Defect Liability Certificate (DPC) is part of these systematic project management processes. So, in a construction project, a final account is created to show the final cost of the project that has been completed by a contractor. In construction contracts, a Final Account is an agreement report of the amount of amount to be paid by the employer to the contractor at the end of the contract. A final account provides a sense of completion to the agreements that lead up to the contract's parties to agree on the Final Account. Also, delays will occur during final account preparation since the procedure is less important to project management. Thus, delays that result in failure to meet target time, budgeted cost, and stipulated quality have a variety of unanticipated negative repercussions on the projects.



In addition, the Digital Revolution refers to the advancement of technology from analogue electrical and mechanical devices to today's digital technologies. The Fourth Industrial Revolution (IR 4.0) is now developed on the Digital Revolution, in which technology and people are becoming increasingly integrated, notably in the construction sector. Technology innovation has discovered new ways to display its powers by blurring the boundaries between physical, digital, and biological components. The revolution not only provides current procedures that support every component of business, but it also promotes sustainability, with renewable energy and energy efficiency being two key components.

The digitalization, automation, and widespread use of Information and Communications Technology (ICT) in the industry are referred to as IR 4.0. The goal of IR 4.0 is to digitize industrial processes to accomplish an adaptive yet extensive production and service network. IR 4.0 can improve performance in industries such as construction. These technologies include cyber-physical systems, the Internet of Things (IoT), cloud computing, and cognitive computing. The adoption of IR 4.0 creates a zone in which all mechanized machinery will be networked via technology improvements to function and communicate information without the need for people, hence enhancing efficiency.

#### 2. Methodology

Research design is the conceptual structure within where it contains the blueprint for the collection, measurement and analysis of data. It portrays a flow from the hypothesis and its operational implications to the final data analysis. It can be termed as plan, structure and strategy of a research to seek for alternative tools in problem solving and variance mitigation They are essentially planned, scientific and value-neutral (Rajasekar et al., 2006). The operational framework as in *Figure 1* shows the detailed flowchart of the study methodology. Quantitative method by Survey distribute to respondents by Google Form and analysis by SPSS for objective 1 and 3. Meanwhile, objective 2 is to develop the E-FATs by mobile application.



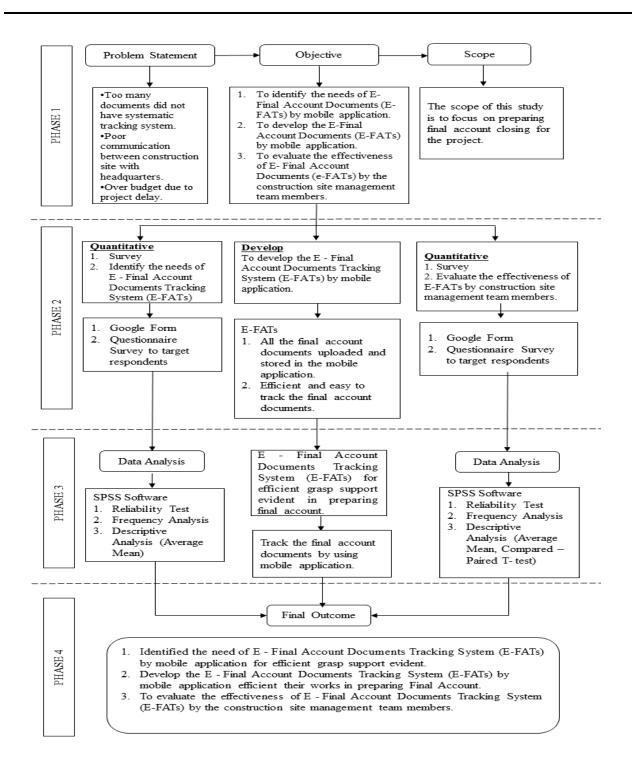


Figure 1:Research Flow methodology



In general, phase 1 is the preliminary study to identify the problem statement, aims and objectives, scope of study and significant of study. Issues related to the selected topic were identified during this phase. Further, the objectives of the study to solve the problem have also been set. The phase 2, is the method of identify the problem and evaluate the effectiveness of E-FATs. Continue, phase 3 is the stage of the Data Analysis to achieve the objectives. Where objective 1 is to identify the need of E-FATs and objective 2 is to develop E-FATs by mobile application. Objective 3 is to evaluate the effectiveness of E-FATs by construction site team management. Data for objective 1 and 3 is collect through the questionnaire survey. Objective 2 is developing the application by using Flutter App. Method of data analysis for objective 1 and 3 is using Reliability Test, Frequency Analysis. Meanwhile, objective 2 is to develop E-FATs. The questionnaire for objective 1 and 3 was distributed by google form. The survey input was fed into the SPSS software using Frequency Analysis.

# 2.1 System Process and Development of E- Final Account Document Tracking System (E-FATs)

System processes are the outcome of compiling and quantifying a product's inputs and outputs throughout its life cycle (ISO 14040:2006). The process of building or modifying systems, as well as the procedures, techniques, models, and methods required to do so, is referred to as system development. Therefore, the system process and development mobile application tracking system is critical to ensuring that the process is established and operated successfully. A systematic approach is required to guide all work processes while developing a mobile application. To manage a successful product, though, analyze processes to guarantee product efficiency.

E-FATs application was built using the Flutter App development kit. Flutter differs from most other alternatives for developing mobile apps in that it does not rely on web browser technology or the collection of widgets that come standard with each device. Instead, Flutter draws widgets using its own high-performance rendering engine. Furthermore, Flutter app development is the process of creating applications utilizing pre-made widgets. In comparison to other typical techniques like as layouts, views, or controllers, Flutter's widget methodology provides a consistent object model and an easy-to-use development process.



Table 1: Design of E-FAT





Step 3. Sign In.		Step 4.	Home Page.		
← Sign I	n		Contractor	' Home	ŧ
Username Christy			(a) Hi, CHRIST		
Password Ptt1234			1	-AA	
	Submit			DOCUMEN	ITS
				-	
				Ti à	
Q	0 0		⊲	0 []	
Step 5. Create project	list for tracking docume	nts. Step 6.	Upload docum	ent.	
	st Of Projects RL_SEC_5 By: CHRISTY MAK Date/Time: 2022-07- n2			CRL_SEC_5 view document.	
				- Empty record -	
4	•		4	+ Upload Document	

2.1.1 Material Used

Table 2: Material Used

M	Materials							
Computers / Laptops	Smartphone							
	To test functionality of the application.							



<image/>	
Internet/ Wifi	Flutter App
To link the computer and internet connect to upload the data.	To provide a software for application development.
Google Account / Email	Final Account Documents



## 2.2 Testing of Product

The final product was tested using a questionnaire provided through Google form links. This product was tested on 36 site team members and headquarters personnel. These 36 members are Pembinaan Tetap Teguh Sdn Bhd, AECOM Consultant Sdn Bhd, and China Communication Construction Company personnel. Davis' Technology Acceptance Model was used to create the questionnaire (1989). The Technology Acceptance Model (TAM; Davis, 1989) is one of the most influential models of technology adoption, stating that two fundamental factors impact an individual's willingness to utilize new technology and perceived ease of use and perceived value (Neil Charness, 2016). TAM most familiar variables being measured in this study which is Perceived Ease of Use, Perceived Usefulness, Attitude Towards Using Technology and Behavioral Intention to Use. The sample size was determined using Krejcie and Morgan Table (1970) whereby for population of 30 respondents, 27 samples were adequate. However all population were involved in this study.

#### 3. Results and Discussion

There are various methods for determining the user's needs. In this project, The purpose of this questionnaire is to determine the needs of users. The E-Final Account Documents Tracking System (E-FATs) using data analysis and a questionnaire.

## 3.1.1 Reliability Test

The qualities of measuring scales and the items that comprise the scales may be studied using reliability analysis. The Reliability Analysis process computes a variety of regularly used measures of scale reliability as well as information on the relationships between scale items. Inter-rater reliability estimates can be computed using intraclass correlation coefficients as Table 3.1 below.

#### **Table 3: Reliability Test**

	Cronbach's Alpha Based on	
Cronbach's Alpha	Standardized Items	N of Items
0.911	0.923	8

## 3.1.2 Data Collection

Detailed information on how to collect the data from a questionnaire by using google form is provided by the methods of collection. Quantitative method be chosen in this study. By using this method is to collect reliable and accurate data, quick data collection, and wider scope of data analysis.



				- V	I of Agreem	ent	
No	Categories in usage of existing Method	Issues Related to Existing Method	Strongly Disagree	Disagree	Slightly Agree	Agree	Strongly Agree
			1	2	3	4	5
		Existing method is easy to use for document tracking system in work progress.		10 (27.80%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
1	Faster Work Progress	Existing method is systematic to manage the work progress.	.)/	8 (22.22%)	1 (2.78%)	0 (0.00%)	0 (0.00%)
		Existing method can enhance the productivity in completing the tracking work progress.	29 (80.56%)	6 (16.67%)	1 (2.78%)	0 (0.00%)	0 (0.00%)
2	Environmentally friendly	Is it existing method use ring file to compile progress document are environmentally friendly?	30	4 (11.11%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
3		Is it the existing storage method is very efficient?	30 (83.33%)	5 (13.89%)	0 (0.00%)	1 (2.78%)	0 (0.00%)
4	management	Is it the existing method save time in tracking document?		3 (8.33%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
5	Friendly user	ls it existing method friendly user?	27 (75.00%)	6 (16.67%)	3 (8.33%)	0 (0.00%)	0 (0.00%)
6	Efficient Final Account Preparation	Existing method can avoid delay in Final Account preparation and submission due to missing documents.	32 (88.89%)	3 (11.11%)	0 (0.00%)	0 (0.00%)	0 (0.00%)

## Table 4: Data of existing method

## 3.1.2 Frequency Analysis

Frequency analysis is a general method of analysis that is utilized not just in social measurement research, but also in many other scientific domains. Besides, it is a branch of statistics that studies the number of occurrences (frequency) and evaluates metrics such as central tendency, dispersion, percentiles, and so on. By using SPSS to get the analyze frequency date. Below shows the table of issues related to existing method.



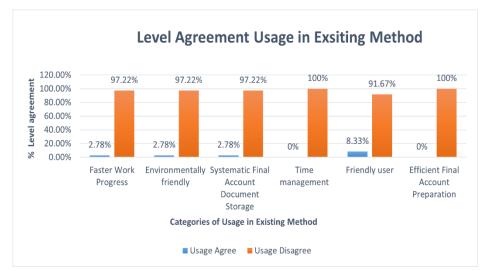


Figure 2: Level Agreement Usage in Existing Method

From Figure 2, shown that more than 91% of respondents is disagree of the usage in existing method for all the categories. In category 6, efficient final account preparation shown that is 100% of respondents is disagree with the usage of existing method. Following is the usability of existing method. Refer to Table 5, interpretation is very low in all the categories with analysis revealing that the mean score for all variables examined was less than 2.50, indicating that the usability level of existing methods was poor. Beside, friendly user is the highest representive 18.56% in average mean compared between the 6 categories. Therefore, E-FATs is need to be develop due to category 6, the efficient final account preparation resulted. It shown that 100% respondents diasagree with the existing method is efficient usage.

for	Existing Method	_		-	-
No	Categories of Usage for Existing Method	Mean	Average Mean	Average Mean (%)	Interpretation
1	Faster Work Progress	1.34			
		1.29	1.29	18.27	Very Low
		1.23			-
2	Environmentally friendly	1.11	1.11	15.72	Very Low
3	Systematic Final Account Document Storage	1.20	1.20	17.00	Very Low
4	Time management	1.06	1.06	15.01	Very Low

1.31

1.09

Total Average 1.18

1.31

1.09

18.56

15.44

100

Very Low

Very Low

Table 5: Percentage Average Mean Categories and usability of Usagefor Existing Method

Friendly user

Efficient Final Account Preparation



## 3.2 Develop E-Fats By Mobile Application

Figure 2 shown the end product of E-Final Account Document Tracking System using Flutter App. E-FATs can store and track all the documents that uploaded in just a click. It even can share with consultants and contractor together. It can be categories with project and documents in different folder. In project, it can see the progress work on site. Documents it keep all the documentations of the project.



Figure 3: E-Final Account Document Tracking System

## 3.3 Evaluate the effectiveness of E-FATs by Construction Site Team Mangement

#### 3.3.1 Realibility Test

Analysis of reliability It enables the investigation of the characteristics of measuring scales and the components that comprise the scale. The average inter-item correlation according to Cronbach's Alpha is 0.941. The acceptable level of dependability is.6. If the reliability result of your questionnaire is more than.6, it is called "reliable."

#### Table 6: Realibility Test

I

	Cronbach's Alpha Based on Standardized	
Cronbach's Alpha	Items	N of Items
0.941	0.945	8

## 3.3.2 Usability Level of E-Final Account Document Tracking System (E-FATs)

Table 7 illustrates respondent usability toward using E-FATs, analysis shows that for all factors examined, the mean score was greater than 4.00, indicating that using E-FATs is significantly simpler than the present approach.



No	Categories of Usage for E-FATs	Mean	Average Mean	Average Mean (%)	Interpretation
1	Faster Work Progress	4.528			
		4.667	4.658	16.27	Very High
		4.778			
2		4.833	4.833	16.88	Very High
3	Systematic Final Account Document Storage	4.917	4.917	17.17	Very High
4	Time management	4.833	4.833	16.88	Very High
5	Friendly user	4.667	4.667	16.30	Very High
6	Efficient Final Account Preparation	4.722	4.722	16.49	Very High
	Total Average		4.77	100	

## Table 7: Percentage Average Mean Categories and usability uage of E-FATs

#### **3.4 Paired Samples Statistics**

Paired samples statistics is the tests to compare the effectiveness of tracking system by using existing method with E-Final Account Documents Tracking System (E-FATs). As figure below, bar chart shows the respondent is more preferred to using E-FATs (Mean=4.77) as a tracking system compared to existing method (Mean=1.18) for final account tracking system. It is because existing method will subject some schedule to be delay in final account closing due of unsystematic tracking system.

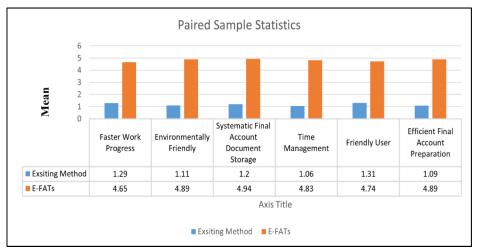


Figure 4: The difference mean value of existing method and E-FATs



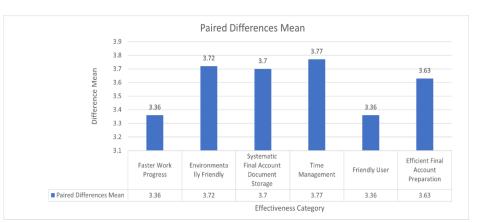


Figure 5: Paired Differences Mean

From the result, the E-FATs by mobile application need to be developed. Meanwhile, evaluate the effectiveness of E-FATs resulted in av. mean >4.5; interpretation very high in E-FATs usage. Paired T Test, show that the category 4, is 3.77 in differences mean; highest among the six (6) categories. Hence, this E-FATs is efficient and able to avoid delay in FA preparation due to missing documents.E-FATs is systematic final account document storage for contract department to prepare FA closing.

## 4. Conclusions

The significant purpose of this study was to determine the necessity for an E-Final Account Document Tracking System (E-FATs) utilizing a mobile application. According to the results of the analytical questionnaire, most respondents had issues with inefficiency, the use of irregular papers, missing documents, and the final account closing delay.

The study's second objective is to develop an E-Final Account Document Tracking System (E-FATs) utilizing a mobile application. The approach utilized throughout the study was addressed in method, including the creation of an application for the establishment of a Final Account Document Tracking System. Most of the papers used for this system are to upload and retain, update the most recent work progress, and numerous irregular and unstructured construction progress reports. A survey is given to the target responder to assess input from construction site team members on the effectiveness of the E-Final Account Documents Tracking System. Respondents highly agree, according to the data, that E-FATs is an incredibly effective final account document tracking solution for projects.

In conclusion, based on the results of the disseminated questionnaire survey, it is feasible to deduce that they have roughly difficulties that occur throughout the document management process. All the respondents agreed that difficulties at the construction site and headquarters affect their job. The E-Final Account Documents Tracking System (E-FATs) was tested at the site office and headquarters and was found to be successful in final account document tracking. According to most responders, the E-Final Account



Documents Tracking System helps to enhance communication of team member, handle final account closure delays, and missing documents, and it is also user pleasant in construction sites and headquarters. Descriptive Analysis by Paired T Test, show that the time management is the highest among the six (6) categories in differences mean. From the result, it shown that objective 1 and 3 was achieved. Hence, this E-FATs is efficient for Final Account preparing to tracking documents at the same time save a lot of time without delay.

#### References

Final Account Preparation in Construction Industry: Competencies and Challenges of Quantity

Surveyors. (2021). International Journal of Service Management and Sustainability, 6(1). https://doi.org/10.24191/ijsms.v6i1.12877

Seo-Zindy R. Industry 4.0 to digital industrialization: when digital technologies meet industrial transformation; 2018 (11 June 2019). Available: industry-4-0-to-digital-

Tumi, S., Omran, A., and Pakir, A. (2009). Causes of Delay in Construction Industry in Libya. In The International Conference on Administration and Business, 14-15 November 2009, Romania (pp. 265–272). Romania.

Davis, F. D. (1989), "Perceived usefulness, perceived ease of use, and user acceptance of

information technology", MIS Quarterly, 13 (3): 319–340, doi:10.2307/249008, JSTOR 249008, S2CID 12476939

Krejcie, R. V., & Morgan, D. W. (1970). Determining Sample Size for Research Activities. Educational and Psychological Measurement, 30(3), 607–610. <u>https://doi.org/10.1177/001316447003000308</u>

- What are unit and system processes? (n.d.). SimaPro Help Center. https://support.simapro.com/articles/FAQ/What-are-unit-and-system-processes/
- Chetty, P. (2022, May 18). *Reliability test in SPSS using Cronbach Alpha*. Knowledge Tank. https://www.projectguru.in/reliability-test-in-spss-using-cronbach-alpha/



# OCEAN FREIGHT COMPARISON BETWEEN QUOTED RATE TO CUSTOMER VERSUS ACTUAL PAID TO SHIPPING AGENT

Husni Nazra Abu Bakar<sup>1</sup> and Nur Azreen Zubari<sup>1</sup>

<sup>1</sup>Mechanical Engineering Department, Ungku Omar Polytechnic, Ipoh, Perak husninazra@polycc.edu.my

<sup>2</sup>Mechanical Engineering Department, Ungku Omar Polytechnic, Ipoh, Perak azreenzubari95@gmail.com

#### Abstract

The charges of shipping goods directly by sea are referred to as ocean freight rates. Pickups, trucking, warehousing, and other charges are all included in freight quotations. Although not all shipments are multimodal, everything will be included when shippers request a freight quote. Ocean freight services are provided by hundreds of carriers all around the world. Each carrier will charge their own fees for the carriage procedure, depending on the carriage contract and the service type mutually agreed upon. Pricing competitiveness, long-term partnerships, and newly adopted technology can all influence the final charges for services. The logistics department is in charge of ensuring that the entire logistics process is maintained and developed in accordance with the business's objectives at a reasonable cost. This includes storage, distribution, warehousing, movement of goods from one place to another (internally or externally), tracking and delivery of goods. It entails a comprehensive process of planning, managing, controlling, and coordinating to ensure that commodities arrive at the appropriate location, at the appropriate time, at the appropriate cost, and in the appropriate condition.

Keywords: : Ocean Freight Rates, Quote, Carrier, Logistic, Cost.

#### 1. Introduction

Exchange rate are the price of foreign currency that an amount of one currency can buy which is one USD. Foreign exchange rate is considered as price for a nation's currency in order to buy another nation's currency; it indicates a domestic currency's quotation in terms of foreign ones. For example, quotation of 0.24 MYR/USD means that 1.00 MYR is able to buy 0.24 USD; or it can be quoted as 4.20 MYR/USD, which refers to people able to exchange for 4.20 MYR per USD (Mohamed et al., 2021).



Foreign exchange rate is determined by the foreign exchange market, a market open for currency trading continuously 24 hours every weekday except weekends. Every countries manages value of its currency through different mechanism, this will determines the foreign exchange rate regime, which apply to its currency. For example, countries can set their currency be floating, pegged, fixed or hybrid. An increase in the value of the sterling means one pound can buy an increased amount of foreign currency, meaning getting more for the same amount of money. Businesses that import and export goods need to pay close attention to these exchange rates as the value of goods are highly sensitive, chopping and changing with the constant fluctuations (Abdoh et al., 2016).

Businesses that trade domestically must also be aware of changes in exchange rates as they will have an indirect impact by virtue of the wider economy The level of the exchange rate between any two currencies is determined by a host of factors including the pace of economic activity, the level of market interest rates, the gross domestic product, and the unemployment rate in each of the countries in question. Exchange rates are set in the global financial marketplace, where banks and other financial institutions trade currencies around the clock based upon their views on the above-mentioned factors as well as their own financing needs and investing strategies (Abdoh et al., 2016).

Carrier is shipping company that corporation that is engaged in maritime transport and specialize in the moving (or forwarding) of freight, or cargo, from one place to another. These companies are divided into several variant sections. For example, international freight forwarders ship goods internationally from country to country, and domestic freight forwarders, ship goods within a single country. It is usually the case that ship owners are either involved in maritime or inland waterway transport. It is interesting to note that not every shipping company has its own ships, containers but also operates ship charters. Statistics from the world's largest shipping companies show that only about half of the fleets consist of own ships the other half is used by charter or third party (Saloodo.com, 2022).

There are the well-known biggest shipping company in the world that frequently used by the Company A to export the finished goods to other country such as Compagnie Maritime d'Affrètement (CMA) and Compagnie Générale Maritime (CGM) Malaysia,Hapag-Lloyd, Ocean Network Express, Evergreen Marine Corporation, Hyundai Merchant Marine, Yang Ming Marine Transport Corporation, Cosco Shipping Lines, Mediterrannean Shipping Company, Maersk and Orient Overseas Container Line.

On the average, the USD exchange rates charged by the logistics service providers are about 0.1 to 0.3 higher than what the prevailing rates indicated by the bank. Based on the invoices shared by finance, the variance for the difference in percentage is about 2%-5% between BNM published rate and supplier USD rate. To be recorded on the company's financial accounts, financial transactions received in United States Dollar must be translated to Malaysian Ringgit. Foreign exchange risk refers to changes in the exchange rate between the United States Dollar (foreign currency) and the Malaysian Ringgit (domestic currency). Appreciation or depreciation of the base currency, appreciation or



depreciation of the foreign currency, or a combination of the two can all generate foreign exchange risk. For exporters or importers and enterprises that deal on foreign markets, it is a significant risk to consider. Hence to achieve this aim, the objectives listed are to analyses with highest and lowest exchange rate, that charges from carrier that frequently used in shipment and to identify the source of exchange rate carrier.

#### 2. Methodology

2.1 Global Data Management (GDM) master data

Global Data Management (GDM) master data consist of several steps. The first step is extracting data in GDM Master of Sept 2020 to August 2021 and do VLOOKUP to get information in a table or data set with categorize organisable and match a new sheet for copying the data as illustrated in Table 1.

Table 1: GDM report master	data November	2020 (FY21)
----------------------------	---------------	-------------

Remark 1. To ut 2. Place 3. To cs	te below mesti w fill in ORAN	er dat GC h	le general Ighlighted	ta NOV'20 [FY21] Ird Jone SAP GDM Report for report column (Quoted to Customer (USO d column (Region,Container type &	S. Exchange Rate (Involce R								
Ship Porty	504		Numbe .	Customer	oic .	Incolar ANT ,	Act. Gds Mymret Date _1	Agent	Carrier	Container Type	TRU	Final Destination	Country
0033	3000124634		90012	20-DREAT OLOVE USAINC	CHEN JAM	CFR.	01110020	SNARBRAT LOOISTIK PETINE MAS SI	TRUE RASIA LINE	401HC UPGRAZE D CO		2 SHANGHN .	Otela
4053	2000116255			OLGUN MEDIKAL INSAAT VE TICARE		F08		NOATUM LOGISTICS MALAYSIA SD		47 HC Container		Z ISTANDUL	Tarkey
4033	2000110028					108		KUEHNE + NAGEL SON BHD		40' HC Container		2 COAVEK	Poland
4033	2000104385			INTERNATIONAL MEDICAL PRODUCT		FOB		BOLLORE LOGISTICS MALAYSIA SE				2 HAMANURG	Germany
9033	2000113500				ANGELINE CHIN CHEE SUM			TRANSCARGO WORLDWDE (M) 50		49 HC Container		2 INCHEON SEAPORT	South Korea
8033	2000119027					F08		KUEHNE + NAGEL SON BHD	CMA-COM	#0"HC Container		2 COANSK	Poland
0033	2000119767		20447			CE .		UNLEXPRESS LOGISTICS SON BHE		47 HC Cottainer		Z COANSK	Poleid
40.33	2000120376		29441		NAZIRAH BINTI HAMBI	OF.		UNLEXPRESS LOGISTICS SON INC				Z GOANSK	Poland
4032	2000120379		25462		NAZIRAH INNTI HAMM	OF		UNHEXPRESS LOOKTICS SDN BHE				2 GDANSK	Polend
4030	2000116257			OLGUN MEDIKAL INSAAT VE TICARE		F08		NOATUM LOGISTICS MALAYSIA SO		40' HC Container		2 ISTANERA	Tarkey
8033	2000120102		27921	GUANGDONG GUANGTAI COOPERA				SYARIKAT LOGISTIK PETIKEMAS SI		60' HC Coreaner		2 SHADONG	Chris
0033	2000120909					F08		THE GLOBAL FORWARDING MALA		407 HC Coreaner		2 HAMOURG	Germany
4033	2000120910					F08		DHL GLOBAL FORWARDING MALA				2 HAMBURG	Germeny
4033	2000112043				AVCELINE OWN CHEE SUN			TRANSCARSO WORLDWDE (M) 52		40° HC Conteiner		2 INCHEON SEAPORT	South Kores
4033	2000114158				AVCELNE CHIN CHEE SUN			TRANSCARGO WORLDWDE (M) 50		40' HC Container		2 NOHEON SEAPOR?	South Korea
4033	2000116492					FOB		TRANSCARGO WORLDWDE (M) SE		40' HC Cortainer		2 TAKHUNO	Taneon
a033	2000122540			MATION GAOLK URINLER SAVA		FOB		SAIT SPEED MARK FORMARDERS		40' HC Corbener		2 IETANERA.	Talkey
4032	2000122501			MICTION SAGLICURUNLER DAVA		F08		SATT SPEED-MARK FORWARDERS		40' HC Container		2 ELTANEKA	Tarkey
8030	2000110617				NORFARAMANANI BT. MUNA			OCEAN NETHORIK EXPRESS (MAL				2 ACANILA	E) Salvador
6775	Doppendants		10,703	PERCENCIA ( ARCORA) 15 A	NAMES IN A STACK AND ADD			TO SAFLAGRADAS' CONVERT STOLE				3 CALLAG	Para

VLOOKUP which is (lookup value, table array, col index num, [range lookup]). The VLOOKUP function uses the following arguments:

- i.Lookup value (required argument) Lookup value specifies the value that we want to look up in the first column of a table.
- ii. Table array (required argument)-The table array is the data array that is to be searched. The VLOOKUP function searches in the left-most column of this array.
- iii.Col\_index-num (required argument)-This is an integer, specifying the column number of the supplied table array, that want to return a value form.
- iv.Range\_lookup (optional argument)-This defines what this function should return in the event that it does not find an exact match to the lookup value. The argument can be set to TRUE or FALSE, which means;

TRUE-Approximate match, that is, if an exact match is not found, use the closest match below the VLOOKUP value and FALSE -Exact match, that is an exact match is not found, then it will return an error.



Next is to make new table separate by month from Sept 2020 to August 2021 and check in the blank carrier as shown in Table 2. Then, the summary data for each month is combined in one excel as shown in Table 3. There are 2959 shipments for whole year from six regions such as Asia, Europe, Middle East, Africa, North America, Latin America and Oceania.

o chan	ige the green	wording to own factory											
EA FR	EIGHT								'DO NOT chai	sge the formul			
Ship Point	SO.		Ехсhange rate (Auto generate from Cl)		*Quoted to Customer (RM)	Ocean Freight (ZF01)	Ехоhange Rate (Invoice Received)	Frt to Agt (USD)	"Frt to Agt (MYR)	Difference (USD)	*Difference (RM)	Variance (%)	Remark
		EBUNO (JAPAN) CO., LTD.	4.1815		836	542.08	4.235	128	542.08	72.00	294.22	36.00	
8AB		KEVENOLL DO BRASIL PROD				5,931.80	4.237	1400	5,931.80	-	(87.50)	-	
		20.GREAT GLOVE USA INC	4.1745			64.95	4.33	15	64.95	105.00	435.99	87.50	
		AMLAK ALMADA TRADING 8			26,136	14,789.50	4.223	3,500.00	14,780.50	2,800.00	11,355.05	44.44	
337	2000112842	CONVEREX INT' L (HK) COMP ENANA DRUG SCIENTIFIC BU				0.00	4.223	0		200.00	834.70	100.00	
			4.1655			4,919.80	4.223	1165		435.00	1,745.01	27.19	
		FORSAN FOODS AND CONS			12,470	5,447.67	4.223	1290	5,447.67	1,710.00	7,021.83	57.00	
		VINASEA CO., LTD	4.134			76.01	4.223	18	76.01	188.70	778.48	91.29	
		KEVENOLL DO BRASIL PROC	4.1105		24,663	23,940.00	4.2	6000	25,200.00	-	(537.00)		
		05.TG MEDICAL (USA) INC	4.141			15,293.21	4.234	3612	15,293.21	-	(335.92)	•	
		KEVENOLL DO BRASIL PROC		7100		29,891.00	4.21	7100	29,891.00	-	(294.65)	-	
		LIMSON TRADING, INC KEVENOLL DO BRASIL PROD	4.1635	4900 4000		18,642.24 168.000.00	4.178	4462 4000	18,642.24 16.800.00	438.00	1,758.91	8.94	
SAB	5400002385	KEVENOLL DO BRASIL PROL	4.1005	4000	16,6/4	168,000.00	4.2	4000	16,800.00		(126.00)		
IR FRE	EIGHT												
Ship Point	50 <b>9</b>	Customer	Exchange rate (Auto generate from CI)	Customer	*Quoted to Customer (RM)	Ocean Freight (ZF01)	Exchange Rate (Invoice Received)	Frt to Agt (USD)	Fit to Agt (MYR)	"Difference (USD)	Difference (RM)	Variance (%)	Remark
												#DIV/0!	
													Activate Wind

#### Table 2: Summary data each month

Table 3: Shipments for whole year

						-		_		
Ship Point	SOM	Customar	OK	Incoherma	Agent	Carrier	Container Type	πu	Final Destination	Country Na
1897	2000129638	STRONG MEDICAL PARTNERS	EZA FAIGA BT. ABOUR, KADIR ALIAILANE	CF	INTENTION PREIGHT CO., LTD.	CONCO	All HC Container	2	PINEVILLE, NC	USA
1386	2000139026	HANDGARDS LLC	LIM SHIRINGAN	OR	KOW LOGISTICS (M) SON BHD	000.	1X40' HC Container	3	COLUMBLE, OH	USA.
1897	2000133512	HANDGARDS LLC	PEH BEE CHING	OFR .	INTENTION PROGHT CO., LTD.	ONE	1040' HC Container	2	SANTA TERESA, NM	154
1807	200013291#	HANDGARDS LLC	UM SHRINNAR	OR	INTENTION PREIGHT CO., LTD.	MSC	1040' HC Container	2	SANTA TERESA, NM	1/5A
1607	2000132987	HANDGARDS LLC	UM SHEENNER	OH .	INTENTION FREIGHT CO., LTD.	MIC	1X47 HC Container	2	SANTA TERESA, NM	USA.
1887	2000132999	HANDGARDS LLC	LIM SHIRINNAN	018	INTENTION FREIGHT CO., LTD.	MSC	1000° HC Container	2	SANTA TERESA, NM	USA
1887	2000139055	HANOGARDS LLC	LIM SHRINNIN	OFR	INTENTION PREIGHT CO., LTD.	IMC	1X407 HC Container	2	SANTA TERESA, NM	USA
18A7	2000139376	HANDGARDS LLC	UM SHRANKE	OR	INTENTION FRENCHT CO., UTD.	MSC	1X407 HE Container	2	SANTA TERESA, NM	USA
1807	2000129344	SEMPERIT INVESTMENTS ASIA PTE LTD	NUR ADHWA'122ATI BT MOHAMAD AM	OF	INTENTION PREIGHT CO., UTD.	00500	40' HC Container	2	LOS ANGELES, CA	1/5A
1807	2000145325	SEMPERIT INVESTMENTS ASIA PTE LTD	NUR ADHWW (22AT) 8T MOHAMAD ASR	CF	INTENTION PREIGHT CO., LTD.	00500	AIT HC Container	2	LOS ANGELES, CA	054
1748	2000128079	HANDGARDS LLC	UM SHIRINNAK	08	KOW LOGISTICS (M) SON BHD	MSC	AO' HC Container	3	COLUMBUS, OH	USA
1786	2000133367	HANDGARDS LLC	LIM SHEAMAN	CHR.	KDW LOGISTICS (M) SON BHD	MSC	40° HC Container	3	COLUMBUS, DH	USA.
1887	3000543621	40.TG MEDICAL (USA) INC	THEAM CHEW WEETIN	DF	INTENTION FREIGHT CO., LTD.	00500	ACT HC Container	- 2	HOUSTON,TX	USA.
1796	2000133250	HANDGARDS LLC	LIM SHRINNIN	OFR.	KOW LOGISTICS (M) SON BHD	MSC	40' HC Container	2	SANTA TERESA, NM	1/54
1807	2000139370	INANOGARDS LLC	LIM SHRIMMAN	018	INTENTION FRENCHT CO., LTD.	ONE	10402 HC Container	2	SANTA TERESA, NM	USA:
1867	20001330211	HANDGARDS LLC	UM SHIRINANAN	CIR	INTENTION FREIGHT CO., UTD.	ONE	A0' HC Container	2	SANTA TERESA, NM	1/54
1786	2000125146	TRONER INTERNATIONAL INC.	LANG SHOP YEE	CIR	RENOWIN GLOBALOG CO., LTD.	MSC	1342 HC Container	2	SAVANNAH, GA	UM
1786	2000111379	TRONER INTERNATIONAL INC.	SING SHIH YEE	OR.	RENOWIN GOBALOG DD., LTD.	MIC	ACT HC Contrainer	- 2	SAVANNAR, GA	USA
1847	2000114825	01.60 CARE INC	WONG PUT YEE	OF .	INTENTION FREIGHT CO., LTD.	IMC .	1047 HE Container	2	LOS ANGELES, CA	1/54
1119	2000102210	SURVITAN INDUSTRIAL TRADING CO.	MICHAELLIM SOON SHAP	CH.	EVERGREEN MARINE CORP (MALAYSIA)	IMC	2042' HC Container	4	CHBR.	144
3887	2000132680	HANDGARDS LLC	LM SERIAME	CTR.	INDIR'LOGISTICS (MUSON BHD	MSC	40° HC Container	2	SANTA TERESA, NM	UNA
1786	2000115212	TRONER INTERNATIONAL INC.	LING SHEH YES	0/8	HENOWN GLOBALOG CO., LTD.	MIC	40/ HC Container	1	NEW YORK, NY	1/54
1286	2000114232	TRONER INTERNATIONAL INC.	LING SelectEd	08	RENOWN GLOBALOG CO., LTD.	MIC	40' HC Container	2	SAVANNAR, GA	154
1746	2000116878	THE SAFETY ZONE LLC	SEET WE KEY	C#	KOW LOOPTICS (MS SON BHD	0001	1840' HC Container	2	NEW YORK, NY	USA
1011	100001-01011-0	THE TY REPORTED AND ADDRESS.	in terms arriver endors used	100	when constants are married	4477	where the standards		BALTINGTON AND	and a

Lastly, summarizing the data and sort it via frequently used by way of month for 46 carrier that regularly used in Company A as tabulated in Table 4.



	Average of Exchange Rate (Invoice Received)		20	20					20	21				Grand Total
ио	Carrier	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	յոլ	Aug	for FY2021
1	RCL		4.3178	4.2900	4.2211	4.1971	4.2025	4.2363		4.2886	4.2800	4.3710		4.28
2	HAPAG-LLOYD	4.3032	4.3173	4.3240	4.2020	4.1633	4.1887	4.2400	4.2953	4.2785	4.3045	4.3438	4.3890	4.24
3	CMA	4.2633	4.2614	4.2538	4.1345	4.1400	4.1546	4.1842	4.2425	4.2366	4.2520	4.3365	4.3118	4.23
4	YANG MING	4.2470	4.2470	4.2360	4.1444	4.1272	4.1530	4.2038	4.2095	4.2213	4.2248	4.2927	4.2970	4.22
5	KMTC	4.2130	4.2481	4.2024	4.1527	4.1102	4.1258	4.1647	4.1935	4.1899	4.2065	4.2736	4.2909	4.20
6	COSCO	4.2239	4.2143	4.1911	4.1149	4.0987	4.1176	4.1765	4.1954	4.1768	4.2004	4.2505	4.2724	4.18
7	ООСГ	4.2233	4.2230	4.1953	4.1255	4.1117	4.1037	4.1447	4.1920	4.1820	4.1944	4.2408	4.2918	4.17
8	EWC	4.2135	4.2134	4.1804	4.1159	4.0987	4.1099	4.1543	4.1880	4.1864	4.2035	4.2540	4.2696	4.17
9	INTERASIA LINE	4.2228	4.2065	4.1528	4.1223	4.1060	4.1110	4.1731	4.1887	4.1840	4.1877	4.2722	4.2824	4.16
	SHAL HAWK												4.3340	4.33
	BOX OPERATOR												4.3100	4.31
	TRANS VISION												4.3000	4.30
13	MAXICONT SHIPPING											4.2970		4.30
14	TRANS-COASTAL LINES												4.2925	4.29
15	PACIFIC SELATAN AGENCY SDN BHD										4.2220	4.2890		4.27
16	CNC LINE	4.2589					4.2000		4.2025	4.2220		4.3275	4.2954	4.26
17	ВЕИ ГІИЕ				4.1920	4.1920	4.2030					4.3333		4.25
18	SITC								4.1860	4.1870	4.2030		4.2913	4.25
19	MAERSK		4.2517	4.2531	4.1481			4.2157	4.2440					4.24
20	мсс		4.2430						4.2390					4.24
21	COLLYER SHIPPING		4.3694						4.1910	4.2044	4.2374			4.22
22	MSC		4.2632	4.2531			4.1538	4.1663		4.2274		4.2602	4.2986	4.22
23	TRANSWORLD GLS	4.1800		4.2200							4.2000		4.2800	4.22
74	CTP SHIPPING LINE (M) SDN BHD					4.1500		4.2000					4.3015	4.22

# Table 4: Common carrier regularly use by Company A

Grand Total for FY2021	4.2335	4.2371	4.1963	4.1309	4.1170	4.1289	4.1753	4.2015	4.2002	4.2156	4.2824	4.2971	4.19
6 MTT SHIPPING SDN BHD									4.1200				4.12
5 UNIFY SHIPPING					4.0730	4.1000	4.0500	4.1688	4.1250	4.1480		4.1819	4.13
4 NEWSTAR					4.1080	4.0980	4.1625	4.1910					4.14
3 TRANSHUB						4.1500							4.15
2 GLOBELINK CONTAINER LINE (M)		4.2000	4.1300		4.0950			4.1910					4.15
1 INFINITY LOGISTIC AND TRANSPORT SDN BHD	4.2280			4.1220									4.16
0 ONE		4.2121	4.1795	4.0969	4.1023	4.1159	4.1802	4.1878	4.1824	4.1950	4.2691	4.2930	4.17
9 SAMUDERA								4.1820	4.1630				4.17
8 SM LINE	4.1735												4.17
7 TS LINE	4.2096	4.2085	4.1817	4.1110	4.1026	4.1054	4.1877	4.1926	4.1808	4.2074		4.2968	4.18
6 PACIFIC INTERNATIONAL LINE										4.1790			4.18
5 INFINITY LINES SDN BHD	4.2340					4.1080			4.1800	4.2035			4.18
4 SINOKOR			4.2000	4.1700	4.1400	4.1430	4.1900	4.2000		4.2000		4.2620	4.18
3 EMIRATES	4.2180		4.1550										4.19
2 HAMBURG SUD	4.2235				4.1150								4.19
1 WAN HAI	4.2137	4.2080	4.2150		4.0977	4.1120	4.1820	4.1925		4.1796	4.2405	4.2921	4.19
0 ANL		4.2487		4.1677	4.1348				4.2486	4.2250			4.20
9 FESCO							4.2000						4.20
8 I CARRY CONTAINERS				4.2010									4.20
7 COSPREY SHIPPING								4.2030					4.20
16 HEUNG A	4.1780	4.2220					4.1675	4.1970	4.2010			4.2620	4.20
15 HYUNDAI	4.1725	4.2060	4.1323		4.0800	4.1278		4.2157	4.2096	4.2074	4.2/14	4.5505	4.22



### 2.2 Bank Negara Malaysia (BNM) Exchange Rate

Table 5 displays the sample of rates from the Interbank Foreign Exchange Market in Kuala Lumpur as at 0900, 1200 and 1700. Rates at 1130 are the best counter rates offered by selected commercial banks. Not all currencies and rate types are available.

#### Table 5: Bank Negara Malaysia (BNM) Exchange Rate

					B	NM Middl	e Rate at 1	2.00PM							
	USD1.00/RM														
Month	Sep-20	Oct-20	Nov-20	Dec-20	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	Average FY2021		
Rate	4.1507	4.1527	4.1138	4.0562	4.0391	4.0454	4.1095	4.1241	4.1275	4.1348	4.1985	4.2229	4.12		

#### 3. Results and Discussion

#### 3.1 Exchange rate charges by carrier

From the commercial invoice that has been received from carrier or forwarding agents to the company, then, the company can identify that each carrier has follow their own source of currency. The equipment team will get them the Sales Order (SO) number based on shipping from factory, then the equipment team will update into website invoice automation project. The difference of calculation depends on the exchange rate stated. Then, Company A will pay based on the exchange rate charges and some of them will got the difference loses and profit. From the data collected, and combined it for a year, thus it can conclude that some of the carrier has highest and lowest exchange rate. It will give benefit to company to decide whether to manage which carrier to send product to customer in the country. The person in charged need to keep it update about the data exchange rate once a week in excel system for booking team department to arrange for the scheduled. As per result, overall the top carrier have exchange rate for this year from September 2020 to August 2021 as demonstrated in Table 6.



# Table 6: Average of Highest Exchange Rate (Invoice Received) Based on theFrequently Shipment Used

No	Average of Exchange Rate (Invoice Received)		20	20							Grand Total for FY2021			
IVO	Carrier	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	
1	RCL	4.3304	4.3178	4.2900	4.2211	4.1971	4.2025	4.2363	4.2700	4.2886	4.2800	4.3710	4.3658	4.28
2	HAPAG-LLOYD	4.3032	4.3173	4.3240	4.2020	4.1633	4.1887	4.2400	4.2953	4.2785	4.3045	4.3438	4.3890	4.24
3	СМА	4.2633	4.2614	4.2538	4.1345	4.1400	4.1546	4.1842	4.2425	4.2366	4.2520	4.3365	4.3118	4.23
4	YANG MING	4.2470	4.2470	4.2360	4.1444	4.1272	4.1530	4.2038	4.2095	4.2213	4.2248	4.2927	4.2970	4.22
5	КМТС	4.2130	4.2481	4.2024	4.1527	4.1102	4.1258	4.1647	4.1935	4.1899	4.2065	4.2736	4.2909	4.20
6	COSCO	4.2239	4.2143	4.1911	4.1149	4.0987	4.1176	4.1765	4.1954	4.1768	4.2004	4.2505	4.2724	4.18
7	OOCL	4.2233	4.2230	4.1953	4.1255	4.1117	4.1037	4.1447	4.1920	4.1820	4.1944	4.2408	4.2918	4.17
8	EMC	4.2135	4.2134	4.1804	4.1159	4.0987	4.1099	4.1543	4.1880	4.1864	4.2035	4.2540	4.2696	4.17
9	INTERASIA LINE	4.2228	4.2065	4.1528	4.1223	4.1060	4.1110	4.1731	4.1887	4.1840	4.1877	4.2722	4.2824	4.16

Most financial reporting and dividend payments are done quarterly. Not all companies will have fiscal quarters that correspond to calendar quarters and it is common for a company to close their fourth quarter after their busiest time of year. The standard calendar quarters that make up the year are as follows: January, February, and March (Q1), April, May, and June (Q2), July, August, and September (Q3) and October, November, and December (Q4).

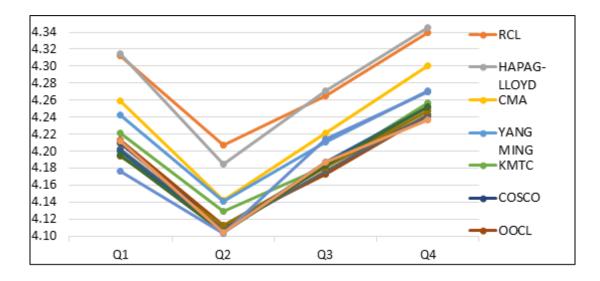
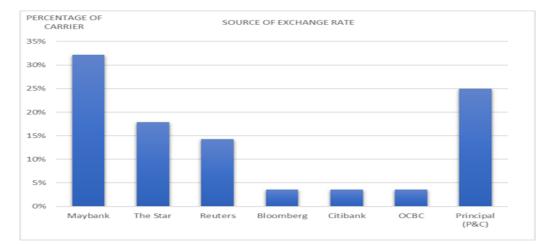


Figure 1: Average of Exchange Rate Carrier by Quarter in Year



Furthermore, Figure 1 shows the average of exchange rate carrier that shipment frequently used by year in Company A to export their goods to customers to reach final destination. The line graph illustrates that the RCL carrier has the highest exchange rate compare to other carrier. This was the strongest quarterly result, arising from exceptional market conditions caused by global supply chain disruptions.



## 3.2 Source of exchange rate by carrier in Malaysia

## Figure 2: Source Exchange Rate by Malaysia Business and Finance News, Stock Updates with Commercial Bank Published Rate

# Table 7: Source Exchange Rate by Malaysia Business and Finance News, Stock Updates with Commercial Bank Published Rate

Source	Carrier
Maybank	Regional Container Lines (RCL), SINOKOR, TS LINE, WAN HAI, COSCO, OOCL, EMC, MSC, CTP SHIPPING LINE
Principal	MERSK, SEALAND, MCC, SAFMARINE, HAMBURG SUD, BEN LINE, INTERASIA LINE
The Star	KMTC, ONE, HEUNG-A, SITC, TRANS-COASTAL LINE
Reuters	CMA, ANL, CNC, YANG MING
Bloomberg	HAPAG-LLOYD
Citibank	HYUNDAI
OCBC	NEWSTAR



Figure 2 shows the source of exchange rate by carrier in Malaysia while Table 7 tabulated the source of exchange rate by Malaysia business and finance news, stock updates with commercial bank published rate. For the exported the goods Company A follows United States Dollar as currency. This is due to dollar is considered strong when it rises in value against other currencies in the foreign exchange market. The United States dollar has been a bedrock of the global economy and a reserve currency for international trade and finance. Like any other fiat currency, the dollar's relative value depends on the economic activity and outlook of the United States. In addition to fundamentals and technical factors, market psychology and geopolitical risk also influence the dollar's value on the world market.

## 3.3 Current situations which determines ocean freight rates

Ocean freight is one of the most important factors in the transportation of goods over sea routes. However, there are various variables that affect the sea freight tax. For this reason, shippers using cargo ships must be careful in determining applicable charges. It is very important to understand sea freight and its application, as the shipper is at risk of significant loss if he or she attempts to move the product without the required expertise. The freight rates is depending on the current situation that happen in the region covered such as North America, Middle East, Europe and Asia. Thus

According to Chinese industry insiders and analysts, ports in several Southeast Asian nations have seen a new round of freight rate increases since late November, spurred by US port congestions and surging market demand for much-needed Chinese commodities less than two months before the Chinese New Year. The 'insane' pre-Chinese New Year ocean building is causing problems for US forwarders. Transpacific head haul rates, demand are at an all-time high ahead of the Chinese New Year holidays next month, with carriers failing to respect contracts, and guaranteed slots only available at costs considerably above quoted spot rates. Transpacific ocean freight markets show no signs of slowing, with supply chain bottlenecks, equipment shortages, and a lack of capacity keeping ocean logistics capacity tight and pricing high.

Civil conflicts in the Middle East are representative of a broken and failing region, since they are symptomatic of nations' failure to generate legitimacy and inclusive governance. Despite some reduction in the levels of violence and fatality in the civil wars in 2021, these conflicts kept the Middle East in a vice-grip of regional dysfunction for the most of the year, which is expected to continue in 2022. The Middle East has been locked in a conflict trap throughout 2021, with civil conflicts stoking regional tensions and rivalries between regional entities making resolving the civil wars impossible. While there are numerous encouraging indicators of a melting of tensions between regional entities, particularly the GCC nations and Iran, we must be mindful of how the current situation in the region's civil conflict zones may function as a headwind, slowing progress toward eventual regional security and stability.



The new Brexit restrictions, on the other hand, will create considerable barriers to both European and worldwide commerce. However, the last-minute agreement between the UK and the EU has not changed. Shippers must still deal with more paperwork, certification, and border procedures than in the past. Shippers dealing with products from outside Europe may face rising duties and levies. It remains to be seen whether and how smaller enterprises will deal with this extra cost. It will take a long time for global trade and the economy to recover to a more normal level. Collaboration among stakeholders has never been more important than now to ensure adaptable and sustainable business operations.

The epidemic has disrupted trade to an unprecedented degree all around the world, increasing the cost of delivering products and posing a new obstacle to the global economic recovery. The virus has disrupted the flow of cargo from one continent to another. The shipping container, globalization's workhorse, is in the epicentre of the storm. Southern Chinese ports affected by COVID-19 lockdowns (Yantian/ Shekou/Hong Kong/ Nansha/Huangpu) are further impacting global box commerce and have experienced a considerable drop in container availability over the previous two weeks. More than 600,000 TEU's are thought to have been affected by the aftermath from a Covid-19 outbreak near the port of Yantian in southern China. Ports throughout the world are bracing for a serious shortage of equipment in the coming months. Ocean carriers will implement more rate hikes, with Freight of All Kinds (FAK) prices from Asia to North Europe approaching \$20,000 per 40ft. This indicates a staggering 1,000% rise in the spot rate over the previous year.

## 3.4 Discussion

As the geopolitical or global market approaches, businesses are providing customers with regular updates on supply chain delays and extended delivery timeframes. Manufacturing delays, traffic bottlenecks at harbours and ports, and a lack of labour have all contributed to substantial problems for enterprises that rely on worldwide shipping routes to reach clients. Understanding the primary shipping routes utilised for global trade is the first step toward reducing these issues and improving supply chains in a variety of sectors.

Shipping routes are concentrated around ports, with certain ports handling more than double the average number of ships. This may easily cause bottlenecks and halt traffic in areas like Singapore's Port. The Malacca Strait is the quickest route between the Pacific and Indian Oceans, with over 40% of world commerce passing via Singapore, Malaysia, and Indonesia each year. Finally, according to one analyst, "just a few nations have direct shipping connections to their trading partners". Only around 6% of the 22,650 pairs of nations having cargo ports are directly connected." This significantly complicates supply chain operations.



## 4. Conclusion

According to economic theory, currency swings will eventually revert to the mean because cheap imported goods should stimulate demand, rising prices. At the same time, when global demand for such commodities drops, the price of pricey domestic exports will have to reduce until an equilibrium exchange rate is achieved. Aside from factors such as interest rates and inflation, the currency exchange rate is one of the most important determinants of a country's relative level of economic health.

Exchange rates play a vital role in a country's level of trade, which is critical to most every free market economy in the world. Economic theory predicts that currency fluctuations will eventually revert to a mean since cheap foreign goods should increase the demand for them, raising their prices. At the same time, expensive domestic exports will have to fall in price as demand for those items declines worldwide until, ultimately, some equilibrium exchange level is found.

As a conclusion, foreign exchange exposure is the term used to describe changes in currency rates that have an impact on a firm's value, which in this case is represented by stock return. The dangers to the company rise as a result. Firms and investors are concerned about the expected and unexpected fluctuation in foreign currency rate movement, which affects stock return.

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#### References

- Abdoh, W. M., Yusuf, N. H., Zulkifli, S. A., Bulot, N., & Ibrahim, a. N. (2016). Macroeconomic Factors That Influence Exchange Rate Fluctuation in ASEAN Countries. *International Academic Research Journal of Social Science*, 89-94.
- Dr. Jean-Paul Rodrigue, D. T. (1998-2022). *The Geography of Transport Systems*. Retrieved 27 May, 2022, from Maritime Transportation: https://transportgeography.org/contents/chapter5/maritime-transportation/
- FOB on An Invoice Explained. (14 October, 2021). (Cleartax) Retrieved 27 May, 2022, from https://cleartax.in/s/fob-invoice
- *Freight Carrier.* (n.d.). (Saloodo) Retrieved 27 May, 2022, from https://www.saloodo.com/logistics-dictionary/freight-carrier/
- International Shipping from Malaysia [Updated: Jul 2021]. (4 July , 2021). (Shipa Freight) Retrieved 27 May, 2022, from https://www.shipafreight.com/shippingfrom/malaysia/



- Joe. (28 December, 2017). The Logistics Department Supporting The Entire Operation. (THE BEST LOGISTICS GUIDE - All About Logistics) Retrieved 27 May, 2022, from https://bestlogisticsguide.com/basics/logistics-department/
- Kramer, L. (30 January, 2022). *How Importing and Exporting Impacts the Economy*. (Investopedia) Retrieved 27 May, 2022, from https://www.investopedia.com/articles/investing/100813/interesting-facts-aboutimports-and-exports.asp
- Mohamed, S., Abdullah, M., Noh, M. K., Isa, M. A., Hassan, S. S., Ibrahim, W. M., & Nasrul, a. F. (2021). Impact of Economic Factors towards Exchange Rate in Malaysia. International Journal of Academic Research in Economic and Management Sciences, 81 - 91.
- Norrbin, M. M. (2017). Chapter 1 The Foreign Exchange Market. In *International Money* and *Finance*. Elsevier Inc.
- United Nations. (2021). Review of Maritime Transport. *United Nations Conference on Trade and Development.* Geneva: United Nations Publications.



## INFOGRAFIK 360° DI GUNUNG LEDANG

## Ahmad Hisham Abdul Rahim<sup>1</sup>, Hamidon Saniman<sup>2</sup>, Muhammad Helmi Abu Bakar<sup>3</sup>

<sup>2</sup>Jabatan Rekabentuk dan Komunikasi Visual, Politeknik Ibrahim Sultan, Johor, Malaysia *ahmadhisham1996@yahoo.com hamidon@pis.edu.my muhammadhelmi@pis.edu.my* 

## Abstrak

Taman Negara Gunung Ledang yang terletak di Tangkak, Johor adalah antara satu tempat popular bagi pendaki-pendaki tegar. Selain kisah lagenda Puteri Gunung Ledang, Gunung Ledang juga sangat kaya dengan hidupan hutan seperti tumbuhan dan haiwan. Gunung Ledang juga terkenal dengan laluan yang sangat mencabar iaitu K.F.C bermaksud *Killer For Climbers*. Baru-baru ini, sukan lasak di Gunung Ledang semakin kurang dikunjungi kerana kurangnya pendedahan mengenai sukan mendaki. Ini disebabkan Galeri Gunung Ledang kurang informasi mengenai peralatan dan persiapan untuk mendaki. Antara objektif kajian ialah menguji keberkesanan aplikasi Interaktif Infografik dan dapatkan maklumbalas pengguna. Kaedah yang digunakan untuk pembangunan infografik adalah dengan menggunakan Adobe XD dan Illustrator. Hasil dapatan menunjukkan bahawa aplikasi ini dapat menyampaikan maklumat dengan lebih mudah difahami. Kesimpulannya, dengan adanya Infografik 360° ini dapat memberi maklumat dengan lengkap agar pengunjung dapat membuat persiapan mendaki ke Gunung Ledang.

Kata kunci: aplikasi, infografik, 360, sukan mendaki, gunung ledang.

#### 1. Pengenalan

Menurut Perbadanan Taman Negara Johor (2021), Gunung Ledang menyimpan pelbagai kisah lagenda turun temurun dari nenek moyang hingga ke hari ini. Salah satu kisah lagenda Gunung Ledang yang terkenal di seluruh Malaysia iaitu Lagenda Puteri Gunung Ledang, seorang puteri misteri yang menetap di gunung, dikatakan masih lagi hidup dan masih menetap dipuncak gunung hingga ke hari ini. Selain kisah lagenda Puteri Gunung Ledang, Gunung Ledang juga sangat kaya dengan hidupan hutan seperti tumbuhan dan haiwan. Di Gunung Ledang mempunyai lapan (8) pusat pemeriksaan atau CP singkatannya dimana ia adalah sebagai penanda bagi setiap ketinggian dan paras gunung sehingga ke puncak.



Kajian ini dijalankan bagi menyampaikan maklumat mengenai persiapan peralatan pendakian di Gunung Ledang. Objektif bagi kajian ini adalah untuk menguji keberkesanan infografik 360° dan dapatkan maklumbalas pengguna. Maklumat-maklumat mengenai pendakian Gunung Ledang masih lagi disampaikan secara konvensional, iaitu secara bertulis dan bergambar walaupun telah berada di zaman berteknologi tinggi.

Pihak Gunung Ledang masalah yang dihadapi oleh Galeri Gunung Ledang iaitu kurangnya informasi tentang sukan mendaki seperti persediaan dan peralatan untuk mendaki di Gunung Ledang. mengatakan bahawa pengunjung-pengunjung seringkali menanyakan keperluan barang untuk mendaki membuatkan staf galeri letih untuk menjawab persoalan yang sama berulang kali. Justeru itu, bagi menyelesaikan masalah yang dihadapi dengan membangunkan prototaip Infografik 360° berharap dapat memberi maklumat dengan jelas dan mudah faham kepada pengunjung dan pada masa yang sama menjimatkan tenaga, masa dan kos.

#### 2. Kajian Literatur

Bahagian ini menceritakan tentang kajian-kajian yang telah dijalankan oleh pengkaji-pengkaji terdahulu mengenai pembangunan prototaip Infografik 360°. Hal ini adalah supaya pengkaji dapat mengetahui apakah kajian yang telah dilakukan oleh pengkaji terdahulu dan maklumat dapat membantu perlaksanaan kajian yang dilasanakan oleh pengkaji. Bahagian ini juga akan merangkumi perbincangan mengenai infografik, aplikasi dan interaktif.

#### 2.1 Infografik

Dekad yang lalu, infografik telah meningkat dengan pesat, ia telah menjadi komunikasi di dalam bilik darjah, di tempat kerja dan juga di seluruh internet. Maksud infografik adalah merupakan pemberi data dan maklumat secara artistik dengan menggunakan elemen yang berbeza seperti graf, gambar, gambar rajah, naratif, garis masa, senarai semak (Marr, B., 2014).

Menurut Sudarman et al., (2019) maklumat, komunikasi, dan teknologi (ICT) sebagai hasil komunikasi pembangunan teknologi adalah penting untuk masyarakat, terutamanya dalam sektor pendidikan, robotik, awam pentadbiran, bidang kerja, perniagaan, dan kesihatan. Beliau tambah, multimedia interaktif dapat membantu pelajar menumpukan perhatian dan memberi lebih menyertai. Dengan ini dapat membuktikan bahawa generasi zaman ini lebih menumpukan perhatian kepada peranti digital daripada tulisan.

Dengan visual, orang awam dapat memahami dengan sekilas pandang. Dan infografik telah digunakan secara meluas di sekeliling kita dengan adanya papan-papan tanda di tepi jalan dan di kedai-kedai. Ini bersesuaian dengan Arum, (2017) infografik mempunyai permintaan tinggi, ia bermula meningkat pada tahun 2010 dan telah



berterusan sejak itu. Infografik juga dapat memberi kesan yang sangat ketara dimana orang akan menjadi lebih kreatif. Menurut Arum, (2017), infografik memerlukan teknik dan kreativiti untuk memvisualisasikan data atau idea daripada maklumat kompleks kepada sesuatu yang lebih mudah dihadam oleh penonton.

Menurut Aldalalah (2020), mengatakan rekabentuk infografik mempunyai kesan yang hebat dalam memudahkan dan meringkaskan paparan, pembentangan dan pembacaan maklumat terkumpul ini untuk pelajar dengan menyampaikannya dengan menarik kerana rekabentuknya yang pelbagai yang menyediakan pelajar dengan bentuk visualisasi baharu dalam mengumpul, mempersembahkan dan menyampaikan maklumat dan data kepada mereka.

Selain daripada itu, infografik bukan sahaja dalam bentuk cetakan, ia juga boleh disebarkan melalui atas talian untuk tujuan pendidikan. Salah satu bentuk media visual yang baru-baru ini dipopularkan di ruang atas talian adalah informasi grafik atau infografik (Elena Gallagher et al., 2017). Tambahan beliau lagi, infografik adalah media visual yang membentangkan data dan konsep menggunakan imej dan visual, dan ia bertujuan untuk menyampaikan maklumat dengan cara yang jelas, cepat dan estetik (Elena Gallagher et al., 2017).

## 2.2 360-darjah

360-darjah ialah panoramik yang boleh dikawal yang mengelilingi titik asal dari mana tangkapan diambil. Menurut Adnan et al., (2020), 360-darjah mampu secara maya meneroka dunia rekaan atau melihat rakaman sebenar yang sebenar dunia yang dibuat oleh kamera video 360 darjah. Pada telefon pintar, sebagai pelajar menggerakkan dan memusing peranti mereka ke kiri dan kanan atau atas dan bawah, imej yang mereka lihat bergerak dalam penyegerakan yang sempurna; pada komputer riba komputer dan desktop, mereka boleh menavigasi video sfera 360 darjah dengan mudah dengan mengklik dan menyeret butang navigasi. 360-darjah juga boleh digunakan samada dalam bentuk imej atau video.

Menurut Foehrder et al., (2021), 360-darjah telah menjadi popular dalam pendidikan alam sekitar sebagai cara untuk memaklumkan orang ramai tentang bagaimana perhutanan memberi manfaat kepada manusia dan hidupan liar. Ini dapat membukti bahawa pembangunan 360-darjah dapat sambutan hangat agensi-agensi perhutanan atau organisasi-organisasi yang terdapat di Malaysia.

Aplikasi 360-darjah dapat menghindari dari penyakit yang tidak diingini. Menurut Foehrder et al., (2021), replika maya hutan dunia sebenar membolehkan pengguna berulang kali mengalami pengalaman dalam kawasan tertentu, keadaan cuaca semasa, musim tahun atau pengangkutan. Ini bermaksud, pengguna boleh mengalami pengalaman 360° tanpa batas dan tanpa perlu merisaukan cuaca, musim atau kos pengangkutan.



Pada masa sekatan dan pandemik khususnya apabila isu jarak jauh dan pendidikan dalam talian telah menjadi lebih penting berbanding sebelum ini, keperluan untuk persekitaran pembelajaran yang bermotivasi dan realistik, yang kedua-duanya mudah digunakan oleh bakal pelajar dan membolehkan penciptaan kandungan pantas oleh pendidik, telah menjadi jelas sekali lagi. 360° sangat sesuai digunakan oleh masyarakat yang risau akan keselamatan kesihatan mereka (Pirker & Dengel, 2021).

#### 3. Metodologi

Metodologi kajian adalah meliputi cara, kaedah dan pendekatan yang digunakan untuk mencapai objektif dan matlamat kajian. Metodologi kajian akan menjadikan kajian yang dijalankan lebih bersistematik dan perjalanan kajian akan lebih teratur dalam mencapai objektif. Di dalam bab ini akan membincangkan mengenai metodologi yang digunakan dalam kajian yang dijalankan. Hal ini telah dirancang dengan teratur, metodologi kajian dan strategi-strategi yang digunakan untuk mendapatkan maklumat dan data melalui kaedah-kaedah tertentu.

## 3.1 Rekabentuk Populasi dan Persampelan

Populasi untuk kajian ini adalah penduduk tempatan berdekatan dengan Taman Negara Johor Gunung Ledang yang pernah atau tidak pernah mengunjungi ke Galeri Gunung Ledang. Kategori daripada golongan dewasa muda dan dewasa yang meminati sukan mendaki. Populasi akan diperoleh melalui soal selidik yang akan disebarkan secara atas talian dan juga dengan kaedah temu bual di lokasi kajian iaitu Taman Negara Gunung Ledang. Persampelan adalah berkaitan dengan proses memilih sebilangan subjek daripada sesuatu populasi untuk dijadikan responden kajian. Sampel bagi kajian ini adalah lelaki dan perempuan, kategori berumur 18 tahun sehingga 30 tahun ke atas. Terbuka kepada semua bangsa di Malaysia.

#### 3.2 Instrumen Kajian

Instrumen kajian merupakan alat bantu yang dipilih yang dipilih dan digunakan pengkaji dan mengumpul maklumat dan data agar menjadi lebih sistematik dan menjadi lebih mudah. Kajian pembangunan prototaip aplikasi interaktif infografik sebagai strategi menambahkan maklumat mendaki di Gunung Ledang menggunakan instrument kajian berbentuk soal selidik. Tujuan adalah mendapatkan keseragaman di dalam jawapan yang diberikan kepada respondden untuk memperolehi data.



Jadual	1: h	nstrumen	Kajian
--------	------	----------	--------

men Kajian
al selidik
1

Jadual 1 di atas menunjukkan kaedah dan instrument kajian yang digunakan di dalam kajian ini iaitu kuantitatif dengan menggunakan soal selidik.

#### 4. Dapatan Kajian

Hasil dapatan kajian yang diperolehi menerusi instrumen soal selidik secara online yang dijalankan ke atas kumpulan responden yang disasarkan. Dapatan kajian ini dianalisis dengan soalan-soalan bagi melihat peratusan daripada jawapan maklumbalas bagi mencapai keputusan terhadap objektif projek yang digariskan. Dapatan kajian ini juga dibentangkan dengan mudah dan jelas serta dipaparkan dalam bentuk jadual dan graf bagi memudahkan pemahaman serta penghuraian yang lebih berkesan. Penyelidik menghuraikan analisis terhadap data serta maklumat yang diperolehi melalui kajian ini mengikut susunan objektif kajian sepertimana yang ditetapkan dalam bahagian terdahulu. Berikut adalah bentuk item instrumen yang digunakan dalam kajian ini bagi menjawab soalan kajian yang dikemukakan

Umur	Kuantiti	Jumlah (%)
18 - 21	28	17
22 – 25	39	23.6
26 - 30	61	37
30 ke atas	37	22.4
Jantina	Kuantiti	Jumlah (%)
Lelaki	100	60.6
Perempuan	65	39.4
Bangsa	Kuantiti	Jumlah (%)
Melayu	123	74.5
Cina	18	10.9
India	21	12.7
Siam	2	1.2
Iban	1	0.6
Status	Kuantiti	Jumlah (%)
Bujang	97	58.8



Berdasarkan kepada Jadual 2, menunjukkan demografi responden kajian. Kategori umur, majoriti responden berumur 26 hingga 30 iaitu 61 (37%) responden. Jantina pula majoriti adalah lelaki iaitu 100 (60.6%) responden. Seterusnya adalah bangsa, majoriti adalah dikalangan Melayu berjumlah 123 (74.5%) responden. Dan terakhir ialah status majoriti adalah bujang berjumlah 97 (58.8%) responden

	Kemudahgunaan (Facility)	)					ŕ
Bil.	Soalan		Pe	eratus	(%)		Min
		STS	TS	KS	S	SS	
1.	Saya berpendapat aplikasi GLI ini mudah untuk digunakan.	0.6	1.2	3.0	54.5	40.6	4.3
		(1)	(2)	(5)	(90)	(67)	
2.	Navigasi di dalam aplikasi GLI mudah difahami.	0.6	1.2	3.0	55.1	40	4.3
		(1)	(2)	(5)	(91)	(66)	
3.	Penggunaan <i>interface</i> dalam aplikasi GLI sangat menarik.	1.2	1.8	5.4	49.6	41.8	4.3
		(2)	(3)	(9)	(82)	(69)	
4.	Arahan yang disampaikan di dalam aplikasi GLI dengan	1.2	1.2	3.6	54.5	39.3	4.3
	jelas.	(2)	(2)	(6)	(90)	(65)	
5.	Aplikasi GLI akan mendapat sambutan dimana-mana	0.6	1.2	6.0	52.7	39.3	4.3
	sahaja.	(1)	(2)	(10)	(87)	(65)	
6.	Saya berpendapat aplikasi GLI amat mesra pengguna.	0.6	2.4	3.0	52.7	41.2	4.3
		(1)	(4)	(5)	(87)	(68)	
	Aplikasi GLI telah membantu saya mendapatkan maklumat	1.2	0.6	3.0	51.5	43.6	4.4
	pendakian di Gunung Ledang	(2)	(1)	(5)	(85)	(72)	
8.	Secara keseluruhan, aplikasi GLI amat mudah untuk	0.6	1.2	3.0	54.5	40.6	4.3
	digunakan.	(1)	(2)	(5)	(90)	(67)	
	Purata						4.3

Berdasarkan kepada Jadual 3, purata min keseluruhan bagi faktor Kemudahgunaan berada pada tahap yang tinggi iaitu 4.3. Responden secara keseluruhan bersetuju bahawa Infografik 360° yang telah dibangunkan mudah untuk digunakan dan navigasi di dalam Infografik 360° mudah difahami. Responden juga bersetuju bahawa Infografik 360° ini amat mesra pengguna dan dapat membantu responden mendapatkan maklumat pendakian dengan mudah. Responden kajian bersetuju secara keseluruhan bahawa Infografik 360° akan mendapat sambutan dimanamana.

Jadual 4: Fakto	or Penerimaan Responde	n terhadap Infografik 360°	(Kebergunaan)
	Kebergunaar	n (Usefulness)	

Bil.	Soalan	Peratus (%)				Min	
		STS	TS	KS	S	SS	
	Penggunaan aplikasi GLI meningkatkan tahap pengetahuan saya.	0.6 (1)	3.0 (5)	5.4 (9)	48.4 (80)	42.4 (70)	4.3
2.	Pemahaman saya mengenai pendakian Gunung Ledang telah meningkat setelah menggunakan aplikasi GLI.	0.6 (1)	3.0 (5)	.4 (9)	48.4 (80)	42.4 (70)	4.3
3.	Tahap pengetahuan saya telah meningkat selepas menggunakan aplikasi GLI.	0.6 (1)			50.3 (83)	40 (66)	4.3



4.	Tugasan saya menjadi lebih berkesan setelah menggunakan aplikasi GLI.	0.6 (1)	4.2 (7)	.4 (9)	49 (81)	40.6 (67)	4.2
	Aplikasi GLI berkemampuan memberikan manfaat kepada semua pengguna.	0.6 (1)	1.2 (2)	7.2 (12)	47.8 (79)	43 (71)	4.3
	Aplikasi GLI telah meningkatkan kemahiran saya dalam mendaki Gunung Ledang.	0.6 (1)	4.2 (7)	6.0 (10)	49 (81)	40 (66)	4.2
	Purata						4.3

Berdasarkan kepada Jadual 4, purata min keseluruhan bagi faktor Kemudahgunaan berada pada tahap yang tinggi iaitu 4.3. Responden secara keseluruhan bersetuju bahawa Infografik 360° dapat meningkatkan tahap pengetahuan pengguna dan pada masa yang sama pemahaman responden meningkat setelah menggunakan Infografik 360°. Responden kajian bersetuju bahawa Infografik 360° telah meningkatkan kemahiran mendaki dan berkemampuan memberi manfaat kepada semua pengguna.

Jadual 5: Faktor Penerimaan Responden terhadap Infografik 360° (Sikap Terhadap Pengguna)

	Sikap Terhadap Pengguna						
Bil.	Soalan	Peratus (%)				Min	
		STS	TS	KS	S	SS	
	Sesiapa sahaja boleh menggunakan aplikasi GLI tanpa memerlukan kepakaran untuk menggunakan aplikasi berkenaan.	1.2 (2)	3.0 (5)	6.6 (11)	46.6 (77)	42.4 (70)	4.3
	Pengalaman menggunakan aplikasi GLI sangat menyeronokkan.	1.8 (3)	2.4 (4)	3.6 (6)	52.1 (86)	40 (66)	4.3
3.	Minat saya bertambah terhadap pendakian Gunung Ledang apabila menggunakan aplikasi GLI.	1.8 (3)	2.4 (4)	4.2 (7)	51.5 (85)	40 (66)	4.3
4.	Saya berpuas hati menggunakan aplikasi GLI.	1.2 (2)	1.8 (3)	3.6 (6)	48.4 (80)	44.8 (74)	4.3
5.	Pengguna akan lebih bermotivasi untuk memahami/mendapatkan maklumat pendakian Gunung Ledang selepas menggunakan aplikasi GLI.	0.6 (1)	1.8 (3)	.4 (9)	49 (81)	43 (71)	4.3
	Purata						4.3

Berdasarkan kepada Jadual 5, purata min keseluruhan bagi faktor Kemudahgunaan berada pada tahap yang tinggi iaitu 4.3. Responden secara keseluruhan bersetuju bahawa minat responden bertambah apabila menggunakan Infografik 360° dan responden kajian menjadi lebih bermotivasi mendapatkan maklumat pendakian. Responden kajian telah bersetuju secara total bahawa sesiapa sahaja boleh menggunakan Infografik 360° tanpa memerlukan kepakaran untuk menggunakannya.



	Tingkahlaku (Behaviour)						
Bil.	Soalan		Min				
DII.	SUdidii	STS	TS	KS	S	SS	IVIIII
1.	Sesiapa sahaja boleh menggunakan aplikasi GLI.	1.2	1.2	6.6	49	41.8	4.3
		(2)	(2)	(11	(81)	(69)	4.3
2.	Aplikasi GLI mampu mendorong saya memahami	0.6	1.8	4.2	50.9	42.4	
	dengan lebih baik mengenai pendakian Gunung	(1)	(3)	(7)	(84)	(70)	4.3
	Ledang.						
3.	Saya berpendapat aplikasi GLI sangat berkualiti.	0.6	1.8	3.6	53.9	40	4.3
		(1)	(3)	(6)	(89)	(66)	4.5
4.	Aplikasi GLI sangat mudah.	0.6	0.6	4.8	50.3	43.6	4.4
		(1)	(1)	(8)	(83)	(72)	4.4
5.	Di dalam aplikasi GLI mempunyai 'menu' bantuan bagi	0.6	3.0	4.2	50.3	41.8	4.3
	pembelajaran aplikasi.	(1)	(5)	(7)	(83)	(69	4.3
	Purata						4.3

## Jadual 6: Faktor Penerimaan Responden terhadap Infografik 360° (Tingkahlaku)

Berdasarkan kepada Jadual 6, purata min keseluruhan bagi faktor Kemudahgunaan berada pada tahap yang tinggi iaitu 4.3. Responden secara keseluruhan bersetuju bahawa Infografik 360° ini mampu mendorong responden memahami lebih baik mengenai pendakian dan Infografik 360° ini sangat mudah digunakan. Jadi responden kajian telah bersetuju secara total bahawa sesiapa sahaja boleh menggunakan Infografik 360° ini kerana ia sangat berkualiti.

#### 5. Kesimpulan

Secara kesimpulannya, kajian yang telah dijalankan telah mengukur empat (4) faktor seperti kemudahgunaan, kebergunaan, sikap terhadap pengguna dan tingkahlaku. Secara keseluruhannya responden kajian sebulat suara bahawa Infografik 360° yang dibangunkan ini telah dapat menyampaikan maklumat dengan jelas dan mudah difahami. Aspek kebergunaan juga telah dikaji dan dilihat berada di tahap yang tinggi oleh infografik yang dibangunkan dipersetujui dapat memberikan maklumat persiapan peralatan pendakian secara menyeluruh.

Dari segi faktor sikap terhadap pengguna dan tingkahlaku juga telah dikaji dan dilihat bahawa ia berada ditahap yang tinggi. Responden kajian bersepakat bahawa sesiapa sahaja boleh menggunakan aplikasi ini tanpa memerlukan kepakaran dan responden menjadi lebih bermotivasi untuk memahami atau mendapatkan maklumat pendakian dengan lebih mendalam.

Kajian ini pada dasarnya melihat kepada aspek kebolehgunaan infografik yang dibangunkan. Faktor yang dikaji telah dianalisa mempunyai tahap yang tinggi. Kajian lanjut berkaitan dengan aspek aksesibiliti dan kepada kumpulan pendaki yang lebih luas dilihat perlu bagi menjamin penggunaan yang lebih optimum dalam kalangan pengguna.



#### Rujukan

- Adnan, A. H. M., Shak, M. S. Y., Karim, R. A., Tahir, M. H. M., & Shah, D. S. M. (2020).
  360-degree videos, VR experiences and the application of education 4.0 technologies in Malaysia for exposure and immersion. *Advances in Science, Technology and Engineering Systems*, 5(1), 373–381. https://doi.org/10.25046/aj050148
- Aldalalah, O. M. A. (2020). The Effectiveness of Infographic via Interactive Smart Board on enhancing Creative Thinking: A Cognitive Load Perspective. *International Journal* of Instruction, 14(1), 345–364. https://doi.org/10.29333/IJI.2021.14120A
- Arum, N. S. (2017). Infographic: Not Just a Beautiful Visualisation. University of Birmingham.
- Elena Gallagher, S., O'Dulain, M., O'Mahony, N., Kehoe, C., McCarthy, F., & Morgan, G. (2017). Instructor-provided summary infographics to support online learning. *Educational Media International*, 54(2), 129–147. https://doi.org/10.1080/09523987.2017.1362795
- Foehrder, T., Mund, J. P., & Spathelf, P. (2021). Advantages of 360° Virtual Forest Tours to Supplement Academic Forestry Education. *GI\_Forum*, *9*(2), 34–44. https://doi.org/10.1553/giscience2021\_02\_s34
- Perbadanan Taman Negara Johor, (2021, November 11) Gunung Ledang, Johor National Parks Corporation. (2021, November 28)
- Pirker, J., & Dengel, A. (2021). The Potential of 360° Virtual Reality Videos and Real VR for Education A Literature Review. *IEEE Computer Graphics and Applications*, *41*(4), 76–89. https://doi.org/10.1109/MCG.2021.3067999
- Sudarman, S., Sugeng, S., & Hairullah, H. (2019). Development of Interactive Infographic Learning Multimedia on Study Methodology Study Course of Economic Education Program of Mulawarman University. JPP (Jurnal Pendidikan Dan Pembelajaran), 25(2), 51–64. https://doi.org/10.17977/um047v25i12018p051



## TOURIST SATISFACTION TOWARDS THEME PARKS IN MALAYSIA

Nur Aimi Yasmin Binti Abdul Razak<sup>1</sup> and Dr. Nurul Azhani Binti Mohd Azmin<sup>2</sup>

Department Tourism and Hospitality Politenik Ibrahim Sultan, Pasir Gudang, Johor missmiyayasmine@gmail.com nurul\_azhani@pis.edu.my

## Abstract

Theme parks are important attractions or destinations in tourism as they deliver a sense of fantasy and escape emphasizing on hedonic and pleasurable experiences. Therefore, theme parks are important sectors within the tourism industry, which has grown dramatically and become the main tourist destinations in some countries. The purpose of this research is to analyze the tourists' satisfaction towards the quality, safety and experience at the theme park in Malaysia. Data was collected via a questionnaire survey distributed to 190 tourists, who had experienced activities and games at theme parks in Malaysia. The data collected were then analyzed using Statistical Package for Social Sciences (SPSS). The results of this study reveals that half of the respondents mentioned are somewhat satisfied with the high level with the theme parks in general which made it a significant variable towards the quality, safety and experience at the theme parks in the future.

Keywords: theme parks, satisfaction, tourist, safety

## 1. Introduction

Theme parks are a part of the leisure and tourism industry (Pikkemaat & Schuckert, 2007). According to Swensen (2021), approximately over 250 million tourists visited theme parks all over the world. However in the year of 2020, there was a significant drop of tourists visiting the theme parks to 83 million (TEA/AECOM, 2020). This is due to the spread of COVID-19 in 2020 that causes the whole world to undergo quarantine in the pandemic. This pandemic has impacted the global economy causing a lot of sectors to close down temporarily until the quarantine has been lifted off (Bartik et al., 2020). Fortunately in 2021, there was a slight improvement to this COVID-19 pandemic where many sectors such as the government, business, education and tourism were allowed to be opened again. Even though sectors allowed to be reopened, many are still recovering from the big loss during the lockdown (Auto, 2021). As stated, theme parks are one of the desired activities for Malaysians to do during their leisure holidays. Theme



parks are one of Malaysia's tourism attractions that produce revenue for the country and impact the tourism economy's growth (Romli et al., 2015). Even before the pandemic, it was reported by Nur Haziqah (2020) that local theme parks and attractions will continue to be major drivers in reaching the government's goals for the Visit Malaysia 2020 (VM2020) campaign. Unfortunately, the theme parks in Malaysia suffered from the consequences of the Control Movement Order (MCO) that took place on 18th March 2020 as this industry reported an estimated RM280 million loss (EdgeProp.my, 2020).

Most people were scared of the newly built theme park. As there are cases of malfunction of the rides around the world (Kutenai & Sulc, 2021). There have been plenty of indoor and outdoor theme parks in Malaysia since 2003. The recent theme park that was officially opened was the Genting Skyworlds Theme Park on 10th December 2021. People had been waiting for quite some time for the opening, however the due date was delayed due to the lockdown. This causes a higher expectations set on the public on the grand opening of the theme park. Since there are higher expectations towards this theme park, tourists hope that the reopening of Genting Skyworlds could satisfy the quality, safety and the experience gained from the theme park.

The importance of the study towards the industry is to increase the relationship between the stakeholders and the visitors. From the pandemic stage now to endemic, visitors need the consolation from the stakeholders to make sure that they are safe while riding the rides after being closed for a while and keep sanitizing the area. This study aims to analyze the tourists' satisfaction towards the safety at the theme park in Malaysia.

#### 2. Literature Review

## 2.1 Safety

Theme parks are a popular family attraction all over the world, known for their thrilling rides and rollercoasters that appeal to both children and adults. Installing progressively more daring rides and appealing to prominent cultural personalities and franchises ensure their success and profitability. Due to the nature of theme park rides, however, when something goes wrong, the consequences can be devastating, and the stakes for theme park administrators in guaranteeing the safety of their facilities are quite high. Failure to follow health and safety requirements, as well as inadequate management systems and mechanical flaws, have resulted in unfortunate accidents on numerous rides and rollercoasters, with significant repercussions.

It is critical to ensure that the theme park is well-informed, capable, and able to assume responsibility for the theme park's rides and attractions in order to protect both guests and employees. Things that can be done are daily check and operating the ride which includes everything from loading passengers correctly, ensuring it is balanced,



ensuring all restraints are properly in place and safety features are functioning, ensuring spectators and queuing visitors are clear of any danger zones while the machine is in motion, operating the ride safely through manual control, and dealing with incidents such as passengers becoming ill or injured while on the ride (Duff, 2019).

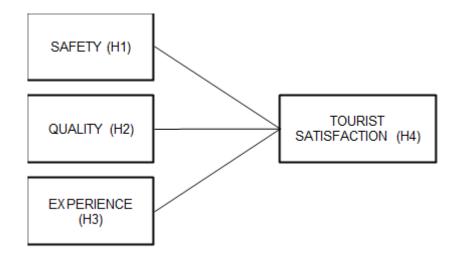


Figure 2.1 Conceptual Framework

## 2.2 Tourist Satisfaction

A review of the literature shows that tourist satisfaction is defined in a variety of ways. Satisfactions are defined differently by each researcher. Some of the definitions are inconsistent and have aspects that overlap. For example, Oliver (1996; as cited in Nurul, 2020) described satisfaction as "the difference between expectation and performance". There are three elements in tourist satisfaction. First, satisfaction is a tourist's response. Next, the response is according to tourists' expectations, product or consumption experience. Lastly, response occurs during post-, pre- purchase, and accumulated experience (Giese & Cote, 2000). "Satisfaction is a psychological state, developed through various consumption experiences" (Oliver, 1997; Lee et al., 2019).

According to Yun and Pyo (2016), expectations and wishes congruence, perceived quality of performance, and perceived quality of experience all have an impact on total satisfaction, which is influenced both directly and indirectly by expectations and desires. In addition, overall satisfaction has a direct impact on the experience of having complaints or complaining behaviors, as well as future behavioral intentions. The experience of having complaints has a direct impact on behavioral intentions.



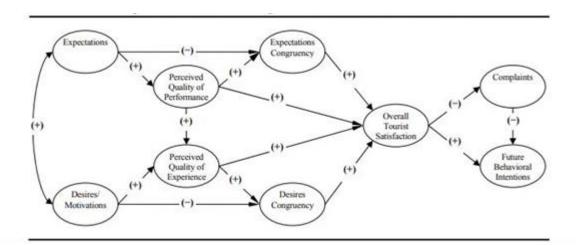


Figure 2.2 Proposed Model of the Integrated Tourist Satisfaction Process

## 3. Method

Researchers focus on data collection in order to get the information throughout the respondent's opinions about the tourist satisfaction towards safety in theme parks by using both methods which are primary data which consists of questionnaires and the other method is secondary data which may include previous articles and journals. Data was collected via an online questionnaire survey (google form) distributed to 190 tourists, who had experienced activities and games at theme parks in Malaysia. The data collected were then analyzed using Statistical Package for Social Sciences (SPSS). The results of this study reveals that half of the respondents mentioned are somewhat satisfied with the safety at theme parks. The Cronbach's alpha reliability coefficient value ( $\alpha$ ) was high at 0.886

On a likert scale of 1 to 5, respondents were asked to express their level of agreement (from strongly disagree to strongly agree). To make sure this survey was pertinent, the researcher focused on respondents who were below 20 years of age and older than 50 years old. Due to the fact that the approach will determine the outcome, it must be suitable to the research's goal and related to it. As a result, this research's goal can be achieved by appropriate methods.

## 4. Results

In order to analyze the tourist satisfaction towards theme parks in Malaysia, descriptive analysis was done. The frequency, percentage, mean, and standard deviation statistical tests were applied.



Table 1: Demographic of respondents							
Demography		Frequency	Percentage				
Gender	Female	104	54.7				
	Male	86	45.3				
Age group	<20 years old	10	5.3				
	21 - 30	91	47.9				
	31 - 40	18	9.5				
	41 - 50	26	13.7				
	>50 years old	45	23.7				
Educational background	SPM	19	10.0				
	DIPLOMA	51	26.8				
	DEGREE	101	53.2				
	MASTER/PHD	19	10.0				
Occupation	Government sector	76	40.0				
	Private sector	30	15.8				
	Self employed	15	7.9				
	Unemployed	15	7.9				
	Student	54	28.4				
Travel party	Alone	11	5.8				
	Family	117	61.6				
	Friends	43	22.6				
	Partner / spouse	19	10.0				
Major purpose of visit	Business	4	2.1				
	Education purpose	2	1.1				
	Leisure	54	28.4				
	Vacation	130	68.4				

#### Table 1: Demographic of respondents

Table 1 shows the profile of respondents in the study. According to gender, the number of female respondents are 104 (54.7%) and 86 (45.3%) male respondents. According to the age group, most of the respondents are from the age group of 21 – 30 years old with a total number of 91 (47.9%) respondents. This is followed by the age group of >50 years old with a total number of 45 (23.7%) respondents. The next age group is 41 – 50 years old with a total number of 26 (13.7%) respondents. This is followed by the age group of 31-40 years old with a total number of 18 (9.5%) respondents and the least number of respondents are in the age group of <20 years old with only 10 (5.3%) respondents

According to educational background, most of the respondents hold a Bachelor's Degree with a total number of 101 (53.2%) respondents. This is followed by respondents with Diploma with a total number of 51 (26.8%) respondents. The next educational backgrounds are both SPM and master/phd with a total number of 19 (10.0). According to occupation, most of the respondents are from the government sector with 76 (40.0%) respondents. Next, the students with 54 (28.4%) respondents. This is followed by the respondents form the private sector and lastly respondents who are self employed and unemployed with 15 (7.9%). Moving on to the next is the travel party, the most respondents travel with family with 117 (61.6%) respondents. Next, the respondents who



travel with spouse/partner with 19 (10.0%) respondents and last but not least, people who travel alone with 11 (5.8%) respondents. According to the major purpose of visit, most respondents go for a vacation with 130 (68.4%) respondents. This is followed by leisure with 54 (28.4) respondents. Next, people who visit because of business with 4 (2.1%) respondents and lastly with education purpose with 2 (1.1%) respondents.

## 4.1 Descriptive Statistic for Variable

Items	Mean	SD	Level
Safety			
1. The staff of theme park will help whenever the visitor has a	3.78	0.691	HIGH
problem			
2. The staff briefed before the rides	3.76	0.886	HIGH
3. The facilities in theme park are safe	3.74	0.714	HIGH
4. The theme park has a good maintenance of equipment,	3.65	0.800	MEDIUM
materials and machinery			
5. The facilities within theme park are reliable	3.71	0.718	HIGH
6. Theme park can accurately perform the service	3.74	0.686	HIGH

#### **Table 2: Descriptive Statistic for Safety**

Table 2 shows the descriptive statistics for the Safety variable. The items with the highest items on the "The staff of theme park will help whenever the visitor has a problem" (Mean=3.78) and lowest level items on "The theme park has a good maintenance of equipment, materials and machinery" (Mean=3.65).

rabie er beeenparte statione for quality				
Items	Mean	SD	Level	
Quality				
1. The facilities within the theme park have a modern outlook	3.64	0.803	MEDIUM	
2. The staff of the theme park have neat appearances				
3. The facilities within the theme park are visually appealing	3.71	0.694	HIGH	
4. The information media such as leaflets, signposts and map	3.76	0.660	HIGH	
inside the theme park are visually appealing				
<ol><li>The setting at the theme park was very attractive</li></ol>	3.85	0.727	HIGH	
6. The theme park's setting paid close attention towards the				
design details	3.92	0.625	HIGH	
	3.74	0.707	HIGH	

#### **Table 3: Descriptive Statistic for Quality**

Table 3 shows the descriptive statistics for the Quality variable. The items with the highest level are the items on the "The setting at the theme park was very attractive" (Mean=3.92) and lowest level item on".The facilities within the theme park have a modern outlook " (Mean=3.64).



Items	Mean	SD	Level
Experience			
1. The activities in the theme park were fun and exciting	3.99	0.655	HIGH
2. Activities in the theme park were entertaining and amusing	3.99	0.659	HIGH
3. It was assuring knowing that the staff is knowledgeable			
4. The staffs were friendly	3.92	0.682	HIGH
5. I received good service from the staffs	3.81	0.717	HIGH
6. It stimulated my curiosity to learn new things	3.77	0.725	HIGH
7. I learned a lot by observing my surroundings at theme park	3.80	0.743	HIGH
	3.83	0.762	HIGH

## **Table 4: Descriptive Statistic for Experience**

Table 4 shows the descriptive statistics for the Experience variable. The items with the highest level are the items on the "The activities in the theme park were fun and exciting" and "Activities in the theme park were entertaining and amusing" (Mean=3.99) and lowest level item "The facilities within the theme park have a modern outlook" (Mean=3.64).

4.2 Relationship between Safety, Quality and Experience towards Tourist Satisfaction

 Table 5: Relationship Between Safety and Tourist Satisfaction

 Correlations

		Tourist Satisfaction	Safety
Safety	Pearson Correlation	.578**	1
	Sig. (2-tailed)	<.001	
	Ν	190	190

\*\*. Correlation is significant at the 0.01 level (2-tailed).

#### H1 : There is a significant positive relationship between safety and tourist satisfaction

Based on Table 5, the relationship between Safety and Tourist Satisfaction is moderate (r=0.578). The relationship is also significant at level 0.01. Therefore, we accept the hypothesis that there is a significant positive relationship between safety and tourist satisfaction.

# Table 6: Relationship Between Quality and Tourist Satisfaction Correlations

		Tourist Satisfaction	Quality
Quality	Pearson Correlation	.572**	1
	Sig. (2-tailed)	<.001	
	Ν	190	190
** 0	tion in also if and at the	0.04 1	- 11 - 11

\*\*. Correlation is significant at the 0.01 level (2-tailed)

#### H2 : There is a significant positive relationship between quality and tourist satisfaction



Based on Table 6, the relationship between Quality and Tourist Satisfaction is moderate (r=0.572). The relationship is also significant at level 0.01. Therefore, we accept the hypothesis that there is a significant positive relationship between quality and tourist satisfaction.

Table 7:	Relationship Between Exper Correlation		「ouri	st Satis	sfaction
		Tourist	_		

		Tourist Satisfaction	Experience
Experience	Pearson Correlation	.572**	1
	Sig. (2-tailed)	<.001	
	Ν	190	190

\*\*. Correlation is significant at the 0.01 level (2-tailed)

# H3 : There is a significant positive relationship between experience and tourist satisfaction

Based on Table 7, the relationship between Experience and Tourist Satisfaction is moderate (r=0.572). The relationship is also significant at level 0.01. Therefore, we accept the hypothesis that there is a significant positive relationship between experience and tourist satisfaction.

## 5. Conclusions

At present, the best evidence suggests that safety, quality and experience are some of many factors of tourist satisfaction towards theme parks, especially in Malaysia. This study found that safety, quality and experience do bring important impacts towards tourist satisfaction. The staff in theme parks play a significant role to the tourists. Some of many responsibilities are performing the risk analysis, inspection and upkeep of rides, knowing the typical mistakes or mishaps that can occur, protocols for emergencies and last but not least, informing of incidents. When the staff are convinced and believe that all the equipment and rides are safe, it could heighten the tourist satisfaction towards the theme parks. In the future research, the researcher can focus on the respondents in high schools who are teenagers. Not to mention, this study also could be analyzed in a qualitative method in collecting the data.

## References

Auto, H. (2021, September 15). More sectors allowed to reopen in Malaysia as Covid-19 lockdown no longer feasible: PM Ismail. *The Straits Times*. https://www.straitstimes.com/asia/se-asia/more-sectors-allowed-to-reopen-in-malaysiaas-covid-19-lockdown-no-longer-feasible-pm



Bartik, A. W., Bertrand, M., Cullen, Z., Glaeser, E. L., Luca, M., & Stanton, C. (2020). The impact of COVID-19 on small business outcomes and expectations. *Proceedings of the National Academy of Sciences*, *117*(30), 17656–17666.

EdgeProp.My, E. P. M. (2020, July 25). *Covid-19 puts the brakes on Malaysia's theme park ambitions*. Edgeprop.My. https://www.edgeprop.my/content/1716145/covid-19-puts-brakes-malaysias-theme-park-ambitions

Duff, P. (2019, December 18). *Theme Park Safety – The risk of failure*. LinkedIn.Com. https://www.linkedin.com/pulse/theme-park-safety-risk-failure-paul-duff

Giese, J. L., & Cote, J. A. (2002). Defining Consumer Satisfaction. *Academy of Marketing Science*, *2000*(1). https://www.researchgate.net/publication/235357014\_Defining\_Consumer\_Satisfaction

Nur Haziqah, A. M. (2020, January 22). *Theme parks among key drivers for VM2020*. The Malaysian Reserve. <u>https://themalaysianreserve.com/2020/01/22/theme-parks-among-key-drivers-for-vm2020/</u>

Pikkemaat, B., & Schuckert, M. (2007). Success factors of theme parks - An exploratory study. *Preliminary Communication*, *55*(2), 197–208.

https://www.researchgate.net/publication/286363387\_Success\_factors\_of\_theme\_parks \_-\_An\_exploratory\_study

Romli, S. R. M., Ahmad, A., Kassim, A., & Ibrahim, R. (2015). Determining Visitors' Satisfaction in Theme Parks: A Case in Kuala Lumpur. *5th International Symposium 2015*, 323–332.

https://www.researchgate.net/publication/299430605\_DETERMINING\_VISITORS'\_SAT ISFACTION\_IN\_THEME\_PARKS\_A\_CASE\_FROM\_KUALA\_LUMPUR\_MALAYSIA

Swensen, K. (2021, September 24). *New Report Reveals Just How Much Theme Park Attendance Dropped in 2020*. Inside the Magic. https://insidethemagic.net/2021/09/2020-theme-park-attendance-report-ks1/

TEA/AECOM. (2020). *Global Attractions Attendance Report*. Themed Entertainment Association (TEA). https://aecom.com/wp-content/uploads/documents/reports/AECOM-Theme-Index-2020.pdf



# CONTAINER LOADING RECORD SYSTEM

Puan Nazihah Binti Mohd Noor<sup>1</sup>, and Muhammad Shabil Husni Bin Sharif<sup>2</sup>

Mechanical Engineering Department<sup>1,2</sup>, Ungku Omar Polytechnic, Malaysia, Ipoh, Perak shabilsharif98.ss@gmail.com

## Abstract

Container loading is one of the important parts and process of the supply chain due to the product are ready to deliver to consignee or customers. Warehouse are used by nearly all kinds of persons and entities engaged in exporters, importers, manufacturers and so on. All incoming and outgoing container must have record for the office staff to trace it. Currently, at Factory ABC Centralized Warehouse Top Glove only using manual records which is just record in the logbook. So, there always have problem when have internal audit or to trace previous record due to various type of writing in logbook. Due to the problem occur, this proposal aims to solve the issue that been stated by study new system for loading goods inventory system and develop new system for it. It also to minimize human error while manually record the incoming and outgoing container and when to trace the previous records for the internal audit.

Keywords: Container, Warehouse, Warehouse System,

#### 1. Introduction

The supply chain is comprised of several different stages, one of which is the warehouse. The process of keeping finished items, packaging material, and work that is still in progress is known as "warehousing" (WIP). A warehouse is the place where they store the items before selling them or distributing them further to another storage facility or warehouse specifically designed for that purpose. It plays essential functions and will have an effect on everything from the efficiency with which orders are managed and inventories are managed to the timing with which orders are delivered to clients. [1]

Warehouses are a safe and secure place to store the goods or products in an organised manner to track where items are located, when they delivered, how long have the goods been store there, and how many quantities of goods that store. Warehouses also keep track of how many different quantities of goods are stored. The strategic day-to-day operations of a warehouse are known as warehouse management. This type of management focuses on the employees and workers, as well as training, inventory, equipment, safety and security, and maintaining positive relationships with tenants



#### 1. **Problem Statement**

There isn't yet a designated system at ABC Centralized Warehouse that is designated for the Container Loading Record System. Current method to record the container transaction are by using logbook or Due to the many types of writing in the logbook, there are thus always issues when conducting internal audits or trying to track down earlier entries. It is comparable to the CEO's exhortation to go toward paperless operations. Due to the variety in handwriting, human error always happens when manually recording the transaction in the logbook.

## 2. **Objectives**

This proposal aims to solve the issue that been stated in the problem statement is to develop new system that specified for loading purpose and to minimize human error while manually record the container details.

#### 2. Literature Review

To execute this project, it is important to know the reason on localization of a service or product. We need to identify the standards and procedure of selecting a supplier, evaluating, and ensuring the supplier can meet the International Standards Requirements. The challenge in this project is about the time to fully identify the potential, ability and ensure the parts and process provided by the suppliers meets those requirements, in which most of the problem factors are man and method itself. Thus, conduction research to gather information on and the related topic is vital. The sources of the literature review are extracted from journals, article, website, department SOP and knowledge sharing from department seniors and supervisors.

Container loading and unloading supervision is an important aspect of supply chain logistics since it guarantees that the items are signed, sealed, and delivered on schedule and in good shape.

An importer must ensure that the items arrive in pristine condition. However, numerous things can go wrong during the loading or shipping procedure. As a result, a container loading inspection is a necessary step in ensuring that the containers arrive securely. A container loading inspection is usually performed at the shipper's plant or warehouse to ensure that the items are handled correctly and safely when loading into shipping containers, assuring safe transportation and delivery to the final destination.

#### 3. Methodology

The methodology and process for developing the system will be explained in this chapter. In addition, this chapter will outline the methods used to identify the problem as well as the system that will be used to solve it. This strategy is used to ensure that the



project's goals are met. In addition, every element involved in doing the research will be discussed in this chapter.

This chapter provides a detailed explanation of the selected mode of analysis used and the data collection method. The observation would be made by implementation while working on a task to determine the effectiveness of the system. Design modelling also shown in this chapter. To add value to the project, studies were carried out using the primary source and secondary source. The primary source is by carried out questionnaires, and observations have been carried out. The secondary source is from the collection data and analysis. A process path that will be implemented for this project and will be carried out when working on the mission by the implementation knowing the feasibility of the applications.

Furthermore, the approaches to be employed will be completely described based on the difficulties at hand as well as the availability of appropriate systems. This was based on all available work, references such as records, interviews, conversations, and other variables, and it focused on the current job. Following this chapter, the process path that will be executed for the project and applied to the work environment will be attached.

The test site is tested with ABC Centralized Warehouse employees and workers at this stage to see if they are satisfied with the solution or not. Any enhancements to the test site can be made. The feasibility of using primary and secondary sources to bring value to the project was investigated. The goal of a questionnaire that was circulated is to learn about people's perceptions and knowledge about the research endeavour.

#### 3.1 Design Research

A researcher's choice of study methods and techniques is known as design research. The design enables the researcher to investigate approaches that are appropriate for the topic matter and ensures the success of researcher studies. This strategy is critical for any observation planning. Steps leading up to implementation should be tracked in order to identify issues that may develop. If there is a critical issue that is a primary cause of failure in the work's implementation, changes must be addressed. Then, in order to maintain a constant flow, control mechanisms must be used.

In general, design research refers to a framework for planning and carrying out specific research. Design research is an important element of the study since it involves all four major considerations: conceptual framework, identification of who and what to examine, and the tools and methods to be used for data collection and analysis.



## 3.2 System Design

System design part explain the system been designed and the overall system for Container Loading Record System

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Table 3.1: Step to develop the system



## 4. RESULTS AND DISCUSSION

In order to accomplish the goal of this project and monitor the efficacy of the Container Loading Record System that is used by the staff at Centralized Warehouse Factory ABC, a survey was carried out. The purpose of the survey was to collect the staff's level of satisfaction with the system implementation. The system satisfaction was tested by 10 staff at the ABC Company. The staff answered two set of questionnaire regarding the current method before implementation of system and after implementation of system.

No	Current method at Warehouse	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
		1	2	3	4	5
1	Existing methods are irrelevant	0	0	20%	40%	40%
2	Existing methods are not user- friendly	0	0	30%	20%	50%
3	It's difficult to review the data for the existing approaches.	0	0	10%	60%	30%
4	Existing practices are no longer acceptable	0	0	20%	30%	50%
5	How would you grade the existing methods	20%	40%	40%	0	0
6	I believe most people can quickly master this system	0	0	30%	30%	40%
7	I found the existing methods is not efficient	0	0	10%	30%	60%

## Table 4.1: Customer Satisfaction before implementation

#### Table 4.2: Customer Satisfaction after implementation

No	New method at Warehouse	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
		1	2	3	4	5
1	The new method is easy to use	0	0	10%	50%	40%
2	Record manually in the book more efficient	10%	40%	50%	0	0
3	Record in the system more efficient	0	0	10%	60%	30%
4	I prefer to use this system more frequently	0	0	20%	30%	50%
5	This system is more difficult than it needs to be	30%	40%	30%	0	0
6	I believe most people can quickly master this system	0	0	10%	60%	30%
7	I found the system to be functional and well integrated	0	0	10%	50%	40%



## 4. Conclusions

As a consequence of this, we are able to draw the conclusion that the Container Loading Record System makes it simpler for staff members to record container details within the system. An investigation into developing a system that meets the specifications for the loading record system has been carried out. Since the system was put into place, there has been a significant reduction in the amount of human error that occurs while recording the container details in the system. The system is able to be upgraded and kept up to date with the latest technical developments, which is a future suPggestion.

## REFERENCES

Lopienski, K., 2022. What is Warehousing? ShipBob's Guide to Warehousing Solutions and

Logistics. [online] ShipBob. Available

Shen, D., Hu, J., Zhai, T., Wang, T., & Zhang, Z. (2019, October). Parallel loading and unloading: Smart technology towards intelligent logistics. In 2019 IEEE International Conference on Systems, Man and Cybernetics (SMC) (pp. 847-851). IEEE.

Chen, L., Kou, M., & Wang, S. (2020). On the use of importance measures in the reliability of

inventory systems, considering the cost. Applied Sciences, 10(21), 7942.

Dewa, P. K., Pujawan, I. N., & Vanany, I. (2017). Human errors in warehouse operations: an

improvement model. International Journal of Logistics Systems and Management, 27(3), 298-317.

Cimini, C., Lagorio, A., Pirola, F., & Pinto, R. (2021). How human factors affect operators' task evolution in Logistics 4.0. Human Factors and Ergonomics in Manufacturing & Service Industries, 31(1), 98-117.



## IMPLEMENTATION OF LOADING BAY LIGHTS FOR WORKERS ERGONOMICS

Amirthavalli A/P Govindan<sup>1</sup>, Muhamad Haziq Bin Md. Rodzi<sup>2</sup>

<sup>1,2</sup> Mechanical Engineering Department, Politeknik Ungku Omar, Ipoh, Perak
<sup>1</sup>amirtha@puo.edu.my, <sup>2</sup>muhamadhziq@gmail.com

## Abstract

The aim of this project is to study the lighting ergonomics at warehouse. The biggest issue with loading operations is that the workers struggled to complete the loading task due to the lack of lighting at night. This has an impact on the time it takes to load a container and how long it takes for a worker to unload a container. The expected outcomes are the reduction of time to complete a loading activity, increasing in worker performance at night and increasing productivity. Container loading and unloading is the process of loading and unloading items into containers that will be transported to clients.

Keywords: Ergonomics, Loading Bay, Lights, Loading Bay Light

## 1. Introduction

Warehousing is fundamental to the success of any physical goods business. The functions of warehousing include stocking, maintaining, and controlling work in process inventory. Developing a dependable warehouse process for products is crucial for business growth. A well-designed AS/RS or non-automated installation must be capable of performing the warehouse tasks and functions which are reception of all products involved in the industrial activity of the company that owns the warehouse, carry out immediate quality controls, control and inventory of the stored products, correct storage of the goods, preparation of orders to be sent to regional warehouses, customers, or both and rapid dispatch of orders.

Container loading and unloading is a process load and unload goods usually finished goods into the container which will transport to clients. The main concern of loading activities is the lighting at the loading bay is not bright enough to carry out the activity. The workers hard to do the loading job due to the lighting issue. Thus, it affects the time taken to complete loading a container at night. Besides that, the time taken for worker to load a container is high.

The objectives of the project are to study the lighting ergonomic for loading bay at warehouse, analyse lighting ergonomics at warehouse based on illuminances and time taken for workers to load/unload and design a new lighting system for loading bay at warehouse. The project scope are loading bay at warehouse and the light brightness at



loading bay. Project outcomes are reduction of time to complete loading activity, increasing worker performance at night and increase productivity. Page Break

#### 2. Literature Review

## 2.1 Lighting Ergonomics

By allowing employees to work comfortably and efficiently, good lighting adds to workplace safety and health. The more quickly and easily a hazard can be identified, the more easily it can be avoided. As a result, the illumination requirements for safe operation are determined by the sorts of risks present at work. To maintain the safety and health of all employees, there must be enough light in the workplace.

According to (Department of Occupational Safety and Health Malaysia, 2018) the lighting in the workplace should enable employees to comfortably see what they need to do their tasks. Good lighting also contributes to a pleasant working environment and a sense of well-being among employees. This can help them be more productive and efficient.

Employees may experience visual tiredness and discomfort as a result of poor illumination. It can have a negative impact on people's health at work, generating symptoms such as eyestrain, migraines, and headaches. Aside from that, bad lighting at work can cost a company a lot of money in terms of time off work due to accidents and injuries, higher absenteeism, and decreased employee efficiency and production.

#### 2.2 Performing Time Study

Many industries have conducted time and motion studies over the years to determine how long it takes to complete a task and to improve it by defining production targets and eliminating superfluous steps in the process. Today, time and motion studies are solely concerned with the time side of work, or how long it takes to complete a task, and are essential for obtaining basic information about how a process operates.

According to (Holpp, 2019) a time study can establish a baseline from which to drive improvement efforts, or set a standard to control performance. While in (Stanshine, 2014), it is stated that a time study is the most common method to obtain a standard time and is accurate for most assemblies, being very accurate for any cyclical assembly.

It is critical for practitioners to know what they wish to study while doing a time study. Work is a process, not just a series of disconnected activities. These processes have names like maintenance or transfers, and they start with inputs, then go on to processes that modify inputs, and finally end with outputs. It is impossible to assess whether work has improved or whether there are differences in performance in a unit without fundamental time study metrics.



## 2.3 Light Measurement Terms

Lighting measurement is conducted for the purpose of determining or verifying lighting or illuminance level for tasks or activities involved in the related work area according to (Department of Occupational Safety and Health Malaysia, 2018). A light metre (Lux metre) is a convenient gadget having a light detecting sensor that is used to measure illumination. The lux value of the measured illuminance is presented directly (lx). The SI unit of illuminance and luminous emittance is the lux (lx), which measures light flux per unit area. General lighting is used to provide uniform illumination across a work area in order to meet the lighting requirements for a specific type of work activity, such as an office, reception, or storage room. To establish the adequacy of lighting in the work area, the illuminance level for general lighting must be measured.

Luminous Flux is the quantity of the energy of the light emitted per second in all directions as defined by (Department of Occupational Safety and Health Malaysia, 2018). Meanwhile, (Mikulka, 2018) stated that luminous flux is Originating from the Latin word 'Fluxus,' meaning flow, flux is the amount of energy a light emits per second, measured in lumens (Im).

Luminous intensity is the ability to emit light into a given direction, or it is the luminous flux that is radiated by the light source in a given direction within the unit of the spatial angel according to (Department of Occupational Safety and Health Malaysia, 2018). In (Mikulka, 2018) website, he said that luminous intensity is the quantity of visible light that is emitted in unit time per unit solid angle. Both references used the same unit of luminous intensity which is candela.

(Mikulka, 2018) stated illuminance is the amount of luminous flux per unit area and in (Department of Occupational Safety and Health Malaysia, 2018), it is stated that Illuminance is the measurement of the amount of light falling onto (illuminating) and spreading over a given surface area. The SI unit for illuminance is lux (lx) and the non-SI unit is foot-candle.

#### 2.4 Smartphone Usage as Light Meter

This topic needs to be discussed because we cannot obtain the professional tools which is a lux meter with internationally recognized specifications, such as BS 667: 20051, DIN 5032-7:19852 or CIE Publication No. 69 (1987) 3. In this project, we use smartphone as the alternative in measuring light.

Stand-alone lux metres (for use in photography, for example) have existed for a long time, devices featuring a light sensor and a screen that displayed light levels in lux units. Light sensors in today's smartphones and tablets, on the other hand, are commonly utilised to automatically alter screen brightness based on light levels according to (Goldschmidt, 2016). Apps that display the light reading in lux units are available for many phones.



All of the properties of light fulfilled the assessment requirements as a consequence of using the designed method based on the evaluation indicators, and the mean error rate was less than 5%. 2.71 percent of the generation rate exceeded the 10 percent permissible limit of error, which is the illuminance change rate that a person can perceive. To apply the system to the real world, the developed system will need to expand its space and act type in the future, as well as more accurate evaluation indications. This is the result is found by (Yang, Sook, & Jae, 2016) trying to use smartphone as lux meter.

## 3. Methodology

## 3.1 Research Design/Structure

Research design is the crucial part of the research as it includes all the four important considerations: the strategy, the conceptual framework, the identification of whom and what to study on and the tools and procedures to be used for collecting and analysing data. The research design basically is divided into several types for example qualitative research and quantitative research. In this study, quantitative research method is used. Quantitative data sources include systematic observation and official statistics.

## 3.4 Research Methodology

In this study, two methods of data collection techniques are applied. This was done in order to collect adequate and relevant data to address the research objectives of this study. Nonetheless, quantitative research method is used. a. Time Study

A time study is the most common method to obtain a standard time and is accurate for most assemblies. The loading activity is observed until the operator reaches the beginning/end point of the loading activity. The observation method is by using CCTV footage. By using this method, it will assist to recording the time and can replay the footage if the result is not accurate. The selected loading activity required to load more than 35 cartons and the loading container need to be filled up in one day. b. Light Brightness Measurement (Light Intensity)

The lux metre application on a smartphone was used to measure brightness. It is a simple and convenient option for research and studies. Smartphones have a variety of electrical sensors built in that can measure things like sound, light, motion, and more. In this task, a phone or tablet's light sensor is used to compare the brightness of light from various light sources and places.



## 3.5 Lighting System Design

## a. Lumen Method

This method is also called Photometrical Computation and mostly used for interior lighting calculation as referred to (Alzuhairi, 2016). The objective of this method is to determine the total number of luminaires required to produce a given illuminance by the lumen method apply the following formula:

Total number of luminaires (N) required to provide a chosen level of illumination (E) at a given surface is

N = <u>E</u>

E (lx-required)x Area (m2)

lumen from each luminaire x UF X MF

Where

- E is the illuminance level is chosen after consideration of the IES code, The area to be lighted is the working area, and the lumen output of each luminaire is specified in the manufacturer's specification and can be found using reference tables.
- MF is maintenance or (the light loss LLF) factor. This factor varies depending on the building's maintenance crew, but it's usually around 0.8-0.9.

• Utilization factor (UF)

Although some of the light is absorbed by the various surface textures, the light flux reaching the working plane is never greater than the lamp's lumen output. Although lighting manufacturers' catalogues provide figures for conventional situations, the method of calculating the utilisation factor (UF) is outlined in lighting d esign publications.

The UF is expressed as a number that is always less than unity; for a modern office structure, a typical value may be 0.9.

[Equation]

=17.05 ≈17 luminaires



Since 17 luminaires are large number that can be installed in the ceiling, so suggesting to use luminaire with 2x17 W T8 LED fluorescent lamps. Hence, the number of luminaires required will be;

17/2=8.5 ≈9 luminaires

Luminaires distribution calculation are as follows;

Room length Number of luminaire in a single row

25m/9=2.8 m

Design of luminaires distribution;

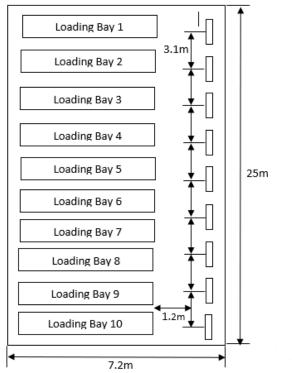


Figure 1: F14AW2 Loading Bay Lighting System Design

#### 4. Result and Discussion

The time study for night time loading activity is described in Table 1. The better the lighting, the time taken for loading activity decrease.



Table 1: Time Study during Night time Loading Activity					
Time Taken (Night time)					
Date	Pallets	Loading (min)	Total (min)	Total per pall	et Total per pallet,
				(min)	loading only
					(min)
23/09/2021	40	372	372	9.3	9.3
03/09/2021	41	414.1	414.1	10.1	10.1
03/09/2021	39	386	386	9.8	9.8
03/09/2021	39	382	382	9.8	9.8
10/09/2021	40	384	384	9.6	9.6

The time taken was obtained during the night time loading. The time taken is high compared to time taken during daytime. However, there was no significant main impact outcome for either illuminance or colour temperature, and there was no significant interaction effect between illuminance and colour temperatures. The light intensity measurement for different time of loading activity is described in Table 2. This shows the loading bay light currently is not bright enough to carry out loading activity at night. The standard light intensity at loading bay is 150 lux as suggested by (Department of Occupational Safety and Health Malaysia, 2018) page 49. The time study after the installation of loading bay light was carried out. The results of the time study are described in Table 3.

Table 2: Measurement of Light Intensity Inside Warehouse					
Location	Light Intensity (lux)				
Ambient light	700 to 900				
Loading Bay	300 to 500				
Ambient light	72 to 87				
Loading Bay	4 to 28				
	Location Ambient light Loading Bay Ambient light				

asurament of Light Intensity Inside Warehouse

Time Taken (Night time)					
Date	Pallets	Loading (min)	Total (min)	Total per pallet Total per pallet,	
				(min)	loading only (min)
12/02/2022	39	359	359	9.2	9.2
06/02/2021	41	391.2	391.2	9.5	9.5
26/02/2021	40	364.8	364.8	9.1	9.1
16/02/2021	39	343.8	343.8	8.8	8.8
21/02/2021	40	343.7	343.7	8.6	8.6



The time taken after installation of loading bay light shows slightly decreased compared to before the installation (refer to Table 1). The overall effectiveness of loading bay light installation is shown in Table 4 with the average of 40 pallet number for the loading activity.

Pallet Number	Before Installation (min)	After installation (min)	Effectiveness, %
39	386	359	7
39	382	343.8	10
40	384	364.8	5
40	372	343.7	8
41	414.4	391.2	6
		Overall Effectiveness	7%

After the installation of the loading bay lights, the light intensity is increased and follows the minimum standard suggested by (Department of Occupational Safety and Health Malaysia, 2018) which is 150 lux. The reading of the light intensity at the loading bay is as described in Table 5.

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Lamp Location	Light Intensity (Ix)		
Lamp 1	166		
Lamp 2	167		
Lamp 3	157		
Lamp 4	155		
Lamp 5	159		
Lamp 6	164		
Lamp 7	161		
Lamp 8	152		
Lamp 9	157		

# Table 5: Light Intensity at Loading Bay After Light Installation

These results show that installing the lights at the loading bay affects the worker performance performing loading activities at night positively. Our findings concerning the working condition of workers to work at night specifically illumination affect the working performance of worker complement the study by (Department of Occupational Safety and Health Malaysia, 2018). They stated that the lighting in the workplace should enable employees to comfortably see what they need to do their tasks. Good lighting also contributes to a pleasant working environment and a sense of well-being among employees. This can help them be more productive and efficient.



The fact that the result indicates implementing loading by lights with the specifications suggested by (Department of Occupational Safety and Health Malaysia, 2018) has slightly increase the worker productivity in completing loading activity. The approach as described in Chapter 3 allows systematic analysis of the event to which the worker performances affected by factors such as workplace lighting, workplace temperature and time taken to complete works.

Despite identifying different numbers of pallet numbers for a loading activity, this study revealed that the light intensity at the loading bay is vary and depends on the location of the light source. It is because this study has a limitation of budget and the specification of lamp that reach the minimum requirement. Given the amount of supporting data for the light intensity at the loading bay, this suggested a further study is required in terms of the environment of loading bay affect that affect the light sources.

As the field of ergonomics especially lighting ergonomics research moves from observational studies to hypothesis-driven projects designed to directly test the contributions of good illumination and its components to health.

#### 5. Conclusion

This research was conducted to improve the worker ergonomics by implementing loading bay lights at warehouse. This study enables to understand the effects of implementing the loading bay lights for workers ergonomics and also focuses on installing the lights that follows the standard from Department of Occupational Safety and Health Malaysia.

The objective of this research effort was to propose of implementing new lighting system for worker ergonomics and performance. The following are key conclusions and findings from this study relative to improving the worker ergonomics and performance for use in loading activity performance at warehouse.

The study offers an explanation to this using the nature of the industry where the study was done. By its nature, the workers did the loading and unloading container in daily basis and the condition of the environment is not sufficient for the activity during night time. The study concluded that by installing the lights at the loading bay affect the worker performance. Based on the results of the study, this study raises implications for practice and awareness.

Future research may integrate these dimensions used in the other warehouses examines how they can install the loading bay lights based on their environment and ultimate decision to improve the lighting at the warehouse.



#### References

Alzuhairi, D. T. (2016). Lighting design and calculations.

- C, G. (2020). *Lighting Ergonomics- The Ultimate Guide*. Retrieved from Ergonomic Trends: <u>https://ergonomictrends.com/lighting-ergonomics-ultimate-guide/</u>
- Department of Occupational Safety and Health Malaysia. (2018). *Guidelines on Occupational Safety and Health for Lighting at Workplace.* Ministry of Human Resources Malaysia. Retrieved from <u>https://www.dosh.gov.my/index.php/legislation/guidelines/industrial-hygiene-1/2912-guidelines-on-osh-for-lighting-at-workplace/file</u>
- Goldschmidt, J. (2016). Luxmeter App versus measuring device: Are smartphones suitable for measuring illuminance? Retrieved from DIALux: https://www.dialux.com/en-GB/news-detail/luxmeter-app-versus-measuringdevice-are-smartphones-suitable-for-measuring-illuminance
- Holpp, L. (2019). *Preparing to Measure Process Work with a time study*. Retrieved from ISIXSIGMA: <u>https://www.isixsigma.com/methodology/business-process-management-bpm/preparing-measure-process-work-time-study/</u>
- Jiayi, B., Xinbo, S., Yan, L., Yinjie, B., & Qianxing, Z. (2021). *Effect of lighting illuminance and colour temperature on mental workload in an office setting.* Scientific Reports. doi:https://doi.org/10.1038/s41598-021-94795-0
- Konigs, S., Mayr, S., & Buchner, A. (2019). A common type of commercially available LED light source allows for colour discrimination performance at a level comparable to halogen lighting. *Ergonomics.* doi:https://doi.org/10.1080/00140139.2019.1663940
- Mikulka, M. (2018). *The Ultimate Guide to Light Measurement*. Retrieved from Lumitex: <u>https://www.lumitex.com/blog/light-measurement</u>

Stanshine, K. (2014). *How to Perform a Time Study.* Kyle Stanshine.

Yang, S., Sook, Y., & Jae, H. (2016). Implementation of Light Quality Evaluation System using Smartphone. *International Journal of Bio-Science and Bio-Technology, 8*(3), 259-270. doi:http://dx.doi.org/10.14257/ijbsbt.2016.8.3.26



## IMPROVEMENT OF RAW MATERIAL DATABASE SYSTEM AT WAREHOUSE

Muhammad Hazim Isham<sup>1</sup>, Azmarini Ahmad Nazri<sup>2</sup> and Muhammad Azirulrahman Aziri<sup>3</sup>

<sup>1, 2</sup>Mechanical Engineering Department, Politeknik Ungku Omar, Ipoh, Perak. <sup>1</sup>hazimmuhd0102@gmail.com <sup>2</sup>azmarini@puo.edu.my <sup>3</sup>logistics@manufacturing.com

#### Abstract

The goal of raw material inventory is to have the proper quantity of material in the proper location at the proper time for the lowest cost. There are numerous key elements in the raw material inventory that can be difficult to manage all at once. Processing multiple items and their quantities at once might be challenging. This paper described a database that integrates excel data into microsoft access to ensure more efficient data management. The objective of this research is to analyze the efficiency of warehouse operation after implementing the new database. Based on the subject of the questions given to the respondents during the interview, the results of the data collection were analysed and the results show that the new database can increase the efficiency in warehouse management by reducing the search time of the items.

Keywords: Database, Microsoft Access, Warehouse, Material, Aluminium.

#### 1. Introduction

The finish goods and raw materials are placed in the warehouse. The warehouse is divided into two parts, the receiving area, and the outgoing area. All finished goods from each model are placed according to the bay that has been set before the goods are exported. This is preferable to the unintegrated option if have enough space. Aluminium has been identified as the most abundant raw material available in this warehouse. Each shelf has its own tagging according to categories such as rack and D.



The situation in the warehouse is quite fibrous where goods are left on the floor even after the checking and improving process by the quality control (QC) department. Due to this scenario, it is difficult for warehouse workers to prepare and deliver the right parts to production and also perform inventory control at the end of each month. Space for the receiving area is also limited and quite narrow because of the ineffective use of space in the warehouse.

Figure 1 shows the rack for aluminium in the warehouse. There is a lot of empty space that is not filled with aluminium. This is because it is not well managed because the available data is insufficient. Therefore, this research focus on improving the raw material management at the warehouse by developing the raw material database.



Figure 1: Rack for Aluminium.

#### 2. Literature review

Inventory is the quantity of goods and materials. A warehouse management system is a set of hardware and software-based tools. Modern inventory management systems are based solely on the use of technology to track and control inventory. This chapter provides an important overview of the research and researched topics. Theoretically and empirically in the existing literature of other scientists and scholars (Agarwal et al., 2009).



Many small business owners use spreadsheets to manage their inventory. Use the appropriate spreadsheet formulas to determine if have enough supplies weekly or after shopping. Maintaining data integrity is a major drawback of manual inventory management. A single input or formula error can result in significant inaccuracies. The manual inventory system does not work with the inventory quantity updated at the end of the day. Every time needs to order a new raw material, product, or consumable needs to check the inventory. This can be a time-consuming process as each product box needs to be physically inspected (Rashid, 2016).

A data warehouse is defined as subject-oriented, integrated, stable, and variant data established over time to support businesses and the key to modernity logistics management decision-making information. Filters are also implemented on all data to generate a feature per data level by calculating the standard mean of each signal. Automated warehouses refer to dozens or even dozens of shelves used to transport goods storage, with corresponding handling equipment for incoming and outgoing goods. Warehouse operations and several types of sensors are needed to collect very different data information around the warehouse. Full warehouse-based automation management can reduce leakage in the management of warehousing, out warehouse and inventory. It can also save quite a lot of management costs, and increase corporate income(Pane et al., 2018).

Microsoft Access is a well-known relational database management system that can use data from Microsoft SQL Server or Access. Additionally, it is rather typical for developers to use ODBC & Access to store application data. Microsoft Office Access offers a robust set of features on the Microsoft home page that make it easy to get started recording, reporting, and sharing data. without the need for in-depth database knowledge, easily construct appealing and useful tracking apps by tweaking one of the numerous pre-made templates, converting an existing database, or creating a new one, and that's it. When using Office Access, it is simple to modify your database and reporting applications to changing business needs.

Access is a microsoft relational database management system combined with the microsoft Jet relational database engine. Integrate your RFID system with your database using LabVIEW to improve the efficiency of your supply chain. Access makes it easy to adapt database applications and reports to your changing business needs. Microsoft access currently has a device database, but it does not include the following built-in functions. Customers need an application as a service-side application that runs on the local network and is accessed by different users on different computers. They need to be



able to track all the states that a device passes through its lifetime before deleting the device. Microsoft access database become decided on due to the fact the server PC did now no longer have a microsoft access database.

This answer is for fee reduction and a clean setup. Users with special pc can then use this utility over their nearby region network. Also, use visual studio 2005 and C++ to construct and run the challenging programming work. This project uses microsoft access as a database resource. It's free and doesn't have to pay for it like any other database management software. Each device has a unique number called the device ID. The primary key is combined with the customer table organization name and contact.

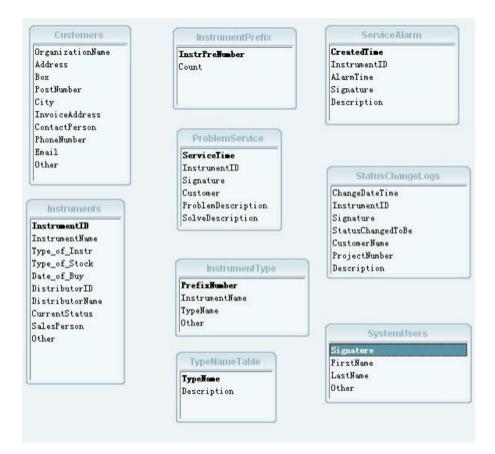


Figure 2.1: Database Connection Diagram.

The distinction between operational data and decision support data is guaranteed. Data support helps with a more flexible user view of data, and ultimately OLAP data. A dimensional data model is denormalized and optimizes the database for search queries. The data modellers organize a data warehouse for the following purposes: A simple report and semantic understanding, rather than the objectives of relational modelling. Every



aspect of the data is organized into a realistic data warehouse project. Each table contains detailed information about the three data dimensions of time, product, and product position. One strategy for improving data navigation within a dimension is to normalize the dimension table (Zou, 2007).

#### 3. Methodology

In this study, detailed interviews were used as a data collection method using target samples. The selection of samples of interest is based on the expertise of the subjects under investigation. Researchers choose the sampling of interest because sampling is limited to a particular type of people who can provide the information needed to achieve the goals of this study (Jamshed, 2014). Thus, a detailed interview was conducted among 10 logistics departments, and the interview took an hour and a half to reach the saturation point. Table 3.1 shows the respondent's background.

No.	Respondent	Station/	Position	Duration of Services
	-	Department		
1	Respondent A	Logistics	Head of Department	8 years
2	Respondent B	Logistics	Logistics Engineer	More than 5 years
3	Respondent C	Logistics	Purchasing	More than a years
4	Respondent D	Logistics	Purchasing	More than a years
5	Respondent E	Logistics	Supervisor	More than 5 years
6	Respondent F	Logistics	Admin Sr	5 years
7	Respondent G	Logistics	Storehand	More than a years
8	Respondent H	Logistics	Storehand	More than a years
9	Respondent I	Logistics	Storehand	More than a years
10	Respondent J	Logistics	Storehand	More than a years

 Table 3.1: Background of the respondents.

The majority of respondents have more than a year of professional experience, which shows that the great experience and data inventory are accurate. The interview protocol used during the interview with the respondents is:



- Issues faced by store workers to find the type of aluminium part number requested.
- What is the inventory data at the warehouse.
- Does new location on rack easy to find aluminium.
- Are there any time savings in finding aluminium items after implementing the new database in access.
- Does the database develop user-friendly and easy to use.

### 4. Result and Analysis

The qualitative data for this study consisted of interviews and this interview session was conducted face to face. To achieve the objective to analyze the efficiency of warehouse operation after implementing the new database, interviews and observations were conducted from the warehouse logistics department, consisting of ten people. Respondents had different opinions on the research questions during the interview. The interview results are obtained for the goals and determine whether the objectives have been achieved.

Question	Interview Question	Respondent A
Q1	Issues faced by storehand to find the aluminium?	The items are hard to find and take some time.
Q2	What is the inventory data?	A complete record of information assets maintained by an organization.
Q3	Does the new location easy to find aluminium items?	Convenient because inventory data is more organized in access and there are locations where the aluminium is stored.
Q4	Are there any time savings in finding aluminium items after implementing the new database?	Yes, because with the new database can know the items for what model and where it is stored on the shelf.
Q5	Is the database in access developed user- friendly?	Yes, because all employees in the logistics department can use it, just open microsoft access and find the desired item.

Table 4.1: Interview	result of respondent A.
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Question	Interview Question	Respondent B
Q1	Issues faced by storehand to find the	The existing goods are scattered and
	aluminium?	disorganized.
Q2	What is the inventory data?	The stock records essential data about an
		information resource such as name,
		address, and email address.
Q3	Does the new location easy to find	Able to know exactly where the aluminium
	aluminium items?	is located.
Q4	Are there any time savings in finding	Yes based on cycle time calculations,
	aluminium items after implementing the new	there are savings in terms of time to find
	database?	items.
Q5	Is the database in access developed user-	Access creates flexible and adaptive
	friendly?	database systems.

## Table 4.2: Interview result of respondent B.

Question	Interview Question	Respondent C
Q1	Issues faced by storehand to find the aluminium?	Aluminium which is a lot of parts no and hard to remember.
Q2	What is the inventory data?	A data inventory is the only reliable source of relevant metadata, including all data sources in the organization, the information collect and where that data is stored.
Q3	Does new location easy to find aluminium items?	Aluminium is more organized and orderly.
Q4	Are there any time savings in finding aluminium items after implementing the new database?	According to the previous data, it takes longer to find the item compared to now.
Q5	Is the database in access developed user- friendly?	Microsoft Access has been around for a long time, so the expertise isn't going away.



Question	Interview Question	Respondent D
Q1	Issues faced by storehand to find the	It is difficult to identify each model used.
	aluminium?	
Q2	What is the inventory data?	The process of receiving, tracking, inspecting,
		and managing inventory stored in a
		warehouse or other storage facility for order
		processing.
Q3	Does the new location easy to find	Items are arranged according to the type of
	aluminium items?	model available.
Q4	Are there any time savings in finding	The new database shows where the
	aluminium items after implementing the	aluminium items are located exactly on the
	new database?	rack.
Q5	Is the database in access developed	Usually included with existing microsoft office
	user-friendly?	license at least for business users.

## Table 4.4: Interview result of respondent D.

### Table 4.5: Interview result of respondent E.

Question	Interview Question	Respondent E
Q1	Issues faced by storehand to find the	Aluminium items mixed with active and
	aluminium?	inactive items.
Q2	What is the inventory data?	Inventory replenishment when the minimum
		quantity is reached. Optimize inventory to
		optimal levels based on historical sales data.
Q3	Does the new location easy to find	Easy because aluminium is separated
	aluminium items?	according to active and inactive models.
Q4	Are there any time savings in finding	With this database access, it is no longer
	aluminium items after implementing the	necessary to find the location where the item
	new database?	is.
Q5	Is the database in access developed	Microsoft Access forms provide a quick and
	user-friendly?	easy way to edit and insert records into your
		database.

Question	Interview Question	Respondent F	
Q1	Issues faced by storehand to find the aluminium?	Models that are no longer active are not isolated aluminium on the shelf.	
Q2	What is the inventory data?	The focus is on managing incoming and outgoing products and knowing where the individual parts are.	
Q3	Does the new location easy to find aluminium items?	The new location is more spacious and all aluminium is placed on shelves.	



Q4	Are there any time savings in finding aluminium items after implementing the new database?	Time can be saved because employees can find out where the goods are stored.
Q5	Is the database in access developed user- friendly?	Yes because employees only need to learn the basics to use it.

	Table 4.7: Interview result of respondent G.				
Question	Interview Question	Respondent G			
Q1	Issues faced by storehand to find the	Not knowing where the aluminium is			
	aluminium?	located exactly.			
Q2	What is the inventory data?	Controlling inventory inflows and outflows,			
		and maintaining and controlling this			
		inventory.			
Q3	Does the new location easy to find	Yes because it has been segregated			
	aluminium items?	according to the car models.			
Q4	Are there any time savings in finding	Storehand no longer needs to find the			
	aluminium items after implementing the new	location of the item because the inventory			
	database?	access is already displayed.			
Q5	Is the database in access developed user-	It is easy to learn how to use and			
	friendly?	understand.			

#### Table 4.7: Interview result of respondent G.

## Table 4.8: Interview result of respondent H.

Question	Interview Question	Respondent H	
Q1	Issues faced by storehand to find the aluminium?	Lack of space to place aluminium on shelves.	
Q2 What is the inventory data?		A comprehensive catalogue of your organization's data assets.	
Q3	Does the new location easy to find aluminium items?	Yes, it's nice to count the stock at the end of each month.	
Q4 Are there any time savings in finding aluminium items after implementing the new database?		Yes, there are savings in terms of time to find the item on the shelf.	
Q5	Is the database in access developed user- friendly?	Simple for workers to use it.	



Question	Interview Question	Respondent I		
		Storage space is rather narrow and unsystematic.		
Q2	What is the inventory data?	A well-maintained data warehouse includes up-to-date and detailed information about the data and data sources within the organization.		
Q3	Does the new location easy to find aluminium items?	Yes because it has been rearranged according to the model that is still running.		
Q4 Are there any time savings in finding aluminium items after implementing the new database?		Yes according to previous calculations the employee only uses memory to find the item where it is stored.		
Q5	Is the database in access developed user- friendly?	The user interfaces in access are also nice and simple.		

#### Table 4.9: Interview result from respondent I.

Question	Interview Question	Respondent J
Q1	Issues faced by storehand to find the aluminium?	Items that are no longer used are not segregated.
Q2	What is the inventory data?	Known as authority records, identify personal data in the system and help map how the data is stored and shared (data mapping).
Q3	Does the new location easy to find aluminium items?	Yes because the item can be searched more accurately and quickly.
Q4	Are there any time savings in finding aluminium items after implementing the new database?	For new employees, just write part no and display the location on the pc and then go on the shelf.
Q5	Is the database in access developed user- friendly?	Best user experience and usability.

#### 5. Conclusions

The main objective of the study is to analyse the efficiency of warehouse operation after implementing the new database. From the results of the analysis of the interview data, it seems that responses from 10 respondents consist of one head of department, one



logistics engineer, two purchasing, one Admin, one supervisor, and four storehand. Interview sessions were conducted face to face. The data needed for research has been collected, analysed, and interpreted during the interview session and linked to the previous study that eventually being used to reveal the findings of this research, hence, could help the researcher to connect its results with the objectives of the research. Overall, from the results of the interviews, it can be concluded that the new database can increase the efficiency in the warehouse by reducing the search time of items and the database is easy to use.

#### 6. References

- Agarwal, P., Prerna Sharma, A., & Singh, S. (2009). Design and Development of an Online Voting System. *Proceedings of International Conference on Information Processing (ICIP)*, 2(8), 524–529.
- Jamshed, S. (2014). Qualitative research method-interviewing and observation. *Journal* of *Basic and Clinical Pharmacy*, *5*(4), 87. https://doi.org/10.4103/0976-0105.141942
- King, M. A. (2009). A Realistic Data Warehouse Project: An Integration of Microsoft Access ® and Microsoft Excel ® Advanced Features and Skills. In *Journal of Information Technology Education* (Vol. 8). www.lowes.com
- Ose, S. O. (2016). Using Excel and Word to Structure Qualitative Data. *Journal of Applied Social Science*, *10*(2), 147–162. https://doi.org/10.1177/1936724416664948
- Pane, S. F., Awangga, R. M., & Azhari, B. R. (2018). Qualitative evaluation of RFID implementation on warehouse management system. *Telkomnika* (*Telecommunication Computing Electronics and Control*), 16(3), 1303–1308. https://doi.org/10.12928/TELKOMNIKA.v16i3.8400
- Rashid,T.(2016).KIMBUGWEJAMES.https://ir.kiu.ac.ug/bitstream/20.500.12306/2297/1/DESIGNANDIMPLEMENTATIONOFANAUTOMATEDINVENTORYMANAGEMENTSYSTEM.pdfSYSTEM.pdfSYSTEM.pdfSYSTEM.pdfSYSTEM.pdf

Reima, E., Krishnan, K., & Wahab, S. N. (n.d.). A Qualitative Case Study on the Adoption



of Smart Warehouse Approaches in Malaysia. https://doi.org/10.1051/e3sconf/2019136010

Software, O. (2015). USING MICROSOFT ACCESS FOR GREATER EFFICIENCY.

- Zhao, Z., Fang, J., Huang, G. Q., & Zhang, M. (2016). IBeacon enabled indoor positioning for warehouse management. 2016 4th International Symposium on Computational and Business Intelligence, ISCBI 2016, 21–26. https://doi.org/10.1109/ISCBI.2016.7743254
- Zou, H. (2007). Build an Inventory Tracking System. *Build an Inventory Tracking System*. http://oatd.org/oatd/record?record=%22oai:DiVA.org:vxu-1580%22



## VIRTUAL REALITY EXPERIENCE: INTENTION TO USE DURING PANDEMIC COVID – 19 AT MELAKA MUSEUM

Nur Fathiyah Binti Aziz<sup>1</sup>and Siti Nurhafizah Binti Ahmad<sup>2</sup>

Department of Tourism And Hospitality, Politeknik Ibrahim Sultan, Pasir Gudang,Johor nurfathiyahaziz@gmail.com sitinurhafizahahmad@graduate.utm.my

#### Abstract

The covid -19 outbreak has caused the most impact in the tourism industry in the first half of 2020, and the situation will not be the same as post pandemic. This research aims to better understand how the VR experience may influence travel decision making by investigating spatial presence in VR experience and its intention to use at Melaka Museum during pandemic covid 19. The analysis revealed that users' attention allocation to VR environments contributed significantly to spatial presence. It was also found that spatial presence positively affects post VR attitude change toward tourism destinations, indicating the persuasiveness of VR. A total of 154 respondent already had experience using VR in the Melaka Museum, and questionnaires were distributed to measure tourists' perception of the experience. This study revealed that tend to concentrate on either the technical aspects of virtual reality (VR) development, such as issues of imaging, digitalization, and users' acceptance by using VR at Melaka Museum. The results demonstrated perceived enjoyment had significant positive impact on immersion. In addition, both flow status and subjective well-being had significantly positive influence on user intention. Overall, the findings showed that certain aspects of users technology acceptance models are still applicable and useful in explaining adoption intentions today, while others are not.

Keywords: Virtual Reality, Intention to use, VR Experience, Tourist's Perception.

#### 1. Introduction

Generally, Tourism has long been known for its high level of innovation (Hjalager, 2018), with the industry evolving in a variety of ways because of the direct and long-term effects of the development and advancement of information and communication



technologies (ICTs) (Buhalis, 2019). As such, study on intention to use with VR experience has been a central focus of tourism researchers as determines the potential of the VR, and further ensures the successful introduction and implementation of the VR. Although virtual reality has proved its capabilities and potential as a marketing tool, more theoretical research on VR consumer behaviour is needed to determine which elements attract potential tourists to visit areas depicted in VR.

Additionally, Virtual tourism is becoming more popular around the world, and it isn't just a reaction to the COVID pandemic, it has been developing quietly for some years. Virtual tourism, also known as virtual reality tourism, has grown in popularity among tourist industry stakeholders in recent years. It was once primarily utilised as a marketing tool. We now witness virtual tourism activities in many sections of the travel and tourist business, fuelled by technical advancements and Internet usage around the world and strongly tied to the concept of smart tourism. However, due to the experience at museum in melaka took an initiative by using advances in digital technology, such as virtual reality (VR) as one of the beneficial digitization to help facilitate consumer learning of products and get memory of experience and behavioural responses. Importantly, an immersive VR Experience allows users to perceive a sense of being in the virtual environment. The perception of presence which is key to the effectiveness of persuasive VR content.

However, the significant of study about intention to use with virtual reality experience at museum Melaka is a method of advertising and providing travel experiences using digital virtual reality instruments. Through the notion of tourism, a virtual reality marketing can be built by exhibiting movies guided by tourism guides. VR is frequently defined as a technology that uses a computer-generated virtual environment. Navigation through this virtual environment and interaction with it frequently results in the real-time reproduction of one or more of the user's five senses. However, Virtual reality is anticipated to help museum branding efforts in Melaka as well as serve as a digital "museum" that can be archived on the website platform and directly integrated as promotional activities for the creative industry sector that is impacted, such as historical, performing arts, and crafts. It is anticipated that this platform will serve as a model for all of Malaysia's creative in tourism industry initiatives.

Lastly, the finding of this studies tend to overemphasise these advantages, overlooking the challenges created by the adoption of VR in the museum environment. Although the analysis of VR's advantages is undoubtedly useful for exploring new opportunities, the other studies have a potential to emphasise these advantages (Marques, D, Costello, & R, 2018). In addition, the majority of studies tend to concentrate on either the technical aspects of virtual reality (VR) development, such as issues of imaging, digitalization, and users' acceptance by using VR at Melaka Museum (Li, et al., 2012). The museum Melaka organization has taken an appropriate action by using VR to reduce the issue of evaluation of the visitors' experiences and perspectives on projects (Jarrier, E., Bourgeon-Renault, & D., 2012). This study to aim the relationship between performance expectancy, effort expectancy, social influence, playfulness expectancy and content relevance expentancy toward intention to use.

#### 2. Literature Review



#### 2.1 Virtual Reality

Virtual reality (VR) experience is a type of virtual technology-based customer learning process for products. Consumer learning is a process in which a consumer's behaviour changes because of information processing. Previous research has stressed the need of delivering "knowledge" for consumers to improve their learning, eliminate uncertainty, and motivate them by generating an engaging relationship with products (Kempf & Smith, 2018) (Kim & Biocca, 2017) (Li, Daugherty, & Biocca, 2015). However, Virtual experience necessitates that consumer learn about items using a virtual interface, and it allows users to experience a product authentically by addressing difficulties stemming from the lack of physical interaction (Suh & Lee, 2015). As a result, a virtual reality experience is defined as a consumer learning process that uses a simulated interface to convey tangible or intangible objects without requiring physical interaction. With the introduction of virtual tourism, the distance between direct and indirect experiences is narrowing.

#### 2.2 Intention to use

The term "intention to use" refers to the likelihood that buyers would enjoy utilising VR in the style of "corporeal tourism." Regarding the adoption of virtual reality experiences that are related to tourism, attitude has been shown to have a substantial influence on intention. However, it is questionable whether the optimistic outlook will change into the preferred intention to the VR tourism mode; hence, physical travel may become the ideal alternative. The way one feels about a certain method of transportation has a significant impact on one's decision-making process. If a customer's expectations regarding the utility of a particular service are not met, this could result in the consumer developing a bad attitude toward the service, which would ultimately lead to the customer no longer using the relevant technology or service.

#### 2.3 The Unified Theory of Acceptance and Use of Technology (UTAUT)

Significant interest in the adoption of new technologies and software in the field of computer science has greatly expanded as a result of the rapid development of new technologies and software in this field. The field of information technology, which currently houses one of the most extensive research bodies on the adoption and utilisation of emerging technologies, makes use of a variety of models. These models come in a variety of forms. Venkatesh et al. (Venkatesh, et al., 2003) combined eight of the most influential models of individual acceptance into a single all-encompassing model in the year 2003. This model was referred to as The Unified Theory of Acceptance and Use of Technology (UTAUT). The model postulates two direct determinants of use: "behaviour intention" and "use behaviour." Both of these are considered to be direct drivers of use. In turn, "performance expectancy," "effort expectancy," and "social influence" all have an impact on "intention to use."



#### 3. Methodology

This study was conducted to identify the level of intention to use with the experience of virtual reality at the Melaka Museum during pandemic Covid-19. This study was measured using a self -administered quantitative questionnaire. Questionnaires were created using an adaptive approach that included specific adjustments from old questionnaires to new questionnaires to collect data on demographics, performance expectancy, effort expectancy, social expectancy, playfulness expectancy, content relevance expectancy and intention to use. The questionnaire will be distributed through the online survey platform https://forms.gle/VPGsXQ8Vi7rwZQco7, the questionnaire will be distributed using the URL to the respondents.

Based on the Figure 3 show research flow that researcher will be followed to collect the data to get the tourist experience toward intention to use related to Unified Theory of Acceptance and Use of Technology (UTAUT). the questionnaire of Section A will ask six demographic questions, including gender, age, race, marital status, education level, and how many time respondent experience using virtual reality at museum Melaka. Section B has five questions that cover the major topics: the purpose of this section is to obtain information about respondents' travel experiences. In a conceptual framework centred in the dependent variables, respondents were asked specific questions on five main points independent variables (performance expectancy, effort expectancy, social expectancy, playfulness expectancy, content relevance expectancy) and the last one is Section C the question based on dependent variables (intention to use). The measure is built on a 5-point Likert Scale, ranging from "strongly disagree" to "strongly agree". The subjects were then asked to rate with the assertions in the instrument.

#### 4. Finding and Discussion

This chapter mainly presents the results in investigating the relationship between User's Acceptance of VR Technological Application (performance expectancy, effort expectancy, social expectancy, playfulness expectancy, content relevance expectancy) and intention to use at selected museum in Melaka. This chapter is a relevant discussion to support the results achieved. This chapter consists of several sections beginning with the introduction and response rate of the survey. Then, it presents the findings to answer all respective research questions, discussion of the research findings and a summary of the findings.

Table 3 Research Flow





From the overall of 154 questionnaires were returned, representing 81% of response rate which been consider as appropriate since the minimum response rate for online surveys is around 32.6% (Watt et al. 2002; Nulty, 2008). From the figure, six questionnaires were excluded because they were not included in the criteria of respondents, namely respondents with no experience with VR in Museum Melaka. Therefore, for the online questionnaire, a total of 154 questionnaires were retrieved. From the figure, no missing data were detected. As a result, the total of usable questionnaire for this study is 154. Table 4.1 shows the summary of distributed and returned questionnaires: -

Response to the Questionnaire	Incomplete and Excluded (online)	Total Usable Questionnaire
182	28	154
Grand	154	

#### Table 4 Total of Respondents (n = 154)

#### 4.1 Demographic

The first segment of the questionnaires created in this study is demographic profiles of the respondents. In this section, the respondents were asked about their gender, race, age, marital status, education level, and the duration of the customer experience using virtual reality at the Melaka Museum. Besides, knowing that the respondents are customers used the products or services of virtual reality, the questions created to identify and determined who the respondents are. It is also to measure the possible effects of demographics profile on the studied variables.

#### Table 4.1

Demographic Variable	Category	Ν	%
Gender	Male	52	33.8
	Female	102	66.2
	Total	154	100
Race	Malay	107	69.5
	Chinese	25	16.2
	Indian	21	13.6
	Others	1	0.6
	Total	154	100

Profile of Respondents (n = 154)



Age	Less than 18 years old	1	0.6
	18 – 25 years old	55	35.7
	26 – 35 years old	86	55.8
	36 – 45 years old	31	20.1
	46 – 55 years old	10	6.5
	56 years old and above	2	1.3
	Total	154	100
Marital Status	Single	95	38.3
	Married	59	61.7
	Total	154	100
Education Level	Diploma	50	32.5
	Bachelor's Degree	54	34.4
	Master's Degree	35	22.7
	Doctoral Degree	8	5.2
	Others	8	5.2
	Total	154	100
How many times have	Less than 2 months	24	15.6
you had experience using virtual reality in Melaka	2-12 months	57	37.0
Museum?	1-4 years	54	35.1
	More than 4 years	19	12.3
	Total	154	100

#### Discussion

This section highlighted the conclusion based on the findings about the demographic profile of the respondents. The respondents were asked about their gender, race, age, marital status, education level, preference get experience by using virtual reality at Melaka Museum to provide a good picture of the background of respondents. Therefore, it can be concluded that for gender, the number of female respondents is slightly higher compared to the male. Most of the respondents are Malays aged between 26 - 35 years old and married. Most of the respondents have an education in bachelor's degree level



and most respondent got experience 2 – 12 months ago as using the virtual reality at Melaka Museum.

#### 4.2 Reliability Analyses

The reliability analysis was conducted by computing the Cronbach's alpha for each measure. The analysis indicates the stability and consistency of the instrument measure a concept and helps to assess the goodness of a measure (Sekaran and Bougie, 2010). The Cronbach Alphas for each dimensions of performance expectancy, effort expectancy, social expectancy, playfulness expectancy and content relevance expectancy are 0.870, 0.862, 0.868, 0.886 and 0.880 respectively. The Cronbach Alphas for each dimension of Intention to use in the range of 0.857 respectively. The findings indicates that the measures have high internal consistency. This is also supported by Sekaran and Bougie (2010) who stated that the reliability coefficient closer Cronbach's alpha is to 1, the higher the internal consistency reliability. Therefore, the measure needs in this study is reliable and valid. Table 4.2 shows the Cronbach's alpha scores for performance expectancy, effort expectancy, social influence, playfulness expectancy, content relevance expectancy and intention to use.

Section Scales		No. of Scale Items	Reliability Coefficient (Alpha)
			(n = 154)
В	Performance Expectancy	6	.870
Effort Expectancy		5	.862
	Social Influence		.868
	Playfulness Expectancy	6	.886
	Content Relevance Expectancy	5	.880
C Intention To Use		3	.857

**Table 4.2***Cronbach's alpha scores for the brand equity and customer loyalty (n = 154)* 

#### 4.3 Hypotheses Testing

The hypothesis testing is to examine the influence of the independent variables, which consist of performance expectancy, effort expectancy, social expectancy, playfulness expectancy and content relevance expectancy. Under this part of analysis, the hypotheses 1 through 6 were tested. The standard approach was chosen on multiple –



regression analysis because the research objectives are to identify whether all the IVs sections have relationship with each intention to use dimension. The main purpose is to understand how the combination of independent variables would influence the dependent variable.

The Influence of the Independent Variables on the Dependent Variables

# **Table 4.3** Hypotheses testing of the influence of the independent variables on the dependent variables

Item	Hypothesis
H1	Significantly relationship between performance expectancy towards intention to use
	at Melaka Museum.
H2	Significantly relationship between effort expectancy towards intention to use at
	Melaka Museum.
H3	Significantly relationship between social influence towards intention to use at
	Melaka Museum.
H4	Significantly relationship between playfulness expectancy towards intention to use
	at Melaka Museum.
H5	Significantly relationship content relevance expectancy towards intention to use at
	Melaka Museum.

#### **Results Based on Research Questions and Hypotheses**

This section focuses on the conclusion based on the analysis of findings in order to answer Research Question Two.

#### **Research Question Two**

What is the relationship between users' acceptance of VR Technological Application (performance expectancy, effort expectancy, social influence, playfulness expectancy, content relevance expectancy) towards intention to use in Melaka Museum?



 Table 4.4 (a) Model Summary between users' acceptance of VR Technological

 Application and intention to use

			Adjusted R	Std. Error of the
Model	R	R Square	Square	Estimate
1	.713 <sup>a</sup>	.508	.491	.42948

The multiple regression result Table 4.4 (a) indicates that a strong relationship exists as hypothesized between users' acceptance of VR Technological Application (performance expectancy, effort expectancy, social influence, playfulness expectancy, content relevance expectancy) and intention to use. This model has a good fit and has moderately high values of R (0.713) and R<sup>2</sup> (0.508). The value of R<sup>2</sup> represents the proportion of variation in the dependent variable which accounted for by the independent variables in the regression model. Meanwhile, R value indicates strong association between the independent and dependents variable. The model 1<sup>st</sup> model suggested that the predictors (performance expectancy, effort expectancy, social influence, playfulness expectancy, content relevance expectancy) can explain about 26.8% of the variance in the dependent variable.

Model	Unstandardized Coefficients		Standardized Coefficients		
Model	В	Std. Error	Beta	т	Sig.
(Constant)	.666	.315		2.116	.036
Performance Expectancy	.224	.109	.198	2.060	.041
Effort Expectancy	.152	.080	.150	1.883	.062
Social Influence	.358	.089	.345	4.009	<.001
Playfulness Expectancy	.150	.085	.146	1.763	.080
Content Relevance Expectancy	002	.088	002	021	.984

 
 Table 4.5 (b) Coefficients<sup>a</sup> between users' acceptance of VR Technological Application and intention to use.

The significance of beta coefficients provides support for the alternate hypotheses in the regression model. The values of standardized beta coefficients of provide some indication on to their comparative influences on the overall intentions. The result table 4.10 (a) indicates that, users' acceptance of VR Technological Application and intention to use (p < 0.05), therefore, H5 was accepted. While performance expectancy, effort



expectancy, social influence, playfulness expectancy and content relevance expectancy are significant impact on the Intention to use (p < 0.05).

#### Discussion

The result based on the correlational data analysis support the Research Question One whereby there was a positive and significant relationship between users' acceptance of VR Technological Application and Intention to use at Melaka Museum. All the elements of performance expectancy, effort expectancy, social influence, playfulness expectancy and content relevance expectancy significantly correlate with Intention to use. This result is supported by Lin and Chang (2003) in their research performance expectancy that dimension plays the important role in customer's experience using VR. In addition, this finding is also consistent with Mellends et al. (1996) who asserted that user's acceptance is the performance expectancy in terms of the consumer experience. Referring the concept of experience, it can be seen, behaviour intention also plays the important role in increasing users' acceptance of VR technologies. Social influence is subjected to change over a period includes several adjustment and changes that do not influence customer to be committed to their expectation.

For purpose of this study, the analysis was continued using the multiple regressions analysis to explore which elements in users' acceptance of VR Technologies Application and Intention to use at Melaka Museum. All the elements of performance expectancy, effort expectancy, social influence, playfulness expectancy and content relevance expectancy are the significant predictor to behavioural loyalty to answer to the developed hypotheses. Therefore, the results based on multiple regressions analysis supported the hypothesis developed hypotheses whereby users' acceptance of VR technologies application as overall significantly influence intention to use VR experience at Melaka Museum. s. Consequently, a deeper understanding of consumers' content quality expectations regarding sufficiency, timeliness and relevance is required.

Nowadays, since performance and effort expectancy are two of the most important influencing elements, it was vital to understand their antecedents. Flow and content quality affect consumers' inclination to use VR indirectly, possibly through performance and effort expectancy. Both concept flow and content quality positively affected performance expectations, while only flow affected effort expectations. This suggests that future VR adoption will be heavily affected by flow experience and content quality, which will be adapted to consumer needs.

However, Desire is an inner impulsion for a goal or purpose that drives conduct. Travel attitudes affect tourist mode choice via desire, according to. Earlier studies tested the strong link between desire and performance expectancy, in terms of technologybased products or services. Desire precedes intention in psychological decision-making; therefore, the difference is important. Intention requires self-efficacy, dedication, and forethought; want does not. Tourism is a high-end commodity that meets non-material cultural requirements. Multiple factors interfere with desire and intention, leading to varied



tourism intentions. Intention might be affected by perceived behavioural control or VR equipment restrictions. Desire-driven travellers will use VR tourism if conditions are right. Most people have feelings and attachments to tourism destinations, and they can get the fun and enjoyment that virtual tourism cannot through corporeal tourism, such as intimate interaction with friends, contact with natural landscape, and experience of food, culture, and other entertainment projects. VR tourism will encourage in-person travel.

The correlation summary for users' acceptance of VR technologies application (performance expectancy, effort expectancy, social influence, playfulness expectancy and content relevance expectancy) and intention to use is shown in Table 4.6 (a) as well as the multiple regressions summary users' acceptance of VR technologies application (performance expectancy, effort expectancy, social influence, playfulness expectancy and content relevance expectancy) and intention to use is presented in Table 4.7 (b).

**Table 4.6 (a)** Summary of correlation for users' acceptance of VR Technological Application and intention to use. (n = 154)

Relationship	Pearson Correlation	Sig. (1-tailed)
Performance Expectancy	.612	.041
Effort Expectancy	.550	.062
Social Influence	.651	<.001
Playfulness expectancy	.555	.080
Content Relevant expectancy	.519	.984

\*\*. Correlation is significant at the 0.01 level (1-tailed)

**Table 4.7 (b)** Summary of multiple regressions of users' acceptance of VR Technological Application and intention to use. (n = 154)

Model	Standardized Coefficient (Beta)	t	Sig.
Performance Expectancy	.198	2.060	.041
Effort Expectancy	.150	1.883	.062
Social Influence	.345	4.009	<.001
Playfulness expectancy	.146	1.763	.080
Content Relevant expectancy	002	021	.984



Item	Hypothesis	Results
H1	Significantly relationship between performance expectancy towards	Supported
	intention to use at Melaka Museum.	(p < 0.05)
H2	Significantly relationship between effort expectancy towards intention to	Supported
	use at Melaka Museum.	(p < 0.05)
H3	Significantly relationship between social influence towards intention to	Supported
	use at Melaka Museum.	(p < 0.05)
H4	Significantly relationship between playfulness expectancy towards	Supported
	intention to use at Melaka Museum.	(p < 0.05)
H5	Significantly relationship content relevance expectancy towards	Supported
	intention to use at Melaka Museum.	(p < 0.05)

#### Table 4.8 Hypothesis Testing Summary

#### 4. Conclusions

When particularly in comparison to print ads and TV commercials, VR apps are better at making people feel and react emotionally. Researchers think that there is a strong sense of presence, which is different from traditional forms of advertising. This is why most people think that VR has a lot of potential in the tourism industry. So, with the deep global recession and the threat of new waves of the pandemic, the tourism industry is trying to rebuild all over the world, and VR could be the key to building a new travel and tourism industry. From a theoretical point of view, this research adds to the literature by looking at how users accept VR applications (social influence, effort expectation, performance expectation, playfulness expectation, and content relevance expectation) and how tourists plan to use them. This could also be useful for museums, since VR experiences for tourists will become more and more common in the future, especially on big travel sites. Based on what we found, the future intention to use VR technology to choose a tourist destination is based on trust and the optimization of a positive experience, especially in the context of the COVID-19 pandemic. Instead of seeing a screen with the potential tourist destination or possible tourist routes, the tourist is introduced to virtual worlds where they can communicate, interact, or explore to figure out if it is worth buying the real trip or not.

The results also show that VR experiences are becoming more important in the decisionmaking process for using virtual reality in destination marketing. The soon-to-bediscovered intuitive operating methods that get rid of user interfaces and look for ways for humans and machines to communicate through gestures, looks, and voices could be a sign that VR will be able to take over in the future. In the short term, VR technology could also be used by tourists who use their phones or tablets as VR screens. But the ease of getting there and the way things are set up become very important factors in a tourist's decision.However, that is important to remember that tourism providers and experts would benefit from a lot of research. They should try to come up with specific marketing plans that include VR technology. Also, this study gives tourist destinations a



place to start making decisions in an area where there is a lot of uncertainty. In the broadest sense, these are topics that are only talked about from a virtual point of view. They include virtual travel ideas and searching for travel information.

#### References

- Bardi, J. (2020). What is Virtual Reality? *https://www.marxentlabs.com/what-is-virtual-reality*.
- Buhalis, D. &. (2019). Progress in information technology and tourism management: 20 years on and 10years after the Internet-The state of eTourism research. *Tourism Management*, 29(4), 609–623.
- Burdea, G., & Coiffet, P. (2017). Virtual Reality Technology; Wiley: Hoboken, NJ, USA,.
- Farah, M., Ramadan, Z., & Harb, D. (2019). The examination of virtual reality at the intersection of consumer experience, shopping journey and physical retailing. *J. Retail. Consum. Serv.*, 48, 136–143.
- Hjalager, A. M. (2018). A review of innovation research in tourism. *Tourism Management*, 31(1), 1–12.
- Jarrier, E., Bourgeon-Renault, & D. (2012). Impact of mediation devices on the museum visit experience and on visitors'behavioural intentions. *Int. J. Arts Manag.*, 18–29.
- Kempf, D., & Smith, R. (2018). Consumer processing of product trial and the influence of prior advertising: A structural modeling approach. *J. Mark. Research*, 35, 325–338.
- Kim, T., & Biocca, F. (2017). Telepresence via television: Two dimensions of telepresence may have different connections to memory and persuasion. J. Comput. Mediat. Communication, 3, JCMC325.
- Li, H., Daugherty, T., & Biocca, F. (2015). The role of virtual experience in consumer learning. *The role of virtual experience in consumer learning.*, 13, 395–407.
- Li, M., & Mao, J. (2015). Hedonic or utilitarian? exploring the impact of communication style alignment on user's perception of virtual health advisory services. *Int. J. Inf. Management*, 35, 229–243.



- Li, Y., Liew, A., Su, & W. (2012). The digital museum: Challenges and solution. *In Proceedings of the 8th InternationalConference on Information Science and Digital Content Technology*, 646–649.
- Marques, D, Costello, & R. (2018). Concerns and Challenges Developing Mobile Augmented Reality Experiences forMuseum Exhibitions. *Curator*, 541–558.
- Suh, K., & Lee, Y. (2015). The effects of virtual reality on consumer learning: An empirical investigation. *MIS Q.*, 29, 673–697.
- Venkatesh, V., Morris, G., M., Davis, B., G., & D., & D. (2003). User acceptance of information technology: Toward a unified view. . *MIS Quarterly*, 425-478.
- Williams, P., & Hobson, J. (2015). Virtual reality and tourism: Fact or fantasy? *Tour. Management*, 16, 423–427.



# LEISURE TOURISM WEBSITE DEVELOPMENT AS PROMOTIONAL TOOL IN DIGITAL MEDIA

Saiyidah Nafisah Saifulhazmi<sup>1</sup>, Nadirah Abd. Aziz<sup>2</sup> and Khatijah Md Saad<sup>3</sup>

<sup>1</sup> Department of Design and Visual Communication, Politeknik Ibrahim Sultan,

Pasir Gudang, Johor ssnafisahs@gmail.com irah.aziz@gmail.com khatijahsaad@pis.edu.my

#### Abstract

Through websites, social media platforms, and other interactive channels, tourism businesses are increasingly engaging with the dynamics of new digital technologies. Developing a website upon the progression of a destination can be made these days therefore the aim of the study is to develop a website for Kong Kong Chalet Terapung as an informative platform to expose activities, services, and 360 Virtual Tour in leisure tourism. The data collected are both from qualitative and quantitative methods related to websites and tourism within the field of study. Findings show the mean of User Experience (4.7), User Interface (4.5) and Content (4.7) is high indicating the website had given a positive impact on the user of Kong Kong Chalet Terapung's website. In conclusion, the application of a website inside the tourism industry can help unveil a rural tourism destination such as Kong Kong Chalet Terapung.

Keywords: Website, Leisure Tourism, Promoting, Digital Media.

#### 1. Introduction

The business in tourism industries are in need of Social Media, Websites, and various engaging platforms as it is receiving new digital technology developments (Camilleri, 2017). The gem of social promotion and environment responsibility known as corporate communication in this sector is always been voiced out by the public for content marketing. Delivering messages in social media platforms through cultural behaviour can attract viewers to participate in the trend of a destination (Caprioli, 2021). The owner of Kong Kong Chalet Terapung shared that there are customers from Malaysia and Singapore that usually comes often to stay at the chalet. The activities and accommodation are open to any visitors who wants to come and experience being on a



floating chalet. Besides that, he informed us his concern on the booking system that they do not have. He stated that it would be better if there is a system that they can manage on their own to attract customers.

Therefore, this study aims to develop a website for the promotion of Kong Kong Chalet Terapung for their benefits. Data that had been accumulated can be used as content to be put inside the website. The website will be used as a landing page for future guest to come and visit. This will create both tangible and intangible items to increase the promotion of Kong Kong Chalet Terapung. Destination branding plays an important role in this process to keep the product original, text and visual related to the environment of the destination (Laura, 2021).

#### 2. Literature Review

#### 2.1 Leisure Tourism

Based on a literature review done by Qiao (2021), the existence of leisure is not limited to only one definition as it evolves when relates to a few topics such as historical events, background in culture and social events. In tourism, leisure is defined as a moment of relaxation and escaping reality to recharge mental and physical needs (TravelPerk, 2021).

#### 2.2 Digital Media

The era of technology is growing fast with the addition of new media as a way of promoting and marketing resources like products and services. Having an established Brand Identity or image is an important asset to an organisation as it contributes to create awareness of a tourism destination's existence (Pike et. al.,2018). Thus, helps the tourists to recognize the positive potential of a destination hence trust their credibility in management and activity. Departments such as marketing and managing are mostly responsible on emphasizing the cleanliness of tourism attraction when promoting a destination (Liew, 2021). In conjunction of an effective marketing it must include notable aspects such as the booking methods that can be digitalised to enhance the capability in organising a transaction and reservation in large volume (Lee B.C, 2014).

#### 2.3 Role of Website in Promoting Tourism

The bloom of digital marketing, online or electronic channels have been mostly employed to communicate with customers, the touch points were changing from brick and mortar to online, offline and omni channels. The digital marketing has recently been widely adopted and used to promote both B2C and B2B products and services including tourism and hospitality industry (Draganov et al., 2018; Ktler et al., 2017; Miller & Que,2012;



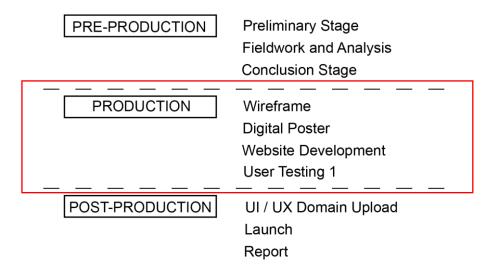
Mkwizu,2020). Marketers need to build awareness so that the customer know about their products and services, then put effort to appeal or attract their target customers so they like the product and services. Therefore, website build must play a role in promoting tourism not just for building awareness, yet for closing sales i.e., reservation and payment too.

User experience or known widely as UX is the experience a person will go through when using a product (Wiryaman, 2011). The evaluations that are in UX is the navigation that refers to the clarity of a website page functions. A Thai study shows websites was a great channel to retrieve the information, however the design to support multiple types of devices i.e responsive web design was recommended (Suthasinee, 2021). Suthasinee (2021) said that a user experience honeycomb can be used to finish the design. Useful, Desirable, Accessible, Credible, Findable, Usable, and Valuable are the seven components that make up the honeycomb. Useful indicates that the design should deliver higher benefits to the users than the present ones. Desirable design is one that the user wants both functionally and emotionally. Accessible means that the goods should be able to reach and serve everyone who is the target user, not just a certain group of personas, and that they should adhere to all applicable accessibility rules and regulations. Credible, the product should be able to establish trustworthiness, and it should be viable and longlasting. Findable, the design with finable should provide consumers the freedom to find what they're looking for quickly and easily. Usable: The design should include all of the usability factors described above so that target people can utilise it efficiently. Finally, the design should offer its value proposition to the consumers, and the users should be able to achieve their goals through the usage of the goods (Suthasinee, 2021).

Based on Adam Dandy (2021), user interface is the design that is implement inside a program such as graphics, readable texts and information. The design of a website should enable the user to see where they are in the internet by organizing buttons that are important in the navigation panel. In relation to the buttons, layout of the web page must be arranged as simple as possible according to the quantity of information offered. Creating white space supported by minimal multimedia elements to prevent the page to load slowly. Next, the usage of colour combination and background patterns that is available inside the web page must be suitable to the eye of the viewer.



#### 3.0 Research Methodology



## Figure 1 Research Design

In Figure 1, the research approach in this study is quantitative. In this paper the researcher focus on the production stage of website development. The production stage will consist of wireframe, digital poster, website development and user testing 1. Based on Figure 2, the user journey is used to determine further sketches, development and final product of the website. Digital poster and website development are executed by research on text readability, colors, copy-writing and multimedia content. Images used are captured by using Sony A7 and GoPro Max 11 (360 Images). User testing 1 is done by online survey via Google Form by using the Likert Scale and Open-ended questions. The questionnaire has four sections (Demographics; User Experience; User Interface; Content). The result is calculated with IBM SPSS Statistic. The last stage of development is post-production which will contain the launching of the prototype website into a chosen domain named Wix.com for its official long-term usage. The total of respondents is 31.



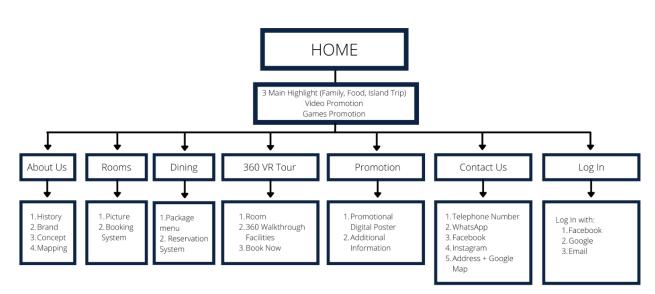


Figure 2 User Journey

Website development was done by using Wix.com and subscription on business plan inside the domain (Image 2). This gave freedom in creating own template that suites the requirement of Kong Kong Chalet Terapung and its content. Booking and VR Tour widgets was used to support the website needs. Pictures are taken from the destination and information were required from pre-production. Contents are improvised from time to time with supervision.



Image 1: Wix Website Development



#### 4.0 Findings and Discussions

#### 4.1 Website Development



Image 2 Homepage Kong Kong Chalet Terapung

Image 1 shows the homepage of the research completed website of Kong Kong Chalet Terapung. The domain chosen was www.kongkongchaletterapung.com for people to find in the search engine. Inside the website contains Homepage, About Us, Rooms, Dining, VR Tour, Promotion and Contact Us page. Homepage focuses on the tagline and featured content and about us contains an overview of Kong Kong Chalet Terapung. Next, Rooms and Dining have booking features of accommodation and food reservations for future guests. VR Tour features 360 Walkthrough of the facilities and a view of Kong Kong Chalet Terapung. The promotion page has posters on the latest ongoing promotional posters. Lastly, contact us contains address, contact info and google map for guests to keep in touch.

#### 4.2 Service and Activities

There are various of services that are offered inside Kong Kong Chalet Terapung such as dining, wedding and family BBQ can be held in Dining Hall 1 and 2, a staycation in VIP Room, Superior Deluxe Room, Standard Room and Economy Room. Next are the activities that can be experienced upon request for instance open and closed karaoke, cruise and fishing boat. There is also a free facility to be used such as a kid's swimming pool.



#### 4.3 Demographics

A survey questionnaire has been distributed online among the targeted audience between the genders in Table 1 which consists of 16 Males (51.6%) and 15 Females (48.4%). Next, the respondent's ages in Table 2 were categorized within the range of 18 - 27 years old and above. Finally, smartphones (83.9%) are used more frequently than laptops or PC (16.1%) and the results are shown in Table 3.

Table 1: Gender			
ltem	Frequency	Percent	
Male	16	51.6	
Female	15	48.4	
Total	31	100.0	

Table 2: Age			
ltem	Frequency	Percent	
18-20	5	16.1	
21-23	22	71.0	
27++	4	12.9	
Total	31	100.0	

#### Table 3: Device used to access website

ltem	Frequency	Percent
Smartphone	26	83.9
Laptop/PC	5	16.1
Total	31	100.0

#### 4.4 User Experience

The satisfaction scale accumulated in user experience is very high according to Moidunny (2009) by 4.58 and above. The questions that are given (Table 4) focuses on user experience such as navigation, buttons, accessibility, responding enquiries that user seek, search engine capability in finding information, the natural and easy to understand of the interaction of 360 Virtual Tour.



Item	Mean	Std. Deviation	N
Navigation of website is clear and easy to use	4.77	.497	31
The Buttons within the website can be interact	4.74	.514	31
The Website is easy to access	4.81	.402	31
The Website responds to enquiries you seek	4.65	.608	31
Search Engine refers to how easy it is to find information	4.58	.848	31
The Interaction of 360 Virtual Tour is natural	4.71	.529	31
The interaction of 360 Virtual Tour is easy to understand	4.74	.514	31

## Table 4: Statisfaction of User Experience

Based on calculated satisfaction scale above, in user experience, easy access to website and clear navigation have the highest satisfaction and should be marked as important when creating a website. The user satisfaction gathered for User Experience is 4.7.

## 4.5 User Interface

The result shown in Table 5 is the summary for the satisfaction scale related to questions asked in the survey. The questions focus on the User Interface within the website like appealing, layout, colours, text, logo and mobile friendly design for the satisfaction of the respondens. The satisfaction level received are very high (Moidunny, 2009),

Item	Mean	Std. Deviation	Ν
The Website looks appealing to me	4.45	.723	31
The Layout for the information is well arranged	4.65	.551	31
The colours that is used compliments the website	4.45	.768	31
The text is readable in terms of size and font	4.65	.608	31
The logo reflects the meaning of the website	4.45	.723	31
Website designed is mobile friendly	4.48	.769	31

## Table 5: Statisfaction of User Interface

Table 5 discuss that the mean of layout information arrangements, text readability in terms of size and font shares the same importance during user testing. The user satisfaction that is accumulated for user interface is 4.5.



## 4.6 Content

The available result are from questions that targeted content such as information, consistency, relevance, up-to-date information, multimedia and personalization of the website. Summary shows the satisfaction of the website's content are very high (Moidunny, 2009).

Item	Mean	Std. Deviation	Ν
The website provides information related to Kong Kong Chalet	4.77	.497	31
Terapung			
The website content has consistency	4.71	.529	31
The website content is relevant to Kong Kong Chalet Terapung	4.77	.425	31
The information is up to date	4.81	.402	31
The multimedia chosen is related to the content	4.77	.425	31
The website personalization is family friendly	4.74	.445	31

## Table 6: Satisfaction of Content

In Table 6, the satisfaction for up-to-date information, related, relevance and multimedia have the highest Mean by 4.81, 4.77, 4.77 and 4.77 respectively. This shows that the points must be taken when implementing information or content related to the destiny inside their website. The satisfaction for content is calculated at 4.7.

## 4.7 Feedback on Website Improvement

In order to gain specific comments on the development of website for future improvements, open ended questions are asked to respondens throughout the process. In Table 7, information are extracted to indicating there are adjustment that can be made in the website.



Table	7:	Feedback Extracted	
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NO.	EXTRACTED INFORMATION
1	Super high-resolution image and video presented
2	Language for 'Pakej Promosi' change to English
3	Size of title must be consistant
4	Include bright colours
5	Dining area layout improvement
6	The colour of website
7	Arrangement of pictures / sizes can be improved
8	Finds website difficult to understand
9	"About us" and "Home" banner are not centred on Mobile.
10	"Homepage" banner image on Mobile not visible.
11	Picture edges blending or frame.
12	Blank space on website (Mobile)
13	State price of packages under "menu"
14	Optimizing design for other platform.

To summarize, respondents have given negative feedback on the website to be improved in terms of image, language, size of the font, colours, layouts, arrangements of content and optimization within different devices.

## 5.0 Conclusions

The main objective of this study is to develop a website for leisure tourism in promoting Kong Kong Chalet Terapung. A literature review has been conducted to find definitions, similar studies and procedures to create a research design. User experience, user interface and content have been a major evaluation points of the study besides focusing on adults and young adults as their target audience. The website that has been created receive both positive and negative impact towards users. The positive impact shows that future guest of Kong Kong Chalet Terapung can use the website to gather information on activities and services that they offer while the negative impact can be used as a mean to improve the website from time to time. Guests would always want to experience the local communities and cultures (Jorgensen,2020) therefore having a website to refer would be a great start on exploring the destination from a far.

## References

Camilleri, M. A. (2017). The Promotion of Responsible Tourism Management Through Digital Media. *Tourism Planning & Development*, *15*(6), 653–671. https://doi.org/10.1080/21568316.2017.1393772



Caprioli, L., Larson, M., Ek, R., & Ooi, C. S. (2021). The inevitability of essentializing culture in destination branding: the cases of *fika* and *hygge*. *Journal of Place Management and Development*, *14*(3), 346–361. https://doi.org/10.1108/jpmd-12-2019-0114

Draganov, M., Panicharova, M., & Madzhirova, N. (2018). Mark eting 5.0. Transactions of Artificial Intelligence Systems in T he Digital Environment 2018 International Conference on Hig h Technology for Sustainable Development (HiTech)

Foo, L. P., Chin, M. Y., Tan, K. L., & Phuah, K. T. (2020). The impact of COVID-19 on tourism industry in Malaysia. *Current Issues in Tourism*, *24*(19), 2735–2739. https://doi.org/10.1080/13683500.2020.1777951

Jørgensen, M. T. (2020). The Attraction of the Mundane – How everyday life contributes to destination attractiveness in the Nordic region. *Tourist Studies*, *20*(4), 467–484. https://doi.org/10.1177/1468797620955251

Mendiola, B. Wiryawan (2011) USER EXPERIENCE (UX) SEBAGAI BAGIAN DARI PEMIKIRAN DESAIN DALAM PENDIDIKAN TINGGI DESAIN KOMUNIKASI VISUAL. Jurnal Humaniora, 02 (02). ISSN 2087-1236

Miller, M., & Que, J. M. (2012). B2B digital marketing: Using the Web to market directly to businesses. Que. Mkwizu, K. H. (2020). Digital marketing and tourism: opportunities for Africa. International Hospitality Review, 34(1), 5-12. ht tps://doi.org/10.1108/IHR-09-2019-0015

Novianto, A. D. P. . (2021). Analisis User Experience Website RSU Pesanggrahan Menggunakan Metode User Centered Design (UCD). *Proceeding KONIK (Konferensi Nasional Ilmu Komputer)*, *5*(1), 14–19.



Sabino, M. (2021, December 9). *Leisure Travel | The TravelPerk Corporate Travel Glossary*. TravelPerk. https://www.travelperk.com/corporate-travel-glossary/leisure-travel/

Susiva, S. (2021). Desirable UX for Promoting Prachinburi Cultural and Local Wisdom Tourism of Thai Tourists. *AU-GSB E-JOURNAL*, *14*(2). https://doi.org/10.14456/augsbejr.2021.24



# SATISFACTION ANALYSIS AT CULTURAL TOURISM DESTINATION

Marion Awing Apung<sup>1</sup> and Dr. Zauyani Zainal Mohamed Alias<sup>2</sup>

Department of Tourism and Hospitality, Politeknik Ibrahim Sultan, Pasir Gudang, Johor marionawing.al@gmail.com zauyani@pis.edu.my

## Abstract

Cultural tourism has topped the preference of the tourists who are constantly looking forward to cultural experiences destination. Sarawak is one of Malaysia most popular cultural tourist destinations, a multiracial and culturally diverse state. Sarawak Cultural Village is one of the most popular tourist destinations. This research aims to evaluate the tourist satisfaction on quality of experience at the cultural village. The main objective is to study the level of satisfaction on facilities that are offered at the cultural village. This research was conducted using quantitative method and questionnaires were distributed to 170 respondents. Data analysis was conducted using Statistical Package for the Social Sciences (SPSS). The result shows that the facilities and services provided should be maintain to enhance the quality of visitors' experiences. The findings of this study should be valuable to the industry and for future researchers.

Keywords: Facilities, Cultural Tourism, Tourist Satisfaction

## 1. Introduction

Tourism is a commonly known as a complicated phenomenon that involves the movement of people between places while industries aim to embrace an enormous number of behaviours, activities, organizations, sectors, or challenges (Baggio, 2019). Over the years, tourism has contributed significantly to the economy, which has profited from it (Carmignani & Moyle, 2019). Cultural tourism is known as the act of leisure travel with the intention of seeing or engaging with a location's unique culture, people, and products or productions. It has been shown that culture has a significant role in luring tourists to a location, underscoring the significance of culture in drawing tourists (Kirom et al., 2018). Satisfaction comes when an event exceed expectations of a tourist meanwhile, dissatisfaction happens when experiences fall short of expectations (Park, Hwang, Lee, & Heo, 2018). The fact that tourist satisfaction is a crucial component in the long-term success of any tourist site considers it one of the most essential criteria in the tourism sector (Gursoy et al, 2003; 2007; Neal & Gursoy, 2008).



Sarawak Cultural Village (SCV) experiencing several issues, namely in renovating and upgrading the existing facilities and premises in the cultural village. This new renovation and refurbishment affect the level of satisfaction and experience of tourists when they visit Sarawak Cultural Village after being out of operation for so long (Sharon, 2021). Ever since the pandemic, reducing and new entry of employees working at the cultural village gave a significant impact on performance in terms of delivering information and services provided to tourist (Zaini, 2021).

The management of the cultural village put a high priority on evaluating tourists' satisfaction with the facilities. (Abi, Mariapan & Aziz, 2015). This research will be used to improve the facilities in cultural villages, which might offer a unique tourism experience. The analysis that is provided in this study will also provide useful results for future studies that analysed tourists' satisfaction and their experiences while they are visiting, and there will soon be improvements that will fulfil tourists' need. This research intends to investigate how satisfied visitors are with the facilities at Sarawak Cultural Village.

## 2. Literature Review

## 2.1 Cultural tourism

The Sarawak Cultural Village (SCV) has traditionally been one of Malaysia's best known cultural tourism destinations. In the state of Sarawak, Sarawak Cultural Village is a well-known location for cultural tourism. Local and foreign visitors are drawn to the cultural village. The cultural village unquestionably portrays Sarawak's diverse ethnic groups and cultural traditions as well as Malaysian culture in general (Abi, Mariapan & Aziz, 2015). The word "cultural tourism" has been difficult to define due to its ambiguous connotation (McKercher et al., 2006). Cultural tourism are referred to as a visit from outside the host community who are inspired entirely or in part by their interest in the historical, artistic, scientific or lifestyle attractions of a place, region, organization or institution. Cultural tourism, which was long considered to be a niche sector, has evolved into a standard building component for modern tourism and has become a major motivator for many tourists. Millions of visitors visit cultural sites and locations each year because they are self-motivated to explore and find the meaning of the cultural experience. The need for genuine cultural experiences in heritage, ethnicity, food, crafts, arts, and music among tourists is on the growth.

## 2.2 Satisfaction towards facilities

Sarawak Cultural Village (SCV) offers tourists a glimpse into the wonderful and distinctive housing designs of the several ethnic groups that make up Sarawak, as well as cultural events. Additionally, a number of facilities are offered to guests to Sarawak Cultural Village for their comfort (Abi, Mariapan & Aziz, 2015). Yoeti (2003) mentioned that the components of tourist facilities are the restaurant, outdoor activity facilities and art activity facilities. Facilities that were provided at the cultural village are as following; cafeteria,



cultural houses, rest areas, walking trail, pavilion and other general and specific facilities. All facilities classified as "tourism facilities" serve the needs of visitors who remain in tourist areas for a limited time so they may unwind, take full advantage of, and engage in the activities offered there. (Yoeti, 2003; Sulistiyana, 2015). An evaluation of the current facilities was necessary to maintain the standard of the given products' experiences. The measurement of tourist satisfaction with the facilities supplied was essential to the cultural village's management. The presence of these amenities is also anticipated to increase tourists' feelings of customers feel at ease, stay longer, and leave a favourable impression of the tourist site they visit (Zaenuri, 2012). Throughout the study, management would be in a better situation to recognize and fulfil visitor expectations. Evaluating visitor satisfaction helps management teams decide whether aspects of the facilities offered will fully commit to visitors' expectations and satisfy their needs (Amanah & Harahap, 2018). Management might provide amenities that would boost tourists' desired experiences by assessing visitor satisfaction. Although experience is the primary economic offering in travel and contributes significant economic value, it is very important for the cultural tourism business.

## 3. Method

Sarawak Cultural Village, situated at the foot of Kuching's fabled Mount Santubong, Kuching, which covers the 14 acres of tropical vegetation. Sarawak Cultural Village located 35 kilometres outside of Kuching City and about 45 minutes by car from Kuching International Airport. Figure 1 illustrates the Sarawak Cultural Village site plan. Each facilities including the Iban Longhouse, Orang Ulu Longhouse, Bidayuh Longhouse, Music Gallery, Theatre, Chinese Farmhouse, Penan Hut, Melanau Tall House, and others were surround the man-made lake.

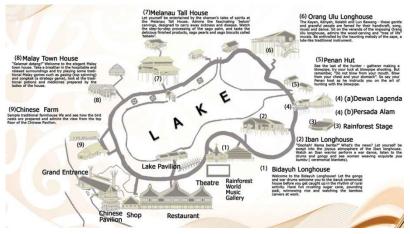


Figure 1 The layout of Sarawak Cultural Village

This study has been conducted at Sarawak Cultural Village, Kuching. A quantitative research approach was used to investigate the tourists' satisfaction towards facilities at Sarawak Cultural Village. A total of 170 respondents participated in the questionnaire's



responses. The population of tourist who have been to the cultural village was participating in this survey. The Statistical Package for the Social Sciences (SPSS) was used to examine the data.

The Sarawak Cultural Village's facilities that were provided were evaluated for tourist satisfaction using the Likert Scale. On a Likert scale from 1 to 5, respondents indicated their degree of agreement or disagreement with a series of statements about the defined qualities using a symmetric agree-disagree scale (from Strongly Disagree to Strongly Agree). If the items are developed appropriately, the results of the analysis of many qualities show a pattern with scaled features of the kind Likert indicated (Burns & Bush, 2008). Variables in Likert Scale are 1 to 5, where 1 (Strongly Disagree), 2 (Disagree), 3 is for neutral on satisfaction level, 4 (Agree) and 5 (Strongly Agree).

The fact that the method used in this study will determine the outcome, it must be suitable to research's goal and associated to it. As a result, this research's goal can be achieved by appropriate methods.

## 4. Result and Discussion

In this study, the result collected was to aim in explaining tourist satisfaction of respondent with facilities at Sarawak Cultural Village. The statistical tests used were frequency, percentage, mean, standard deviation and Cronbach's alpha reliability coefficient value ( $\alpha$ ) for the variable.

Demography		Frequency	Percentage (%)
Gender	Male	62	36.5
	Female	108	63.5
Age	12 – 17	9	5.3
·	18 – 25	103	60.6
	26 – 35	29	17.1
	36 – 45	9	5.3
	45 and above	20	11.8
Occupation	Employed	87	51.2
•	Unemployed	11	6.5
	Student	49	40.6
	Others	3	1.8

## Table 1: Demographic of respondents

Table 1 shows that according to gender, the number of respondents were 62 (36.5%) male respondents and 108 (63.5%) female respondents. According to age group, most of the respondents are from the age group of 18 - 25 years old with a total number of 103 (60.6%) respondents, followed by the age group of 26 - 35 years old with a total number



of 29 (17.1%) respondents. The next age group is 45 and above with a total number of 20 (11.8%). This followed by the least number of respondents are in the age group of 12 - 17 years old and 36 - 45 years old with a total number of 9 (5.3%) respondents. As for occupation, most of the respondents are working or employed with a total number of 87 (51.2%) respondents. Respondents from the students group with a total number of 49 (40.6%) respondents. Respondents that are unemployed with a total number of 11 (6.5%) respondents. The rest of the respondents are categorized on the other group of occupational status with the number of 3 (1.8%) respondents.

Variables		Frequency	(%)
Frequency of	First time	75	44.1
visit	Second time	40	23.5
	Third time	17	10
	More than 3 times	38	22.4
Purpose of	Learn Sarawak Ethnics Lifestyle	93	54.7
visit	Cultural Performance	41	24.1
	Organized Special Event, Activity, or program	36	21.2

Table 2: Trip Characteristics of Tourists

Table 2 shows the trip characteristics of respondents. Most of the respondents have visited Sarawak Cultural Village for the first time with the number of 75 (44.1%) respondents. Followed by the respondents with second time visit with the number of 40 (23.5%) respondents. The number of respondents visit more than 3 times are 38 (22.4%) respondents. It shows that respondents visit Sarawak Cultural Village for their third time are the least number which are 17 (10%) respondents. The most purpose of visitation are was Learning Sarawak Ethnic Lifestyles with the number of 93 (54.7%) respondents, followed by watching the cultural performances 41 (24.1%) respondents, and participate in organized special event, activity, or program 36 (21.2%) respondents.

The level of experience was also evaluated for each item and variable to explore the level of experience among the respondents.

Table 3: Level of Experience on Facilities towards Tourist Satisfaction (N=170, Mean= 4.08)

Items	Mean	SD	Level
Facilities			
1. The condition of the ethnic houses still well maintained	4.17	.807	High
2. Sufficient number of rest areas were available at the cultural village	3.95	.876	High
3. Restaurant available on the cultural village are on a good quality	3.83	.979	High
4. Handicraft shops offered a high-quality product of local arts and crafts	4.19	.769	High



5. The walking trails on site are accessible for the tourists	4.26	.802	High	
	1.20	.002	riigii	

Table 3 shows the level of experience on facilities variable towards tourist satisfaction. Overall, the facilities provided at the cultural village is at a high level (Mean=4.08).

## Table 4: Relationship Between Facilities and Tourist Satisfaction

## Correlation

Deliebility

		Facilities	Tourist Satisfaction
Facilities	Pearson Correlation	1	.833**
	Sig. (2-tailed)		< .001
	Ν	170	170
Tourist Satisfaction	Pearson Correlation	.833**	1
	Sig. (2-tailed)	< .001	
	Ν	170	170

\*\*. Correlation is significant at the 0.01 level (2-tailed)

H1: There is a positive relationship between facilities and tourist satisfaction

Table 4 shows that there is a strong relationship between facilities and tourist satisfaction (r=0.833). The relationship is also significant at level of 0.01. Therefore, the hypothesis is accepted that there is a significant positive relationship between facilities and tourist satisfaction.

#### Table 5: Reliability Analysis

Reliability test			
Variable	No. of items	Item Deleted	Cronbach's Alpha
Facilities	5	-	0.915

Reliability is the idea that the research tool used to gather the needed data can be trusted (reliably) as a data collecting tool and able to provide accurate field data.

Table 5 shows that the variable that was addressed in the questionnaire attained reliability of close to 0.8 or higher. The items in the questionnaire had been used and verified by the other researchers in the same field of study. The reading of Cronbach's alpha reliability coefficient value ( $\alpha$ ) for the variable of Facilities was high at 0.915.

This outcome mostly demonstrated that the questionnaire is comprehensible and relevant to the circumstance.



## 4. Conclusions

From the analysis listed, it was found that the factor influencing the experience of tourists' satisfaction in visiting Sarawak Cultural Village was the facilities provided by the cultural tourism destination. This finding supported by Abi et al., (2015) who identified that tourists were most pleased with the effectiveness of the facilities available. However, there were low indicators of satisfaction with several particular amenities provided at the cultural village. The results of the current study further confirm that the tourism facilities considerably and favourably influenced the tourists' satisfaction. (Simanihuruk, 2019). The justification that tourists travel to a place, region, or country is because they are engaged in the facilities that can be obtained through the facilities and the evaluation of tourists toward facilities in a tourism destination is typically associated with satisfaction after visiting the tourist site (Rezki, Djamhur, & Devi, 2015).

Recommendation was made in consideration of the remarks made by the tourists when the questionnaires were distributed. Tourists suggested that Sarawak Cultural Village's key draw—the cultural goods—must be managed and preserved (maintained) by management. The particular quality of the facilities need to be enhanced such as in houses maintenance, displays and restaurant management.

For future research, some factor should take into consideration such pavilion condition, cultural music houses, and art learning centre that were taken into account in the research study for satisfaction. As the main focus of this study is on experience-related qualities. This is conducted in order to establish a connection between certain features and how they affect tourists' satisfaction.

## References

Abi, J., Mariapan, M. & Aziz, A. (2015). *Journal of Environmental Science, Toxicology* and Food

Technology. Volume 9, Issue 12 Ver. I (Dec. 2015), pp. 16-24

Amanah, D. & Harahap, D. (2019). *Measuring Visitor Satisfaction using Gap Analysis at Trans* 

Studio Bandung, Indonesia. International Journal of Innovation and Business Strategy (IJIBS), Vol. 11, pp. 21 – 35

Baggio R. (2019). Measuring tourism methods, indicators, and needs: Innovation and sustainability. In E. Fayos-Sola & C. Cooper (Eds.), The Future of Tourism, pp. 255–269

Burns, A.C. & Bush, R.F. (2007). *Basic Marketing Research*; Second Edition. New Jersey:

Pearson Education. pp. 245.



Carmignani, F. & Moyle, C. (2019). *Tourism and the output gap*. Journal of Travel Research, 58(4),

pp. 608–621

Gursoy, D., McCleary, K. W. & Lepsito, L. R. (2007). *Propensity to complain: Effects of personality* 

and behavioral factors. Journal of Hospitality & Tourism Research, 31 (3), pp. 358-386.

Gursoy, D., McCleary, K. W. & Lepsito, L. R. (2003). Segmenting dissatisfied restaurant customers based on their complaining response styles. Journal of Food Service Business Research, 6 (1), pp. 25-44.

McKercher, B., Wong, C., & Lau, G. (2006). *How tourists consume a destination*. Journal of

Business Research, 59(5), pp. 647–652.

Neal, J.D., & Gursoy, D. (2008). A multifaceted analysis of tourism satisfaction. Journal of Travel

Research, 47, pp. 53-62.

Park, S., Hwang, D., Lee, W. S., & Heo, J. (2018). *Influence of Nostalgia on Authenticity, Satisfaction, and Revisit Intention: The Case of Jidong Mural Alley in Korea.* (J. Grahe, Ed.) Internet Resource, p. 6.

Rezki, T. S., Djamhur, H., & Devi, F. A. (2015). *Pengaruh Fasilitas Wisata Dan Harga Terhadap* 

*Kepuasan Konsumen (Studi Pada Museum Satwa)*. Jurnal Administrasi Bisnis (JAB), XXV(1), pp. 1-9.

Simanihuruk, M., Mumin, A. T., & Wulan, S. (2018). The Effect of Tourist Attraction Toward Visitor

Satisfaction in Sindang Barang Cultural Village, Bogor Regency. Tourism Research Journal, II(2), pp. 33-44.

Sulistiyana, R. T. (2015). Pengaruh Fasilitas Wisata Dan Harga Terhadap Kepuasan Konsumen

(Studi Pada Museum Satwa). Jurnal Administrasi Bisnis (JAB), XXV(1), 3

Thong, J. Z., Lo, M. C., Mohamad, A. A., & Lim, J. (2020). Culture, Carrying Capacity And

*Perceived Value On Tourists' Satisfaction And Revisit Intention.* European Proceedings of Social and Behavioural Sciences.



Kirom, N. R., Sudarmiatin, & Putra, I. W. J. A. (2018). *The influence of tourists' attractions towards* 

the tourists' satisfaction. KnE Social Sciences, 3(3), pp. 270–288.

Ling, S. (2021). *Cultural village prepares to reopen*. The Star. Accessed 10 May 2022, from

https://www.thestar.com.my/metro/metro-news/2021/08/10/cultural-village-prepares-to-reopen

Yoeti, O. A. (2003). Tours and Travel Management. Jakarta: Pradnya Paramita.

Zaenuri, M. (2012). Perencanaan Strategis Kepariwisataan Daerah: Konsep dan Aplikasi.

Yogyakarta: e-Gov Publishing



# AWARENESS LEVEL ON EDUTOURISM PACKAGE AMONG POLYTECHNIC STUDENTS

Izyan Raihanah Binti Ishak<sup>1</sup> and Humairah Binti Hamzah<sup>2</sup>

<sup>2</sup> Department of Tourism and Hospitality, Politeknik Ibrahim Sultan Pasir Gudang, Johor *izyanraihanah.ishak@gmail.com humairah\_hamzah@pis.edu.my* 

## Abstract

One of the alternative steps in government's effort to promote Malaysia on a universal platform as the combination of tourism and education to boost tourism industry performance is Malaysia 101 Edutourism Package. Edutourism was initiated to benefit from both the booming tourism industry and the growth of education sector in Malaysia. The lack of studies on edutourism elements, on the other hand, has a significant impact on edutourism promotion efforts. To put it another way, the tourism industry has given little attention to Edutourism research, resulting in a scarcity of data and research in this area. This study investigates Polytechnic students' perception on the growth of Edutourism package. The data was collected through a questionnaire to a total of 377 respondents. It was to measure students' awareness towards Edutourism package, how the package benefit students in their studies and how price can affect their decision-making process. Data was analyzed using SPSS version 27. In conclusion, the findings of this study should be useful for Polytechnic to develop Edutourism package in accordance to support government's effort.

Keywords: Education Tourism, Package, Polytechnic Students Perception



## 1.0 Introduction

Recent decades have seen a growth in the recognition of the tourism and education industries from both an economic and social standpoint. Nugroho and Soeprihanto (2016) investigated the relationship between education and tourism in further depth in 2016. They defined educational tourism as a three-dimensional product: (a) the educational experience at the tourism destination and the resulting learning benefit (main product); (b) the tourist package that meets the needs of the tourists (real product); and (c) all the tangible and intangible aspects of the tourism experience that are added to the primary service (additional product).

However, a scarcity of studies on edutourism elements has a substantial impact on edutourism promotion efforts (Matahir & Tang, 2018). In other words, the tourism sector has paid little attention to educational tourism research, resulting in a lack of research and information in this field (Rahman, Hassan, et al., 2017). Based on the Ministry of Tourism and Culture (MOTAC) records, it shows that only three universities out of 11 universities participated in M1EP managed to generate revenue from the activities (Hishamuddin, 2016). This unpleasant start is seen as a downward to targeted tourism revenue. According to recent research, colleges could be marketed to create cash, particularly in smaller developing countries such as Malaysia, where international students are considered education revenues.

Thus the findings of this research will be beneficial to universities management to increasing attention to their engagement with civic society, collaborating in place-based projects with local stakeholders to enhance sustainable local economic development (Trencher et. al, 2013). This paper aims to identify the awareness level of Polytechnic students on the growth of Edutourism package in Malaysia.

## 2.0 Literature Review

## 2.1 Education in Tourism Context

Since the term was first used, it has been the subject of extensive scholarly debate. A segment of the tourism industry is called "educational tourism," or "edutourism."



Edutourism has been viewed as a new way for the nation to generate income. Prior to Wood's research in 2001, Kalinowski and Weiler had a significant discussion of tourism research in 1992. Both scholars had initially concentrated their research and discussion on topics related to adult extension programmes for adult tours and cultural educational tourism. The Canadian Tourism Commission defined educational tourism or learning tourism as "continuum ranging from general interest learning or exposure while travelling to purposeful learning and travel" in light of this (Ritchie, Carr and Cooper, 2003).

The early debate on educational tourism has revealed fresh insights and improved comprehension of the idea. But because of their emphasis on learning as the primary goal of edutourism and the assumption that travel will occur once students are abroad, these researchers have helped to narrow the definition of education tourism. They label students who travel as edu-tourists. In a nutshell, going abroad is primarily for education. However, while they are still students, they may have free time to travel to the host country and engage in leisure activities.

An example of activities classified as edutourism includes a two-week visit to local homestay for the purpose of language-related learning and /or an academic exchange program between two schools and which travelling to local attractions become one of the activities in the itinerary (The Star, January 10, 2010). As part of the effort to educate by teaching in terms of training, process, ways, and acts of educating, education is also a process of changing one's attitude. Dewey (1930) described education as a fundamental process of developing one's attitude—both intellectual and emotional—towards nature and other people. It is an effort to organize knowledge to aid humans in acquiring their innate, or natural, knowledge so that education can aid in leading a more secure, fruitful, and informed life.

## 2.2. Perception

According to Lamb et al. (2014), perception is the processes by which people select, organize, and interpret stimuli into a meaningful and coherent picture. Similarly, Solomon (2001) defines perception as the process by in which the sensations are selected, organized, and interpreted. Furthermore, the sensation refers to the immediate response of the human sensory receptors, i.e., eyes, ears, nose, mouth, skin to basic stimuli such as sights, sounds, smells, taste, and feelings. In general terms, perception implies human being's knowledge and cognition of his interior and exterior world. Perception has long laid the foundation for human being's cognition. The simplest form of perception is human being's encounter with the world and his impression of the environment and the situation he lives in (Borchert, 1996: 394).



## 2.3 Types of Perception

Perception is the interpretation of a thing, an event, or information based on the interpreter's personal experiences. What a person feels and what is actually true can differ significantly. Irwanto (2002) claims that after people interact with perceived objects, two types of perceptions emerge: positive perceptions and negative perceptions.

- a) Positive perception is one that encompasses all information and actions that continue with the intention to use it. This will proceed with the activation, acceptance, and support of the perceived thing.
- b) Negative perception is a perception that encompasses all information and actions that are out of sync with the perceived object. It will either move forward in a passive manner or reject and combat the perceived object.

Thus, it can be said that a person's actions are always influenced by their perception, which can be both positive and negative. Whether an object is perceived positively or negatively depends on how individuals sum up all of their information about it.

## 2.4 Importance of Awareness on Edutourism

Through Edutourism, it is expected students to increase their knowledge and perspective on particular subjects and issues. Edutourism has been reported as a significant strategy to increase student awareness. Edutourism provides opportunities to learn directly, and therefore it is important to increase student knowledge (Nasruddin et al, 2019). The area with potential resources for education programs should develop a strategy to meet Edutourism market needs. Planning and development strategies are a crucial factor to ensure the sustainability and competitiveness of tourism destinations, especially in the high competition era of the tourism business (Attar et al, 2013).

## 3.0 Method

This study focuses on the awareness level of Edutourism package from the perception of Polytechnic students. The study uses quantitative data which is targeted among Polytechnic students across Malaysia. The data is analyzed by the use of the Statistical Package for Social Science (SPSS). A sum of 202 Polytechnic students contributes in participating in answering the questionnaires survey. A total of 80 visitor voluntarily participated in the pilot study. The Cronbach's alpha reliability coefficient value ( $\alpha$ ) was high at 0.836.



A structured set of questions was used to gather the relevant data for this study. This was used to direct the respondents into the relevant variables that will be tested in the study. The questionnaire consisted of five sections, which includes: Section A (Demographic), Section B (Level of Awareness),

Section C (Trends of Edutourism Package), Section D (Selection of Price Offered) and Section E (Students' Perception). The first part of survey consisted of 2 questions which covered the respondent's demographic background that include gender and level of education. Second part comprises on students awareness about the Edutourism packages.

A five step "Likert" scale was used to measure the level of awareness among students. The responses of respondents were categorized into five groups and given them weight from minimum 1 to maximum 5; then assigned point 1 for the response "strongly disagree"; 2 for "disagree"; 3 for "neutrals", 4 for "agree" and 5 for "strongly agree". If one is strongly agreed with particular statement that indicates he is highly satisfied with that particular criterion. On the other hand, if one is strongly disagreed with particular statement that indicates he has negative attitude or dissatisfaction with that particular criterion.

## 4.0 Results and Discussion

## 4.1 Demographic Information

Descriptive analysis was carried out with the aims of investigating level of awareness towards Edutourism package. The statistical tests used were frequency, percentage, mean and standard deviation.

Demography		Frequency	Percentage
Gender	Male	90	44.6
	Female	112	55.4
Level of Education	Diploma	124	61.4
	Degree	78	38.6

## Table 8 Profile of Respondents (N=202)



Table 1 represents the descriptive statistics on demographic information about the respondent which includes the frequencies and percentages of the variables. The summary of the findings represents the demographic variables of their gender and level of education. In this study, 55.4% of the respondents were female and 44.6% of respondents were male. According to the level of education, most of the respondents were Diploma students with a percentage of 61.4% while 38.6% were Degree holder. Therefore, author can conclude that there is no bias in this study.

## Table 2: Level of Awareness among Polytechnic Students

#### Report

#### PERCEPTION

LEVELOFEDUCATION	Mean	Ν	Std. Deviation
Diploma	4.2728	124	.59177
Degree	4.5043	78	.41087
Total	4.3622	202	.54012

Table 2 shows that the perception on Edutourism package varied depending on the level of education, the Degree students are more aware of the Edutourism package with mean score 4.50.



Table 3: Level of Awareness Among Polytechnic Students (N=	=202, Mean=4.32)
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Items	Mean	SD	Level
1. Aware of the existence of Edutourism package in Malaysia (eg: adventure tour, eco-tour, nature tour, city tour and Edu-trip)	4.20	.811	High
2. Open policy by the government towards Edutourism will encourage international students to Malaysia.	4.28	.716	High
3. The initiative by the government to make Malaysia as an educational hub will promote Edutourism.	4.29	.690	High
4. Institution will benefit from the existence of the Edutourism package.	4.38	.653	High
5. Local communities will get an advantage from the development of Edutourism package	4.31	.680	High
<ol><li>Edutourism will bring positive impacts to Malaysia on a global market.</li></ol>	4.43	.689	High

Table 3 shows the level of awareness among Polytechnic students on the Edutourism package. Overall, the awareness level among Polytechnic students is at high level with mean score 4.32. Mostly, Polytechnic students are aware that Edutourism will bring positive impacts to Malaysia on a global market with mean score 4.43.

 Table 4 Relationship Between Level of Awareness and Students' Perception

## Correlations

		AWARENESS	PERCEPTION
AWARENESS	Pearson Correlation	1	.569**
	Sig. (2-tailed)		.000
	N	202	202
PERCEPTION	Pearson Correlation	.569**	1
	Sig. (2-tailed)	.000	
	Ν	202	202

\*\*. Correlation is significant at the 0.01 level (2-tailed).



Correlation Analysis has been made, resulting in significant positive relationship between level of awareness and students' perception towards Edutourism package. Although the mean level of awareness is high, the strength of relationship between level of awareness and the students perception is moderate (r=0.569)

## 5.0 Conclusion

According to the study's findings, edutourism is indeed a promising project that should be developed, but for it to be successful, a more solid business model is needed. The results would help edutourism initiatives and efforts get better especially towards the benefits of local institutions in generating income, increasing visibility and helps to cultivate the spirit of entrepreneurial among staffs and students. This study also emphasises how edutourism encompasses more than just luring international students to enrol in nearby universities. This study takes the position that unique edutourism packages created by universities attract visitors interested in higher education. Finally, we must assert that educational tourism is the tourism of the 21st century because this type of tourism is found in most forms of tourism, as 21st century tourists are active tourists. They are people who want to participate in discovering new horizons, people who want to learn something new, becoming better, more competitive and more competent, and, upon returning to their country, people that also have the opportunity of applying their newly acquired knowledge, obtained through educational tourism, in their lives and careers. Although the results from this study stated that the level of awareness among Polytechnic students about the Edutourism package is neutral, that is neither high nor low, it should be a concerning issue towards the management of Polytechnic to give more exposure about Edutourism among students. The existence of a leading Higher Education Institution that offers various Edutourism Package are able to attract local and international tourist to Malaysia. This is because an exciting and interesting package, affordable price, up-todate with the current youth trend, comfortable and conducive learning while traveling environment will guarantee Edutourist visits



## References

Attar, M., L. Hakim and B. Yanuwiadi. 2013. Analisis potensi dan arahan strategi

kebijakan pengembangan Desa Ekowisata di Kecamatan Bumiaji–Kota Batu. Journal of Indonesian Tourism and Development Studies 1(2), 68-78.

- Borchert, D. M. (1996). Encyclopedia of Philosophy. New York: Simon & Schuster Macmillan.
- Dewey, J. (1930) Democracy and Education: An Introduction to the Philosophy of Education. New York: The Macmillan Company.

Hishamuddin, M. (2016). Malaysia 101 Edutourism packages. Tourism Malaysia

Irwanto, Psikologi Umum, Jakarta: PT. Prenhallindo, 2002.

Kalinowski, K., &Weiler, B. (1992). Review educational travel. In: B. Weiker and C. Hall

(Eds), Special Interest Tourism. London Belhaven.

Lamb, C., Hair, J. & McDaniel, C. (2014). Principles of Marketing. Boston: Engage Learning.

Matahir, H., & Tang, C. F. (2018). Effects of infrastructure, safety and academic qualities

on demand for educational tourism in Malaysia. Institutions and Economies, 10(3),

Nasruddin, N., Normelani, E., & Kumalawati, R. (2019). Strategy for the Development of

Kampung Sasirangan as Edu tourism Village.

<sup>14–36.</sup> 

Martyn, D. (2017). The Good Research Guide, 6th Edition (6th ed.). Open University Press.



Ritchie, B., Carr, N and Cooper, C. (2003) Managing Educational Tourism. Clevedon: Channel

View Publications.

Solomon, M.R. (2001). Consumer Behaviour: Buying, Having, Being (5th ed.). New Jersey: Prentice Hall.

The Star. (2010). Edutourism gaining ground: South Koreans come to learn languages. 10

January, 27.

Trencher, G.P.; Yarime, M.; Kharrazi, A. Co-Creating Sustainability: Cross-Sector University

Collaborations for Driving Sustainable Urban Transformations. J. Clean. Prod. 2013,

50, 40–55.

Wood, D. (2001). The winners and losers of participation in praxis: A case study of strategic

tourism planning in Australia's North West. Paper for the World Planning Schools

Congress, Shanghai, China, 11-15 July 2001.



# SUSTAINABILITY AND THE IMPACTS OF TOURISM ACTIVITIES TOWARDS COASTAL AREA OF PORT DICKSON, NEGERI SEMBILAN

Nur Qamariah binti Abdul Hakim<sup>1</sup> and Humairah binti Hamzah<sup>2</sup> Department of Tourism and Hospitality, Politeknik Ibrahim Sultan, Pasir Gudang, Johor *nurqamariah.work@gmail.com* <sup>2</sup> Department of Tourism and Hospitality, Politeknik Ibrahim Sultan, Pasir Gudang, Johor

humairah\_hamzah@pis.edu.my

## Abstract

Port Dickson is a popular destination with over 18km of lovely beaches and plenty of intriguing locations to explore, as well as amazing sea vistas and a plethora of tourist activities. Despite being one of the busiest tourist destinations in Malaysia, Port Dickson now faces serious environmental issues that affect its sustainability. Sustainability is typically defined as the procedures and actions that humans use to avoid depletion of natural resources and preserve an ecological balance that does not allow modern society's quality of life to deteriorate. Henceforth of the tourism industry's growth in recent years, the need to investigate the impact of tourism on a location's long-term viability became apparent. The purpose of this study was to analyze the impact of tourism activities and to identify the level of awareness towards the sustainability of the coastal area of Port Dickson, Negeri Sembilan. This survey was carried out online via questionnaire with a total of 250 respondents with different backgrounds participating. A quantitative method was applied to collect the data. Furthermore, Statistical Package for Social Sciences (SPSS) version 27 was used in the processing and analyzing survey data. On top of that, the results showed that uncontrolled tourism activities and a weak level of awareness had a significant impact on the sustainability of the coastal area of Port Dickson, Negeri Sembilan, making it overcrowded and polluted. The findings of this study should be valuable in improving better sustainable tourism planning strategies, controlling and conserving, and sharing awareness in order-making Port Dickson a sustainable tourist destination.

Keywords: Sustainability, Tourism Activities, Coastal Area, Port Dickson.



## 1. Introduction

The worldwide economy is significantly impacted by the tourism sector, which also generates a significant quantity of cash and numerous job possibilities. Hirschmann (2021) acknowledges that tourism is one of Malaysia's most significant industries, contributing 5.9% of the nation's GDP and employing nearly one-fourth of its workers. According to International Civil Aviation Organization (ICAO) (2018), the travel and tourism have the capacity to improve people's lives through promoting economic growth and development, eliminating poverty via the supply of livelihoods, and building respect and harmony by cultural exchanges and awareness. Tegar and Saut Gurning (2018) noted that coastal tourism is a subset of travel in which the presence of water or the sea is prominent and is viewed as the main asset and benefit. Sulaiman et al. (2017) mentioned coastal tourism is one of the most important contributors to Malaysia's tourism sector's growth, and it is steadily increasing. It is a unique type of tourism in which visitors choose to spend the majority of their holiday time participating in aquatic activities. It draws visitors who want to explore and take in the stunning views of the sea. According to Kamaruddin et al. (2021), Port Dickson's coastal regions have long been a draw for local and international tourists as one of Peninsular Malaysia's must-see destinations, located in the state of Negeri Sembilan on the west coast of Peninsular Malaysia. Pantai Port Dickson, Pedas, Bandar Seremban, Hutan Lipur & Rekreasi Ulu Bendul, and Nilai were five of the most popular tourist sites, according to Department of Statistics Malaysia (DOSM) (2020).

According to Isa (2021), Port Dickson's beach was polluted with rubbish left by visitors after it was opened to the public, causing its previously clean environment to be polluted with food and beverage containers and face masks belonging to visitors scattered so as to spoil the view of the resort beach. The act clearly shows the lack of concern for hygiene among visitors who are still superficial on the issue of hygiene and accountability. While Hasbi A. (2020) expressed that since cross-state licences were issued, there has been a 17% rise in the volume of solid garbage in Port Dickson's vacation zones. In a newspaper article written by Zulkifli S. (2020) mentioned that the Menteri Besar of Negeri Sembilan, Datuk Seri Aminuddin Harun, voiced his displeasure at the behaviour of some beachgoers in Port Dickson who threw trash all over the place. On his official Facebook page, he stated that the the absence of rubbish bins in the area was not an excuse for visitors to throw rubbish arbitrarily.A research from Kamaruddin et al. (2021) mentioned that as an ecotourism destination, Port Dickson demonstrated that excessive activities along the coastline have resulted in a high concentration of suspended particles in the water. In research from Yi and Kannan (2016), there is academic alarm over the worsening of water quality in Port Dickson due to busy tourism activities, shipping, refineries, and coastal zone projects.



The findings of this study will redound to the benefit of society considering that activities in coastal tourism plays an important role in maintaining also ensuring the sustainability of the place. Thus, this study aims to analyse the level of tourist awareness towards sustainability of coastal area in Port Dickson.

## 2. Literature Review

## 2.1 Tourism Activities

Tourism-related activities and development can result in rubbish generation, involving solid waste such as rubbish and industrial waste, as well as liquid waste such as domestic sewage and wastewater. Unmanaged waste disposal can emit a foul odour that is harmful to the environment. While Othman et al. (2012) discovered that the presence of tourists in a tourism region increases demand for services such as water, electricity, telephones, and lodging. Infrastructure such as water, electricity, telecommunications, and lodging are necessary to meet these demands. The construction of these facilities involves unrestricted land exploration, resulting in ecological disruptions such as the destruction of plant and animal habitats, as well as the removal of soil nutrients and their repercussions.

According to Garcia and Servera (2003), beaches and water are just two of the natural factors that have been harmed by the coastal's tourism surge. The demand on the land from an increase in visitors and residents has led to poor water supply management and the expansion of the coastal zone. Because of inadequate urban planning, overcrowded beaches, and massive coastal construction, the beach-dune system has vanished. As more beaches have been converted to urban beaches, the shoreline has degraded.

## 2.2 Level of Awareness towards Sustainability

According to previous research by Abdullah et al. (2012), Port Dickson Beach's sustainability has been negatively impacted by visitors who prefer to leave waste all over the area. The primary challenge for the tourism sector in tourism destinations in the twenty-first century is to maintain a sustainable combination of economic, social, and environmental conditions in an increasingly competitive market, as consumers seek environmentally friendly products and gain a better understanding of tourism's effects on the natural surroundings. (Aminuddin et.al, 2014) Other than that,



environmental awareness is the awareness that people have and exhibit of what is going on around them. Environmental awareness actually encourages people to act positively and take better care of their surroundings. (Laroche et al. 2001; Adejoke et al., 2014)

## 3. Methodology

Researchers are focus on data collection in order to get the information throughout the respondent's opinions about the level of awareness of the tourists towards sustainability of the coastal area of Port Dickson by both method which are primary data which consists questionnaire and the other method is secondary data which may include by previous articles and journals. Total of 250 respondents were participated in answering the questionnaire. Questionairres were developed on Google Form and distributed through social media platforms such as Facebook, Instagram, Whatsapp, Twitter and Telegram. Researcher used Statistical Packages for the Social Sciences (SPSS) software to analyze the data gathered.

A pilot study was conducted and 10% of the population data were analyzed. The Cronbach's alpha reliability coefficient value ( $\alpha$ ) was high at 0.801. A screening question was asked to secure that the tourists had visited the coastal area of Port Dickson, to prevent response error. Respondents were asked to indicate their level of agreement based on a likert scale of 1 to 5 (from strongly disagree to strongly agree). The method needs to consequently be applicable and related to the objective of this research and as the result will be decided through the method used. Hence, the objective of this research can be done through proper procedures.

## 4. Result and Discussion

Demographic Variable	Category	Ν	%
Gender	Male	147	58.8
	Female	103	41.2
	Total	250	100
Age	< 19 years old	23	9.2

## Table 1: Profile of Respondents (N=250)



	20 – 50 years old	217	86.8
	> 51 years old	10	4.0
	Total	250	100
Education Level	Secondary	45	18.0
	Tertiary	205	82.0
	Total	250	100
Occupation	Government	44	17.6
	Non-Government	81	32.4
	Self-Employed	58	23.2
	Unemployed/Student	67	26.8
	Total	250	100
Travel Partner	Solo	85	34.0
	Friends	79	31.6
	Family	86	34.4
	Total	250	100

Looking at Table 1, the majority of the respondents are male which is 147 respondents (58.8%), while the remaining 103 respondents (41.2%) are female. The majority of respondents with the number of 217 respondents (86.8%) were between the ages of 20 and 50, followed by below 19 years old 23 respondents (9.2%), and the rest are 10 respondents (4.0%) are from 51 years old and above. According to education qualification, the majority of the respondents had acquired education up to tertiary level (82.0%), and the rest are secondary level (18.0%). Next, for occupation, the highest number of respondents came from non-government sector with the number of 81 respondents (32.4%), followed by 67 respondents (26.8%) of unemployed/student. Lastly, the lowest number of respondents came from government sector with a total of 44 respondents (17.6%). For travel partner, family has the highest number of respondents (34.4%), followed by solo traveler with a total number of 85 respondents (34.0%).

## Table 2: Pollution Trace (N=250, Mean=4.60)

Item	Mean	SD	Level
1. Pollution can be traced in the coastal area of Port Dickson.	4.63	0.678	High
2. There is land pollution happened in the coastal area of Port Dickson. (e.g.: plastic, trash, and litter to sewage)	4.64	0.626	High



3. There is water pollution happened in the coastal area of Port Dickson. (e.g.: bad water quality, greasy water, excess amounts of natural substances from fertilizers and animal waste)	4.52	0.746	High
4. There is air pollution happened in the coastal area of Port Dickson. (e.g.: unpleasant smell, vehicle smoke)	4.53	0.729	High
5. Most of the pollution is caused by human activities.	4.70	0.602	High
6. Vendors and business operators in the coastal area of Port Dickson are also one of the factors that contribute to pollution.	4.61	0.669	High

Table 2 shows the data collected for the pollution trace variable. It can be said that there are trace of pollution happened in the coastal area of Port Dickson which the data shows the mean number is (Mean=4.63). This can be supported with second item in the data with the mean score of (Mean=4.64), followed by item number three (Mean=4.52) and item number four with the mean of (Mean=4.53). The highest mean from the data (Mean=4.70) shows that most of the pollution is caused by human activities and also vendors and business operators in the coastal area of Port Dickson are also one of the factors that contribute to pollution with the mean score of (Mean=4.61).

Therefore it can be proved that there are high number of pollution happened in the coastal area of Port Dickson.

## Table 3: Level of Awareness towards Sustainability in coastal area of Port

## Dickson

Items	Mean	SD	Level
1. Cleanliness is practiced when visiting the coastal area of Port Dickson.	2.73	1.720	Medium
2. Uncontrolled number of tourism activities can cause pollution in the coastal area of Port Dickson.	4.65	0.679	High
3. Usage of biodegradable products is highly practiced.	2.55	1.623	Medium
4. Reduce, Reuse, Recycle (3R) is practiced in daily life.	2.64	1.688	Medium
5. Awareness of sustainability should begin at home.	4.67	0.643	High



Table 3 shows the descriptive statistics for Level of Awareness variable. Overall, the level of awareness is at a medium level (Mean=3,45). However, the highest mean of these variables is item "Awareness of sustainability should begin at home" which is (Mean=4.67). The lowest mean score can be identified through item number three which is "Usage of biodegradable products is highly practiced (Mean=2.55). Other than that, the practice of 3R (Reduce, Reuse and Recycle) has a medium level with the mean score of (Mean=2.64).

# Table 4: Relationship Between Pollution Trace and Understanding the<br/>concept of Sustainable Tourism

		Pollution Trace	Understanding the concept of Sustainable Tourism
Pollution Trace	Pearson Correlation	1	.374**
	Sig. (2-tailed)		<.001
	Ν	250	250

Correlations

\*\*. Correlation is significant at the 0.01 level (2-tailed).

Based on the Table 4, the relationship between Pollution Trace and Understanding the concept of Sustainable Tourism is weak (r=0.374). However, the relationship is also significant at level of <.001. Therefore, we accept the hypothesis that there is a significant positive relationship between Pollution Trace and Understanding the concept of Sustainable Tourism.



# Table 5: Relationship Between Level of Awareness and Understanding theconcept of Sustainable Tourism

## Correlations

		Level of Awareness towards Sustainability of coastal area of Port Dickson	Understanding the concept of Sustainable Tourism
Level of Awareness towards	Pearson Correlation	1	.398**
Sustainability	Sig. (2-tailed)		.000
of coastal area of Port Dickson	N	250	250

\*\*. Correlation is significant at the 0.01 level (2-tailed).

Based on the Table 5, the relationship between Level of Awareness and Understanding the concept of Sustainable Tourism is weak (r=0.398). However, the relationship is also significant at level of <.001. Therefore, we accept the hypothesis that there is a significant positive relationship between level of awareness and understanding the concept of Sustainable Tourism.

## 4. Conclusions

The sustainability of the Port Dickson coastline area as a travel destination is substantially impacted by tourism-related activities and the level of understanding of sustainable tourism, which in turn influences visitor behaviour. In light of this, this study concludes that the public's understanding of sustainable tourism, the environment's sustainability, and the effects of tourism activities all have a substantial impact on a destination's sustainability. In other words, the key variables impacting the sustainability of Port Dickson's coastal areas after visiting the destination are environmental sustainability and understanding of sustainable tourism. As a result, sustainable tourism destinations are essential for establishing positive word of mouth communication in the tourism industry. Most significantly, visitors are more likely to return and refer other travellers to a place if they had a positive experience with the area's environmental sustainability. Therefore, local community or tourists are also encouraged to constantly refrain from actions that could degrade the cleanliness of the environment, particularly in beach areas and on public roadways, and that the lack



of waste bins in the area is no justification for people to discard trash anywhere they choose. As for reccommendation, the Port Dickson

Municipal Council's local government must take more steps in addition to urging tourists to maintain the beach tidy and follow SOPs while in Port Dickson. Local government officials should focus more on raising knowledge of the value of sustainable tourism and consider this information when making decisions. Lastly, Reduce, Reuse and Recycle (3R) practice, and having deep knowledge and awareness regarding sustainability can help contribute to a better future. The results of this study have repercussions for both local community and tourists.

## References

- Abdullah, M. A., Ali, N., Rose, R. A. C., Jali, M. F. M., & Awang, A. (2012). Industri pelancongan dan alam sekitar di Port Dickson: Menyorot titik keseimbangan antara permintaan dan penawaran (Tourism industry and the environment in Port Dickson: Highlighting the equilibrium of demand and supply). Geografia, 8(7).
- Adejoke, O. C., Mji, A., & Mukhola, M. S. (2014). Students' and Teachers' Awareness of and Attitude towards Environmental Pollution: A Multivariate Analysis Using Biographical Variables. Journal of Human Ecology, 45(2), 167–175. <u>https://doi.org/10.1080/09709274.2014.11906690</u>
- DOSM (2020). Domestic Tourism Survey 2020, Negeri Sembilan. Jabatan Perangkaan Malaysia. file:///C:/Users/USER/Downloads/05%20DTS%20NEGERI%20SEMBILAN %202020.pdf
- Garcia, C., & Servera, J. (2003). Impacts of tourism development on water demand and beach degradation on the island of mallorca (spain). *Geografiska Annaler: Series A, Physical Geography*, *85*(3–4), 287–300. <u>https://doi.org/10.1111/j.0435-3676.2003.00206.x</u>
- Hasbi, A. (2021, December 11). Sampah di pantai Port Dickson meningkat. Beritaharian. <u>https://www.bharian.com.my/berita/wilayah/2021/12/897757/sampah-di-pantai-port-dickson</u>
- Hirschmann, R. (2021, August 18). *Travel and tourism in Malaysia statistics & facts*. Statista.



https://www.icao.int/Meetings/iwaf2018/Documents/Travel%20and%20Tour ism.pdf

https://www.statistica.com/topics/5741/travel-and-tourism-inmalaysia/%23dossierKeyfiguresmalaysia/#dossierKeyfigures

- International Civil Aviation Organization (2018). TRAVEL & TOURISM A FORCE FOR GOOD IN THE WORLD. Uniting Travel.
- Isa, B. H. M. (2021, September 17). Sampah sarap cemari pantai Port Dickson. Utusan Digital. <u>https://www.utusan.com.my/nasional/2021/09/sampah-sarap-cemari-pantai-port-dickson/</u>
- Kamarudin, N. A., Mohamat-Yusuff, F., Zulkifli, S. Z., Zainuddin, A. H., Ali, M. Y., Ekhsan, N. F. M., Hassan, M. Z., Aris, A. Z., & Md Yusoff, F. (2021). Port Dickson Surface Water Quality Status: A Year with COVID-19 Pandemic. *IOP Conference Series: Earth and Environmental Science*, 934(1), 012049. <u>https://doi.org/10.1088/1755-1315/934/1/012049</u>
- Laroche, M., Bergeron, J., & Barbaro-Forleo, G. (2001). Targeting consumers who are willing to pay more for environmentally friendly products. Journal of Consumer Marketing, 18(6), 503–520. <u>https://doi.org/10.1108/eum000000006155</u> *Management, 6*(6), 629–633. https://doi.org/10.3923/ibm.2012.629.633
- Othman, N., Mohamed, S., & Aziz, F. K. (2012). Tourism Activities and its Impact on Environmental Sustainability in Coastal Areas. *International Business*
- Sulaiman, F. C., Jamaluddin, E. R., Jaini, N., & Hashim, N. I. (2017). The Influence of Marine Tourism towards the Quality of Life among Local Tour Operators at Pulau Pangkor, Perak. *Environment-Behaviour Proceedings Journal*, 2(6), 169. https://doi.org/10.21834/e-bpj.v2i6.1000
- Tegar, D., & Saut Gurning, R. O. (2018). Development of Marine and Coastal Tourism Based on Blue Economy. *International Journal of Marine Engineering Innovation and Research*, 2(2). <u>https://doi.org/10.12962/j25481479.v2i2.3650</u>
- Yi C. & Kannan N. (2016). Solid Waste Transportation through Ocean Currents: Marine Debris Sightings and their Waste Quantification at Port Dickson Beaches, Peninsular Malaysia. EnvironmentAsia. 9. 39-47. https://doi.org/10.14456/ea.2016.6.
- Zulkifli, S. (2020, June 29). MB kecewa sikap pengunjung pantai Port Dickson. *Sinarharian*. https://www.sinarharian.com.my/article/89905/EDISI/Melaka-NS/MB-kecewa-sikap-pengunjung-pantai-Port-Dickson



## MINIMIZING LIVER WASTE BETWEEN HARVESTING AND WASHING MACHINE

## Nor Hasliza Binti Mohd Fadzil Mohd Firdaus Bin Asrani

Ungku Omar Polytechnic, Ipoh, Perak mohdfirdaus1st@gmail.com

## Abstract

The main reason of this project is to minimizing liver waste between liver harvesting machine and washing machine after complete evisceration process at a poultry processing factory. Higher price and market demand for chicken liver led to profitable by-product for the industry. However, during the processing, there are some waste occurred up to 15% total liver production where 10% of it existed between liver harvesting machine and washing machine. Through an observation, guestionnaire and data from production team has confirmed the occurrence of liver waste issue. So, the idea of making some improvement is going to be performed. After the root cause have been identified, it then analysed in detail in order to find the effective solution. Then, brainstorming process are taken place and any suitable ideas are highlighted. The best ideas are refined to meet the design needs and functionability, then the actual design has been made using a computer aided design application. After that, some metal fabrication has been done using correct material to fulfil the engineering needs, then do an assembly and apply some setting to ensure the modification works smoothly. After the improvement has been done, then it is time to run the machine and monitor the performance. Then collect some data regarding the current status of the waste issue for one week. Finally, the result showing that 0% of liver waste (no more liver waste) occurred between liver harvesting machine and washing machine. So, the improvement is successful and the waste issue has been solved.

Keywords: Evisceration, Liver, Poultry Processing, Harvesting and Washing.

## 1. Introduction

Poultry processing industries started from receiving live birds as a raw material from suppliers, then slaughtering, scalding, defeathering and eviscerating as a primary process, then few step in secondary processing until the final product are sent to the customers. Evisceration process consist of six main machines which running continuously and simultaneously. Those machines are opening machine, vent cutter and evisceration machine. Beside the main machines, the process also including support machines such as outside washer, intestine remover, drum washer, liver



harvester and gizzard cleaner. There are two production lines that perform preliminary process with different processing speed.

## **1.1 Problem Statement**

The liver harvesting machine extract liver from other organs and transferring it to drum washer and later transfer it to the inspection station for further processes. After complete liver harvesting process, some livers fall on the machine floor during transfers from liver harvesting machine to drum washer. Livers fall to the machine floor during feeding from harvester to transfer plate. After transfer from harvester, some livers are gathered and stacked at the edge of the transfer plate, and then fall to the ground. Both situations make the livers can't be use anymore. Moreover, the gathered and stacked livers may be exposed to bacterial infection although the livers not fall down.

## 1.2 Objectives

The objective of this study is to innovate transfer plate and inclination angle in order to minimizing liver waste, increase liver production volume, prevent healthy liver becoming bacterial contaminant and minimizing human interfere during machine processing where most of it caused by act to preventing liver from fall by fixing liver location manually because of machine limitation, and also to analyze the performance of the new installed transfer plate and the inclination angle.

## 1.3 **Project Scope**

The total liver production volume may not indicate the total liver volume to be packed as final product. Some livers are rejected during quality inspection process due to defect from incoming raw material. Shortage of workers at livers inspection station that may also contribute to lower volume of livers sorted and inspected. This situation occurs when some of the workers are on leave or suddenly resigned and communication issue. Questionnaires only done to selected response because some of them are foreign workers, mainly from Bangladesh, Pakistan, Nepal and Myanmar yet unable to communicate in Bahasa Melayu or English fluently.

## 1.4.1 Outcome

The study will provide the solution to minimizing waste at liver harvesting machine by improve the machine efficiency through technical research, design and improvement at the affected area. Based on production data sheets indicate that currently the efficiency rates are 86% with production line



maximum capacity is 12000 birds/hour (200 birds/minute). However the normal running capacity is 195 birds/minute. Total liver produced after evisceration is 185 liver/minute. Total liver entering harvester are equal to total liver produce after evisceration. Total liver volume at inspection station is 165 liver/minute. Total liver volume at inspection station is 165 liver/minute. Total liver volume at inspection station is 165 liver/minute. Total liver volume at inspection station is 200 birds/minute. Total liver volume at inspection station is 200 birds/minute. Total liver volume at inspection station is 200 birds/minute. Total liver volume at inspection station is 200 birds/minute. Total liver volume at inspection station is 200 birds/minute. Total liver volume at inspection station is 200 birds/minute. Total liver volume at inspection station is 200 birds/minute. Total liver volume at inspection station is 200 birds/minute. Total liver volume at inspection station is 200 birds/minute. Total liver volume at inspection station is 200 birds/minute. Total liver volume at 200 birds/minute. In percentage, (165/185) x 100% = 89.2% is current efficiency.

# 2 Background Research

# 2.1 Poultry Manufacturing Technology

Poultry products are often found contaminated with microorganisms such as *Salmonella* spp., *Campylobacter* spp., *Escherichia coli*, *Listeria monocytogenes* and *Staphylococcus aureus*. The new evisceration technology automatically removes the intestinal pack and transfers it to a synchronously running organ line with no contact between carcass and product. Later on, hearts, lungs and livers are removed automatically. For all machines used during opening and evisceration, cleaning in-place systems have been developed. These developments also mean that cross-contamination from equipment to product is less likely[1].

A poultry processing specialist, Baader Food Processing Machinery, explaining about high performance evisceration processing technology can help in perform high capacity, more flexible production, enhance biosecurity and food safety, easy maintenance and hygiene yet more intelligent to ensure workers' safety. Latest evisceration technology capable of processing up to 13,500 birds per hour with focus on quality and food safety. Evisceration process is flexible to handle varying flock sizes, and tolerates some degree of size variations within the flocks and breeds being processed. The Eviscerator removes the giblet and intestines pack then transferred to a separate clip overhead conveyor to avoid faecal contamination from the intestines to the carcass. Adjusting the evisceration machine to fit the actual flock size allows for obtaining a complete pack removal, protecting the pack and the ribcage, and minimizing contamination with gall or faeces. Automation and high line speed place great demands on the security around the machines and guaranteed of workers safety. Maintenance become easier by minimizing lubrication points, implementing easy-release units, and using service-friendly bearing constructions and easy access for cleaning[1].

#### 2.2 Waste Management



There are seven types of waste in production of a goods and service. The seven wastes was originated in Japan, where waste is known as "muda". Lean is a way of achieving more with less resources, creating an organization that responds to greater flexibility with shorter lead time and where the focus is on the customer, both external and internal. Lean management is an approach to running an organization that supports the concept of continuous improvement, a long-term approach to work that systematically seeks to achieve small, incremental changes in processes in order to improve efficiency and quality. Lean management seeks to eliminate any waste of time, effort or money by identifying each step in a business process and then revising or cutting out steps that do not create value[2].

#### 2.3 Liver Health And Safety

Regarding to Bartkowiak-Higgo, Veary, Venter and Bosman from article 'A Pilot Study On Post-Evisceration Contamination Of Broiler Carcasses And Ready-To-Sell Livers And Intestines (Mala) With *Campylobacter Jejuni* And *Campylobacter Coli* In A High-Throughput South African Poultry Abattoir', indicated that the *Campylobacter* are occasional pathogens in a wide range of animals, is the source of infection for humans. *Campylobacter* can often be isolated from the carrier-animals, such as poultry, cattle or sheep. Contamination of poultry is thought to be colonization of birds in a flock. *Campylobacter* are usually introduced into a flock by single birds and transmission throughout the remainder of the flock is rapid. Poultry meat is cited as the most important source of human *campylobacter* spp. in their intestinal and contamination of carcasses and products is common during slaughtering and processing[3].

By referring to Food Safety And Inspection Service (FSIS), United States Department of Agriculture (USDA), from their official government website https://www.fsis.usda.gov/ChickenLiver, there are some food safety risk from chicken liver which contributed to numerous outbreaks of illness as reported in Most these outbreaks that country. of were caused bv the bacteria Campylobacter and Salmonella. Consuming inadequately cooked chicken liver is risky because pathogens can exist both on the external surface of the liver and in its internal parts. Chicken liver dishes should be consumed only after being cooked throughout to a safe minimum internal temperature of 73.9°C and should be handled carefully to prevent cross-contamination[4].

Research by New South Wales Food Authority on September 2018 titled *Campylobacter* In Chicken Liver, specify that there is a scientific agreement that



poultry meat is a major transmission, in most countries for campylobacteriosis. Campylobacteriosis is spreads from infected animals to humans, from person to person via water, food or direct contact. The symptoms of campylobacteriosis normally last from two to 10 days diarrhoea, vomiting, and cramping. There have been various interventions of poultry production to attempt to reduce *Campylobacter* contamination. Interventions such as increasing on farm biosecurity controls, minimising cross contamination from the intestinal tract during slaughter, air and water chilling, post slaughter rinses and storage conditions. At the poultry abattoir, liver is removed by machine and visually inspected. Damaged livers are removed manually, and the remaining livers are rinsed with chlorinated chilled water to remove any loose organic matter[5].

Although some of chicken liver containing harmful bacteria, there are some health benefits of consuming the chicken liver. As reported by *webmd.com*, the chicken liver is a great source of nutrients. Rich with iron, folate, and a variety of vitamins and minerals, the food packs a powerful punch of health benefits. Chicken liver is rich with essential fatty acids and protein. Chicken liver also contains Vitamin A, B12, C and E. Chicken liver also is a source of Copper, Choline, Folate, Niacin and Riboflavin. Chicken liver is a rich source of protein. Its health benefits include weight management - chicken liver is a filling, low-calorie food. It is also good for blood health. Human body red blood cells need iron and vitamins to transport oxygen and prevent conditions like anaemia, which is when your body lacks the red blood cells they need. With its iron and vitamin content, chicken liver can help combat vitamin B12 deficiency. Besides, it contributes to healthy heart. Chicken liver contains selenium, a mineral that helps to prevent and manage cardiovascular conditions such as heart disease, stroke, and high cholesterol. It is also help maintain organ health. Chicken liver is a "superfood" that packed with nutrients to keep a body healthy. Vitamin A helps protect vision and eye health, strengthens immune system, and helps organs like the kidneys and heart function properly. Vitamin B2 helps body make energy from food and keeps cells strong. Vitamin B12 helps brain to work better[6].

With using the lean manufacturing practices, there are few wastes has been identified. At least five types of waste are identified that are possible to eliminate which is **transportation** where liver movement from harvester to washer using transfer plate as transportation medium, **waiting** where operators need to wait for livers output from washer to inspection station. The output will be less because some of the liver accumulate on transfer plate. Another waste is **unnecessary motion** when operators interfere in the machine operation by moved the stacked liver manually from transfer plate to washing machine. **Inappropriate processing** is another waste that exist when harvesting machine produce more



liver volume compare to the liver volume that entering washing machine and the fifth waste is **defect** where mixing between healthy and contaminate liver on transfer plate causing defect to the product.

This improvement project needs to be done at a location where liver waste is very high during production cycle are running, simple yet effective in order to solve the stated issue. The liver also must not to be expose to the surrounding in certain duration because the delay might increase the risk of contamination and must be able to prevent the intervention from the operators toward machine by eliminating the delay of transfers from one machine to another machine.

#### 3 Methodology

#### 3.1 **Problem Analysis.**

3.11 Livers fall to machine floor during feeding from liver harvester to transfer plate.

Liver harvester movement principle is harvesting is rotating in clockwise. The machine pull down the liver and separate them from gizzard and heart. The livers then transferred to collector plate. A rotating wiper then wipes and gather all livers, and clean the plate together with water flow. The wiper then pushed them into a hole on the edge of the plate causing the livers fall to the transfer plate beneath. Inertia generated from the fast-rotating wiper make the livers that fall to the transfer plate is not in vertical movement but fall with some offset in angle. Due to the circumstances, some livers not fall on the transfer plate but directly to the bottom of the machine and becoming waste. The rest of the liver fall at the edge of the transfer plate and remains on it. The cycles keep repeating causing more liver accumulated and then start to fall to the bottom of the machine.



Figure 1:



3.1.2 Livers gathered and stacked at the edge of transfer plate before entering washing machine, then fall to the ground.

After liver being transferred towards drum washer, some livers are gathered and stacked at the edge of transfer plate. Livers accumulated just in front of drum washer. Although the transfer plate being drained by water directly from the harvester, it is still unable to move the liver towards the washer smoothly. Later, the accumulated livers fall to the ground before entering the washer. The cause upon the issue which is transfer plate feeding angle is nearly in horizontal. Even though enough water flow on transfer plate, it is still unable to move the livers towards drum washer.

#### 3.1 Brainstorming

3.1.1 Livers fall to the machine floor during feeding from liver harvester to transfer plate.

The main cause of the issue is 'inertia effect' from top rotational mechanism dynamicity towards static transfer plate at the bottom. Two types of adjustment may overcome the problem but both ideas have its own advantages and weaknesses. Adjustment on dynamic parts is to reduce the inertia effect before the product (livers) reach static transfer plate and adjustment on static part is to ensure the it is compatible to receive incoming product properly with inertia effect from dynamic parts.

Adjustment On Dynamic Parts				
No.	Ideas	Advantages	Weaknesses	
	Reduce rotation speed.	Lower the inertia effect.	Reduce speed means reduce production volume. Every machine has synchronized by	
1.			controller and communication systems. Any adjustment must consider the chain effect and related setting.	
			Risk of communication problem between machine and conveyors.	
			Difficult to do.	
	Reduce water flow on collector plate.	Lower the inertia effect.	Reduce cleanliness on collector plate.	
2.		Saves water consumption	Risk of liver contamination on collector plate.	

 Table 1: Analysis for possible adjustment on dynamic parts.



Table 2: Analysis for possible adjustment on static parts. Idea from column 2
is selected.

	Adjustment On Static Parts					
No.	Ideas	Advantages	Weaknesses			
1.	Repositioning transfer plate	Liver may fall nicely on the transfer plate from harvester.	Liver may not enter washing machine since currently plate position has been perfectly align facing washing machine.			
	Assemble a support of the	Inertia will not affect the livers because vertical plate will act as stopper to prevent liver falling.	Use only food grade material to assembly. Transfer plate is made by stainless steel,			
2.	Assemble a support at the edge of the transfer plate.	Easy to do yet effective.	so do the vertical plate extension should.			
		Low-cost improvement.				
		If not succeed, the				
		assembly can be removed				
		anytime.				

3.1.2 Livers are gathered and stacked at the edge of the transfer plate before entering the washing machine, and then fall to the ground.

Table 3: Analysis on liver feeder adjustment. Idea from highlighted
column is selected.

Adjustment On Liver Feeder				
No.	Ideas	Advantages	Weaknesses	
1.	Increase water flow on transfer plate surface	Liver will not accumulate on transfer plate.	Increase water consumption. Proper water piping needs to be installed with extra cost. Need for servicing.	
2.	Adjust angle of inclination for transfer plate	Liver will not accumulate on transfer plate. Simple yet effective. No extra cost needed. Can be refix at any time if needed. Maintenance free.	Need to find accurate inclination. Too steep will make livers move too fast towards washing machine, and hit machine surface causing damage on livers.	
3.			High starting cost.	



Chan	Change transfer plate to small	Liver will not accumulate on conveyor.	Need of electrical wiring and power supply.
			Complicated to proceed
CONVE	eyor.	Smooth liver movement.	Need maintenance.

- 3.1.3 Current issue Liver falls to the machine floor during moved from liver harvester to transfer plate. The improvement is to assemble a support at the edge of the transfer plate. It has many advantages such as inertia will not affect the livers because vertical plate will act as stopper to prevent falling, easy to do yet effective and low-cost improvement. Although it has many advantages, it is also having a limitation which is need to use only food grade material to be fixed.
- 3.1.4 Current issue Livers are gathered and stacked at the edge of the transfer plate before entering the washing machine, and then fall to the ground. The improvement is to adjust angle of inclination for transfer plate. This idea has an many advantages such as liver will not accumulate on transfer plate, simple yet effective, no extra cost needed, can be refix at any time if needed and also maintenance free.

Although it has many advantages, it is also having a limitation which is need to find an accurate inclination angle. Too steep will make livers move too fast, and hit washing machine surface may damage the livers.

# 3.2 Installation

The installation has been carried out with eight major steps:

- Find a size of stainless-steel plate with thickness of 2 mm at maintenance store an cut and fabricate the plate to achieve the desired dimension (100 x 450 mm).
- ii. Aligned the fabricated piece to transfer plate with 45° angle opening from bottom.
- iii. Welding the fabricated plate to the transfer plate exactly as planned.
- iv. Adjustment transfer plate feeder angle, from 10° (default) to 20°. The inclination is only 10° in order to make sure all livers moved towards washing machine smoothly and prevent livers hitting the washing machine wall that may damage the liver.
- v. Monitor the result Fabricated plate; successful. Angle inclination; need to decrease because livers move quite fast.



- vi. Fine-tuned the feeder angle from 20° to 15°. This is because livers move quite fast into the drum washer. Although the liver quality is still acceptable at 20° angle, minimizing the angle to 15° may maintain the liver quality at its best.
- vii. Monitor the result again. From the observation, the improvement is successful.
- viii. Do counting on sampling for a week, three samples per day. Record the findings and compare the data before and after improvement.

#### 4 Result And Discussion

#### 4.1 Result

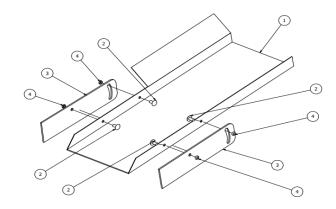


Figure 3: Exploded view of transfer plate assy.

#### Discussion

Liver Production	Before		After	
Volume (12k Processing Line)	Volume/Min	Percentage	Volume/Min	Percentage
Normal Bird Capacity (NBC)	190	100 %	190	100 %
Liver Entering Harvester (LEH)	185	97.37 %	185	97.37 %



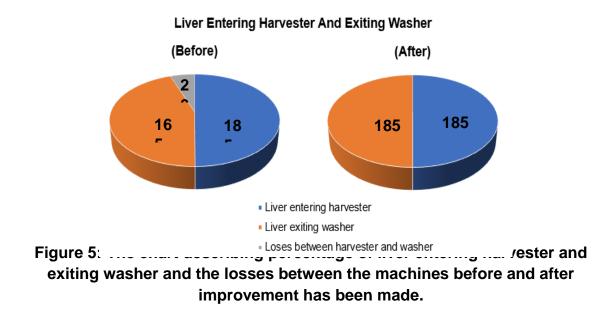
Liver Exiting Washer (LEW)	165	86.84 %	185	97.37 %
Losses Between Harvester & Washer	20	10.81 %	0	0 %
Total Losses (NBC – LEH – LEW)	25	13.16 %	5	2.63 %

# Table 5: Liver production volume data comparison on average before and afterimprovement.

Table 5 clearly shown that loses between harvester and washer before improvement is 20 pcs/minute and after improvement is zero. It also shown that liver volume when exit from washer is 165/min before, and 185/minute after the improvement.

The table also describing the percentage of the waste between harvester and washer is 10.81% of total production volume before improvement is taking place. The table also shown that the waste between harvester and washer is 0% of total production volume after improvement. Liver exiting washer is 86.84% of total production before improvement and rise to 97.37% after the improvement.

From chart on figure 5, volume of liver entering liver harvesting machine and exiting washing machine and the losses that occur between both machines before and after the improvement shown. Before the improvement has taken place, 20 of liver are becoming waste at this point. After the improvement, the waste becoming zero.





#### 5 Conclusion

### 5.1 Conclusion

The project is successful and obtain best result in minimizing liver waste. From 10% waste occur between harvester and washer previously, the improvement has eliminated the issue up to 0% waste occur. It has met the objective as to innovate transfer plate and inclination angle in order to minimizing liver waste, increase liver production volume, prevent healthy liver becoming bacterial contaminant and minimizing human interfere during machine processing where most of it caused by act to preventing liver from fall by fixing liver location manually.

# 5.2 Suggestion

Although the losses at the spot is 0%, there are still an accumulated waste for the entire production line for 2.63% of total production. Despite the figure is very low, it is still having a potential to be improved in the future.

#### References

*High Performance Evisceration.* (2018, January). Baader Food Processing Machinery,

Linco Food System, Denmark.

David McBride, (2003, August 29). *The 7 Wastes In Manufacturing*. EMS Consulting Group Inc, Calsbad, California, USA. <u>https://www.emsstrategies.com/dm090203article2.html</u> (retrieved on Oct 25, 2021)

- Bartkowiak-Higgo A J, Veary C M, Venter E H, Bosman A M. (October 2006). A Pilot Study On Post-Evisceration Contamination Of Broiler Carcasses And Ready-To-Sell Livers And Intestines (Mala) With Campylobacter Jejuni And Campylobacter Coli In A High-Throughput South African Poultry Abattoir. Journal of the South African Veterinary Association.
- Chicken Liver Resources for Illness Prevention. (2021, April 7). Food Safety And Inspection Sevice (FSIS), United States Department of Agriculture (USDA). https://www.fsis.usda.gov/ChickenLiver (retrieved on October 12, 2021)



Campylobacter in chicken liver, (2018 September). NSW Food Authority, New South Wales Government. https://foodauthority.nsw.gov.au, NSW/FA/FI283/1809 (retrieved on November 15, 2021)

Chicken Liver: Are There Health Benefits? WebMD.

https://www.webmd.com/diet/health-benefits-chicken-liver#1 (retrieved on October 12, 2021)



# BICYCLE TOURISM: THE POTENTIAL OF KUALA LUMPUR CYCLIST PATH AS AN URBAN CYCLING TOURISM DESTINATION

#### Muhamad Adib Bin Zainol Agos<sup>1</sup> and Humairah Binti Hamzah<sup>2</sup>

Department Of Tourism and Hospitality, Politeknik Ibrahim Sultan, Pasir Gudang, Johor muhamadadib9860@gmail.com <sup>1</sup> humairah\_hamzah@pis.edu.my

#### Abstract

In the last decade, cycling has become an increasingly important factor for national and local governments around the world, owing to popular knowledge of its health advantages and ability to reduce greenhouse gas emissions. Satisfaction is the act of satisfying a need or want, as well as the sensation that results from such completion and allows a better quality of life among the consumers or users. The goal of this research was to determine the impact of sports tourism activities on urban citizens' satisfaction with the cyclist route connecting the Kuala Lumpur Convention Centre (KLCC) and Dataran Merdeka. This survey was carried out online via a questionnaire with 360 respondents with cyclists' backgrounds participated. The data was collected using a quantitative approach. Using evidence from existing literature, observations of the quality and use of Kuala Lumpur's first cyclist route from Kuala Lumpur Convention Centre (KLCC) to Dataran Merdeka. Findings from this research came to the results of the effectiveness of the cyclist route, the satisfaction towards cyclist route, healthy lifestyle and the development pattern from the collection of data. This exploratory research highlights the challenges that a car-dependent city faces in urban transformation and promoting cycling, as well as residents' motivations and deterrents to use bicycle for commuting and a healthy lifestyle.

Keywords: Urban Cycling, Tourism, Sports Tourism, Bicycle Events.

#### 1. Introduction

Sports tourism has become a popular sub-industry in today's tourism industry. Previously, scholars, policy makers, and governments involved in the tourism and sports fields all independently perceive their own interests. Each other; now people realize that the synergy of the two produces far greater benefits. This research examines the development of sports tourism in Malaysia. Found that the Le Tour competition was successfully held in the de Langkawi in 1996 was a turning point for the government to focus on the development of the sports tourism sector.



In later a long time, cycling has developed as a progressively critical thought for national and local authorities around the world, fundamentally since of the public developing mindfulness approximately its health benefits and nursery emanations diminishment. Within the final decade, transport-related arrangements in Malaysia and especially in Kuala Lumpur have been looking for to back cycling as a travel mode, however, cycling levels in Kuala Lumpur stay moo and prove approximately mediations are blended. Information from an exploratory case ponder is utilized here to get it the transportation framework arranging and urban growth of Kuala Lumpur and their effect on cycling take-up, looking at the current status of cycling offices in KL, assessing the capability of the cycling intercessions, and the states of mind of members of cycling events towards utilizing bike.

Moreover, although the impact of weather conditions on cycling is well documented, they have covered countries with mainly mild climates or relatively cold and snowy winters, excluding Malaysia, which has a tropical climate. (Böcker, 2013; Flynn 2012; Helbich et al, 2014; Koetse and Rietveld, 2009; Saneinejad, 2012; Wadud, 2014). There is only a single paper (Meng 2016) that discusses systematically the impact that tropical weather conditions and weather forecasts have on cycling travel behavior in Singapore; however, that was a study looking at established cyclists. Thus, this study is to identify the effectiveness of the Kuala Lumpur Cyclist Path to be an Urban Cycling Tourism Destination.

#### 2. Literature Review

A literature review is a synthesis of the available scholarly literature on your issue. This synthesis combines the conclusions of numerous sources to explain the topic's broad understanding, so setting the groundwork for both the research question and primary study.

# 2.1 Urban cycling and tourism

This essay will claim that there are significant ties between local mobility cultures, particularly local cycling cultures, and the growth of bicycle tourism. An issue in analyzing tourism mobility, such as bicycle tourism, is the separation of transport systems from tourism in the majority of the literature. For this reason, this section includes considerations of urban riding in general and bicycle tourism in particular.

After the urban cycling revival, many texts have examined cycling as urban mobility. Some have taken a comprehensive view of urban riding, comparing advances in different parts of the world and looking at health, safety, gendered elements, etc (Dextre, Hughes & Bech, 2013; Parkin, 2012; Pucher & Buehler, 2012). Ecological, accessibility, and space-saving benefits of cycling for urban development. Several efforts have been made to promote cycling (Heinen, van Wee, & Maat, 2010; Pucher, Dill, & Handy, 2010), focusing on bike lanes, commuting trails, inter-modal solutions at traffic nodes, bike-share schemes, and internet-based smart mobility (Behrendt,



2016; Bendiks & Degros, 2013; Furth, 2012; Pucher et al., 2010; Zhang, Zhang, Duan, & Bryde, 2015). This literature focuses on technical solutions or the supply side.

# 2.2 Sports Tourism

In research from Saayman (2012), the concept of sports tourism may be traced back to Baron Pierre de Coubertaine, the "Father of Modern Olympic Games," who served as an inspiration for its development. He believed that participation in sports brought people closer together and, as a result, improved ties between diverse nations and the groups that comprised them. It was de Coubertaine's idea that sparked the growth of the sports tourism industry and laid its basis. As a direct consequence of this, the profession of sports tourism is now a functioning industry, which has provided a boost to the pursuit of business entrepreneurship, increased economic effect, and increased profitability within the tourist sector. The term "sports tourism" refers to "the use of sporting activities as a medium for the promotion of tourist endeavours." After coming to this conclusion, a comprehensive definition for "sports" within the context of sports tourism was provided. This definition focused on the "physical" part of activities such as running, leaping, strolling, racing, throwing, shooting, hitting, and other similar activities. This description included the key remark that a "sports tourist" might be either an active participant or a passive spectator in the sporting event. The "physical" part of a sport, on the other hand, is what acts as the "polarizer" for the tourist industry. The concept of "sports tourism" has also been segmented along the lines of several activity categories that have direct connections to tourism. Within each activity category, factors such as history, destination, policy, economic effect, social impact, and others of a similar kind are taken into consideration.

According to recent "tourism endeavors," the following sorts of activities have been designated as being part of sports tourism:

- 1. Sports Tourism Event When it comes to sports events that bring in a lot of people, it's important to remember that most people will only be there to watch, not to play. These athletic events are accessible to players, coaches, and other sports professionals who do not reside in the local region. There may be a cultural component included in some sports tourism events. Additionally included in this category are well-known mega-events and tourism destinations all across the world. Examples of such events include the Olympics, the World Cup, and several other significant regional, national, and worldwide gatherings.
- 2. Sports Tourism Attraction Attractions for sports tourism are those attractions that give "energizing power" by centering their principal point of interest solely on sports-related physical activities. These attractions are known as "energizing power attractions." These kinds of attractions are typically located in certain areas of a region, in the countryside, or in an urban setting, and they offer guests a wide range of things to see and do in an atmosphere in which their personal and societal expectations are fulfilled to varying degrees, depending on the specifics of the attraction. Attractions for tourists may be either found



naturally (such as parks and mountains) or man-made (such as buildings and museums).

- 3. Sports Tourism Tour Tours that are considered to be part of the field of sports tourism often include visits to a certain number of sporting venues spread out over the course of a certain amount of time. Aside from that, a tour of a sports destination often includes stops to both big sporting events and significant sports destinations, such as historic buildings, halls of fame, and sports competitions. A sports tourism tour may also be defined as attendance at a certain number of important sporting events as well as involvement in a variety of sporting-related conferences, seminars, and clinics. Ultimately, trips that are connected to the natural features of a location and are sought for by visitors for aesthetic or physical reasons (such as canoeing, cycling, and hiking).
- 4. Sports Tourism Resorts This category includes resort buildings or villas that have sports as their major concentration and marketing approach. These complexes and villas are well-planned and integrated. The majority of the time, these vacation centers feature facilities and services accessible to sports tourists that are of a very high grade. In general, this resort category provides instructors, trainers, and coaches who have a significant amount of knowledge and personal prominence. In addition to that, high-tech educational equipment for both practice and gameplay is given to you. The majority of the time, these resorts provide expansive and ideal locations, venues, and facilities for a variety of sporting activities. For instance, golf resorts, fitness and spa resorts, outfitters, condominiums that provide both golf and skiing, and more.
- 5. Sport tourism cruises Despite the fact that the technology used to build ships has only made incremental improvements over the years, cruise ships are increasingly resembling hotels and resorts. The cruise category identifies those kinds of boat cruises that make the participation in sports or other athletic activities the primary focus of their marketing approach. It's possible that some ships may host exclusive sporting events, complete with well-known athletes in attendance. Another major aspect of this category is the use of watercraft for the purpose of participating in athletic activities such as yachting, sailing, and barging.

#### 3. Methodology

Researchers are focusing on data collecting to obtain information regarding respondents' perspectives on the effectiveness of the Kuala Lumpur Cyclist Path. A destination for urban bicycle tourism based on both primary data collected through a questionnaire and secondary data collected from prior papers and journals. There were a total of 360 respondents that filled out the questionnaire. The demographic is included in the distribution of questionnaires to Kuala Lumpur's cyclist groups via WhatsApp, Facebook, Instagram, and Telegram which consists of around 3 thousand members. Google Forms are utilized to analyze the data. On-



site observations and informal conversations with bicycle tourist actors supplemented the document analysis.

Demography		Frequency	Percentage
Gender	Male	68	51.9
	Female	63	48.1
Age group	Under 19	8	6.1
	18 – 29	84	64.1
	30 – 39	34	26
	40 – 49	5	3.8
Education	Primary	3	2.3
Level	Secondary	21	16
	Tertiary	107	81.7
Occupation	Governent	34	26
	Non-Government	35	26.7
	Student	59	45
	Unemployed	3	2.3

Table 1: Demographic profile of Respondent

Results in Table 1 shows that the majority of the respondents were male (51.9%) and the rest (48.1%) were female. Most of the respondents (64.1%) were aged between 18 until 29 years old, followed by respondents aged 30 until 39 years old (26%), 40 untill 49 years old (3.8%) and aged 19 years old and below (6.1%). The majority of respondents (45%) were students, while the others is consist of government and non government employees followed by the unemployed respondents. Most of the Respondents received education up to tertiary level (81.7%), secondary level (16%), while (2.3)% were primary level.



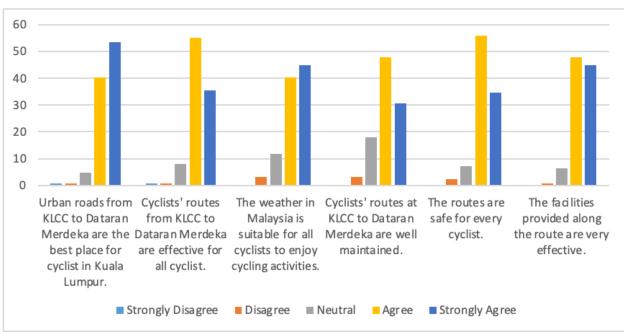
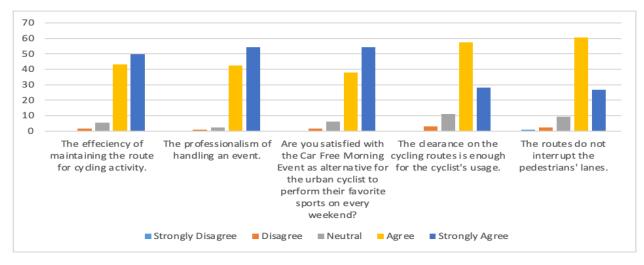


Figure 1: Shows the score of the Urban Cyclist Satisfaction

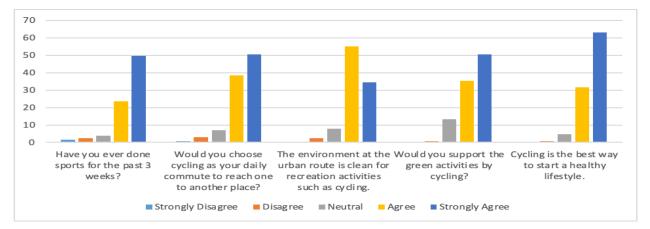
The results in the figure 1 shows the score of the urban cyclist satisfaction which is the matiority of the respondents agree and satisfy with cyclist path from Kuala Lumpur Convention Centre (KLCC) to Dataran Merdeka as a bicycle tourism destination especially in Kuala Lumpur.







The results in the figure 2 shows the score of the efficiency of the cyclist path which is the score of the respondents agrees is slightly past the strongly agree scores which considers the respondents agree that development of the cyclist path from Kuala Lumpur Convention Centre (KLCC) to Dataran Merdeka is efficient for public use.



# Figure 3: Shows the score of the Event Venue from the cyclist path

The results in the figure 3 shows the score of the event venue from the cyclist path which is the matiority of the respondents agree and satisfy with cyclist path from Kuala Lumpur Convention Centre (KLCC) to Dataran Merdeka as a bicycle tourism destination especially in Kuala Lumpur.



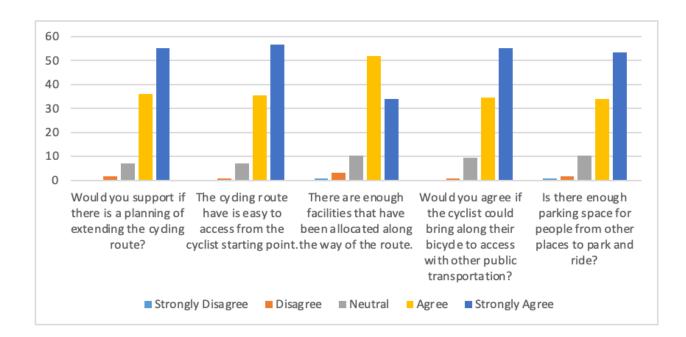


Figure 4: Shows the score of the Maintenance from the cyclist path

The results in the figure 4 shows the score of the maintenance from the cyclist path which is the majority of the respondents agree and satisfy with cyclist path from Kuala Lumpur Convention Centre (KLCC) to Dataran Merdeka as a bicycle tourism destination especially in Kuala Lumpur.

#### 4. Conclusions

Since the 1890s, bicycle and tourism have been linked, but only recently has scholarly interest grown. This work intended to remedy a lack of debate about the features that distinguish bicycle tourists from other tourists, which hampered research into the full scope of this relationship. This research examines existing definitions of bicycle tourism and their concepts. Bicycle tourism is defined as trips away from a person's native region when cycling is the main goal. This revised definition widens the scope for examining the relationship between cycling and tourism by include competitive cyclists and those who visit to attend cycling events. It was suggested that researchers should present different findings for excursionists and overnight visitors to reduce ambiguous interpretations of research results. This is especially important when measuring the benefits of same-day and overnight bicycle visitors in certain places.



#### References

- Behrendt, F. (2016). Why cycling matters for Smart Cities. Internet of Bicycles for Intelligent Transport. *Journal of Transport Geography*, *56*, 157–164. <u>https://doi.org/10.1016/j.jtrangeo.2016.08.018</u>
- Bendiks, S., & Degros, A. (2013). Cycle infrastructure. *Distributed Art Pub Incorporated.*
- Böcker, L., Dijst, M., & Prillwitz, J. (2013). Impact of Everyday Weather on Individual Daily Travel Behaviours in Perspective: A Literature Review. *Transport Reviews*, 33(1), 71–91. <u>https://doi.org/10.1080/01441647.2012.747114</u>
- Dextre, J. C., Hughes, M., & Bech, L. (2013). *Cyclists & Cycling Around the World*. Alianza Editorial.
- Furth, P. G., Mekuria, M. C., & Nixon, H. (2012). Network Connectivity for Low-Stress Bicycling. Transportation Research Record: Journal of the Transportation Research Board, 2587(1), 41–49. <u>https://doi.org/10.3141/2587-06</u>
- Heinen, E., van Wee, B., & Maat, K. (2010). Commuting by Bicycle: An Overview of the Literature. *Transport Reviews*, *30*(1), 59–96. <u>https://doi.org/10.1080/01441640903187001</u>
- Helbich, M., Böcker, L., & Dijst, M. (2014). Geographic heterogeneity in cycling under various weather conditions: evidence from Greater Rotterdam. *Journal of Transport Geography*, *38*, 38–47. https://doi.org/10.1016/j.jtrangeo.2014.05.009
- Koetse, M. J., & Rietveld, P. (2009). The impact of climate change and weather on transport: An overview of empirical findings. *Transportation Research Part D: Transport* and *Environment*, 14(3), 205–221. <u>https://doi.org/10.1016/j.trd.2008.12.004</u>
- Meng, M., Zhang, J., Wong, Y. D., & Au, P. H. (2016). Effect of weather conditions and weather forecast on cycling travel behavior in Singapore. International Journal of Sustainable Transportation, 10(9), 773–780. <u>https://doi.org/10.1080/15568318.2016.1149646</u>
- Parkin, J., Ison, S., & Shaw, J. (2012). *Cycling and Sustainability*. Van Haren Publishing.

Pucher, J., & Buehler, R. (2012). City Cycling. Amsterdam University Press.



- Pucher, J., Dill, J., & Handy, S. (2010). Infrastructure, programs, and policies to increase bicycling: An international review. *Preventive Medicine*, 50, S106– S125. <u>https://doi.org/10.1016/j.ypmed.2009.07.028</u>
- Saayman, M. (2012). *Introduction to Sports Tourism and Event Management, An.* Amsterdam University Press.
- Saneinejad, S., Roorda, M. J., & Kennedy, C. (2012). Modelling the impact of weather conditions on active transportation travel behaviour. *Transportation Research Part D: Transport and Environment*, 17(2), 129–137. https://doi.org/10.1016/j.trd.2011.09.005
- Troy, N., Flynn, D., Milligan, M., & O'Malley, M. (2012). Unit Commitment With Dynamic Cycling Costs. *IEEE Transactions on Power Systems*, *27*(4), 2196–2205. <u>https://doi.org/10.1109/tpwrs.2012.2192141</u>
- Wadud, Z. (2014). Cycling in a changed climate. *Journal of Transport Geography*, 35, 12–20. <u>https://doi.org/10.1016/j.jtrangeo.2014.01.001</u>
- Zhang, L., Zhang, J., Duan, Z. Y., & Bryde, D. (2015). Sustainable bike-sharing systems: characteristics and commonalities across cases in urban China. Journal of Cleaner Production, 97, 124–133. https://doi.org/10.1016/j.jclepro.2014.04.006



# EYE STRAIN MONITORING SYSTEM FOR ELECTRONIC GADGET USERS

Foong Yee Lai, Dr. Hjh Wan Rosemehah binti Hj Wan Omar

Department of Electrical Engineering, Electronic Engineering Technology (Medical Electronic) Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor Darul Ehsan. foongyee9949@gmail.com, rosemehah@psa.edu.my

#### Abstract

COVID-19 use causes dry eyes, fatigued eyes, increased myopia, shoulder, and back pain. Symptoms include dry eye, vision correction, binocular visual pressure, and precorneal tear film complaints. This project will construct a distance circuit utilising an ultrasonic sensor for a vision care detector, a timer circuit for managing the time duration in using electronic devices to prevent eye strain, and an analysis of the eye strain user's usability in distance and time duration. The Arduino microcontroller monitors the user's sitting distance from the screen and time spent on electronic devices. This project's ultimate result is detecting the user's distance from the computer screen; 40 cm is a reasonable distance. Every two minutes, the user's seating distance is monitored to monitor eye movement, improving sitting posture and preventing eye strain.

Keywords: Eye Strain, Computer, Distance between screen and body.

#### 1. Introduction

The Covid viral pandemic put the world on lockdown towards the end of 2019. Following the forced removal of all teaching process to the online. Using technology in the classroom has gained worldwide appeal throughout this time, attracting both critics and advocates (Branzila, 2020). The overuse of technology may have a stronger impact on children and teenagers who are still developing. Portable tablets, smartphones, and computers can hold a user's attention for hours. Causing eye strain. Social media and mobile gadgets can cause psychological and physical concerns such as eye strain and difficulty concentration. This includes serious disorders like depression. Digital eyestrain creates dry eyes. Neck and shoulder pain from eye strain.



Then, contemporary technological advances have revolutionised worldwide lifestyles. While technology provides many benefits, it also has drawbacks (Stephenson et al., 2017).

Thus, long-term use of electronic devices causes vision problems, such as dry eyes, tired eyes, increased myopia, etc during COVID-19. Digital Eye Strain (DES) can cause eyestrain, headaches, impaired eyesight, dry eyes, and neck and shoulder pain. Sheedy described two causes and symptoms of eye strain, or asthenopia. Internal symptoms of strain, discomfort, and headache behind the eyes are linked to accommodative and/or binocular vision stress. External symptoms of burning, irritation, weeping, and dryness are linked to dry eye.

Correspondingly, Portello distinguished between two types of computer-related symptoms: ones related to accommodation such as blurred vision at close range, blurred distance vision after computer use, and difficulty refocusing from one distance to another. For those related to dry eye that will having irritated/burning eyes, dry eyes, eyestrain, headache, tired eyes, sensitivity to bright lights, and eye discomfort (Sheppard & Wolffsohn, 2018).

Additionally, too far or too near when using electronic devices causing eye discomfort even though electronic gadgets greatly facilitate daily living (Jaschinski-Kruza, 1991). Screen height affects blink rate, ocular symptoms, and accommodation amplitude (Atchison et al., 1994; Burgess-Limerick et al., 1998; Jaschtnski-Kruza, 2007; Saito et al., 1997; Villanueva et al., 2007). Because height affects neck muscle activity and pain, the screen should be 15° to 25° below eye level (James E. Sheedy, 2002; Rempel et al., 2007). According to David Rempel and Kirsten Willms' publication, the average viewing distances from the reference postures for near, middle, and distant distances were 52,4, 73,0, and 85,3 cm, respectively. In each action, participants went closer to the screen. When the display was set to a far distance, participants moved their head and torso forward during the exercise, decreasing viewing distance from 85,3 cm to 77.5 cm. Participants moved farther for the farthest viewing distance compared to near and average. Close distance was related with less blurred vision, dry or irritated eyes, headache, and improved convergence recovery. Displays and computer screens should be 52 cm and 73 cm distant (Rempel et al., 2007).

Finally, continuous or uncontrolled long-term use of electronic gadgets might cause discomfort eye symptoms as well as other symptoms such as pain, weakness and numbness in eyes, neck muscles, arm, and wrist (Sarla, 2020).

The project is to design a distance circuit system by using ultrasonic sensor for vision care detector, proposed a timer circuit for managing the time duration in using electronic gadgets as prevention to sore eyes then analyse the usability of eye strain user in distance and time duration of using electronic gadgets.



#### 2. Methodology

In this section, the progress of a product based on the first and second goals is elaborated. This product is meant to provide a monitoring system and reduce eye strain problems by using a distance-monitoring system. The developed project is then tested through Real-time simulation and data analysis for certain users.

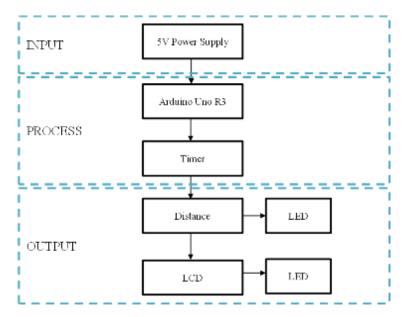


Figure 3: Block Diagram of Eye Strain Monitoring System for Electronic Gadget

#### Users

Figure 1 shown a block diagram of the Eye Strain Monitoring System for Electronic Gadget Users for those who suffer from eye strain, neck and back pain as a result of long-term use of electronic devices. In order for an electronic project to work, it needs a power source. In this case, the power source is a 5V power supply from their devices' USB ports or a smartphone adapter. Arduino Uno R3 is a low-cost and open-source board, and its IDE software is compatible with all operating systems. This system contains an Arduino Uno R3 microprocessor, which serves as the system's central processing unit. The Arduino Uno R3's built-in timer keeps the operation on schedule by synchronising with either the system clock or an external clock, and it can also serve as a reminder to the user to keep track of the time.



A user's distance from their screen is detected after two minutes of the system being activated. The LCD of the device would display messages to remind the user to alter their sitting position in order to maintain proper posture. The LCD would also display additional messages every minute based on the existing distances established in the Arduino to advise the user to rest their eyes and stretch their muscles. Finally, these operations will continue to repeat until the system is shut down.

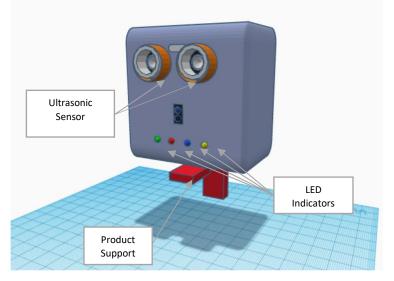


Figure 4: Front View of the Project



Figure 5: Overview of The Project With Electronic Gadget

Both Figure 2 and Figure 3 shown the 3D design that was created for the project using Tinkercad. This design includes all of the necessary components for the project, with their respective layout sizes taken into consideration. After being designed in Tinkercad, the product is expected to have dimensions of 9 cm x 15 cm x 8 cm. As a result, the product is compact and lightweight.



#### 3. Result And Discussions

In this section, the findings of the produced Eye Strain Monitoring System For Electronic Gadget Users are discussed briefly relying on the hardware implementation, data analysis, and standard operating procedure for the product.

3.1 Developed Eye Strain Monitoring System for Electronic Gadget Users

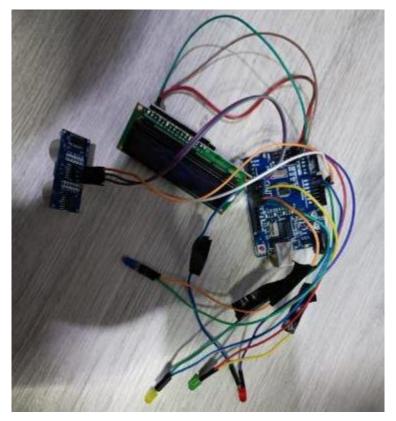


Figure 6: Electronic Circuit connection of the Product

Figure 4 shown that a circuit connection for the electronic component. The electronic components consist in the block diagram are Arduino Uno R3, 16x2 Liquid Crystal Display (LCD) Module, Male-to-Male connection jumpers, 4 LEDs (blue, green, red and yellow) and an ultrasonic sensors. This project was succed to launch as a product and a LCD is added to display messages sush as "Please sit properly." and "You should rest your eyes or massage the area around your eye".



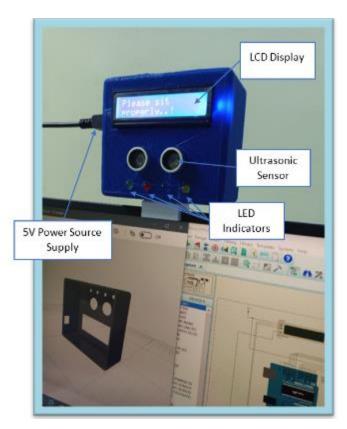


Figure 7: Prototype of the Product To The Electronic Gadget

Figure 5 shown that the application of the product to the electronic gadget for example laptop.

Stages	LCD Messages Display	LEDs
The product is turned on.	"Initialize" " Please wait" " WELCOME"	Blue & Green & Red & Yellow
When the distance is exceed 40 to 60 cm.	" Please sit properly!"	Blue & Yellow
When the timer counted every interval 1 minutes and the distance exceed in 40 to 60cm for eye blinks.	" You should rest your eye or massage around your eyes."	Red & Blue



# 3.2 Standard Operating Procedure of Product

This section will outline the application of the project, as well as the flowchart used in the developed of Eye Strain Monitoring System For Users Of Gadgets.

Figure 6 and 7 shown the used of "Eye Strain Monitoring System for Electronic Gadget Users". The user will use electronic gadgets while the monitoring system is active. After two minutes, the Eye Strain Monitoring System begins to detect and compute the distance between the user and the device's screen. If the distance detected is not between 40cm and 60cm, the yellow and blue LED will blink and the LCD will display the message "Please sit properly." Following that, the Arduino Uno R3's timer will count up to 1 minute's intervals. After 1 minute, the ultrasonic sensor will detect the distance between the user and the screen once again. Alternately, if the detected distance is out of range, the LCD will display a message such as "You should rest your eyes or massage the area around your eye." The red and blue LEDs will blink simultaneously. The process is repeated until the user stops using their gadget, at which point the Monitoring System is turned off.



Figure 8: User (A) before using Eye Strain Monitoring System



Figure 9: User (A) after using Eye Strain Monitoring System



Figure 6 shown that the user was no awareness without the monitoring system. Due to the analysis stage, the symptoms such as dry eye, headache, shoulder and back pain obviously discovered before she was used the product. Figure 7 shown that the user was using her laptop within the product. During the testing stage, the products control the ultilize timing for the user while using laptop. The eye strain symptoms and also the sitting distance also improved due to the messages displays that notify the user. The message "Please sit properly" is to notify the user the maintain a good sitting distance with the screen while the message "You should rest your eyes or massage the area around your eye." is to monitor the user to follow up their vision condition and also stretch their shoulder, arm and back.

# 4. Conclusions

These studies served three unique aims, all of which were accomplished. First, the development of an eye strain monitoring system for electronic gadget users is performed by embedding a system that maintains the user's distance from the device's screen. The rate of eye blinks increased due to the use of this product by those who experience eye strain and bodily pain while using electronic devices. It has been demonstrated that reminder messages can relieve symptoms of eye strain and body pain. Aside from the fact that the product was successfully developed, several suggestions were made to enhance its usefulness. Modernize the detection of body-screen distance using an AI camera in order to detect and identify the sitting angle and several sitting positions. Configure the distance and height studies and product updates based on different user categories, such as children, adults, and the elderly. Develop an IoT interface system so that consumers may utilise the product by selecting and controlling modes based on their group status.

#### References

- Atchison, D. A., Claydon, C. A., & Irwin, S. E. (1994). Amplitude of accommodation for different head positions and different directions of eye gaze. Optometry and Vision Science : Official Publication of the American Academy of Optometry, 71(5), 339– 345. https://doi.org/10.1097/00006324-199405000-00006
- Branzila, C. I. (2020). Online teaching English for Business and Economics in the time of pandemics. *Review of Economic Studies and Research Virgil Madgearu*, *XIII*(2), 27–36. https://www.ceeol.com/search/article-detail?id=951399

Burgess-Limerick, R., Plooy, A., & Ankrum, D. R. (1998). The effect of imposed and



self-selected computer monitor height on posture and gaze angle. *Clinical Biomechanics*, *13*(8), 584–592. https://doi.org/10.1016/S0268-0033(98)00021-7

James E. Sheedy, P. G. S. M. (2002). *Diagnosing and Treating Computer-Related Vision Problems - James E. Sheedy, OD, PhD, Peter G. Shaw-McMinn, OD -Google Books.* Google Books. https://books.google.com.my/books?hl=en&Ir=&id=z4GnbPmRQp8C&oi=fnd&pg =PA1&dq=sheedy,+J.+E.,+%26+Shaw-McMinn,+P.+G.+(2003).+Diagnosing+and+treating+computerrelated+vision+problems+(1st+ed.).+Burlington,+MA:+Butterworth+Heinemann. &ots=G5o5lqvBtb&sig=lnwr5fGbmitjF8deWM6xMtjajuE&redir esc=y#v=onepag

- e&q&f=false
- Jaschinski-Kruza, W. (1991). Eyestrain in VDU users: Viewing distance and the resting position of ocular muscles. *Human Factors*, *33*(1), 69–83. https://doi.org/10.1177/001872089103300106
- Jaschtnski-Kruza, W. (2007). Visual strain during VDU work: the effect of viewing distance and dark focus. *Http://Dx.Doi.Org/10.1080/00140138808966788*, *31*(10), 1449–1465.
- Rempel, D., Willms, K., Anshel, J., Jaschinski, W., & Sheedy, J. (2007). The effects of visual display distance on eye accommodation, head posture, and vision and neck symptoms. *Human Factors*, 49(5), 830–838. https://doi.org/10.1518/001872007X230208
- Saito, S., Miyao, M., Kondo, T., Sakakibara, H., & Toyoshima, H. (1997). Ergonomic Evaluation of Working Posture of VDT Operation Using Personal Computer with Flat Panel Display. *Industrial Health*, *35*(2), 264–270. https://doi.org/10.2486/INDHEALTH.35.264
- Sarla, G. S. (2020). Excessive use of electronic gadgets: health effects. *The Egyptian Journal of Internal Medicine 2020 31:4*, *31*(4), 408–411. https://doi.org/10.4103/EJIM.EJIM\_56\_19
- Sheppard, A. L., & Wolffsohn, J. S. (2018). Digital eye strain: prevalence, measurement and amelioration. *BMJ Open Ophthalmology*, *3*(1), e000146. https://doi.org/10.1136/BMJOPHTH-2018-000146
- Stephenson, A., McDonough, S. M., Murphy, M. H., Nugent, C. D., & Mair, J. L. (2017). Using computer, mobile and wearable technology enhanced interventions to reduce sedentary behaviour: a systematic review and meta-analysis. *The International Journal of Behavioral Nutrition and Physical Activity*, *14*(1), 105. https://doi.org/10.1186/S12966-017-0561-4

Villanueva, M. B. G., Takeuchi, Y., Sotoyama, M., Jonai, H., & Saito, S. (2007).



Adjustments of posture and viewing parameters of the eye to changes in the screen height of the visual display terminal. *Http://Dx.Doi.Org/10.1080/00140139608964515*, *39*(7), 933–945.



# DEVELOPMENT FORMALDEHYDE GAS LEAKAGE DETECTOR USING MQ-135 SENSOR IN THE LABORATORY ROOM

<sup>1</sup>Fatin Aqilah binti Hazli, <sup>2</sup>Dr.Hjh Wan Rosemehah binti Wan Omar Electronic Engineering Technology (Medical Electronic), Department of Electrical Engineering, Politeknik Sultan Salahuddin Abdul Aziz Shah, Malaysia. fatinhazli1609@gmail.com, rosemehah@psa.edu.my

#### Abstract

Healthcare workers in contact with formaldehyde in histopathology laboratories are at greater risk than other individuals. Formaldehyde gas is relatively difficult to detect by the human senses. Healthcare workers in contact with formaldehyde in histopathology and anatomy laboratories are at greater risk than other individuals because they are exposed to higher amounts of formaldehyde on a daily basis, either through inhalation or direct contact with the skin. It is difficult to make measurements of safe levels of formaldehyde gas. Exposure to very high levels of formaldehyde over many years has been linked to rare nose and throat cancers in workers. This project is proposed to design and develop a formaldehyde leakage detector for monitoring and to analyses formaldehyde reading for safety precaution. The component that use is exhaust fan and MQ-135 as an input, Arduino Uno is the processor that control the input and output, and for the output are buzzer, red alarm light and LCD display. As a result, exhaust fan will absorb air in surrounding into the box device, then the buzzer and redlight alarm will trig to give alert to the people in the laboratory if leakage occur to 10ppm concentration in air, when accurately measuring, the proper alarm point for the gas detector and the LCD display will display the information of the leakage if leakage occur. This project will come out successful by detecting the gas leakage. Therefore, it may help the laboratory worker to aware about formaldehyde leakage and help to track the position of leakage and smoothing out their daily work.

Keywords: Formaldehyde Gas, Alert, Concentration of Gas

# 1. Introduction

Formaldehyde is used widely in medical applications worldwide, including as a tissue preservative in pathology laboratories, as a sterilizing agent, and as a dis-infectant in operating rooms. It is considered an occupational indoor air pollutant because it volatilizes easily and is emitted into the working environment. Healthcare workers in contact with formaldehyde in histopathology and anatomy laboratories are at greater risk than other individuals because they are exposed to higher amounts of



formaldehyde on a daily basis, either through inhalation or direct contact with the skin. (Zain S. M., 2019).

Development of formaldehyde gas leakage detector using MQ-135 sensor in the laboratory room is to develops a circuit that detecting formaldehyde gas leakage using MQ-135 sensor, the buzzer and red-light alarm will trig to give alert to the people in the laboratory if leakage occur to 10ppm concentration in air thus the exhaust fan will remove the leaking gas away from the leaking area. (IARC, 2006) Research stated that when accurately measuring, the proper alarm point for the gas detector should be determined after considering the temperature and humidity influence.

Therefore, the formaldehyde is mostly used in specialized applications as a tissue fixative and embalming agent. Formaldehyde acts as a preservative or a fixative for tissue or cells. Cross-linking of primary amino groups is required for this process. At normal temperature, 4% formaldehyde solution fixes pathological tissue specimens at a rate of around one millimeter per hour. (ATSDR, 2015)

# 2. Methodology

This paragraph of the study discusses the development of a product based on first and second that is aimed at the detector of formaldehyde gas will detect the leakage and alert the workers in the laboratory. There were, several methods are employed in this chapter to fulfill the task. In making a project, this step must be done before the project is done. In order to generate a high-quality project, it is critical that these processes be completed with caution. Figure (1) displays the block diagram of a formaldehyde gas detector that is intended for laboratory workers at histology that exposed for extended periods of time due to the nature of their employment, which might result health. The device has the ability to detect and alert the user if leakage occur.



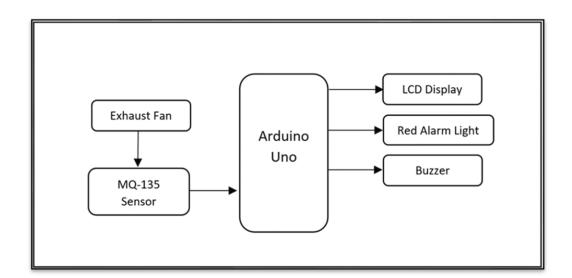


Figure 1: Block Diagram of Formaldehyde Gas Leakage Detector

Figure 1 shown a block diagram that consists of a processor, input, and output. There is an exhaust fan and MQ-135 sensor on the input side, while on the processor side, Arduino uno is used and on the output side, there is an LCD display, red alarm light and buzzer. From the input, the exhaust fan will absorb the air into the device that has a sensor which is detect the present of formaldehyde gas. The output will trig the buzzer and alarm light to inform to the workers about the leakage of formaldehyde and the LCD display will display the information of the leakage if leakage occur.

Tinkercad was used to make the prototype of the model and make sure that the user could imagine using the portable. Tinkercad is an online set of tools developed by Autodesk that makes it possible for inexperienced users to construct three-dimensional models. The perspective of the product is shown in Figure 2, the following below shows design of gas leakage detector using MQ-135 sensor in the laboratory room. The 3D design was sketch by using an online 3D design software, Tinkercad...



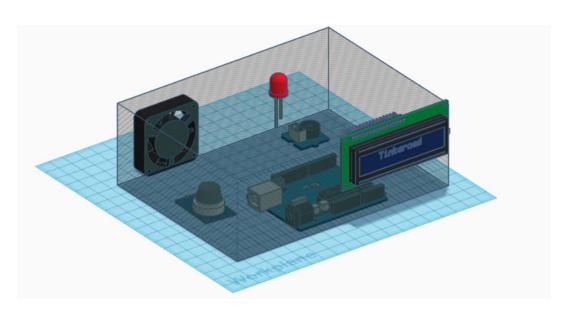


Figure 2: View of product

# 3. Result and Discussion

In this section, the results of the developed product Formaldehyde Gas Leakage Using MQ-135 Sensor in the Laboratory Room are described in detail based on the hardware implementation, application interface, and standard operating procedure for using the product.

3.1 Developed Formaldehyde Gas Leakage Using MQ-135 Sensor

As can be seen in Figure 3, the items that were developed as a direct result of this project were highly successful in its development. The operation of detecting formaldehyde gas leakage using MQ-135 sensor, air will be absorbed into the exhaust fan and if the present of detecting formaldehyde gas leakage using MQ-135 sensor, the buzzer and redlight alarm will trig to give alert to the people in the laboratory if leakage occur to 300ppm concentration

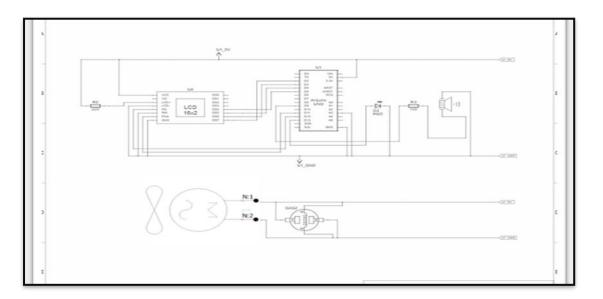




#### Figure 3: Developed product.

As can be seen in the diagram below in Figure 6, show the circuit diagram of the formaldehyde gas leakage detector. Exhaust fans have 2 terminal which is anode (+) and cathode (-) to rotate the motor and spin the fan blade. For the anode it connects to the 5V pin for power supply and cathode connect to grounding (GND) pin for safety to prevent an electronic device's chassis from delivering an electrical shock. For the MQ-135 sensor, has 4 pins where each pin has its own function. Each pin consists of a 5V pin to supply the power, a ground pin to protect the sensor from electric shock, an analog pin, and a digital pin to get the reading. For this project, analog pins are used to get more accurate readings. Then Arduino Uno works as processor to process all the data that receive from the input and issue the result on output based on the coding that has embedded into the processor. Buzzer, red alarm light and LCD display acts as an output to show the result that receive from the input and then process by the processor. Buzzer and alarm light consists of 2 terminal which is anode and cathode, and both connected to the 5V pin and grounding (GND) pin. Last, the LCD display have 16 pins and each pin have their own function. The pins used are pins 1 to 6 and 11 to 16.





# Figure 4: Schematic diagram of project

# 3.2 Standard Operating Procedure of Product

This part explained in detail the standard operating procedures (SOP) for Formaldehyde Gas Leakage Detector using MQ-135 Sensor in The Laboratory Room. The project starts with, based on functions of detecting formaldehyde gas leakage using MQ-135 sensor, air will be absorbed into the exhaust fan and if the present of detecting formaldehyde gas leakage using MQ-135 sensor, the buzzer and redlight alarm will trig to give alert to the people in the laboratory if leakage occur to 300ppm concentration. Research stated that when accurately measuring, the proper alarm point for the gas detector should be determined after considering the temperature and humidity influence. Therefore, it will help the laboratory worker to aware about formaldehyde leakage and help to track the position of leakage and smoothing out their daily work.

# 4. Conclusion

This study developed to develop gas leakage detector of formaldehyde gas with alert system Formaldehyde gas can cause irritation of the skin, eyes, nose, and throat.[5] High levels of exposure may cause some types of cancers. On all occasion gases are used, it is possible that a gas could be leaking into the room or contiguous areas. Gas detectors can be used to detect formaldehyde gas leakage and in fault to alert the user before the gas widely spread and endangering the public. It also helps the early detection of gas before the concentration of gas reaches the dangerous level. There were a few ideas made to improve the product's use, despite the fact that it was successfully produced. This was despite the fact that there were no problems with the product's construction. Increase the sensitivity of the warning system in the event that



there is a leakage, so that it can notify the person in charge even if nobody is in the laboratory.

## 5. Acknowledgement

I am overwhelmed with humility and gratitude for everyone who assisted me in concretizing my concepts beyond the level of simplicity and into something substantial. I would like to express my gratitude to my supervisor, Dr.Hjh Wan Rosemehah Binti Wan Omar, for providing me with the opportunity to complete this project which also assisted me in conducting extensive research and enlightened me to a great number of new things. By supporting and penetrating, they assisted me in achieving one of my life goals. I appreciate the advice I was given.

#### 6. REFERENCES

- [Zain, S. M. S. M., Azmi, W. N. F. W., Veloo, Y., & Shaharudin, R. (2019). Formaldehyde Exposure, Health Symptoms and Risk Assessment among Hospital Workers in Malaysia. Journal of Environmental Protection, 10(06), 861–879. https://doi.org/10.4236/jep.2019.106051
- Mohd Hasbi Sidek. (2016, November 4). Tiga silinder kimia bocor | Harian Metro. https://api.hmetro.com.my/node/179201
- ATSDR Division of Toxicology, C., & Human Sciences, H. (2015). Formaldehyde-ToxFAQsTM CAS . www.atsdr.cdc.gov/toxFAQs.
- Formaldehyde, 2-butoxyethanol and 1-tert-butoxypropan-2-ol. Lyon: International Agency for Research on Cancer; 2006. Formaldehyde; pp. 39–325. (IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans, Vol. 88)
- Golden, R. (2011). Formaldehyde. Critical Reviews in Toxicology, 41(8), 672–721. https://doi.org/10.3109/10408444.2011.573467
- Cadwallader, L., 2007. Gas Monitoring System Design and Operation. Inldigitallibrary.inl.gov. Accessed at https://inldigitallibrary.inl.gov/sites/sti/3772047.pdf

Kim, K. H., Jahan, S. A., & Lee, J. T. (2011). Exposure to Formaldehyde and Its Potential Human Health Hazards. Journal of Environmental Science and Health, Part C, 29(4), 277–299. https://doi.org/10.1080/10590501.2011.629972

J.L.B.G.W.M. (n.d.). Monitoring of formaldehyde in air. PubMed.Gov. https://pubmed.ncbi.nlm.nih.gov/4061288



# A PILOT STUDY ON PROMOTING RURAL TOURISM USING SHORT FILMS VIA YOUTUBE

Afham Dimyati<sup>1</sup>, Khatijah Md Saad<sup>2</sup> and Nadirah Abd Aziz<sup>3</sup>

<sup>1</sup> Department of Design & Visual Communication, Politeknik Ibrahim Sultan, Pasir Gudang, Johor *afhamdimyati98@gmail.com khatijahsaad@pis.edu.my irah.aziz@gmail.com* 

#### Abstract

A short film can be use in the industry of tourism to represent culture and lifestyle of places that can be a great ability to attract people attention. Therefore, the main objective of this study is to produce a short film via YouTube as a medium for promoting rural tourism. The researcher uses qualitative research based on comment column, opinions or experience, like, dislike, and sharing the short film made by the researcher via Youtube. The findings received positive likes and comments from viewers resulted towards the understanding of the storyline, unique camera angle involvement and product placement of Kong Kong Chalet Terapung. To conclude, a short film as a medium for tourism promotion can represent the environment of a place to attract tourists.

Keywords: Short Film, Rural Tourism, Tourism Promotion, Youtube.

#### 1. Introduction

The short film in tourism can get the positive impact to promote the beauty of nature and culture as well as local wisdom of the images destination. The effect of short film can be proved that promotional and marketing strategies can pull up the factors of induced tourism films, namely place, personality, and performance (Adisty, Dita, 2021). The short film can be implements broadcasting platform such as television and YouTube. YouTube is an alternative choice to provides the various information surrounding the world as their medium. Viewers may watch a short film multiple times while it is still available on YouTube. As a result, when tourists get there, they will recognize the locations from the film and begin to tour and feel the experience (Fadhilah, Kuntum, 2019).



In this study, lack of the video material to present the brand and explaining the product and services because of that there required the information videos that describe products and services for them to attract visitors as a major problem. The solution is to design short films by shows the image destination to induce tourist to visit the tourism places. The production of a short film for a tourism destination could attract more tourists and provide them with information about tourist sites. The YouTube platform proved extremely effective in distributing the short films among the community.

#### 2. Literature Review

Video marketing can influence the audience's attitude about the brand, positive word, sharing, promoting, and viewing (K.K. Coker, R.L. Flight, D.M. Baima, 2017). The evolution of commercial video to short film has proven that creating a short film to market a destination image may be acknowledged as advertising. The concept of the short film is what will attract consumers to watch short films on that platform (Rodriguez, P. 2017). Nowadays, the capabilities of social media has become the new method of the internet to distribute content as well as tourism locations (G.F. Liu, P.C. Gao, Y.C. Li, & Z.P. Zhang, 2019). The "Video Era" is a new marketing approach, and videos have the ability to advertise research and commercial operations (J. Rokka, J. Hietanan, & D. Brownlie. 2018). YouTube is the world's largest consumer video content provider (M. Wattenhofer, R. Wattenhofer, Z. Zhu, 2012). YouTube improves the cultural communication process (J. McMullan, 2017). Tourist industry films. Films have a significant impact in shaping people's thoughts and views of an area before they visit it (Noridawati A. Rahman, Zairul A. Dawam, Jeanifer K. Lian, 2019).

The scenery images will be brought to the tourist decision to create the approach as the foundations for visitors to visit. Filming a video to promote rural tourism was a great marketing strategy for promoting tourist areas (Manisha S., Dr. P. N. Premalatha, 2020). Utilizing video as a communication medium provides for more efficient customer engagement. Learning the demands of the target demographic is critical for creating a video that can answer them (M. Malec, T. Cieplak, & L. Jarmul, 2016). Divides short video marketing on social media into three categories: fascinating content, scene-based experience, and user engagement and interaction. Positive brand attitude influence will offer the notion of serving as a bridge between short video marketing and brand attitude. Several companies use short video pan-entertainment material to exhibit a positive brand attitude in social media short video marketing (GaoFu Liu, YuChun Liu, PengChao Gao, ZhuoPing Zhang, 2019).

#### 3. Methodology



This research uses qualitative research methods. It was resolved through qualitative study the method to employ for classifying and analysing data. It is necessary to sift over the data in detail, assess its significance, and identify the sections that are most relevant to the study objectives. Thematical analysis is a frequent approach. Thematic analysis must detect patterns in data, label necessary subjects and concepts, and then arrange into themes.

The framework for completing a study is provided in the research approach. The research methodology is a major aspect that ensures the study is carried out using the proper manufacturing process approach. Furthermore, the methodology of this study can assist researchers in achieving the study's aims and solving the challenges found.

The research strategy and empirical methods for the general approach, and specific techniques to address the research objectives. It also discusses the research design and the methods used it to select research participants and collect data. The logic of development of the process used to generate theory, which is the procedural framework within which the research is conducted, is known as the research methodology. It outlines the foundations of organizing, planning, designing, and conducting research. The research paradigm that a researcher wants to follow impacts methodological decisions. The research paradigm guides not only the selection of data collection and analysis, but also the selection of competing conceptual methods (Kumar Mohajan, H. 2017).

The continuous research and study of materials and resources to establish facts and reach new conclusions, or to investigate something systematically, is described as research. For the aim with doing research, research methodology is critical, and the most appropriate and effective method for solving research problems may be used. As a result, the study techniques involve the design of the study, the study data source, and the data collection method.

A method of answering information gained from a built research problem is called study design. In addition, the study design aids in answering and achieving the study's goals in a holistic manner. Interviews, observations, and visual audits were used to carry out this research, which detail a few of the issues that were discovered. The study's flaw is that KKCT only promotes social media by using images of their customers. They only post images and do not promote videos; instead, they explain the products and services they provide.



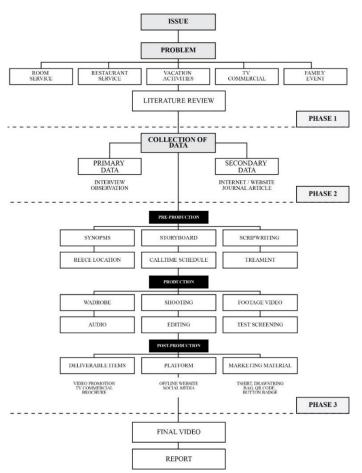


Figure 1 : Research Design

According to Figure 1: Research Design, the first step is to identify the issue and problem statement. That includes the findings concerning the KKCT, as well as how we can solve it as the project's title. The concern, according with study, is that KKCT lacks a promotion item that helps in social media marketing. The KKCT's absence of items stems from video footage that can represent the client of the service it provides. The next step is to read a literature review of another article that is relevant to the research question. The phase was started when the information gathered was divided into two categories: primary data and secondary data. The interview and observation provide primary data, while the internet, website, and journal article provide secondary data.



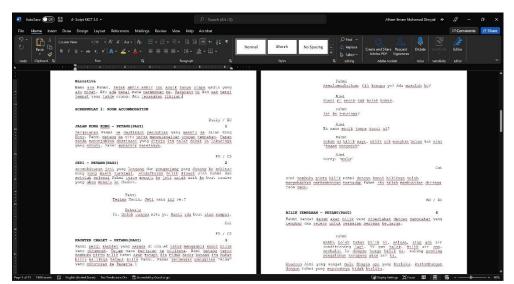


Figure 2: Scriptwriting

On the next phase is the cast and crew, which consist of people from preproduction, production, and post-production, is designed as showed in the figure above, depending on the findings of the research. The synopsis, storyboard, and scriptwriting, among other things, are all part of the pre-production process. Figure 2 show the scriptwriting was in the process typing by using the Microsoft Word and Figure 3 show storyboard draw using the Adobe Photoshop.

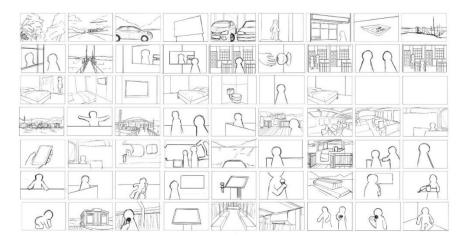


Figure 3: Storyboard

Following that will follow the production process, which includes shooting, sorting, and editing the video. Shooting is the process of shooting a scene according to a storyboard that includes the type of shot and the object or product that will be presented to the audience. Figure 4: show the shooting process.





Figure 4: Shooting Process

Sorting is the process of selecting good footage and matching it with effective audio and sound. The next process is the editing process, which involves compiling all the video and audio footage everything into final video. Figure 5: Editing was the task in the production process.



Figure 5: Editing



Figure 6: Santai Cinta on YouTube



The Figure 6: Santai Cinta on YouTube show the distribution of short film. On the final phase the final video. The platform was selected by using the YouTube. YouTube is the platform for the short film to distribute. According to the platform there are have the features they called the application of YouTube Studio(YTS). The YTS is the application that we can monitor all the video in the channel.

#### 4. Findings and Discussion

The destination of the research is the Kong Kong Chalet Terapung, Jalan Kong Kong at Pasir Gudang, Johor Bahru. KKCT was built as early as 2018 and improved from time to time. The management of the floating chalet has influenced various aspects such as taking reservations, accommodation, as well as the restaurant as a dining area at sea. Initially, this KKCT was a self -farmed fish cage by the owner that was built as early as 2008. As a result, the owner only expected his employees to manage the cage such as feeding the fish and selling it in the market. The owner and his family only came on weekends to monitor but what was expected did not turn out as desired. All his efforts and expenses did not bear fruit and were considered failed.

The failure that KKCT faced continues to be the fruit of the mind that makes the fish cage a place to visit on weekends for the owner's family. KKCT is the focus of the surrounding population, it is also the focus among the community, and tourists. With the perseverance of the owner, he has built the first five rooms referring to the owner's family consisting of 4 of his children, and the main room is reserved for him husband and wife. Mr. Jamaluddin Bin Hassan as the Advisor and the wife of Ms. Latifah Binti Abdul Ghani as the Director devised a strategy to receive customers who will come to visit KKCT.

The KKCT has become a focal point for the surrounding residents, as well as a community and tourism destination. KKCT has been operating slowly since 2018 and has increased the number of rooms and provided some interesting services for equipment to visitors. Now, KKCT has been completed by adding more room and restaurant dining area located above the chalet as their main service in continuing KKCT operations after the weekend accommodation service. This research will aid KKCT in getting video promotion of their goods and service on their offer.



The Activity that we can do on the chalet is family activity such as fishing, family gathering in the restaurant, and family event like wedding ceremony. Another activity we can do is for go back is open karaoke and karaoke on the boat. This Kong Kong Chalet Terapung is the tourism placest that we can get it as the eventspace and restaurant and its call the main of the signature of theat is the room accommodation and the floating restaurant.

This video was published on 26 May 2022 in Afham Dimyati's Channel for collecting the data to analyse. According to the Analytics of YouTube we conclude it on the 21 June 2022 to 630 views. Following the views we get the data of viewers of gender is Male on 69.5% and Female is 30.6%.

The data shown on the Table 1 : Analytics on YouTube.

Video	Views	Watch time (hours)	Average view duration	Impressions	Impressions click- through rate
Santai Cinta	630	32.5	3:05	12,784	1.5%

Source: Analytics on YouTube Afham Dimyati

Finalise the viewers on 630 views. The number of watch time (hours) contribute to the channel is 32.5%. The average of view duration on the video is on 3:05. This funnel depicts 12,784 times a thumbnail was shown to viewers on YouTube impressions, frequently those thumbnails resulted is 1.5% in a view click-through rate and those views ultimately led to watch time.

This short film with a YouTube title with the title "Santai Cinta - 2022 | Short Film | Kong Kong Chalet Terapung" is said to have succeeded in attracting netizens' interest so that they watch the content in it. Please note that Youtube is a social media that allows twoway communications. Where netizens are considered an active audience because they can respond by leaving opinions, criticisms, suggestions and so on in the YouTube comments column. Even comments that have been left by netizens can be commented on by other netizens. This proves that YouTube is a social media that allows interconnectivity in it.





Figure 7: Santai Cinta Poster

Figure 7: Santai Cinta Poster is the one of the method to spread the short film. According to the Poster we use it for making the thumbnail of the video on YouTube. Figure 8: YouTube Features Button was the thing we use for analyse the findings and compiling the comment.



Figure 8: YouTube Features Button

The next Chart is going to show the target market is making realistic to this study. Its show the effectiveness of making the short film to tourism destination on the target market. The Chart 1 : Viewer age show that the target market to circle of youth and adult in between age of 15-35 years old.





In the Chart 1 : Viewer age above show that viewers from age 18-24 years old 32% less than viewers age 25-35 years old on 68% plus on the Watch Time (hours) also the same 18-24 years old is 42% less than the viewers age 25-35 years old on 58%. Promotion Promotion is an activity that involves all parts for the purpose of launching a product and service. Promotion is also our way of influencing customers to buy products and use the services provided. Promotions can also be seen in the form of advertising, broadcasts, billboard displays, newspapers and so on. The collected feedback was shown on Table 2 : Feedback Respondent about what the improvement that we can use in the further study. The short film has been collected 28 comment. In the table have only 5 comment advisable to have an improvement of making the videos.

Respondent	Comment	Theme
R1	Happy to see short film that is produced by you as a student.	Camera Handling
	These are my few comments for future improvements.	Audio Noise & Grain
	• • • • • • • • • • • • • • • •	Sound Effects
	Camera handling if shooting involving reflection material	Drone Shot
	(cars/windows). Audio noise + gain can be improved. Honorable	Storyline
	mention of work:	Product Placement
	Additional Sound effects to lighten up the mood. Drone Shot is	
	such a unique experience. The storyline is fun and lovely to	
	watch. Good comedy effect in a few scenes. Product placement	
	of KKCT can be seen	
	Keep up the good work! Nak kerja sekali next time hahaha	
R2	Storyline sampai kepada penonton, Dari segi cinematic video	Storyline
	terbaik, Lighting lawa , tapi boleh improved lagi. Sound Dan	Cinematic Video
	sebagainya semua nice.	Lighting
_		Sound
R3	Jalan cerita yang bagus walaupon pendek. Maklumat2	Storyline
	mengenai chalet kong kong dpt diterima dgn baik. Ade	Information
	beberapa part visual dgn audio mcm jagged/choppy sikit. 8/10	Audio
R4	Fuhh steadyy terbaikkk. Aku rasa color dengan audio kot boleh	Audio
	improve lagi tapi yang lain cun habis.	
R5	Lawa shot drone dengan view Terbaik	Drone Shot

#### Table 2 : Feedback Respondent

The main focus for the future improvements will be at the theme (Table 2). The column theme in the table is Camera Handling, Audio Noise & Grain, Sound Effect, Drone Shot, Storyline, Product Placement, Cinematic Video, Lighting, and Information in the short film.



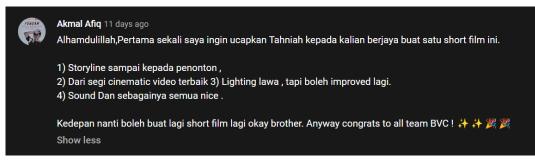


Image 3 : R2 Comment on YouTube

The thing that can improve for the further study is on the theme column is camera handling, audio noise & grain, sound effects, drone shot, storyline, product placement, cinematic, lighting, and information of sequence on the short film.

#### 5.Conclusions

This paper is looking forward short film were effective to induce a rural tourism of some destinations. Short film was written to show the product of service of tourism destination and as a medium to attract tourist to visit. The shooting process have positive and negative impact on the output of the short film therefore it can be used in strategy to market a destination. YouTube platform is one of the medium to distribute the short film as it contains features to collect the data of comment, views, or graph analytics from the viewers.

# References

- Abd Rahman, N., Md. Dawam, Z. A., & Lian, J. C. K. (2019). THE DEVELOPING MARKETING STRATEGY TO PROMOTE FILM TOURISM IN MALAYSIA. *BIMP-EAGA Journal for Sustainable Tourism Development*, 8(1).
- Keisha K Coker, Richard L Flight, & Dominic M Baima. (2017). The Role of Video Storytelling in social Media Marketing. *Skip It or Leave It*, *27*(2), 75–87.
- Liu, G.-, Gao, P.-, Li, Y.-, & Zhang, Z.-. (2019). Research on the Influence of Social Media Short Video Marketing on Consumer Brand Attitude. *Influence of Social Media Short Video Marketing*, *36*.
- Malec, M., Cieplak, T., & Jarmuł, U. (2016). Video Materials As A Means Of Promotion And Advertising Of The Fields Of Study. *Advances in Science and Technology Research Journal*, *10*(31), 274–280. https://doi.org/10.12913/22998624/64389



- McMullan, J. (2017). A new understanding of 'New Media': Online platforms as digital mediums. *Convergence: The International Journal of Research into New Media Technologies*, *26*(2), 287–301. https://doi.org/10.1177/1354856517738159
- Rodriguez, P. (2017). Effectiveness of Y eness of YouTube Adv ube Advertising: A Study of A tising: A Study of Audience Analysis. *Youtube*.
- Seal, M. M., & Premalatha, D. P. N. (2020). REBOOTING AND RESILIENCE STRATEGY FOR TOURISM SECTOR THROUGH RURAL TOURISM IN COVID-19 PANDEMIC – A CASE STUDY ON ANEGUNDI VILLAGE, KARNATAKA. UGC Care Journal, 43(4).
- Wattenhofer, M., Wattenhofer, R., & Zurich, E. T. H. (2012). The YouTube Social Network. *Wearable Computing Laboratory in ETH Zurich*.



# PEMBANGUNAN KISAH LAGENDA PUTERI GUNUNG LEDANG DALAM ILUSTRASI PANORAMA 360°

Abdul Hafiz Abdul Rani<sup>1</sup>, Muhammad Helmi Abu Bakar<sup>2</sup>, Hamidon Saniman

Jabatan Rekabentuk & Komunikasi Visual, Politeknik Ibrahim Sultan, Pasir Gudang, Johor hafizrani98@gmail.com muhammadhelmi@pis.edu.my hamidon@pis.edu.my

#### Abstrak

Kisah Lagenda Puteri Gunung Ledang yang memberi 7 syarat untuk menolak pinangan Sultan Mahmud merupakan di antara cerita-cerita rakyat di Malaysia yang dipaparkan dalam galeri di Taman Negara Gunung Ledang. Kisah lagenda tersebut hanya dipaparkan dengan menggunakan lukisan 2 dimensi di dalam galeri. Hal ini membataskan maklumat diperolehi secara global oleh orang ramai kerana penyampaian yang tidak terperinci dan hanya menerangkan tentang 7 syarat sahaja. Satu penyelesaian harus dilakukan bagi mempamerkan penceritaan Lagenda Puteri Gunung Ledang di dalam galeri dengan lebih jelas dan menarik. Objektif utama kajian ini adalah mengujinya melalui kaedah yang sesuai untuk mendapatkan ulasan dan maklum balas dari pengguna. Kaedah pembangunan ilustrasi panorama 360° ini adalah dengan menggunakan perisian Adobe Illustrator dan Adobe Photoshop. Hasil dapatan merumuskan bahawa ilustrasi panorama 360° ini dapat memberi gambaran yang lebih menarik. Kesimpulannya, hasil dapatan kajian menunjukkan bahawa ilustrasi panorama 360° ini dapat memberi gambaran yang lebih menarik. Kesimpulannya, hasil dapatan kajian menunjukkan bahawa ilustrasi panorama 360° ini dapat memberi gambaran yang lebih menarik. Kesimpulannya, hasil dapatan kajian menunjukkan bahawa ilustrasi panorama 360° ini dapat memberi gambaran yang lebih menarik. Kesimpulannya, hasil dapatan kajian menunjukkan bahawa ilustrasi panorama 360° ini dapat memberi gambaran yang lebih menarik. Kesimpulannya, hasil dapatan kajian menunjukkan bahawa ilustrasi panorama 360° ini dapat memberi gambaran yang lebih menarik. Kesimpulannya, hasil dapatan kajian menunjukkan bahawa ilustrasi panorama 360° ini dapat memberi gambaran yang lebih menarik. Kesimpulannya, hasil dapatan kajian menunjukkan bahawa ilustrasi panorama 360° pang dihasilkan mempunyai tahap kemudahgunaan , kebergunaan, sikap terhadap penggunaan dan tingkah laku yang efektif.

Kata Kunci: Lagenda, Puteri Gunung Ledang, Ilustrasi panorama 360°, Galeri

#### 1. Pengenalan

Di Malaysia, unsur mitos dan legenda sering ditemui dalam cerita-cerita rakyat dalam bentuk tradisi lisan dan juga pensejarahan tradisional sesuatu kawasan (Hassan & Isa, 2014). Kisah Lagenda Puteri Gunung Ledang merupakan salah satu cerita rakyat yang terkenal di Malaysia dan seharusnya disampaikan dengan cara yang menarik agar mudah untuk difahami. Projek ini melibatkan pembangunan kisah Lagenda Puteri Gunung Ledang dalam ilustrasi panorama 360° untuk memperbaharui kisah lagenda itu yang dipaparkan di dalam galeri di Taman Negara Gunung Ledang. Tujuan projek ini adalah untuk memberi pengetahuan yang lebih jelas soal Lagenda Puteri Gunung Ledang.



Kisah lagenda tersebut hanya dipaparkan dengan menggunakan lukisan 2 dimensi di dalam Galeri. Hal ini membataskan maklumat diperolehi secara global oleh orang ramai kerana penyampaian yang tidak terperinci dan hanya menerangkan tentang 7 syarat sahaja. Menurut Hassan & Isa, (2014) antara produk pelancongan yang berupaya menarik minat ramai pengunjung ke sesuatu destinasi ialah produk yang dikaitkan dengan unsur-unsur mitos dan lagenda. Jika galeri ini kurang memberi pendedahan tentang kisah lagenda yang mampu menjadi tarikan utama, galeri mungkin akan diabaikan oleh pengunjung. Pengunjung akan kurang berminat untuk melawat galeri jika mereka mengekalkan cara yang sama. Satu penyelesaian harus dilakukan bagi mempamerkan penceritaan sejarah Lagenda Puteri Gunung Ledang di dalam galeri dengan lebih jelas dan menarik.

Matlamat projek ini adalah untuk mencipta penyelesaian yang sesuai dengan menggantikan dokumentasi sejarah Puteri Gunung Ledang kepada kandungan digital untuk dipamerkan di dalam galeri. Tujuan yang hendak dicapai dari kajian ini adalah memperkemaskan kaedah pameran penceritaan sejarah Lagenda Puteri Gunung Ledang di dalam galeri dengan lebih jelas dan menarik. Seterusnya, memberi penceritaan dengan cara yang bersesuaian agar pengunjung mendapat pendedahan tentang kisah Puteri Gunung Ledang apabila mengunjungi galeri di Gunung Ledang. Mempromosikan galeri yang terdapat di Taman Negara Johor Gunung Ledang

#### 2. Kajian Literatur

Setelah projek diterbitkan di dalam platform Artstation, projek dikongsikan melalui link dan QR kod untuk dilihat oleh pengguna bagi mendapatkan maklum balas sama ada ilustrasi panorama 360° yang dihasilkan berjaya atau tidak dalam memenuhi objektif projek. *User testing* yang dihasilkan telah dianalisis bagi mengenal pasti maklum balas yang didapati adalah positif atau negatif.

#### 2.1 Media Baru dalam Galeri

Peranan galeri atau muzium bukan sahaja tempat untuk menyimpan barang bersejarah, objek, artifak budaya dan gambar bersejarah, tetapi berperanan sebagai perakam pendidik budaya bangsa (Abas & Yusoff, 2017). Menurut Rizki (2016), galeri yang baik mestilah mempunyai kualiti, imej, falsafah, serta ekspresi yang dipamerkan di dalam galeri. Pada era globalisasi ini, perkembangan teknologi ini mula menyentuh hampir setiap aspek kehidupan kita. Pada masa kini, kebanyakan bentuk media massa,



televisyen, rakaman muzik dan filem dihasilkan mula diedarkan secara digital. Semua media ini mula menumpu ke arah digital, seperti internet, *World Wide Web* dan permainan video untuk menghasilkan sesuatu seperti media digital yang maju. Di tempat kerja, kita dikelilingi oleh teknologi, sama ada dalam pejabat atau di pasar raya dan kilang, di mana hampir setiap aspek perancangan, reka bentuk, pemasaran, pengeluaran dan pengedaran dipantau atau dikawal secara digital (Yazici, 2008). Galeri dan muzium juga tidak terkecuali daripada kesan transformasi teknologi.

Menurut Shao et al. (2019) peningkatan di mana-mana media mengenai maklumat yang dikongsi memberikan cabaran tertentu kepada galeri atau muzium sebagai sebuah pusat memperolehi pengetahuan. Di samping itu, cara penyebaran dan komunikasi yang dihasilkan oleh teknologi kini boleh digunakan untuk bersaing sebagai medium untuk amalan budaya dalam dunia yang semakin tepu media. Antara cabaran tertentu adalah dari segi pemerolehan, penyusunan, dan tafsiran. Cabaran lain boleh dikatakan jauh lebih mendalam dan membimbangkan status galeri atau muzium di mana teknologi sedemikian secara radikal membawa persoalan bukan sahaja cara galeri atau muzium beroperasi, tetapi pengertian sejarah dan warisan (Shao, Ying, Shu, Morrison dan Booth, 2019).

#### 2.2 Mitos dan Lagenda dalam Pelancongan

Menurut Izani dan Razak (2003), cerita rakyat dalam kategori mitos dan lagenda dikenali sebagai "kisah asal usul," yang menggabungkan pelbagai kepercayaan cerita rakyat. Di Malaysia terdapat beberapa lokasi yang mempunyai unsur mitos dan lagenda tersendiri. Sebuah artikel bertajuk "Mitos dan Lagenda sebagai Produk Pelancongan di Malaysia: Kajian kes Lembah Lenggong" oleh Fatimah Hassan dan Hamid Mohd Isa (2014) yang fokus kepada kesesuaian menaikkan mitos dan lagenda tempatan sebagai produk pelancongan dengan menggunakan Lembah Lenggong sebagai lokasi untuk kajian kes. Hassan, Isa (2014) menyatakan bahawa unsur-unsur mitos dan lagenda di Lembah Lenggong boleh menjadi tarikan pelancong seperti asal usul nama Lembah Lenggong iaitu kisah Gua Puteri, Batu Puteri atau Batu Gajah. Menurut Hassan, Isa (2014) elemen mitos dan lagenda di Malaysia mampu menjadi tarikan dan produk dalam pelancongan. Ini adalah kerana keunikannya yang berbeza antara satu cerita dengan yang lain di tempat yang berbeza.



Dalam pelancongan, terdapat konsep yang berdasarkan elemen ini yang dikategorikan atau dinamakan sebagai Cultural Tourism. Walaupun mitologi kelihatan seperti cerita yang tidak benar dan kurang konsisten, malah mereka mempengaruhi tingkah laku dan cara, tindakan dan reaksi orang hingga akhir hayat dan mitologi mencerminkan pemikiran terpendam dan jelas sesuatu etnik dan budaya (Bolourieh dan Alemi, 2012). Taman Negara Gunung Ledang yang merupakan lokasi pelancongan untuk mendaki, berkelah dan sebagainya, mempunyai kisahnya tersendiri iaitu Lagenda Puteri Gunung Ledang yang boleh dijadikan sebagai tarikan utama pusat pelancongan itu. Menurut Harun, (2020) lagenda bukan mengisahkan sejarah hidup seseorang tokoh yang biasa tetapi menampilkan peristiwa-peristiwa yang sangat istimewa yang berhubungan dengan tokoh tersebut sehingga menjadi sebutan masyarakat zaman-berzaman. Menurut Noor et. al. (2020) mitos dan lagenda sebagai produk pelancongan pasti dapat menarik minat pelancong untuk melihat dan mengalami tempat-tempat dalam cerita.

#### 2.3 Penceritaan Mitos dan Lagenda dalam Ilustrasi panorama 360°

Perubahan teknologi baru telah menjanjikan banyak kemungkinan dan pandangan baru yang belum pernah dilakukan sebelum ini terutamanya dari segi interaktiviti, animasi, teknologi maklumat, internet, dan multimedia. Medium baru ini membolehkan pengguna menjadi proaktif dalam pembelajaran, penerokaan, dan mencari kandungan bermaklumat (Izani & Razak, 2003). Seperti yang lain, percubaan untuk memelihara cerita rakyat Melayu penting untuk memastikan keberkesanan penyampaian maklumat sambil memuaskan hakikat bahawa kandungan akan lebih mudah difahami serta menggalakkan pengguna dalam mendapatkan maklumat.

Kaya dengan sejarah, ilustrasi telah membangunkan cara komunikasi visual yang pelbagai dan mencapai kawasan penggunaan yang luas. Daripada hanya terdiri daripada limning buku, dengan pelbagai teknik, kaedah dan peluang teknologi ia terus berlaku di tempat lain juga (Soylucicek, 2019). Satu contoh sedemikian ialah ilustrasi 360° yang boleh direka bentuk dan dipaparkan pada media realiti maya. Ilustrasi panorama 360° pada asasnya berdasarkan penciptaan paparan panorama. Paparan dan pengeluaran 360° pada media ini bukan sahaja memerlukan cermin mata VR tetapi juga portal web dan beberapa program pembangunan. Paparan lebar ini membolehkan imej mendatar dilihat dalam 360°. Menurut Soylucicek, (2019) tujuan utama ilustrator panorama adalah untuk mencipta semula dunia sebenar secara realistik, membuat orang percaya imej yang mereka lihat adalah nyata dan mengelilingi mereka sepenuhnya dengan imej.



### 3. Metodologi Kajian

Metodologi kajian digunakan bagi mencapai objektif kajian yang ditetapkan. Metodologi kajian yang digunakana adalah reka bentuk populasi dan persampelan serta instrument kajian. Komponen penting dalam metodologi dibincangkan dengan terperinci dalam seksyen berikutnya.

#### 3.1 Rekabentuk Populasi dan Persampelan

Populasi untuk projek ini adalah daripada golongan penduduk tempatan yang pernah dan tidak pernah mengunjungi Taman Negara Gunung Ledang. Kategori umur adalah umum iaitu daripada golongan kanak-kanak, remaja, dan juga dewasa. Populasi yang dipilih dipengaruhi daripada kategori pengunjung di Taman Negara Gunung Ledang.

Persampelan yang diperoleh adalah berdasarkan populasi projek ini dan berdasarkan pengetahuan dan kesesuainan penyampaian kisah Lagenda Puteri Gunung Ledang dalam ilustrasi panorama 360° untuk dipamerkan di dalam galeri di Taman Negara Gunung Ledang. Persampelan yang terkumpul akan menyokong kepada objektif projek yang akan dilaksanakan.

#### 3.2 Instrumen Kajian

Dalam kajian ini, terdapat satu instrumen dalam kaedah pengumpulan data digunakan, iaitu:

#### Jadual 10: Kaedah Instrumen Kajian yang Digunakan

Kaedah	Instrumen Kajian
Kuantitatif	Soal Kaji Selidik

Berdasarkan Jadual 3.1, instrumen yang digunakan dalam kajian ini adalah berbentuk soal kaji selidik untuk mengumpul data yang diperlukan bagi menjawab soalan penyelidikan yang telah ditetapkan.



Soal selidik yang dijalankan untuk mengetahui maklumat responden, mengenal pasti tahap pengetahuan kisah Lagenda Puteri Gunung Ledang kepada pengunjung. Instrumen kajian ini adalah kaedah untuk memperolehi dan mengumpul maklumat berkaitan data kajian. Instrumen ini mendalami konsep persepsi, penerangan latar belakang yang berbentuk data primer dan data sekunder.

#### 4. Dapatan Kajian

Hasil dapatan kajian bagi projek adalah dengan menggunakan instrumen kajian yang telah ditetapkan. Hasil dapatan kajian yang diperolehi menerusi instrumen soal selidik secara atas talian dengan menggunakan *Google Form*. Dapatan kajian dianalisis dengan soalan-soalan bagi mendapat perartusan daripada jawapan maklum balas bagi mencapai objektif projek. Dapatan kajian ini juga dibentangkan dengan menggunakan jadual bagi menjelaskan lagi fahaman serta memberi huraian yang lebih jelas. Penyelidikan menghuraikan analisis terhadap data serta maklumat yang diperolehi melalui kajian ini adalah mengikut susunan objektif kajian. Berikut adalah analisis daripada instrumen yang digunakan dalam kajian bagi menjawab soalan kajian yang telah dikemukakan.

Jantina	Kuantiti	Peratus (%)
Lelaki	78	52
Perempuan	72	48
Umur (tahun)	Kuantiti	Peratus (%)
15 – 17	34	22.7
18 – 29	64	42.7
30 – 39	38	25.3
40 dan ke atas	14	9.3
Bangsa	Kuantiti	Peratus (%)
Melayu	90	60
Cina	26	17.3
India	21	14
Lain-lain	13	8.7
Status	Kauntiti	Peratus (%)

# Jadual 2: Demografik Pengguna



2<sup>nd</sup> National Conference on TVET Undergraduate Students (NCTS) Politeknik Tuanku Syed Sirajuddin 19-20 July 2022

Bujang	98	65.3
Berkahwin	52	34.7

Berdasarkan Jadual 2 di atas, jumlah responden lelaki adalah sebanyak (78) 52% peratus dan jumlah responden perempuan adalah sebanyak (72) 48% peratus daripada 150 jumlah keseluruhan responden. Kategori responden yang berumur 18 hingga 29 tahun adalah yang tertinggi iaitu sebanyak (64) 42.7% peratus dan berikutan dengan responden berumur 30 hingga 39 tahun sebanyak (38) 25.3% peratus. Responden berumur 15 hingga 17 tahun adalah sebanyak (34) 22.7% peratus dan responden yang berumur 40 tahun dan ke atas adalah sebanyak (14) 9.3% peratus. Kategori responden yang berbangsa melayu adalah yang tertinggi iaitu sebanyak (90) 60% peratus. Seterusnya, responden yang berbangsa cina adalah sebanyak (26) 17.3% peratus, responden berbangsa india adalah sebanyak (21) 14% peratus dan kategori lain-lain yang terdiri daripada siam, iban dan serani adalah sebanyak (13) 8.7% peratus sahaja. Status responden yang diperoleh adalah sebanyak (98) 65.3% peratus responden yang masih bujang dan (52) 34.7% peratus responden yang sudah berkahwin.

No.	Item		Pe	ratus (%	%) f		Min
		STS	TS	KS	S	SS	
1.	Saya berpendapat ilustrasi panorama 360°	0	0.7	6.6	64	28.7	4.2
	ini mudah untuk digunakan.	(0)	(1)	(10)	(96)	(43)	
2.	Navigasi di dalam ilustrasi panorama 360°	0	0.7	2.7	52.6	44	4.4
	mudah difahami.	(0)	(1)	(4)	(79)	(66)	
3.	Cerita di dalam ilustrasi panorama 360°	0	0.7	2	46.7	50.6	4.5
	disampaikan dengan jelas.	(0)	(1)	(3)	(70)	(76)	
4.	Saya berpendapat ilustrasi panorama 360°	0	2	4	58	36	4.3
	amat mesra pengguna	(0)	(3)	(6)	(87)	(54)	
5.	Ilustrasi panorama 360° telah membantu	0	0.7	0.7	48	50.6	4.5
	saya memahami kisah lagenda puteri	(0)	(1)	(1)	(72)	(76)	
	gunung ledang.						
6.	Secara keseluruhan, ilustrasi panorama	0	1.3	2	51.3	45.4	4.4
	360° amat mudah untuk digunakan.	(0)	(2)	(3)	(77)	(68)	
	Purata						4.4

Jadual 3: Faktor Penerimaan Responden terhadap Ilustrasi Panorama 360° (Kemudahgunaan)

Berdasarkan kepada Jadual 3, purata min keseluruhan bagi faktor kemudahgunaan berada pada tahap yang tinggi iaitu 4.4. Responden secara keseluruhan bersetuju bahawa ilustrasi panorama 360° yang telah dibangunkan mudah untuk digunakan dan mudah untuk difahami. Responden juga bersetuju bahawa ilustrasi



panorama 360° disampaikan dengan jelas dan membantu pengguna untuk memahami kisah lagenda Puteri Gunung Ledang dengan mudah. Responden kajian bersetuju secara total bahawa ilustrasi panorama 360° yang dibangunkan mesra pengguna dan mudah untuk digunakan oleh pengguna.

No.	Item		Pe	۶) ratus	6) f		Min
		STS	TS	KS	S	SS	
1.	Ilustrasi panorama 360° ini menjelaskan	0.7	0.7	2	46.6	50	4.4
	lagi tahap pengetahuan saya tentang Puteri	(1)	(1)	(3)	(70)	(75)	
	Gunung Ledang.						
2.	Pemahaman saya mengenai kisah	0	1.3	2.7	43.3	52.7	4.4
	Lagenda di Gunung Ledang telah	(0)	(2)	(4)	(65)	(79)	
	meningkat setelah melihat ilustrasi						
	panorama 360°.						
3.	Cerita yang disampaikan dalam ilustrasi	0	1.3	1.3	44.7	52.7	4.4
	panorama 360° mudah untuk difahami.	(0)	(2)	(2)	(67)	(79)	
4.	Ilustrasi panorama 360° berkemampuan	0	1.3	1.3	43.3	54	4.4
	memberikan manfaat kepada semua	(0)	(2)	(2)	(65)	(81)	
	pengguna.						
5.	Ilustrasi panorama 360° telah	0.7	0.7	1.3	42	55.3	4.5
	meningkatkan pengetahuan saya tentang	(1)	(1)	(2)	(63)	(83)	
	kisah disebalik Gunung Ledang.						
	Purata						4.5

Jadual 4: Faktor Penerimaan	Responden terhadap	Ilustrasi Panorama	360° (Kebergunaan)
	nooponaon tornadap	naotraor r anorama	ooo (nooorganaan)

Berdasarkan kepada Jadual 4, purata min keseluruhan bagi faktor kebergunaan berada pada tahap yang tinggi iaitu 4.5. Responden secara keseluruhan bersetuju bahawa ilustrasi panorama 360° yang telah dibangunkan menjelaskan lagi tahap pengetahuan dan pemahaman mereka tentang kisah lagenda Puteri Gunung Ledang. Responden juga bersetuju bahawa cerita yang disampaikan dalam ilustrasi panorama 360° mudah untuk difahami dan berkemampuan memberikan manfaat kepada semua pengguna. Responden kajian bersetuju secara total bahawa ilustrasi panorama 360° yang dibangunkan mesra pengguna dan mudah untuk digunakan oleh pengguna.



# Jadual 5: Faktor Penerimaan Responden terhadap Ilustrasi Panorama 360° (Sikap Terhadap Penggunaan)

No.	Item	Peratus (%) f					Min
		STS	TS	KS	S	SS	
1.	Sesiapa sahaja boleh melihat ilustrasi panorama 360° tanpa memerlukan kepakaran untuk menggunakan aplikasi berkenaan.	1.3 (2)	1.3 (2)	10.7 (16)	60.7 (91)	26 (39)	4.1
2.	Pengalaman melihat ilustrasi panorama 360° tentang kisah Lagenda Puteri Gunung Ledang sangat menyeronokkan.	0.7 (1)	1.3 (2)	2.7 (4)	44.7 (67)	50.7 (76)	4.4
3.	Minat saya bertambah terhadap Lagenda Puteri Gunung Ledang apabila melihat ilustrasi panorama 360°.	0.7 (1)	1.3 (2)	2.7 (4)	39.3 (59)	56 (84)	4.5
4.	Saya berpuas hati mengenali Lagenda Puteri Gunung Ledang melalui ilustrasi panorama 360°.	0.7 (1)	1.3 (2)	4 (6)	38 (57)	56 (84)	4.5
5.	Pengguna akan lebih bermotivasi untuk memahami/mengetahui kisah Lagenda di Gunung Ledang selepas melihat ilustrasi panorama 360°.	0 (0)	1.3 (2)	4 (6)	38.7 (58)	56 (84)	4.5
	Purata						4.4

Berdasarkan kepada Jadual 5, purata min keseluruhan bagi faktor sikap terhadap penggunaan berada pada tahap yang tinggi iaitu 4.4. Responden secara keseluruhan bersetuju bahawa sesiapa sahaja boleh melihat ilustrasi panorama 360° tanpa memerlukan kepakaran untuk menggunakan aplikasi berkenaan. Responden juga bersetuju bahawa melihat ilustrasi panorama 360° memberi pengalaman yang menyeronokkan dan akan lebih berminat terhadap kisah lagenda Puteri Gunung Ledang. Responden kajian bersetuju secara total bahawa mereka berpuas hati dan akan lebih bermotivasi untuk memahami kisah Lagenda Puteri Gunung Ledang selepas melihat ilustrasi panorama 360° yang dibangunkan.



No.	Item		Pe	ratus (%	%) f		Min
		STS	TS	KS	S	SS	
1.	Sesiapa sahaja boleh melihat ilustrasi	0	0.7	11.3	67.3	20.7	4.1
	panorama 360°.	(0)	(1)	(17)	(101)	(31)	
2.	Ilustrasi panorama 360° mampu	0	0.7	0	44.7	54.7	4.5
	mendorong saya memahami dengan lebih	(0)	(1)	(0)	(67)	(82)	
	baik mengenai Lagenda Puteri Gunung						
	Ledang.						
3.	Saya berpendapat ilustrasi panorama 360°	0	1.3	0.7	42	56	4.5
	sangat berkualiti.	(0)	(2)	(1)	(63)	(84)	
4.	Ilustrasi panorama 360° sangat mudah	0	1.3	12	58	28.7	4.1
	untuk dilihat.	(0)	(2)	(18)	(87)	(43)	
5.	Di dalam ilustrasi panorama 360°	0	1.3	0	42	56.7	4.5
	mempunyai jalan cerita yang disampaikan	(0)	(2)	(0)	(63)	(85)	
	dengan jelas.						
	Purata						4.4

# Jadual 6: Faktor Penerimaan Responden terhadap Ilustrasi Panorama 360° (Tingkahlaku)

Berdasarkan kepada Jadual 6, purata min keseluruhan bagi faktor tingkah laku pengguna terhadap ilustrasi panorama 360° berada pada tahap yang tinggi iaitu 4.4. Responden secara keseluruhan bersetuju bahawa ilustrasi panorama 360° yang telah dibangunkan boleh dilihat oleh sesiapa sahaja dan mampu mendorong penonton untuk difahami dengan lebih baik tentang kisah lagenda Puteri Gunung Ledang. Responden juga bersetuju bahawa ilustrasi panorama 360° disampaikan sangat berkualiti dan mudah untuk dilihat. Responden kajian bersetuju secara total bahawa ilustrasi panorama 360° yang dibangunkan mempunnyai jalan cerita yang disampaikan dengan jelas.

#### 4. Kesimpulan

Secara kesimpulannya, kajian yang telah dijalankan ini telah mengukur empat faktor utama dalam pengujian bahan ilustrasi panorama 360° kisah lagenda Puteri Gunung Ledang. Secara keseluruhannya, responden bersetuju bahawa ilustrasi panorama 360° yang dibangunkan mempunyai tahap kemudahgunaan dan kebergunaan yang tinggi. Ilustrasi panorama 360° yang dibangunkan adalah mudah untuk digunakan dan mesra pengguna. Aspek kebergunaan juga telah dikaji dan dilihat berada pada tahap pengukuran yang tinggi oleh pengguna. Illustrasi yang dibangunkan dipersetujui oleh responden bahawa ia dapat memberikan maklumat secara khusus berkaitan lagenda Puteri Gunung Ledang.



Di samping itu, responden kajian secara total memberi jawapan yang positif dalam faktor sikap terhadap penggunaan dan tingkahlaku responden mengenai ilustrasi panorama 360° yang dibangunkan. Responden secara keseluruhan bersetuju bahawa sesiapa sahaja boleh melihat ilustrasi panorama 360° tanpa memerlukan kepakaran untuk menggunakan aplikasi berkenaan. Responden juga bersetuju bahawa ilustrasi panorama 360° yang telah disampaikan berkualiti dan mudah untuk dilihat.

Kajian ini pada dasarnya melihat kepada aspek kebolehgunaan aplikasi yang dibangunkan. Faktor yang dikaji telah dianalisa dan mempunyai tahap persetujuan responden yang tinggi. Kajian lanjut berkaitan dengan aspek aksesibiliti dan kepada kumpulan repsonden yang lebih luas dilihat adalah perlu bagi menjamin penggunaan yang lebih optimum dalam kalangan pengguna. Kajian mendalam yang melibatkan temubual mendalam juga diperlukan bagi mendapat maklum balas yang lebih jitu terhadap ilustrasi panorama 360° yang dibangunkan. Ini akan memberikan maklumat yang lebih terperinci bagi tujuan penambahbaikan ilustrasi panorama 360° yang telah dihasilkan.

#### Rujukan

- Abas, N. H., & Mohd Yusoff, M. Y. (2017). Peranan Galeri Sultan Azlan Shah Sebagai Pendidikan Tidak Formal Galeri Sultan Azlan Shah Role As Informal Education. In JURNAL WACANA SARJANA Jilid (Vol. 1, Issue 1). <u>https://spaj.ukm.my/jws/index.php/jws/article/view/42/21</u>
- Bolourieh, F., & Alemi, A. (2012). Modern Mythology in Animation. J. Basic. Appl. Sci. Res, 2 (8), 8485–8489. <u>www.textroad.com</u>
- Harun, J. (2003). "The Legend of Nakhoda Ragam" in The Malay World and Its Link to Penang's Early History ("Legenda Nakhoda Ragam" di Alam Melayu dan Hubungannya dengan Sejarah Awal Pulau Pinang).
   <u>https://www.researchgate.net/publication/255567540\_Malay\_Digital\_Folklore\_Usin</u> <u>g\_Multimedia\_to\_Educate\_Children\_Through\_Storytelling</u>
- Hassan, F., & Isa, H. M. (2014). Mitos dan legenda sebagai produk pelancongan di Malaysia: Kajian kes Lembah Lenggong. <u>http://koding-</u> <u>kn.blogspot.com/2012/11/terokai-sejarah-manusia-</u>



- Izani, M., Abidin, Z., & Razak, A. A. (2003). Malay Digital Folklore: Using Multimedia to Educate Children Through Storytelling. In Information Technology in Childhood Education Annual. <u>https://www.researchgate.net/publication/255567540\_Malay\_Digital\_Folklore\_Usin</u> <u>g\_Multimedia\_to\_Educate\_Children\_Through\_Storytelling</u>
- Mohd Noor, A. Y., Mohd Mokhtar, A., Mohamad Sharif, S., Long, A. S., Ab Rahman, Z., & Abdul Wahab, N. A. (2020). Main Tourism Sectorsin Malaysia: A Contribution Towards Economic Growth. In Journal of Development Economics and Finance (Vol. 1, Issue 1). <u>https://arfjournals.com/abstract/46911\_4.pdf</u>
- Rizki, M. (2016). Tugas Akhir Galeri Seni dan Budaya di Kota Surakarta Dengan Penekanan Desain Green Architecture. <u>http://lib.unnes.ac.id/27376/1/5112411008.pdf</u>
- Shao, J., Ying, Q., Shu, S., Morrison, A. M., & Booth, E. (2019). Museum tourism 2.0: Experiences and satisfaction with shopping at the national gallery in London. Sustainability (Switzerland), 11 (24). <u>https://doi.org/10.3390/su11247108</u>
- Soylucicek, S. (2019). Global Journal of Arts Education Looking through the sphere; Illustration in virtual reality. <u>https://www.tiltbrush.com</u>
- Yazici, H. H. (2008). New Media Art and the Gallery in the Digital Age. <u>https://www.academia.edu/1526527/New\_Media\_Art\_and\_the\_Gallery\_in\_the\_Dig</u> <u>ital\_Age</u>



# FACTORS OF OUTSOURCING IN FACILITIES MANAGEMENT SERVICES IN HEALTHCARE FACILITIES

Mary Kathlyn Anak Vincent<sup>1</sup>, and Nik Zety Akhtar Abdul Aziz<sup>2</sup>

Civil Engineering Department, Polytechnic Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor marykathlyn63@gmail.com nikzetypsa@gmail.com

#### Abstract

Outsourcing is an important consideration for any organization mainly in a hospital facility. In a more progressive community, hospitals will have to provide modern technology to increase treatment efficiency and provide excellent services to the customers. Various medical research, engineering, and others have produced a vast selection of new treatments and equipment, much of which requires specialized training and facilities for its use. Hospitals thus have become more costly to operate. Therefore, to manage the hospital facility equipment more efficiently, outsourcing is one of the decisions to have a more organized and cost-effective selection. The objective of this research is to analyze factors in decision-making for outsourcing. There are 3 comparisons of hospital buildings to obtain 123 total respondents from different classifications. This research study suggests an improvement in outsourcing strategy for facilities management in hospitals.

Keywords: Outsourcing, Hospital Facility, Technology, Cost-Effective

#### 1. Introduction

A facility is an asset or property built, installed, or established to provide social and economic activities (Xu et al., 2019). A facility is also a building, amenity, place, or piece of equipment for a specialized purpose (Market Business News, 2022.). Meanwhile, the management of facilities such as facilities management is a profession that encompasses multiple disciplines to guarantee functionality, comfort, safety, and efficiency of the built environment by integrating people, place, process, and technology (Xu et al., 2019). In general, Facilities Management (F.M.) is service-based, so it is necessary to focus on the end-user, and the client and ensure communication between both ways of agreed service level and expectation (Bartleby, 2021.). The two types of management operations are strategic and tactical management. Strategic includes consultancy of designers,



accountants, cashiers (and so forth). Tactical management includes managing agents, engineers, catering, security, and I.S. management.

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Meanwhile, operational management deals with the performance of contractors, artisans, and industrial workers and staff. Facilities management deals with all the below disciplines department to accomplish the organisational goal with. The development of information technologies changed the business environment. Companies seeking cost reduction and increased accessibility of their services have started investing in virtual offices in strategically convenient areas. The increase of information and the changing economic structure urged the development of global and incorporated operations (Zitkiene & Dude, 2018). Therefore, the facility management services market has come into a high experience phase, owing to increasing awareness with end-users, though the market will continue to grow progressively. High infrastructure growth has headed to an increased requirement for more specialised vendors who have the skill to operate in both technical and non-technical tasks within a given business (*Maintenx*, 2018).

Hospital is a treatment facility used to treat and diagnose patients. For modern hospitals, they can also serve as a place for teaching. In a more progressive community, hospitals will have to provide modern technology to increase treatment efficiency and provide excellent services to the customers. Various medical research, engineering, and others have produced a vast selection of new treatments and equipment, much of which requires specialised training and facilities for its use. Hospitals thus have become more costly to operate. Therefore, to manage the hospital facility equipment more efficiently, outsourcing is one of the decisions to have a more organised and cost-effective selection (Pamela C. Fralick, 2020.). Outsourcing transfers part of the organisational activities to another third party to oversee, manage and make the right decision to perform services to support the business activities. (Man Wah Conny Wang et al., 2020). The need for outsourcing in hospitals is to ensure improvement of the quality and performance of the services. Thus, dividing the functions into a specific area and outsourcing them to service providers is based on their specialities. This will make them focus and produce better results. Other than that, outsourcing is affected by globalisation, technological innovation, competition, and economic changes (Zitkiene & Dude, 2018).



## 2. Background and Literature Review

In this chapter, the information is gathered from related articles and journals. This paper also discussed the relevant topics and issues. Therefore, the purpose of doing a literature review is to give a broad overview of what is the research is about and identify the gap research that can be addressed. Privately owned health care now represents a virtual image in the Malaysian healthcare sector's overall development. These developments point to the emergence of a competitive healthcare enterprise in Malaysia, where private health care will compete with current public health care facilities and increase private enterprise. Private hospitals must preserve their services to meet their objectives and satisfy their clients. Certain facilities in Malaysian private hospitals have been outsourced. As a result, engaging a maintenance staff to keep the facilities provided in private hospitals in good working order is inevitable. Meanwhile, Facilities Management has been defined in various ways, depending on its specific goals and scope. Facilities Management involves people, process, environment, health, and safety, all of which are responsibilities in Facilities Management.

The focus on Facilities Management in the workplace appears to be a generality (Wan Mohd Rani, 2018). Facilities Management's responsibilities, according to some studies, include organizing, managing, and coordinating the operational and strategic management of facilities and buildings. As a result, the practical and proper operation of all its physical features may be ensured, and the creation and maintenance of a safe and productive atmosphere for all occupants. Facilities Management services are provided by a team that can be outsourced and supplied (Man Wah Conny Wang et al., 2020). In (Haugen & Klungseth, 2017) perspective, Facilities Management should be viewed as a "service to an organization" and a discipline different from others, since it focuses on "process and service, as well as the link between facilities and an organization's objectives."

#### 2.1 Facilities Management Outsourcing

Outsourcing facilities management is a cost-effective method of lowering costs, increasing efficiencies, reducing internal workload constraints, and mitigating hazards. As a result, many firms are selecting to outsource their facilities management needs. Facilities management outsourcing allows a company to concentrate on the core functions of its business while cutting down on time spent on property and facility management. It also eliminates the need to work with individual contractors. If subcontracting the services to a trusted specialist, they will benefit from the business (Bellrock Group, 2020). To put it another way, the duty for managing Facilities Management services is transferring to either expert partners or outsourcing the complete package to a total facilities management business (Ikediashi & Odesola, 2016). Meanwhile, outsourcing means outsourcing support services to an outside contractor for all maintenance work to control and deliver quality and service standards, typically for big projects (Osita et al., 2021). However, Facilities Management services are a cost-effective



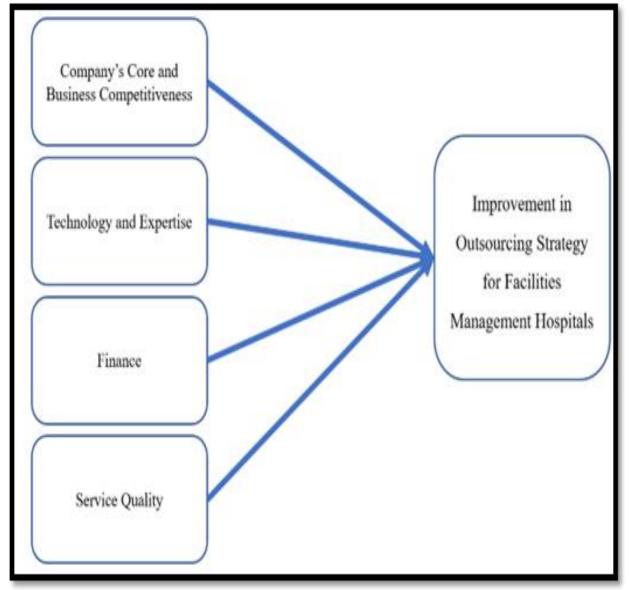
solution to ensure that your facility requirements are met. Hence, your facility management concerns are handled by a third party (Cubitt James, 2020).

## 2.2 Outsourcing in Healthcare Facilities

Today, the outsourcing market is primarily driven by the healthcare systems, health insurance, and pharmaceutical industries. Healthcare practitioners are under pressure to provide a wide range of services to an ever-growing number of patients in an increasingly fast-paced world. These businesses have begun to use the outsourcing model to improve and focus on their core competencies while lowering operating and maintenance expenses. Working on behalf of other sectors, the healthcare industry, particularly hospitals and health systems, is turning to outsource or hiring another firm or provider to run some areas of the business to gain efficiency and save money on administrative expenses. This will move the attention away from cost concerns and toward care quality and efficiency. Furthermore, for healthcare providers, outsourcing is about more than just lowering administrative expenses. Healthcare outsourcing should be able to meet the demands of such advances with new health plans. This entails broadening outsourcing's scope beyond basic and routine front-office activities to include health management and patient engagement (Richardson & Mosman Wrench, 2020). According to (Prachi, 2019), healthcare is one of the most important sectors, with the goal of effectively treating every patient. The industry focuses on increasing workforce productivity to provide positive outcomes for patients. Customer happiness, or, to put it another way, patient comfort, is extremely important for a healthcare company since it not only produces goodwill for the company but also secures its recognition among rivals. When a firm outsources a business service, it receives assistance from a competent partner, which is the most effective option for the company to reduce its burden and focus on key operations.



# 2.3 Research Conceptual Framework



# Figure 1: Conceptual Framework

Figure 1 above shows a conceptual framework for factors of outsourcing in facilities management services in healthcare facilities. There are company's core and business competitiveness, technology and expertise, finance and service quality. These factors can contribute to the improvement in outsourcing strategy for facilities management hospitals.



## 2.3.1 Company's Core and Business Competitiveness

Due to long-term aims, the outsourcing strategy criterion allows the organization to acquire more significant advantages. Strategic concerns influencing outsourcing decisions include focusing on the core activity, releasing resources for the main action, improving adaptability vs change, risk-sharing, and legal oversight. Because strategy incentives allow the organization to focus on critical competencies and activities, the main drivers of outsourcing have shifted from economic to strategic challenges (Summers & Visser, 2021). However, strategic outsourcing is enhancing strategic planning, building strategic relationships with contractors, complying with legislation controlling outsourcing activities, and boosting adaptability in adapting to shifting market dynamics (Suweero et al., 2017). Strategic in other perspective will lowering risks in constantly changing markets and in the context of rapidly growing technology; an outsourcing strategy transfers risks from technological change and R&D spending outside the corporation, therefore shortening production cycles and making customer reaction faster and more flexible (Michela & Carlotta Meo Colombo, 2011).

### 2.3.2 Technology and Expertise

It appears that expanding the organization's capacity to use technical skills and expertise and managers considering fresh ideas are essential factors for outsourcing. However, access to vital technology is one of the primary motivations for outsourcing. As a result of outsourcing, the company may acquire new skills and information and expand its competence in sustaining high-level technology (Kavosi et al., 2018). However, based on (Suweero et al., 2017) technological factors is the collection of tools, skills, methods, and processes used to achieve objectives are referred to as technological factors. Obtaining flexibility with changing technology, initiating innovative ideas and technology, increasing efficiency for competitive advantage, resolving advanced technologies, requirement analysis uncertainties, filling a need for specialist knowledge, gaining experience or technological expertise, and replicating competition are some of these. According to (Lok et al., 2018), globalization and the increasing relevance of information technology are causing advanced FM technology to evolve guickly. Clients and service suppliers must be technologically up to date. Both parties will need to improve their abilities or competences because of this. Their cooperative outsourcing client ties may be maintained by utilizing talents and resources effectively among the stakeholders.

# 2.3.3 Finance

According to most surveys, the primary motivation for outsourcing tasks is to save money for the company. To achieve cost savings, businesses require a competitive strategy. The most common reason for outsourcing is to save money on labor, materials, and other resources. When the estimated expenses of outsourcing a task are less than performing



it in-house, the job is outsourced. In other words, if the cost of an activity in an organization rises beyond the estimated cost of outsourcing, the possibility of outsourcing increases as well (Kavosi et al., 2018). Economic considerations are used to improve a company's capacity to earn profits. Close monitoring of economic issues such as saving, reducing labor and operating costs, converting fixed costs to variable cost and improving cash flow (Suweero et al., 2017). However, according to (Summers & Visser, 2021) economic decision components' importance has been thoroughly documented. Cost reduction was identified as the primary goal of outsourcing in logistics management study, with the qualification that the total cost of ownership was only relevant when the job to be outsourced was of low strategic value. Cost reduction has frequently been mentioned as a consideration in the decision to outsource maintenance.

# 2.3.4 Service Quality

Quality enhancement is one of the main objectives of most outsourcing projects. In this sense, health outsourcing operations aim to improve quality and service productivity by concentrating on critical activities and patients. Monitoring the quality of outsourced services is one of the variables determining the success and efficiency of outsourcing strategies. As a result, monitoring and control techniques must be considered to ensure outsourced services' maintenance and improvement. Increasing the quality of services may improve credibility and reputation in the organization, lower expenses, and more customer satisfaction. FM healthcare is described as the management of health facilities, which are sites that offer healthcare. Hospitals, clinics, outpatient care centers, specialty care centers, birthing facilities, and mental care centers are among them. The development of multiple health facilities has increased the burden on healthcare because each institution must ensure that its service delivery is competitive and that it can resist the present market trend. Choosing excellent healthcare services is critical for achieving health equity and improving the quality of a healthy life, which is everyone's necessity (Pakrudin et al., 2017). According to (Tim Crosby, 2015), quality isn't only about the product or the service. Quality may also refer to the entire process of developing products and services. Not just audits and monitoring, but all aspects of outsourcing are subject to quality issues. Product recalls or substantial outsourcing risks might occur from a lack of quality at any step in the outsourcing process. Outsourcing might wind up being more expensive than in-house production or service owing to a lack of proper research and proper controls, resulting in high failure rates, late delivery, poor service, and low customer satisfaction.

# 3. Method of Data Collection and Analysis

Data analysis is a process utilized for gathering, modeling, and analyzing large amounts of data to develop effective and efficient decisions. Thus, there are various methods and strategies used for performing this type of analysis. All these different data analysis approaches are essentially based on two major areas of research: quantitative methods and qualitative methods (Bernardita, 2021). Therefore, this research utilizes both



qualitative (interviews) and quantitative approaches (questionnaires). Also, this study's methodology will involve private healthcare sectors and employees ranging from upper management to lower management. In the analysis, percentages, means, and frequencies will be developed. And after interviews are conducted and the questions are distributed, all the results will be written, and the information obtained will be generated as results obtained.

One of the most significant components of a study is the research questions, the conceptual framework, and the suitable procedures for collecting and validating the study's data. These research questions serve as a valuable guide for carrying out research.

### 3.1 Sampling and Data Collection

Results and determination of the sample size were based on Krejcie and Morgan's (1970) table. Population of this study refers to the scope of the study which is 3 different hospitals buildings with total sample size of 180(n).

No	Location	Company	Total Population (N)
1	Sultan Ahmad Shah Medical Centre,	А	30
	Kuantan Pahang		
2	Hospital Pulau Pinang	В	62
3	Hospital Selayang, Kuala Lumpur	С	87

#### Table 1: Total Population

#### 4. Results and Finding

	Items	Percentage(%)
Gender	Male	87
	Female	12
Age	18-24 Years	24
	25-39 Years	75
Departments	Civil	44
	Mechanical	35
	Electrical	20

#### **Table 2: Respondent Demographic Profile**

The table above in figure 4.1 is the percentage of technical staff in 3 hospitals. Where the percentage of male is higher than female. Thus, the age of 25-39 years old have higher percentage than others.

#### 4.1 Findings



Objective: To analyse factors in decision making for outsourcing. The data collection instrument used in this study was a questionnaire specifically to achieve the objective of the study. Each item using 5 Likert scales namely (5) Strongly Agree, (4) Agree, (3) Not sure, (2) Disagree and (1) Strongly Disagree.

No	Item	Average
1	Outsourcing can reduce risk in facilities management services. (Penyumberan luar boleh membantu pemindahan risiko dalam pengurusan fasiliti)	4.60
2	Outsourcing helps improves adaptability in a competitive market. (Penyumberan luar membantu meningkatkan kebolehsuaian dalam pasaran yang kompetitif)	4.54
3	Outsourcing could help enhance and maintain relationships between suppliers in long term. (Penyumberan luar boleh membantu meningkatkan dan mengekalkan hubungan antara pembekal dalam jangka panjang)	4.55
4	Outsourcing contributes to improving technology and gaining access to skilled resources. (Penyumberan luar menyumbang kepada peningkatan teknologi dan mendapatkan akses kepada sumber mahir)	4.62
5	Outsourcing could obtain flexibility with technology advancement. (Penyumberan luar boleh memperoleh fleksibiliti dengan kemajuan teknologi)	4.61
6	Outsourcing expertise has a positive impact on the quality of work conducted. (Kepakaran penyumberan luar memberi kesan positif terhadap kualiti kerja yang dijalankan)	4.37
7	Technology and expertise could improve facilities to enhance operational efficiencies. (Teknologi dan kepakaran boleh menambah baik kemudahan untuk meningkatkan kecekapan operasi)	4.59

## Table 3: Factors in decision making for outsourcing



### 5. Discussion

Based on table 3 above, the highest decision factors in outsourcing is more on technology which is the average of 4.62. Because, by improving technology the organization will gain access and skilled resources to support their business. Thus, providing the best and effective work quality. However, the least decision factor in outsourcing is the positive impact given by the expertise on the quality of work conducted which is the average of 4.37. Somehow, the work done by vendors are not up to expectation therefore, the work conducted doesn't give positive impact to the organization.

#### 6. Conclusion

Outsourcing is an important consideration for any organization. Quality, price, and other considerations all play a role in this selection. Customers are also involved in the decision-making process. As the globe becomes increasingly international, low-cost countries may see their costs rise. Many businesses rely on outsourcing to increase productivity and profitability. Many outsourcing firms may be located all around the globe. Therefore, outsourcing plays a vital role in achieving the company goals and objective by focusing on the core business. Thus, outsourcing contribute to the growth of the organization depending on what they outsource.

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#### References

- *Facilities Management Outsourcing | The Risks and Rewards | Bellrock Group.* (2020.). Retrieved December 6, 2021, from <u>https://b38group.com/facilities-management/facilities-management-outsourcing/</u>
- I Journal of the Islamic Republic of Iran, 32(1), 327–333. https://doi.org/10.14196/MJIRI.32.56
- Lazor, D. (n.d.). *The Pros and Cons of Outsourced & In-House IT*. Retrieved January 8, 2022, from <a href="https://www.lazorpoint.com/insights/prosandcons">https://www.lazorpoint.com/insights/prosandcons</a>
- Lok, K. L., Opoku, A., & Baldry, D. (2018). Design of sustainable outsourcing services for facilities management: Critical success factors. *Sustainability (Switzerland)*, *10*(7), 1–15. https://doi.org/10.3390/su10072292



- Man Wah Conny Wang, Cheng Ling Tan, & Wahid, N. A. (2020). Service Quality, Facilities Management Practices and Outsourcing Service Provider Capabilities: A Critical Review and Conceptual Framework for Facilities Management Companies. *Global Business & Management Research*, 12(2), 50–63. <u>http://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,shib&db=bth&AN</u> =145163968&site=ehost-live&scope=site&custid=s1131971
- Management, F. (2011). Facilities Management: For more information on Facilities Management: *Facilities*.
- Michela, P., & Carlotta Meo Colombo. (n.d.). (pdf) outsourcing strategies. how to formalize and negotiate the outsourcing contract. Retrieved December 5, 2021, from <a href="https://www.researchgate.net/publication/227462756">https://www.researchgate.net/publication/227462756</a> outsourcing strategies how <a href="https://www.researchgate.net/publication/227462756">to formalize and negotiate the outsourcing contract</a>.
- Migunda, M. W., & Namusonge, P. G. (n.d.). http://www.ijssit.com. 2723–2729.
- Osita, C., Chinedu, P., & Jessica, D. (2021). Outsourcing and In-house Facilities Management Practices: Advantages and disadvantages. *International Journal of Innovation Science and Research Technology*, 6(4), 338–344.
- Outsourcing Facility Management Services: Everything Helpful You Should Know | James Cubitt Facilities Management. (n.d.). Retrieved December 9, 2021, from https://www.jamescubittfacilities.com/uncategorized/facility-management-services/
- Pakrudin, N. A. A., Abdullah, M. N., Asmoni, M., Mei, J. L. Y., Jaafar, M. N., & Mohammed,
   A. H. (2017). Critical Success Factors For Facilities Management Implementation In
   The Healthcare Industry. *International Journal of Real Estate Studies*, *11*(2).
- Patanapiradej, W. (2005). The Scope of Facility Management. *The Scope of Facility Management*, 75–90.
- Prachi, P. (n.d.). *Healthcare and Outsourcing: How they are connected!* Retrieved January 8, 2022, from <u>https://cyfuture.com/blog/healthcare-and-outsourcing-how-they-are-connected/</u>
- QSI, F. (n.d.). 6 Reasons Why Outsourcing Facilities Services Is Exactly What You Need. Retrieved January 8, 2022, from <u>http://blog.qsifacilities.com/outsourcing-facilities-services</u>
- Richardson, & Mosman Wrench. (n.d.). *The Impact of Outsourcing in the Global Healthcare Industry*. Retrieved January 8, 2022, from https://outsourceworkers.com.au/the-impact-of-outsourcing-in-the-global-healthcare-industry/



- Somjai, S. (2017). Advantages and Disadvantages of outsourcing O2I. The Business and Management Review, 9(1), 1.
- Summers, D. J., & Visser, J. K. (2021a). Factors that influence the decision to outsource maintenance in the processing industry. South African Journal of Industrial Engineering, 32(1), 24–36. <u>https://doi.org/10.7166/32-1-2127</u>
- Summers, D. J., & Visser, J. K. (2021b). factors that influence the decision to outsource maintenance in the processing industry. South African Journal of Industrial Engineering, 32(1), 24–36. <u>https://doi.org/10.7166/32-1-2127</u>
- Suweero, K., Moungnoi, W., & Charoenngam, C. (2017). Outsourcing decision factors of building operation and maintenance services in the commercial sector. *Property*



# PENYEDIAAN ALAT PENCEGAH KEBAKARAN DALAM KONTEKS KESEDARAN PEKERJA DI HOSPITAL

Glory Priskila Chongloi<sup>1</sup>, Nik Zety Akhtar Abdul Aziz<sup>2</sup>

<sup>1</sup>Jabatan Kejuruteraan Awam, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor glorykila95@gmail.com nikzetypsa@gmail.com

#### Abstrak

Objektif utama dalam kajian ini adalah untuk mengkaji faktor-faktor yang boleh mempengaruhi tahap kesedaran pekerja dalam alat pencegah kebakaran dan untuk mengenal pasti tahap kesedaran pekerja tentang pengurusan alat pencegah kebakaran dalam hospital. Kajian ini akan memfokuskan 3 hospital iaitu 2 hospital kerajaan dan 1 hospital swasta. Data-data yang diperolehi di dalam kajian ini adalah berdasarkan borang soal selidik yang diedarkan. Semua responden ini adalah daripada pekerja teknikal yang bekerja dalam 3 bangunan hospital tersebut. Borang soal selidik tersebut akan diedarkan kepada 103 orang pekerja teknikal. Semua data ini akan dianalisis menggunakan *Microsoft Excel.* Hasil daripada kajian ini menunjukkan tahap kesedaran pekerja teknikal mengenai alat pencegah kebakaran di hospital adalah sangat tinggi iaitu mempunyai nilai min sebanyak 4.57.

#### Kata kunci: Kesedaran, Hospital, Alat Pencegah Kebakaran

#### 1. Pendahuluan

Hospital adalah satu institusi penjagaan kesihatan yang menyediakan pelbagai rawatan kepada pesakit dan menyediakan pelbagai peralatan perubatan. Hospital juga adalah sangat penting kepada orang ramai dan menandakan titik utama dalam kehidupan mereka (World Health Organization, 2018).



Apabila membina sesuatu bangunan tidak kira bangunan besar atau kecil aspek yang utama adalah keselamatan. Kebanyakan bangunan pada masa kini mempunyai alat pencegah kebakaran. Alat pencegah kebakaran adalah satu tindakan untuk mencegah penyebaran api dan memadam api yang akan berlaku di sesebuah bangunan. Menurut Jabatan Bomba dan Penyelamat Malaysia alat pencegah kebakaran seharusnya di pasang di dalam setiap bangunan yang telah dibina bersesuaian dengan akta dan juga standard yang telahpun ditetapkan. Jabatan Bomba dan Penyelamat Malaysia juga ada menetapkan garis panduan penyediaan alat pencegah kebakaran mudah alih di tempat kerja. Ada 2 jenis alat pencegah kebakaran iaitu aktif dan pasif. Menurut (Guard, 2021) alat pencegah kebakaran aktif juga berfungsi untuk membantu memadam api tersebut. Alat pencegah kebakaran pasif termasuklah pintu api, dinding yang disalut dengan salutan epoksi tahan api, lantai, siling, dan banyak lagi.

Seperti yang dinyatakan oleh (Sobral, 2017) sistem keselamatan kebakaran biasanya telah direka dengan keadaan yang sangat baik dan telah dipasang dengan betul. Menurut (Chandrakantan, 2015) walaupun bangunan hospital mempunyai kelengkapan yang baik dalam sistem kebakaran namun masih kurang kesedaran dalam pengendalian sistem kebakaran tersebut. Ketua Pengarah Jabatan Bomba dan Penyelamat Malaysia (JBPM), Datuk Wira Wan Mohd Nor Ibrahim, berkata kesalahan tersebut menunjukkan kesedaran terhadap aspek keselamatan dalam kebakaran di negara ini masih rendah (Mohd Roji Kawi, 2016, Berita Harian).

# 2. Kajian Literatur

#### 2.1 Kesedaran

Menurut (Cienca, 2021) kesedaran adalah salah satu perkataan Inggeris yang membawa maksud tindakan seseorang individu menyedari atau menyedari sesuatu. Selain itu, kesedaran juga diterjemahkan ke dalam Bahasa Sepanyol yang membawa maksud kepekaan. Dalam psikologi, kesedaran adalah satu tindakan menyedari apa yang dirasakan oleh seorang individu terhadap realiti untuk bersentuhan dengan dirinya sendiri. Menurut (Cienca, 2021) lagi, kesedaran mempunyai tiga zon iaitu:

i. Kesedaran Luaran – iaitu pengetahuan deria terhadap objek dan juga persekitaran.



- ii. Kesedaran Dalaman iaitu hubungan deria dengan mekanisme dalaman kita. Contohnya, pernafasan kita, ketegangan otot kita dan juga gegeran.
- iii. 'Fantasy Awareness' boleh dikenali sebagai zon perantaraan iaitu kesedaran terhadap semua aktiviti mental yang masih berlaku pada masa kini.

### 2.2 Tahap Kesedaran

Menurut (Fogoros, 2021) tahap kesedaran adalah apabila kita semakin dekat dengan permukaan kita mula melihat banyak perkara dan kita mula menjadi lebih sedar dengan apa yang ada di hadapan sehinggalah kita memecahkannya kepada kesedaran. Kesedaran bertindak disebabkan otak kita berjalan dan tahap kesedaran yang berubah-ubah adalah petunjuk bahawa ada sesuatu yang salah dan mungkin bakal terjadi.

### 2.3 Teori Kebakaran

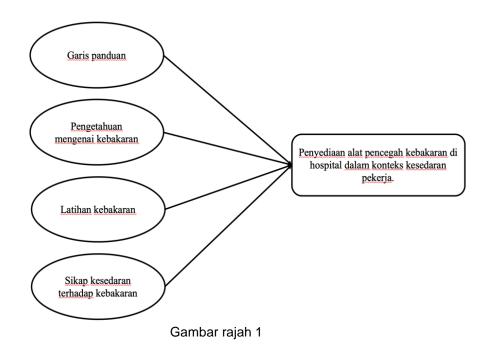
Dalam teori kebakaran, kebakaran bermaksud satu kejadian yang tidak diingini dan satu kejadian yang tidak dapat dikawal. Kebakaran tersebut akan membebaskan tenaga haba. Apabila terjadinya api yang masih mampu dikawal maka gejala tersebut masih belum dinyatakan sebagai kebakaran. Tetapi apabila api mula membesar dan tidak mampu untuk dikawal maka gejala tersebut dikatakan sebagai kebakaran (Azlin, 2021).

# 2.4 Punca Kebakaran

Kebakaran hospital biasanya berpunca daripada tiga sumber iaitu cecair mudah terbakar. Contohnya seperti larutan yang mengandungi alkohol dan adanya oksigen (O2) dan nitrus oksida (N2O). Percikan kecil ataupun haba yang datang daripada peralatan yang berhampiran dengan oksigen (O2) juga memudahkan kebakaran (Chowdhury, 2014).



# 2.5 Kerangka konseptual kajian



#### 2.5.1 Garis panduan

Menurut Kamus Dewan menyatakan bahawa garis panduan adalah satu panduan ataupun satu petunjuk yang harus diikuti.

#### 2.5.2 Pengetahuan mengenai kebakaran

Menurut (Utusan Borneo Online, 2014) pengetahuan mengenai mencegah dan juga memadamkan kebakaran perlulah didedahkan sejak usia yang masih muda. Ini bertujuan untuk mengurangkan kehilangan nyawa dan juga mengelakkan kemusnahan harta benda. Harus juga mengajar anak kecil bagaimana untuk mencegah kebakaran dan juga senantiasa mengingatkan ibu bapa mereka betapa pentingnya keselamatan kebakaran di rumah.



#### 2.5.3 Latihan kebakaran

Sama ada di tempat kerja ataupun bangunan awam latihan kebakaran adalah sangat penting sekiranya berlaku kebakaran. Latihan kebakaran juga adalah keperluan undangundang dan setiap orang mahupun kakitangan harus mengambil bahagian dan mempunyai pengetahuan mengenai latihan kebakaran (Ukhwah, 2019). Menurutnya juga, keperluan latihan kebakaran di tempat kerja sangat penting. Ini adalah satu peluang kepada semua kakitangan untuk mengamalkan prosedur pemindahan dan juga memastikan mereka mengenali tahap keselamatan mereka. Latihan kebakaran dan dapat untuk menguji sepantas mana kakitangan bertindak dengan laluan kebakaran dan dapat menilai keberkesanannya (Ukhwah, 2019). Menurut (Aito, 2021) di Malaysia, kesedaran mengenai latihan kebakaran kepada masyarakat amatlah dititikberatkan oleh pihak bomba.

### 2.5.4 Sikap kesedaran terhadap kebakaran

Dimana-mana kita berada dan apapun yang kita lakukan aspek kesedaran terhadap kebakaran mestilah dititikberatkan. Banyak kemalangan yang boleh berlaku sekiranya hal ini diremehkan. Kempen ataupun program mengenai kesedaran kebakaran ini bertujuan untuk menanam sikap kesedaran terhadap bahaya kebakaran dan juga memberikan langkah mencegah serta mengawal kebakaran dan melatih untuk menyelamatkan diri sekiranya berlaku kebakaran (Harian Metro, 2014). Menurut (Latif, 2017) penganjuran kursus mengenai kebakaran juga berperanan untuk menyebarkan maklumat yang berkaitan dengan keselamatan dan cara mencegah kebakaran dalam kalangan kakitangan Hospital. Tambahan lagi, aktiviti tersebut selaras dengan komitmen pihak pengurusan hospital untuk meluaskan lagi kesedaran terhadap risiko bahaya yang wujud ketiJka waktu bekerja.

# 3. Kajian Metodologi

Kajian yang dilakukan adalah menggunakan borang kaji selidik. Cara ini bertujuan untuk memberikan penjelasan bagaimana kajian tersebut dilaksanakan, data-data yang telah diperoleh dan yang telah dianalisis bagi mendapatkan maklumat yang tepat. Responden yang terlibat dalam kajian ini adalah pekerja teknikal.



Syarikat	Kuantiti
Syarikat A	23 orang
Syarikat B	55 orang
Syarikat C	60 orang

Jadual 11: Sampel Saiz

#### 4. Analisa dan Dapatan

Rajah di bawah menunjukkan peratus umur pekerja teknikal yang terlibat dalam menjawab soal selidik tersebut.

Umur	Peratus
21 – 25 tahun	41.1%
26 – 30 tahun	36.7%
31 – 35 tahun	14.4%
36 – 40 tahun	7.8%
41 – 45 tahun	-
46 – 50 tahun	-
Total	85.6%

#### Jadual 2: Sampel Saiz

Jadual di atas adalah umur pekerja teknikal di 3 syarikat tersebut. Pengkaji mendapati bahawa antara umur 21-25 tahun mempunyai peratus yang tinggi berbanding yang lain iaitu 41.1%. Manakala untuk responden berumur 26-30 tahun pula mempunyai 36.7%, responden berumur 31-35 tahun adalah 14.4% dan untuk responden berumur 36-40 tahun adalah sebanyak 7.8%.

Untuk objektif kajian yang pertama, bahagian ini adalah untuk mengkaji faktor-faktor yang boleh mempengaruhi tahap kesedaran pekerja teknikal dalam alat pencegah kebakaran.



Bil	Item	Purata
1	Garis panduan yang sedia ada dapat membantu mempengaruhi kesedaran pekerja teknikal dalam pelaksanaan pengurusan keselamatan kebakaran.	4.47
2	Latihan kebakaran yang dijalankan mampu meningkatkan kesedaran dan pengetahuan pekerja teknikal mengenai keselamatan kebakaran.	4.51
3	Polisi keselamatan kebakaran dapat membantu pekerja teknikal dalam pelaksanaan pengurusan keselamatan	4.47
4	kebakaran.	4.57
5	Program-program keselamatan kebakaran adalah penting untuk pekerja.	4.54
6	Pengurusan alat pencegah kebakaran perlu dititikberatkan bagi mengelakkan berlaku kelalaian.	4.57
7	Penglibatan pekerja teknikal menyertai latihan	4.45
8	keselamatan kebakaran yang dianjurkan adalah penting.	4.41
	Pendedahan mengenai alat pencegah kebakaran perlu dipertingkatkan.	
	Menyertai program-program yang berkaitan dengan alat pencegah kebakaran yang telah dianjurkan.	

### Jadual 3: Sampel Saiz



Untuk objektif pertama, purata yang paling tinggi adalah sebanyak 4.57. Ini menunjukkan bahawa kebanyakkan responden sangat bersetuju mengenai program-program keselamatan adalah penting untuk pekerja dan responden sangat bersetuju bahawa penglibatan pekerja teknikal menyertai latihan keselamatan kebakaran yang dianjurkan adalah penting.

Untuk objektif kajian yang kedua pula, bahagian ini adalah untuk untuk mengenal pasti tahap kesedaran pekerja teknikal tentang pengurusan alat pencegah kebakaran dalam hospital.



Bil	Item	Purata
1	Saya mengetahui garis panduan keselamatan kebakaran yang telah ditetapkan.	4.44
2	Saya mengetahui polisi-polisi keselamatan kebakaran yang telah ditetapkan.	4.34
3	Saya mengetahui prosedur-prosedur keselamatan kebakaran dan juga saya mematuhi piawaian yang telah ditetapkan.	4.35
4	Saya juga mengetahui amalan pengurusan keselamatan dengan baik.	4.36
5	Saya mengetahui kategori alat pemadam api kebakaran melibatkan peralatan elektrik iaitu karbon dioksida (CO2).	4.32
6	Saya mengetahui alat pemadam api jenis "ABC" atau "Multi- Purpose Dry Chemical" digunakan untuk memadam kebakaran yang melibatkan kayu, kertas, kain, sampah dan juga cecair yang mudah terbakar.	4.23
7	Saya akan memberikan kerjasama untuk menyertai latihan keselamatan kebakaran yang telah dianjurkan.	4.44
8	Saya menyertai program yang berkaitan dengan keselamatan kebakaran.	4.36
9	Saya mengelak daripada melakukan kecuaian semasa menjalankan tugas.	4.42
10	Saya diberi pendedahan untuk mempertingkatkan lagi pemahaman tentang keselamatan kebakaran.	4.42
11	Saya akan melibatkan diri dalam latihan kebakaran yang akan dijalankan.	4.38
12	Saya menyertai program-program yang berkaitan dengan keselamatan kebakaran.	4.39
13	Saya menitikberatkan tentang keselamatan kebakaran bagi mengelakkan berlakunya kecuaian.	4.37

Jadual 4: Sampel Saiz



Untuk objektif kedua pula, purata yang paling tinggi adalah sebanyak 4.44. Ini menunjukkan bahawa responden mengetahui garis panduan keselamatan kebakaran yang ditetapkan oleh

pihak hospital dan juga responden boleh memberi kerjasama untuk menyertai latihan kebakaran yang dianjurkan.

Skala	Tahap Kemahiran
1.00 – 2.39	Rendah
2.40 - 3.70	Sederhana
3.71 – 5.00	Tinggi

# Jadual 4: Sampel Saiz

#### 5. Perbincangan

Berdasarkan hasil dapatan soal selidik diatas, pengkaji dapat simpulkan bahawa kebanyakan responden memberikan komen yang baik dan juga mereka memahami kehendak soal selidik tersebut. Berdasarkan jadual 3 item yang mempunyai purata tertinggi adalah item nombor 4 dan juga nombor 6. Program-program keselamatan kebakaran seperti latihan kebakaran itu adalah sangat penting untuk memberikan kesedaran kepada pekerja. Selain itu, penglibatan pekerja teknikal dalam menyertai latihan kebakaran yang dianjurkan juga adalah penting dan responden sangat bersetuju untuk item tersebut. Untuk jadual 4 pula, min yang paling tinggi adalah item nombor 1 dan nombor 7. Kebayakkan responden juga mengetahui garis panduan keselamatan kebakaran yang pihak hospital tetapkan. Selain itu, responden juga memberikan bomba.



# 6. Kesimpulan

Kesimpulannya, hasil kajian ini pengkaji mendapati bahawa tahap kesedaran mengenai alat pencegah kebakaran di hospital adalah sangat penting. Hal ini disebabkan di hospital terlalu banyak pesakit dan orang awam yang datang ke tempat tersebut untuk mendapatkan rawatan. Sekiranya pekerja teknikal mengetahui tentang alat pencegah kebakaran tersebut maka kebakaran boleh dikurangkan dan mereka juga tahu bagaimana untuk menyelamatkan diri mereka juka berlakunya kebakaran. Segala kelemahan dapat dikenalpasti dan cadangan telah diberikan bagi penambahbaikan tahap kesedaran mengenai alat pencegah kebakaran di hospital.

# 7 Penghargaan

Pengkaji ingin berterima kasih kepada pihak-pihak yang terlibat dalam menjayakan kajian ini. Pihak pihak yang terlibat adalah daripada 2 hospital kerajaan dan juga 1 hospital swasta.

# 8. Rujukan

Bagaimana Mengendalikan Latihan Kebakaran Dengan Betul. (2021), from https://pemadamapi.com.my/bagaimana-mengendalikan-latihan-kebakaran-denganbetul/

Chandrakantan Subramaniam. (2013). (PDF) Hubungan Amalan Pengurusan Keselamatan dengan Pematuhan Keselamatan Pekerjaan di Jabatan Bomba dan Penyelamat Malaysia (Relationship between Safety Management Practices and Job Safety Compliance in Fire and Rescue Department Malaysia).
https://www.researchgate.net/publication/280689670\_Hubungan\_Amalan\_Pengurusan\_Keselamatan\_dengan\_Pematuhan\_Keselamatan\_Pekerjaan\_di\_Jabatan\_Bomba\_dan\_Penyelamat\_Malaysia\_Relationship\_between\_Safety\_Management\_Practices\_and\_Job\_Safety\_Compliance\_in\_Fir

Chowdhury, K. (2014). Fires in Indian hospitals: Root cause analysis and recommendations for their prevention. *Journal of Clinical Anesthesia*, *26*(5), 414–424. https://doi.org/10.1016/J.JCLINANE.2013.12.014



- Cienca Y Salud. (2021). MAKNA KESEDARAN (APAKAH ITU, KONSEP DAN DEFINISI) -UNGKAPAN BAHASA INGGERIS - 2021. https://ms.encyclopediatitanica.com/significado-de-awareness
- Dedah pengetahuan cegah dan padam kebakaran | Utusan Borneo Online. (n.d.). Retrieved December 16, 2021, from https://www.utusanborneo.com.my/2014/10/12/dedahpengetahuan-cegah-dan-padam-kebakaran
- Home PORTAL RASMI. (2021), from https://www.bomba.gov.my/
- J, S. (2017). Fire Safety Systems in Buildings-Problems and Concerns beyond the Project. *MOJ Civil Engineering*, *Volume 2*(Issue 5). https://doi.org/10.15406/MOJCE.2017.02.00049
- Laman Web Rasmi Hospital Universiti Sains Malaysia HOSPITAL USM ANJUR KURSUS KESELAMATAN, CEGAH KEBAKARAN. (n.d.). Retrieved January 6, 2022, from https://h.usm.my/index.php/arkib-berita/44-berita-2017/658-hospital-usm-anjur-kursuskeselamatan-cegah-kebakaran
- Latihan Kebakaran Boleh Kurangkan Risiko Kebakaran. (2021), from https://aito.com.my/latihan-kebakaran/
- Mohd Roji Kawi. (2016). Kesedaran terhadap aspek keselamatan kebakaran masih rendah -Bomba. https://www.bharian.com.my/berita/nasional/2016/05/156894/kesedaranterhadap-aspek-keselamatan-kebakaran-masih-rendah-bomba
- Richard N. Fogoros. (2018). *Kesedaran dan Tahap Kesedaran*. https://ms.approby.com/kesedaran-dan-tahap-kesedaran/
- *Terap kesedaran hadapi kebakaran | Harian Metro.* (n.d.). Retrieved December 27, 2021, from https://api.hmetro.com.my/node/6244
- Understanding the Differences Between Active vs. Passive Fire Protection Systems | Smoke Guard. (n.d.). Retrieved October 22, 2021, from https://smokeguard.com/blog/2019/august/15/understanding-the-differences-betweenactive-vs-passive-fire-protection-systems
- View of Penggunaan Global System for Mobile (GSM) untuk pemantauan Kebakaran: Kajian Kes di Bangunan LHDN Kluang. (n.d.). Retrieved January 8, 2022, from https://publisher.uthm.edu.my/periodicals/index.php/rmtb/article/view/2053/760



# AUTOMATED FUMIGATION FOR CORONA VIRUS DISEASE

Hazirah binti Hadri<sup>1</sup>, Suryani binti Ilias<sup>2</sup>

Department of Electrical Engineering, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor, Malaysia. <sup>1</sup>hazirahhadri@gmail.com <sup>2</sup>kamasue77@gmail.com

#### Abstract

The SARS-CoV-2 virus, which is the source of the Corona Disease Virus 2019 (COVID-19), has spread across the nation, including Malaysia. Environmental surfaces are particularly prone to COVID-19 viral infection in healthcare settings when certain medical procedures are carried out. As a result, these surfaces must be adequately cleansed and disinfected to prevent additional transmission, especially when COVID-19 patients are being cared for. The goal of this project is to design a fumigation device in reducing of Corona Virus for decontaminate close area using microcontroller system for autonomous disinfecting robot. The effectiveness for this project shown that it is successfully can be used for different areas automatically even at long distances by using automated fumigation. Furthermore, the project system uses the Internet of Things (IoT) through a mobile application which, it greatly simplifies the user through control on a smartphone.

Keywords: COVID-19, fumigation, autonomous robot, Internet of thing (IOT).

#### 1. Introduction

The novel coronavirus disease 2019 (COVID 19), a novel pneumonia disease originating in Wuhan, was confirmed by the World Health Organization on January 12, 2020, before becoming an outbreak in all countries. The wave of COVID-19 spread in Malaysia has 3 in total. The first wave begins in February. The second wave began in March



. The positive case continues to rise and the third wave, which starts in early October (World Health Organization, 2020). The group of cases who get COVID-19 will have mild to moderate symptoms and will recover without any increase in potential.

When an infected person coughs, sneezes, speaks, performs, or breathes, the virus spreads in microscopic liquid particles from their mouth or nose (World Health Organization, 2020). On the other hand, they will become seriously ill and require medical attention. The virus is more easily disseminated indoors and in crowded places (Leonardo, 2019).

This project designs and develop an automated fumigation device using Internet of Things (IOT) that users can perform the device individually from mobile phone. Although coronaviruses may survive on surfaces for hours, they are immediately destroyed by cleaning and disinfection. Regularly cleaning frequently touched surfaces with a detergent solution is advised, as is cleaning frequently used fittings and surfaces as quickly as spills are visible to the human eye (Australian Government, 2020).



# Figure 1: Block diagram of cleaning and disinfection

Physical cleaning with detergent and water is advised for general cleaning. Other than that, it is suggested to regularly clean the floor using detergent and water (Health et al., 2020) Follow the directions on the package and use warm water and a neutral detergent to clean most hard surfaces.



Figure 2: General cleaning



Disinfectants are chemicals that immediately destroy or render the majority of infectious agents inactive. For this disinfection, it is necessary to clean floors that have been contaminated with many resistant species, organisms that have the potential to spread an epidemic, and other potentially contagious materials like blood and other body fluids that have been spread on the floor (Health et al., 2020).



**Figure 3: Disinfection Processing** 

# 2. Methodology

This chapter explains how to developed this project effectively, including the processes required. Design the mechanical components of automated fumigation devices, as well as block and flow diagrams of operating systems and the IoT systems needed for these devices.

# 2.1 Design the mechanical part and component of Automated Fumigation device.

Figure 4 shows the Automatic Fumigation Device. It was designed with Thinkercad. A free online application for 3D design, electronics, and coding is called Tinkercad.

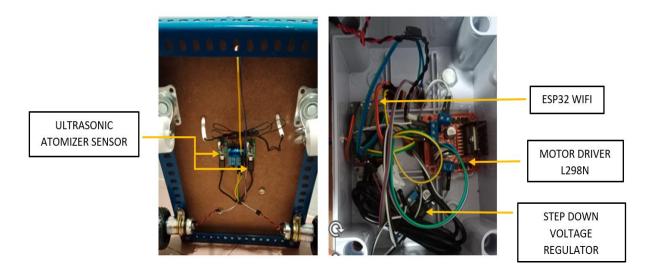




# Figure 4: Mechanical Design of Automated Fumigation using Tinkercad

# 2.2 Developing the hardware and Internet of Things (IoT) application for Automated Fumigation.

The circuit installation system of the automated fumigation device is shown in Figure 5. The ESP32 Wi-Fi module performs the role of a device controller and may be programmed using the Arduino IDE. Driver motor to control the device's movement.

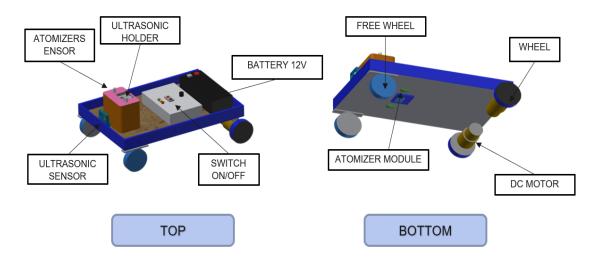


# Figure 5: An Automated Fumigation device circuit installation

Figure 6 had showed the development of electronic and mechanical part of Automated Fumigation device. The main components of the device in this project are the ESP 32 Wi-Fi module where it is connected to the application Blynk, the motor driver that controls the movement of the device, the 12v battery



which will be the power supply for the movement of the device, the atomizer sensor as the component that converts the sanitizer liquid to fumigation, and the ultrasonic sensor as the component that detects the distance of the device from obstacles.



# Figure 6: Development of mechanical and electrical components for Automated Fumigation device

Referring to Figure 7, the interface of Internet of Things (IoT) application for Automated Fumigation device. Blynk was created to be used with the Internet of Things. For IOS and Android system users, the Blynk programme is simple to download and has many fascinating features, including the ability to remotely operate devices, display sensor data, store data, and visualise it. Based on Table 1, which describes each button's use in the Blynk programme when the device is in use.





# Figure 7: Interface of Internet of Things (IoT) application for Automated Fumigation device

# Table 1: Function of the Blynk application button

NO	Button
V0	Button on and off for device
V1	Button on and off for sensor atomizer on right
V2	Button on and off for sensor atomizer on left
V3	Display value of distance in centimeter (cm)
V4	Display volume sanitizer tank in percentage (%)
V5	Slider for adjusting speed percentage (%)
V6	Slider for adjusting timer in minutes
V7	Display timer in second

# 2.3 Block Diagram of the Operating System

The block diagram displayed inn Figure 8. The system's operation is represented by the three part of the diagram which is inputs, process, and outputs. This device is meant to help with disinfection by getting rid if fumigation.



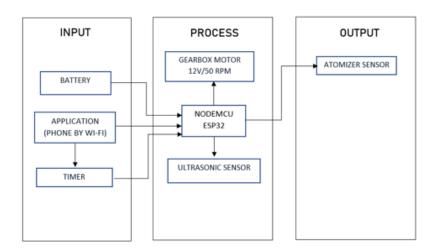
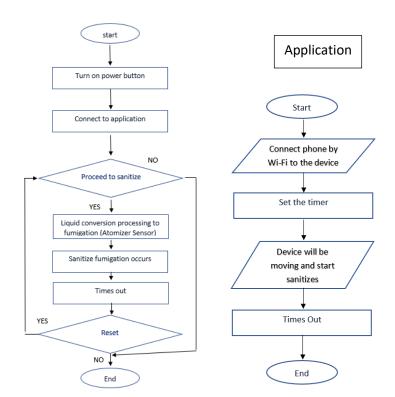


Figure 8: Block Diagram of Automated Fumigation device

# 2.4 Making Flow Chart of the Operation Device

The automated fumigation procedures used to treat coronavirus infections are shown in the flow chart in Figure 8. The given button will turn the device on, and it will then establish a wireless connection with the Blynk app. By using a mobile phone, users may change the desired time. When the timer ends, the device will shut off automatically.





# Figure 10: Flow Chart of Automated Fumigation device and application

### 3. Result and Discussion

Results from testing the performance of the device are collected after the completion of the final hardware prototype. To analyse the Automated Fumigation device's usability, hardware and software tests were conducted an experiment device are used to collect data.

#### 3.1 Experiment on Living Room

Figure 9 shows the living room in this collection is modest, measuring approximately 12 by 18 feet. There is data collection for three distinct speeds, including 100% speed, 60% speed, and 30% speed. This test involves adjusting the speed and duration of operating the sanitising tank (percent), shows in Table 2.





# Figure 11: Experiment of the hardware and software of the device on medium living room

Speed (%)	Timer (Minutes)	Sanitizer Tank % (Before)	Sanitizer Tank % (After)
100 %	20	80%	78%
	40	78%	74%
	60	74%	65%
60 %	20	80%	78%
	40	78%	75%
	60	75%	66%
30 %	20	80%	78%
	40	78%	74%
	60	74%	66%

### **Table 2: Comparison**

As shown in Table 2, reducing the percentage of sanitizer tank by 2% in 20 minutes works to disinfect even when running at different speeds. The tank sanitizer volume is reduced by only 2% at speeds of 100%, 60%, and 30%. 4 percent, the sanitizer tank is reduced when the set time is 40 minutes. The remaining 8% of the sanitizer tank that was disinfected within 60 minutes.



The purpose of this correlation test between speed and water tank is to evaluate the ability of speed to reduce tank senizer fluid. But as can be shown, the difference in speed does not affect the amount of liquid reduced in fact, the liquid decreases the effect of the time used. Therefore, the more time it takes to remove the device, the more liquid is reduced from the tank.

# 4. Conclusion

Automatic fumigation devices have been designed to decontaminate enclosed spaces while reducing coronaviruses. This disinfection robot microcontroller system is an autonomous device. In addition, the device is set up to be controlled via the Internet of Things (IOT), which is accessed through the Blynk app. The effectiveness of automatic fumigation for this infection was evaluated according to the speed, time, and percentage of the sanitizer tank. The longer it takes for fumigation to disinfect, the more sanitizer liquid in the tank is reduced. So, germs in the room are also eliminated a lot, and it will not have a bad effect on humans.

# 5. Acknowledgment

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# 6. References

World Health Organization. (2020). Coronavirus.

World Health Organization. (2020). Water, Sanitation, Hygiene and waste management for the COVID-19 virus. 1.

Leonardo, P. (2019). COVID\_19. Guidelines on disinfection of common public places including offices., 1.



# READINESS TOWARDS INTERNET OF THINGS (IOT) IN FACILITIES MANAGEMENT PRACTICES AMONG EMPLOYEES

Mohamad Adib Bin Mohamad Hazlan Faculty of Facility Management, Persiaran Usahawan, Politeknik Sultan Salahuddin Abdul Aziz Shah, 40150 Shah Alam, Selangor

#### Abstract

IoT enabled intelligent building solutions are safe, scalable, and interoperable because they use Internet-connected devices that gather and transfer data and software for data aggregation and analysis. They advocate for open communication and construction standards, reducing costs, and improving integration possibilities. Adapted quote from Christina Jung (2017). This study focuses on IoT principles and current Readiness towards the Internet of Things (IoT) in facilities management practices among employees. A focused survey was undertaken to address this issue, and the obtained data were examined various suggestions are provided based on the results from the study. The results may be utilized to increase staff readiness for the Internet of Things (IoT) in facilities management operations. Future researchers might utilise the findings of this study to create additional comparisons by examining whether facility management agencies take the Internet of Things (IoT) implementation in facility management procedures seriously.

**Keywords:** Readiness,Internet Of Things,Awareness,Facility Management Practices,Facility Management Employess

#### Introduction

There is now a widespread usage of the Internet of Things (IoT) in households. Wi-Fi-enabled intelligent appliances that can be controlled from a smartphone are becoming more common. Since their inception, IoT efforts have generated several career possibilities and project options. Facility managers are already working on initiatives like this. The necessity for convergence in various transdisciplinary technologies has sparked a lot of IoT research (Wang & Hsieh, 2018).Low awareness of IoT in the construction sector and technology (Ibrahim et al., 2021).Due to limited exposure to the global



construction industry and technology, a lack of understanding among construction players is another hurdle in implementing the IoT (Rad & Ahmada, 2017). This article introduces IoT principles and discusses current Readiness towards the Internet of Things (IoT) in facilities management practices among employees through a systematic analysis of academic research papers, blogs, review articles, and other online publications. Lastly, The researcher thinks this study would shed more light on the usefulness of Internet of Things (IoT) benefits in Malaysian facilities management sectors.

#### Literature review

IoT ready variables for this study, we analyzed the associated ideas from numerous readiness models that have been explored before in the IoT sector, notably Facility Management Practices. As a result, assessments of cloud computing adoption, cultural e-government readiness models, organizational readiness models for digital innovation, and green readiness models were done to acquire a deeper understanding of the theoretical underpinnings of technical readiness.

#### Definition of IoT & Facility Management.

The Industrial Internet of Things (IIoT) is a phrase that refers to a technology that is predicted to revolutionize production and distribution by fusing the digital and physical worlds of manufacturing and distribution. The Internet of Things (IoT) is as follows: (Turcu et al., 2018). A massive network of intelligent gadgets and equipment communicating with one another and with people worldwide. Intelligent objects served as the foundation for a platform that allowed the formulation and monitoring of complicated processes across large distances."The management (FM and Property Management) disciplines—which are less well-defined as disciplines but include maintenance, administration, and financial management-tend to be considerably more short-term in view, frequently day-to-day. They cope with shorter timeframes, project deadlines, end-of-year financial statements, quarterly reports, and imminent crises." (Thompson et al., 1990). Lastly, the current definition of FM emphasizes the function of service supply in a support capacity rather than the constructed asset. The European CEN definition of facility management is as follows: "the integration of procedures inside an organization to maintain and create agreed-upon services that support and improve the efficacy of its principal operations" (CEN EN 15221).



#### The Fourth Industrial Revolution

Over the last three centuries, work has evolved due to several industrial revolutions. Since the 18th century, these industrial revolutions have seen the impact of manufacturing processes, the mass production of steel and automobiles, and the introduction and rise of new technologies improve efficiencies across the globe (Hirschi, 2018).Technological innovations have accelerated dramatically in recent years, affecting how we work, how our economy runs, and how our communities connect (Schwab, 2017).One of the biggest skeptics on 4IR, Robert Gordon, argues that the most influential technologies from this era are already in the past and that future will not bring significant changes to 6 how we live our lives (Burke-Kennedy, 2018).Klaus explores the biological trends driving the revolution, including breakthroughs in genetics, genetic engineering, and healthcare, arguably one of the most controversial implications of recent technological advancements (Klaus, 2017).

### Readiness among staff in Facility Management Industries towards IoT

The term "technology readiness level" (TRL) refers to a conceptual tool for estimating technical maturity on a scale spanning from an idea to a fully working product or service. NASA established the idea and assessment methodology in the 1970s and applied them (Mankins 2009). The idea has gained popularity over time, and it is currently adopted and utilized in a broad variety of organizations worldwide (Bakke , 2017). The technology's performance targets, present degree of preparedness, and an appraisal of the impediments to future development are all covered (Mankins et al., 2009). The extensive use and use of technology readiness assessment across sectors have also resulted in changes and new versions (Hèder et al., 2017).

# METHODOLOGY

Research design, limitation of the study, the population, sample of the population, sampling technique and instrument of the data collection, methodology of the study, and the data analysis were gathered. In order to obtain the data needed for the objectives of this study, a mono method approach is chosen by the researcher, whereby there is quantitative research design has been chosen to attain the findings from the surveys and standardized open-ended questions. The researcher will take an approach to avoid significant errors when determining which sample size is acceptable for the population. Both table (morgan, 1970) decide the sample size. Probability sampling is often associated with survey and experimental research strategies it is possible to answer research questions and to achieve objectives that require to estimate statistically the



characteristics of the population from the sample. (Saunders et al., 2009).Reliability testing of the manufactured products is also conducted. The researcher concludes that the constructed questionnaire has high reliability when the coefficient value is greater than 0.7 (Najib, 1999).Cooper and Schindler (2008) have defined ethics as the norms or standards of conduct that guide moral choices about our behavior and our associations with others. The behavior of the researcher shall be as per the social rules of the society of the respondent (Zikmund 2000).

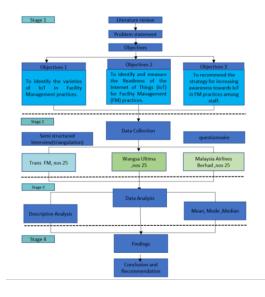


Figure 1 : Research Design Table

# FINDING & DISCUSSION

The sample size is around 73 respondents from 90 population from five different facility management companies. Respondents with a bachelor's degree are the most likely to reply to this poll, as part-time and lower-level management positions have more openings than those in middle and upper management. Respondents in executive positions are the most likely to participate in this survey since middle-level management is the most exposed to the Internet of Things, particularly in facilities management techniques.



### **Sampling Size**

Determining the sample size needed to be representative of a given population is increasing demand for research has created a need for an efficient method. In the article, the research division of the National Education Association has published a formula for determining sample size.

 $S = X^2 NP(1-P) / d^2 (N-1) + X^2 P (1-P)$ 

S= required sample size

 $X^2$ = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841).

N= the population proportion

d= the degree of accuracy expressed as a proportion

# OBJECTIVE 1: TO DEFINE THE INTERNET OF THINGS (IOT) FOR FACILITY MANAGEMENT (FM) PRACTICES

No	Questions	Mean	Rankin
			g
	Have you used or been aware of any of the Internet Of Things (IoT)		
	technologies as stated below?		
1	My Sejahtera	4.384	1
2	Cloud computing or Google Drive	4.219	2
3	Media Social (Email, WhatsApp, Telegram, Facebook)	4.068	3
4	Microsoft Office software	3.753	4
5	Management System(CMMS,CMS,BMS,CAMSIS)	3.644	5
6	Digital sensor	3.616	6
7	Wireless inventory trackers	3.329	7
8	Actuators	3.315	8
9	Autonomous Machinery	3.260	9

Table 1: Mean Score analyse for the Awareness on variety of element /domain related to Internet of Things (IoT)



With a mean score of 4.38, My Sejahtera is the Internet of Things (IoT) technology at respondents' workplaces about which they are best informed and most likely to use. These findings are presented in Table 9. The study was done during the covid 19 epidemic, which may have affected the results. The development of the Internet of Things underpins technological innovation and revolution (Industrial Revolution 4.0). (IoT). The Internet of Things comprises big data analytics, cloud computing, artificial intelligence, machine learning, and robots (Herweijer et al., 2018). This technology has provided benefits throughout the MCO era. Businesses (retail, banking, delivery, and professional services) that adopted digital technology had seen a significant boost in earnings due to the increase in delivery orders when consumers were compelled to stay at home. The IoT has aided these platforms in their real-time visibility and control administration of online transactions. Additionally, the potential of artificial intelligence is limitless; new medicines have been identified utilising machine-learning techniques (Marchant, 2020).

With an average score of 4.21, Cloud computing and Google Drive are the Internet of Things (IoT) technologies that employees are aware of and utilise at work. In addition, those who have utilised or been aware of any Internet of Things (IoT) technologies that are Media Social (Email, WhatsApp, Telegram, Facebook) had an average score of 4.06. In addition, Microsoft Office software has a mean score of 3.75, ranking fourth among those who have used or been familiar with the Internet of Things (IoT) technology. In addition, using or being aware of any Internet of Things (IoT) technologies Management systems (CMMS, CMS, BMS, CAMS) have a mean score of 3.64 and used Internet Of Things (IoT) technologies Digital sensors have a mean score of 3.61. In contrast, Wireless inventory trackers have a mean score of 3.32 and Actuators have a mean score of 3.315. 3.260 was the lowest mean score for Autonomous Machinery respondents who have utilised or been aware of the Internet of Things (IoT) technology.

Reliability Statistics		
Cronbach's		
Alpha	N of Items	
.74	9	

Table 2: Cronbach's alpha for the Awareness on variety of element /domain related to Internet of Things (IoT)

Based on the Table 2, for these items selected, the Cronbach's Alpha is 0.74



that indicated the Awareness on variety of element /domain related to Internet of Things (IoT) on is reliable. As a result, can concluded that the findings obtained from this first objective are also used as a support tool to get more specific answers for second objective.

# 5.3 OBJECTIVE 2: TO MEASURE THE LEVEL OF AWARENESS OF IOT TOWARDS FACILITY MANAGEMENT PRACTICES AMONG STAFF AND USERS

No	Questions	Mean	Ranking
1	Do you use social media (WhatsApp, Telegram, Facebook Messenger) for management activities or discussions?	4.069	1
2	Do you use sensor technology to monitor the utility consumption of building, building structures and building systems?	3.945	2
3	Do you use QR scanner or social media while working	3.944	3
4	Do you use computerized database as a data storage center of company activities.	3.699	4
5	Do you use online systems (zoom, google meet, MS team) for the purpose of company activities	3.681	5
6	Do you use computerized database as a data storage center of company activities ?	3.694	6
7	Do you use sensor technology to control energy consumption to buildings	3.653	7
8	Do you use of e-mail as a medium of information exchange and communication?	3.625	8
9	Do you use BIM technology, AutoCAD for during building operations	3.726	9
10	Do you use the Biometric Time Recorders (fingerprint system) in recording employee attendance	3.028	10

Table 3: Mean Score and analyse for Level of implementation of The Internet Of Things(IoT) among Facilities Management employees

Table 3 shows characteristics affecting Facilities Management IoT deployment. Using social media (WhatsApp, Telegram, Facebook Messenger) for management activities or conversations has the highest mean score of 4.069



. Internet-of-Things (IoT) is a worldwide infrastructure for the information society, according to Chen et al. (2020). It enables advanced services via a linked virtual network of interoperable information and communication technologies. IoT's standard architecture facilitates information sharing and receiving across numerous platforms (Tang et al., 2019).

Sensor-using respondents scored 3.945 on the awareness component and had the second-highest mean. The study found that firms might produce more accurate estimates given data and knowledge. The Internet of Things has improved equipment availability through continuous monitoring, conducted preventive maintenance and repair of construction equipment to guarantee it can perform its work efficiently and effectively, and prevented construction delays (Almeida & Solas, 2016).

Respondent agrees to use a QR scanner or social media at work mean score of 3.944. Using a computerised database as a firm data storage centre averaged 3.699. "Connected things" refers to smart gadgets where the sensor detects environmental elements and communicates the data to the cloud network (Mimos, 2015). Then, data integration and processing provide meaningful information that project participants can view online. The information will be turned into suitable apps for future action and project decision-making.

In addition, respondents used online systems (zoom, google meet, MS team) for company activities with a mean score of 3.681; used a computerised database as a data storage centre of company activities with a mean score of 3.694; used sensor technology to control building energy consumption with a mean score of 3.653; used email as a medium of information exchange and communication with a mean score of 3.625; and used BIM technology with a mean score of 3.6 BIM is a technology meant to digitalize construction projects and is the digital embodiment of a facility's physical and functional elements (Zhai et al., 2019). Biometric Time Recorders (fingerprint system) users scored 3.028 on average.



Reliability Statistics		
Cronbach's Alpha	N of Items	
.78	10	

Table 4 : Cronbach's alpha that determine Level of implementation of The Internet of Things (IoT) among Facilities Management employees.

Based on the Table 4, for these items selected, the Cronbach's Alpha is 0.78 that indicated that determine Level of implementation of The Internet Of Things (IoT) among Facilities Management employees is reliable. As a result, can concluded that the findings obtained from this second objective can support with the reliable Cronbach's alpha.

# OBJECTIVE 3: TO RECOMMEND THE STRATEGY FOR INCREASING AWARENESS TOWARDS IOT IN FM PRACTICES AMONG STAFF DATA ANALYSIS FOR STRATEGY ON ENHANCING IMPLEMENTATION OF THE INTERNET OF THINGS IOT AMONG FACILITIES MANAGEMENT EMPLOYEES

No	Questions	Mean	Ranking
1	Do you agree, the organization have to hire the specialist to improve digital equipment, application and system in organization?	4.22	1
2	Do you agree that the company needs to find the best digital technology employee?	4.05	2
3	Do you agree that this all-digital system, equipment and application needs to have to upgrade every year?	3.91	3
4	Do you agree that all data should be documented in softcopy and stored in the company database?	3.89	4
5	Do you agree that user training courses using the digital system, application and equipment conducted by the company can help employees use this system in a more accurate and practical way?	3.88	5
6	Do you agree to have a proper planning budget for improve the digitalization?	3.87	6
7	Do you agree that this we should have increase the coverage of the internet?	3.82	7
8	Do you agree the organization/company must provide financial assistance to workers in order to upgrade their equipment and gadgets?	3.68	8

 Table 5: Mean Score and analyse Strategy on enhancing implementation of the Internet of Things IoT among Facilities Management employees



Table 5 reveals that respondents who believe the organisation must hire a digital specialist had the highest mean score of 4.22. Respondents agree, with a mean score of 4.05, that the organisation must hire gualified digital technology workers. Third, respondents agree this system, equipment, and application must be improved annually mean score of 3.91. In addition, respondents agree that all data should be documented in softcopy and stored in the Company's database mean score of 3.89 and that user training courses using the digital system, application, and equipment can help employees use this system more accurately and practically (mean score: 3.88) at no additional cost to the organisation. The expensive cost of devices and frequent maintenance may further limit building IoT adoption (Salleh & Fung, 2014). Respondents agree mean score of 3.87 that a planning budget is needed to accelerate digitization. Respondents agree mean score of 3.82 average that we need more internet coverage. Respondents who think the organization/company should help workers upgrade equipment and devices scored 3.68. Lack of team integration can lead to miscommunication and misinterpretation of information, reducing efficiency and productivity (Papadonikolaki, Vrijhoef & Wamelink, 2016). Team integration is a lean technique to boosting working efficiency, integrating processes and resources, maximising project profit, and enhancing project delivery quality (Fulford & Standing, 2014). This was owing to the respondent's remark on the survey form that allocating funding for the project is one of the most effective ways for management to encourage personnel to engage in an IoT deployment programme. All levels of the organisation will be committed to the program's success if they work together.

<b>Reliability Sta</b>	tistics
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Cronbach's Alpha	N of Items
.76	8

*Table 6: Cronbach's alpha* for Strategy on enhancing implementation of the Internet of Things IoT among Facilities Management employees

Based on the Table 6, for these items selected, the Cronbach's Alpha is 0.76 that indicated that determine Level of implementation of The Internet Of Things (IoT) among Facilities Management employees is reliable. As a result, can concluded that the findings obtained from this second objective can support with the reliable Cronbach's alpha.



#### Conclusion

Summarizes the research question's findings, the study's implications, its limits, and recommendations for future researchers to improve staff knowledge of IoT in FM procedures. Respondents who think the company must hire a digital specialist scored best. Team integration is a lean technique to boosting working efficiency, integrating processes and resources, maximising project profit, and enhancing project delivery quality (Fulford & Standing, 2014). The researcher knows all three chapter one objectives, according to the study. This section defines IoT in facility management practises, determines IoT Readiness for FM practises, and raises staff awareness of IoT in FM practises.

Using a single quantitative method, some surprising data were obtained, and the researcher concluded that Readiness Towards the Internet of Things (IoT) In Facilities Management Practices Among Employees is a significant component in the success of effective management practises.Mahmud et al. (2018) report that most IoT devices utilised in Malaysian construction are for intelligent communication. Brilliant communication uses WhatsApp, Telegram, social media (Facebook and Instagram), video conversations, teleconferences, and email.The Malaysian construction sector has begun using sensors on building sites, and their use is rising, especially for monitoring construction equipment and machinery utilisation in terms of work location, work timing, equipment and machinery maintenance, and fuel, power, and energy saving.

The respondent is not aware of Autonomous Machinery at their workplace, but is averagely aware of Management Systems (CMMS, CMS, BMS, CAMSIS) and My Sejahtera. This shows that the value of the Internet of Things (IoT) in construction technology and the variety of IoT for Facility Management (FM) practises are still defined.Respondents agree that Biometric Time Recorders (fingerprint systems) are the least-used IoT devices at work. In conclusion, the responder shows that IoT knowledge influences staff and user awareness of facility management strategies. Coaching & Training, Internet Connectivity & Infrastructure, and Software & Budget Allocation are strategies to strengthen IoT implementation in Facilities Management. Increasing staff understanding of IoT in FM practises might influence employee job adjustments and reduce IoT adoption barriers. IoT improves facilities management by producing and using vast volumes of data. Brous and co. (2015).



The researcher proposes future scholars study IoT's impact on government and facilities management enterprises. Improve Work Procedure, IoT allows the project team to conduct real-time inspections and submit information via real-time reporting, which is easier and faster than the previous manner (Nagy et al., 2018).

### REFERENCE

Abdullah, D. B., Abdullah, Y., Azul, M., & Salleh, M. (2017). A REVIEW ON THE CONCEPT OF FOURTH INDUSTRIAL REVOLUTION AND THE GOVERNMENT'S INITIATIVES TO PROMOTE IT AMONG YOUTHS IN MALAYSIA. https://mytn50.com/

ABDULLAH, M. T., LOLA, M. S., EDINUR, H. A., SAFUAN, S., CHE MAT, N. F., KHALIL, I., & YUNG TEN, D. C. (2022). FRAMEWORK OF MEASURES FOR COVID-19 PANDEMIC IN MALAYSIA: THREATS, INITIATIVES AND OPPORTUNITIES. JOURNAL OF SUSTAINABILITY SCIENCE AND MANAGEMENT, 17(3), 8–18. https://doi.org/10.46754/jssm.2022.03.002

Adelodun, B., Ajibade, F. O., Ibrahim, R. G., Bakare, H. O., & Choi, K. S. (2020). Snowballing transmission of COVID-19 (SARS-CoV-2) through wastewater: Any sustainable preventive measures to curtail the scourge in low-income countries? Science of the Total Environment, 742. <u>https://doi.org/10.1016/j.scitotenv.2020.140680</u>

Alawi, M. M. S. (2021). Successful management of COVID-19 outbreak in a longterm care facility in Jeddah, Saudi Arabia: Epidemiology, challenges for prevention and adaptive management strategies. Journal of Infection and Public Health, 14(4). <u>https://doi.org/10.1016/j.jiph.2020.12.036</u>

Alonazi, W. B. (2020). The impact of emotional intelligence on job performance during covid-19 crisis: A cross-sectional analysis. Psychology Research and Behavior Management, 13, 749–757. <u>https://doi.org/10.2147/PRBM.S263656</u>

Assefa, N., Hassen, J. Y., Admassu, D., Brhane, M., Deressa, M., Marami, D., Teklemariam, Z., Dessie, Y., & Oundo, J. (2021). COVID-19 Testing Experience in a Resource-Limited Setting: The Use of Existing Facilities in Public Health Emergency Management. Frontiers in Public Health, 9. <u>https://doi.org/10.3389/fpubh.2021.675553</u>



Azizi, S., Nair, G., Rabiee, R., & Olofsson, T. (2020). Application of Internet of Things in academic buildings for space use efficiency using occupancy and booking data. Building and Environment, 186. https://doi.org/10.1016/j.buildenv.2020.107355

Baashirah, R., & Elleithy, K. (2019, May 1). Automation of the Baggage Check-in Process Using RFID System in Airports. 2019 IEEE Long Island Systems, Applications and Technology Conference, LISAT 2019. https://doi.org/10.1109/LISAT.2019.8817342

Basu, S. (2020). Non-communicable disease management in vulnerable patients during Covid-19. Indian Journal of Medical Ethics, V(2). <u>https://doi.org/10.20529/IJME.2020.041</u>

Beiting, K. J., Huisingh-Scheetz, M., Walker, J., Graupner, J., Martinchek, M., Thompson, K., Levine, S., & Gleason, L. J. (2021). Management and outcomes of a COVID-19 outbreak in a nursing home with predominantly Black residents. Journal of the American Geriatrics Society, 69(5). <u>https://doi.org/10.1111/jgs.17126</u>

Bennett, R., Miller, T., Pickering, M., & Kara, A. K. (2021). Hybrid approaches for smart contracts in land administration: Lessons from three blockchain proofs-of-concept. Land, 10(2). <u>https://doi.org/10.3390/land10020220</u>

Chipangura, J. K., Naidoo, V., Coertze, N., & Mohr, B. (2021). COVID-19 disaster management plans for two laboratory animal facilities in South Africa. Laboratory Animals, 55(6). https://doi.org/10.1177/00236772211032083



# TO STUDY THE ERGONOMICS OF KARAKURI SYSTEM FOR MATERIAL HANDLING

Aiman Lutfi Mohamad Rahman<sup>1</sup>, Hainol Akbar Zaman<sup>2</sup>

<sup>1,2</sup> Department of Mechanical Engineering,Polytechnic Sultan Azlan Shah, Behrang, 35950 Behrang, Perak *aimanlutfiy@gmail.com akbarzaman@gmail.com* 

#### Abstract

A new material handling system design was developed to prevent the operator from wasting time having to walk around a maximum of 10 meters to take the felt box to use during production. The development of this material handling system would significantly shorten the cycle time. One approach was to design a karakuri system for felt storage to reduce the amount of time and motion required when the operator picks up the box or to lessen the ergonomic condition brought on by handling the felt box. Therefore, this project focuses on developing the aforementioned handling system. This project comprises of a literature review, methodology, data analysis, and conclusion sections. This project focuses on improving and maximising the production of carpet floor due to the increasing customer demand. For this purpose, the Karakuri concept is proposed for the design of felt storage. In this project, the karakuri system mechanism concept design is developed using CATIA V5. By suggesting a new karakuri system design, this study aims to ensure the stability of the karakuri mechanism and employee productivity. Rapid Entire Body Analysis (REBA) and a matrix table were used to analyse the concept and choose the best final concept design based on the operator's ergonomics. The idea was divided into two designs, A and B. Design A was selected in this project based on the votes from the workers along with the REBA score to solve the ergonomics problem.

**Keywords:** Design, Material handling, Karakuri, Felt storage, Time and motion, Egonomics, CATIA V5



#### 1. Introduction

The material is being moved between two separate production line processing units or from point A to point B. The efficient handling of the nmaterial lowers the handling expense of the material, which in turn lowers the cost of production. Better per-unit cost savings are obtained by reducing costs as a result of efficient handling. The reduced efforts through the implementation of this karakuri system improve the efficiency of the system. Automation is always preferred as it avoids the human errors and works very effectively. In most cases, automation is helpful to lessen human effort in the repetitive work of industrial processes. The gravity-based arrangement for the conveyors or roller track is also presented in this project. The intended system has confirmed its usefulness in the movement of the matter for better material handling (Peer & Journal, 2018).

Company X is popular for producing high-quality automotive floor carpet, which will be laid on the vehicle's floor. This company has been specialized in automotive carpets and headliners for almost two decades. Company X manufactures the headlines, automotive carpet floor, quarter trim, deck trim side and back door trim, which are all exceedingly durable. In Malaysia's automotive sector, company X has risen to become one of the most significant suppliers among the major clients.

#### 1.2 Project Background

Company X revenues are attributed to the production of carpet floors. To facilitate the flow of resources, such as raw materials and workers, the concept design of the karakuri system is a better arrangement of production of carpet floor line equipment or workstations. A quality concept design is required for the production of a quality good or service. This problem occurs between the felt storage and the glue table production lines. This is as a result of a separation between the the workstations for inflow and aseembly. The assembly workstation is located 10 metres away from the inflow line. Therefore, a final concept design must be created to lessen the issue faced by Company X.



1.3 Problem Statement

The main issue arised is the operator finds it challenging to move the felt box from the standby area to the production line area on this carpet floor assembly line. This operator

has to take the felt box for approximately 20 times or more in 1 shift/day. The two types of felt boxes have a relatively heavy mass if the same worker handles this process for a distance of 10 meters maximum. The minimum mass of a medium felt box is between 8.40kg – 8.84kg, while the large felt box weight between 12.92kg – 13.15kg. If the same operator performs the same process throughout their shift, it will be extremely taxing. Calculated times for taking the felt box range from 15.58 to 27.42 seconds. Additionally, this might cause damage to the product and pose danger to the workers' safety.



Figure 1: The manual sequences of taking Felt box.



Figure 2: The process of taking felt box



# 1.4 Objective

This study focused on creating a new material handling system to avoid the operator from wasting time taking the product to be used during the production process. This would make the production cycle for carpet floors much longer. One proposed solution is to use a karakuri system in felt storage to decrease time and motion when the operator picks up the box. Besides, the ergonomic condition of the operator will also be adressed.

The objectives or aims of the project govern the scope of this project. Therefore, scope of the project's is to design a karakuri system that will aid in maximizing production rates at the carpet floor production area. The design selection was selected by using a matrix table on the dimensions applied to the karakuri system to reduce ergonomics issues.

# 2.0 Literature Review

Different leaders always have different ways of approaching a specific task. Reviews of past research related to the current study will be carried out in this section. This paper focuses on the systematic analysis technique called karakuri principle method which emphasizes the engineering design problem issues. One of the options to accomplish this is by using the correct mechanical structure design that helps in decreasing cycle time to take the felt box.

# 2.1 Karakuri Kaizen

Karakuri is often used in a process to eliminate non-value-added activity without the requirement for more expensive technology. This often relates to labour transfer, loading and unloading, and assembly duties. Considering the necessity to transport a piece of crate from station A to station B, which is a long distance away, a conveyor belt is an alternative but designing and installing such system may be costly. Combining both words (Karakuri and Kaizen) the movement is based on creating improvements in



manufacturing settings by using mechanical devices that facilitate automation (Aranda Muñoz et al., 2020).

The purpose of Karakuri technology is to automate an objective operation. One category of low-cost automation is considered (Albertos 1989). Karakuri technology is used to make objective operations easier and to increase productivity. What is critical to be understood about Karakuri is that decreasing man-hours, parts replacement time, and total product cycle time is a clever and cost-effective strategy to increase efficiency and product production. One solution to this problem is to increase efficiency on the factory floor in order to satisfy demand and cut manufacturing costs to compete with competitors in China. Reducing or optimising cycle time immediately increases overall production since cycle time is inversely related to cycle duration (Rani et al., 2015).

#### 2.2 Karakuri Mechanism

In engineering mechanics, gravity is also referred to as attraction, the fundamental force of attraction that acts among all issues described. Gravity is defined by the acceleration it provides for free-falling objects.

The design of the system for a conveyor with the consideration of the parameters to improve the performance of the system is the key objective. The partial automated processes are useful for small industries as the cost for implementation is significantly less and saving is effective in terms of the cost. After the fabrication and implementation of the effective material handling system, one could easily demonstrate improved material handling. Gravity itself is a natural phenomenon (Peer & Journal, 2018).

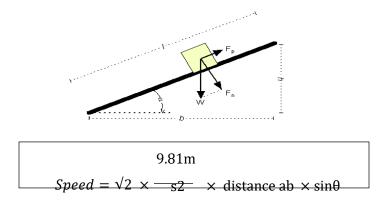


Figure 3: Gravity Formula (Peer & Journal, 2018).



#### 3.0 Methodology

Methodology is a conceptual structure that is used to analyse and organize data and serves as a guideline for solving the research problem. It comprises of theoretical analysis of the associated principles and the methods with the knowledge. It is also important to ensure that the research runs smoothly and systematically. Therefore, it is vital to know and understand the processes occurring in the structure of research methodology, in detail. Below is the process flow chart of this current the project.

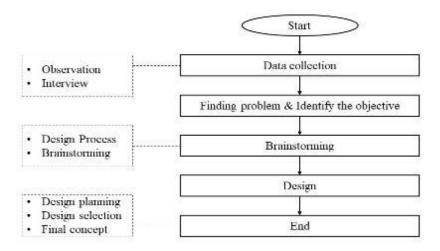


Figure 4: The overall research methodology (Radhwan et al.,2019).

Product planning is based on the data collected through observations and interview. In order to solve the issue, a new concept design for the karakuri mechanism for the felt storage needs to be developed.

From the observation, the raw material (Felt) is actually processed at the first workstation by cutting it and placing it inside the Felt box. Next, the box containing felts are sent to the felt storage area for standby. The operator at the glue table workstations then removes the felt from the box and sprays it before sending it to the following workstations. This process continued on the felt storage area because it contributes to the delay of cycle time in producing the floor carpet.



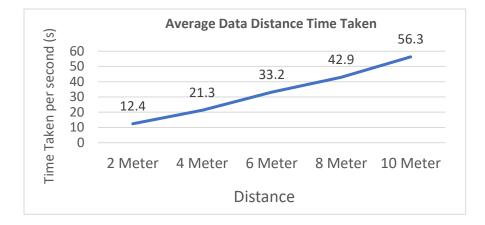


Figure 5: The Average data on the Felt storage area and distance travelled.

The average data on distance travelled and the amount of time required for the operator to take the box felt have been recorded based on figure 5 above. The data was recorded in time; in seconds. This information was gathered five times at five different distances. A stopwatch is used to measure time accurately in seconds.

Additionally, data collection entails the process of gathering information from all pertinent sources, solving the research problem, and evaluating the outcomes. The pimary focus of the research study is data collection because it affects the study's findings. Inaccurate data collection will produce unreliable results. The data collection method must be planned to ensure the accuracy To ensure that the results of a study are valid and reliable, the data collection method must be planned to ensure the data and data analysis is correct by locating the root cause and supported study from the datasheet in order to guarantee that the findings of a study are valid and reliable. Moreover, the operator can reduce the time taken to take the box of felt. If karakuri is utilized in the felt storage space, the supervision of the box is likewise, well-organized.

# 3.2 Identifying the Problem

The problem was detected in the area of the felt storage facility that relies on manual handling from the operator. Additionally, during one shift per day, this cycle is repeated



20 times or more, involving a distance of approximately 10 metres. This result in the extended cycle time in the process of making carpet floors.

In this project, the 4M method; Man, Machine, Material and Method was applied. The researcher was able to analyse the design study problem based on the interview. Table 1 summarizes the data gathered.

There is no schedule for the workers who handle this manual handling, according to the interview with the operator and leader who handle this operation in Felt Storage area. The employee handling this operation will suffer harm if they become injured. The lack of organisation and proper material handling at the felt box storage area is another factor contributing to the low production rate as a result of the rampu up in production.

No.	Typologies	Issues	Correction Action
1	Man	The same operator handles the procedure for 20 times or more day/shift.	Provide material handling that is suitable for this process.
2	Machine	Need tocarry the felt box fa fair distance and refill each felt .	-
3	Method	Picking up the felt box from a distance manually in a non-ergonomical way.	Provide new material handling for better operator ergonomics.
4	Material	The felt box is considered to heavy for the operator to handle it in a single shift.	Provide new material handling for the operator.

#### Table 1: The 4M method used to identified problem (Radhwan et al., 2019).

#### 3.3 Brainstorming

The best method for design teams to generate ideas and solutions for a particular design is through brainstorming. The engineering design process is one of the stages in the product development process that deals with design. In order to find the ideal combination of design characteristics, the karakuri mechanism's functional specifications must first be evaluated. The problem that needs to be solved and what needs to be accomplished at this point should be made crystal clear during the tool design process.



#### 3.4 Design Selection

Design selection is the method of choosing a design that has been analyzed against the specifications and criteria using a matrix table. The karakuri concept will be applied at the targeted area without interrupting other products. The goal of the study is to minimise the operator's motion waste by minimising the distance needed to transport the felt box. This karakuri system was proposed in two designs; A and B.

After the two concept designs were developed, the matrix table for these different concept designs was also produced. The operator from the carpet floor assembly will score and vote on the analysis design based on how well it addresses the problem statement. In addition, the concept of the karakuri system must be stable and long-lasting. According to the matrix table below, design A of the karakuri system received the majority of the operator's score.

	DESIGN A	DESIGN B
DESIGN		
LENGTH	7.5 METER	6.8 METER
WIDTH	1330MM	1100MM
MATERIAL	STRUCTURAL STEEL	ALUMINUM ALLOY
STYLE	TWO ROW OUT	TWO ROW OUT
	TWO ROW IN	ONE ROW IN
TOTAL OF BOX	23 MEDIUM BOX	COMBINE/NOT SPECIFIC
	12 LARGE BOX	
STABILITY	STABLE	NOT STABLE
	SCORING DAT	TA BY OPERATOR
OPERATOR 1	7/10	4/10
OPERATOR 2	6/10	2/10
OPERATOR 3	9/10	5/10
OPERATOR 4	5/10	3/10
OPERATOR 5	9/10	3/10
TOTAL	36/50	17/50

Table 2: The matrix table of two designs based on the karakuri system.



#### 4. Result and Discussions

The results of the selection of designs A and B were carefully discussed in this section. There are two analyses that examine the problem faced by Company X and help choose the best solution. Matrix tables are used in the initial analysis. The matrix table is utilised by Company X's department to determine employee's choice. Several appraisers who handle the process of taking and handling the felt box contributed to the creation of this matrix table. Figure 6 shows the matrix table check sheet that was used to choose the best final concept design to solve the operator's issue. This check sheet was obtaineds from the Engineering Excellent Centre which is the process department that will be selecting the new design for upcoming project in Company X.

Second, Rapid entire body analysis (REBA) was carried out by interviewing the worker about the motion behaviour that was involved throughout the work process. The REBA worksheet is divided into two sections; labelled A and B. Section A (left side) covers the neck, trunk, and leg. Section B (right side) covers the arm and wrist. This segmenting of the worksheet ensures that any awkward or constrained postures of the neck, trunk or legs which might influence the postures of the arms and wrists are included in the assessment. The REBA procedure, which is illustrated in Figure 7, evaluates risk factors and designated body parts for movement assessment.

	MATRIX TABLE CHECKKSHEET	
DEPARTMENT : ENGINEERING EXCELLENT C JOB TITLE : CHOOSING THE DESIGN OF ANALYSIS NAME : <u>AIMAN LUTFI BIN MOHAMA</u> DATE : 10/12/2021 OPERATOR NAME :	KARAKURI D RAHMAN	: Operator selecting the suitable design of karakuri system between design A and B.
Aeasure and record specifications of design.		
Statement	Design 1	Design 2
Ergonomic Condition	~	
Supply Gravity	~	
Stability	~	
Style Concept		✓
Durability	~	
Storage Number of Box	~	
Material	~	
Solid and Rigid	~	
		~

Figure 6: The Matrix Table Checksheet.



		La gefet das.	CHOOM NUMBER	iproyou Autournalic Moreaner	Loge Witten
ERGONEMICS BEDA R. Hock ford and any forder the second s		Image: Section 1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.	A. March Trends and Jog Randonts		The same of the contrained is an one of the contrained is a set of the contrained is set of the contrained is a set of the contrained is a set of the c
Constant Constant Constant 2011 - Low Park Constant Constant Constant 2011 - Low Park Constant Constant Constant 2011 - Constant Constant Constant Constant 2011 - Constant Constant Constant Constant 2011 - Constant 2011 - Constant Constant 2011 -	$\frac{1}{10} = \frac{1}{10} + \frac{1}{10} $	Social and the formulap stockhain filter forms. Social     Bay 10, Author forms     A form the formula and test too leage. But I winder table     A form the formula and test too leage. But I winder table     A formula table of provide and test too leage.	Control of 1 - Possibility from Dot 15 - State from 2 - Andrew State of the state of the state of the state 2 - Andrew State of the state of the state of the state 2 - Andrew State of the state of the state of the state 2 - Andrew State of the state of the state of the state 2 - Andrew State of the state of the state of the state 2 - Andrew State of the state of the state of the state 2 - Andrew State of the state of the state of the state 2 - Andrew State of the state of the state of the state 2 - Andrew State of the state of the state of the state 2 - Andrew State of the state of the state of the state 2 - Andrew State of the state of the state of the state 2 - Andrew State of the state of the state of the state 2 - Andrew State of the state of the state of the state 2 - Andrew State of the state of the state of the state 2 - Andrew State of the state of the state of the state of the state 2 - Andrew State of the state 3 - Andrew State of the st	10 11 12 12 13 13 13 13 13 13 13 13 13 13 13 13 13	Construction State Report and Advancements of Constructions     State Construction State St

Figure 7: Rapid Entire Body Analysis (REBA) Assessment worksheet.

The results are displayed in Graph 7 along with the scores for each activity, starting with Group A (Trunk, Neck, and Legs) postures, followed by Group B (Upper Arms, Lower Arms, and Wrists) postures, and ending with Group C, the overall REBA assessment score. The end result demonstrates that design B is on the right and design A is on the left. In terms of the overall REBA analysis, design A received a score of 7, while design B received a score of 10.

Using the REBA worksheet, the evaluator will assign a score for each of the following body regions: wrists, forearms, elbows, shoulders, neck, trunk, back, legs and knees as shown in Figure 7. After the data for each region is collected and scored, tables on the form are then used to compile the risk factor variables, generating a single score that represents the level of MSD risk as shown in Figure 8:

Score Level of MSD Risk	
1	negligible risk, no action required
2-3	low risk, change may be needed
4-7 medium risk, further investigation, char	
B-10	high risk, investigate and implement change
	very high risk, implement change

Figure 8: The level of MSD Risk.



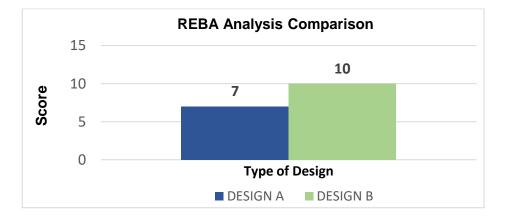


Figure 9: Comparison between Design A and B in terms of REBA Analysis.

Rapid entire body assessment (REBA) findings revealed a striking contrast of about 30% in ergonomic risk, with design A receiving a 7 REBA score and design B receiving a 10, as shown in Figure 9. This is because, with the help of the Karakuri height for design A, which helps to alter the worker's body posture while they are working, the worker is no longer required to bend over their back. According to Figure 8 above, design A's REBA score is categorised as medium risk and can be used to reduce worker errors in body positioning.

# 5. Conclusions

The purpose of the review is to analyse and clarify the implications of the overall findings of what has already been noted regarding the entire study under review. The data from the matrix table was discovered and analysed, and it was found that the productivity of the carpet assembly process could be increased. Additionally, it can be proven that design A is more suitable for fabrication on carpet floors than design B. Design A outperformed Design B in the REBA analysis, scoring a 7 as compared to 10 respectively. Thus, the installation of a karakuri system aids in streamlining the work process and directs an operator to perform their duties more precisely and effectively without risking injury or death. Therefore, by reducing manual handling time and the cycle time of taking the felt box on various distances, the newly designed karakuri system has effectively resolved the issue mentioned in the introduction section.



#### References

- Aranda Muñoz, Florin, U., Eriksson, Y., Yamamoto, Y., & Sandström, K. (2020). the Karakuri Card Deck: Co-Designing Industrial Iot Conceptual Solutions. *Proceedings of the Design Society:* DESIGN Conference, 1, 807–816. https://doi.org/10.1017/dsd.2020.127
- Peer, J.-A. M., & Journal, R. (2018). *Design of gravity basedmaterial conveyor equipment. 4*(2), 2–5.
- Rani, D., Saravanan, A. K., Agrewale, M. R., & Ashok, B. (2015). Implementation of Karakuri kaizen in material handling unit. SAE Technical Papers. https://doi.org/10.4271/2015-26-0074



# DESIGN AND FABRICATE JIGS FOR ROBOT ARM

Ahmad Ashrani Bin Nor Hazman<sup>1</sup>, Khalis Bin Suhaimi<sup>2</sup>

<sup>1</sup> Mechanical Engineering Department, Politeknik Sultan Azlan Shah, ashranixsh143@gmail.com khalis@psas.edu.my

#### Abstract

This research is concentrating on the stamping line workstation, which requires the utilization of a robot arm in order to facilitate a reduction in the total number of workers required for the stamping process. In the use of this robot arm has jigs used. The problem that occurs with these jigs is the design that is not convincing in handling product stamping. Therefore, new designs and new jig production were made. Kouru Ishikawa has been used to analyze the problems faced. Among the elements used to list this problem is to use the element 4'M method. Results were taken and compared with the use of design jigs before and after. In conclusion, jigs with new designs can achieve overcoming the problem statement.

Keywords: Stamping process, Robot Arm, Jigs, Kouru Ishikawa,4'M method.

#### 1.0 Introduction

In the currents era of industry, to achieve industry (4.0) many manufacturing sectors use robots to speed up the manufacturing process a product. For the study made in X companies use robots in small stamping line. Small stamping line that produces small car components that use a stamping machine weighing 200 tons-250-tons. This stamping line uses the 4 robot-arm to perform several stamping processes such as forming, drawing, bending and also piercing. Referring to the figure 1 shows the small stamping line.



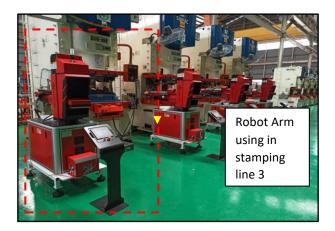


Figure 1: Robot-Arm in Stamping Line 3

The stamping process is one of the important processes for this company to manufacture cars parts. Therefore, all the part for car MPV model is produced through the stamping process. The use of robot arm on this stamping is essential to reduce manpower. But it has a problem with the use of jigs that have been made on the robot arm to handling parts from the stamping process to the next stamping process.

# 1.2 Problem Statement

The problem was discovered in small metal stamping machine lines that were using a robot arm in the process of controlling the components produced through a stamping process that uses a stamping machine that weighs 250 tons. The robot arm was used in the process of controlling the components. During the stamping process, where the jigs are located that are used for the robot arm by referring to Figure 2 below. These jigs are used for handling parts and components.



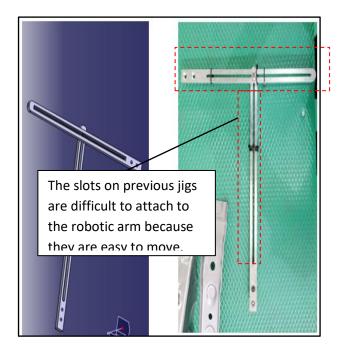


Figure 2: Robotic Arm Jigs for Material Handling

Through the observations that have been carried out in line stamping-3 when the robot arm is used in handling the material to undergo the stamping process. Problems have been found with the jig mounted on the robot arm. Where the problems are:

- a. The thickness of the jig is not strong in handling the material.
- b. Jigs cannot hold parts in a variety of shapes.
- c. The jig is not easily locked and placed on the robot arm.

#### 1.3 Objectives

In a production line, what matters most is how much production can be generated. The purpose of this project is to emphasize several keywords such as production of product by using new methods that can improve safety in production lines, less use of man powers and increase the production.

The objective of the study for this project are as follows: -



- 1. To redesign new jigs for robot arm.
- 2. To make jigs can be hold part in variety shape.
- 3. To increase production output by using robot arm.

# 1.5 Scope of Project

The scope of this project was carried out in small stamping line 3 on a company X. this study has also used parts produced by this company by using the stamping process. Among the types of parts used are such as bracket, room lamp, reinforcement, Fr Floor Under and also Brace, Fr Floor, Ctr.

# 2.0 Literature Review

This section focuses on summarizing all literature reviews from a variety of academic sources. It entails a thorough examination of jigs, materials, and car components. This section will also provide a summary of the project's methodology.

# 2.1 Jig

In manufacturing industry, jigs and fixtures are most important device that can assist the workers in their production process become easier. Jig and fixture are important tool using in industry (Radhwan et al., 2019). In this project, jigs were used on the robot arm to handle the part during the stamping process by holding the part through the suction process to the stamping process to the next stamping process on the small stamping line 3. Jigs should be built in such a way that it takes the least amount of time to insert and remove the workpiece. In the automobile sector, a jig is a work-holding device where all assembly or production locations are pre-located. The design parameter such as maximum deformation, maximum shear stress, number of contact faces, and maximum holding force were presented. It is found that the gripping ability is the important factor that affected to the clamping and holding the work part perfectly during machining operation (Radhwan et al., 2019).

# 2.2 Metal Stamping Process

In the stamping process, the simple meaning of stamping is the process in which metal plate is pressed into a form of product. An example of press work is blanking, punching, bending, coining and other process which transformed the sheet metal to any shape (Rahman et al., 2017). There are several stamping processes involved at line 3 production lines such as forming, drawing or banding and piercing.

The company has produced car parts using a stamping process. The first process is the blanking process that is the first step of stamping process and it cuts the size of a sheet



of metal or a coil of metal to fit the shape of a part. Blanking is usually performed when a stamped metal piece will be drawn or formed.

The second process is forming, it similar with bending process that creates part with multiple bends, such as U-bends in one step. Next step is drawing that a punch presses a piece of metal through a die, forming the part's basic shape. When the depth of the part is less than the primary opening, it is considered shallow drawing; parts with a depth greater than the opening are deep drawn. Last process is piercing, if a part requires slot, holes or other cutouts, piercing can be employed.

In the other hand, the company has produced car parts using a stamping process. The first process is the emptying process which is the first step of the stamping process and it cuts the size of a sheet of metal or a coil of metal to fit the shape of the part. Blanking is usually done when a stamped piece of metal is to be painted or molded.

The second process is forming, it is similar to the bending process which produces a part with multiple bends, such as U-bending in one step. The next step is to draw a shot that presses a piece of metal through the dice, forming the basic shape of that part. When the depth of a section is less than the main opening, it is considered a shallow drawing; parts having a depth greater than the opening is drawn in. The final process is piercing, if the part requires slots, holes, or other cuts, piercing can be used.

#### 2.3 Robotic-Arm

In today's sophisticated era it is found that most the manufacturing sector almost entirely uses robots to increase product output, and reduce labor consumption. A robotic arm is a type of mechanical arm, usually either programmable or computable (On, 2019). For a common and ordinary robot, the degrees of freedom (DOF) range from one to six, allowing it to perform a variety of movements. The connections of such a system are frequently held together by joints that enable rotational or translational movement. A robot with 6-dof is capable of moving in a translational in all three perpendicular axes of movements and respective rotational movement taking each axis into account (Poll, 2019). Figure 3 below shows a robot arm used in a company X. This robot arm is placed on stamping line 3 of 5 robot arms to replace the use of manpower in addition to achieving a company that is towards industry 4.0.





Figure 3: 4 DOF Robotic – Arm

2.3.1 Classification of Robotic Arm

For industries that use robot arms to replace manpower in doing work to get a high product production rate. There are several types of robots used such as Articulated Manipulators, Spherical Manipulators, SCARA Manipulators, and Cylindrical Manipulators.

Company X has used 5 robot arms, which are cylindrical manipulators. This type of robot is also called rectangular, rectilinear, or gantry. This robot has the ability to move its gripper to any position within the cube or cuboid workspace. For the first three joints are prismatic and joint variables are the Cartesian coordinates of the end-effector with the respect to the base. The kinematic description of this manipulator is the simplest of all configurations (Poll, 2019). Based on figure 4 below shows a cylindrical manipulator-type robot.



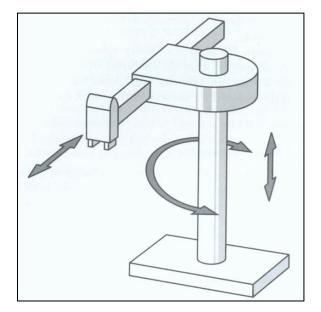


Figure 4: Classification of Robots

2.3.2 Grippers for industry

Initially, grippers were designed for industrial uses. They are typically characterized as grippers installed on a fixed platform that are utilized for mass manufacturing. The industrial grippers can be studied through different aspects such as geometrical condition of grasping, position and orientation of grasping, static equilibrium of grasped object, and dynamic conditions (Tai et al., 2016).

The first industrial robot was the UNIMATE installed in a General Motors assembly plant in 1961(Tai et al., 2016). This was a rigid parallel manipulator used to grasp hot die cast metal pieces. Many industries have now used robotic grasping technology and created various driving methods. Previously, electric motors or hydraulic actuators were employed, but more recently, piezoelectric and shape memory alloys have been utilized. Based on the figure 5 shows the type of grippers on robot arm. The grippers used on the robot arm in company X is this type of grippers picobot vacuum grippers because these grippers use air suction and are safer to lift parts made of metal and do not easily damage the product.





Figure 5: Types of Robot Arm Grippers

The grippers used on the robot arm in this company are this type of picobot vacuum grippers because these grippers use air suction and are safer to lift parts made of metal and do not easily damage the product.



Figure 6: Picobot Vacuum Grippers



# 3.0 Methodology

The 4'M is a strategy for identifying and classifying factors that have an effect on a certain result. 4M categories (Material, Method, Machine, Man) are often used in the Cause-Effect Diagram created by Kaoru Ishikawa (Knop & Mielczarek, 2018). The 4M method can be widely used in problem solving in each department, by solving related to a given problem. This tool used in Lean and WCM concepts (Knop & Mielczarek, 2018). When critical has been identified, 4M approaches may be utilized to identify and rectify it utilizing specified remedial activities (Poll, 2019).

The use of 4'M method has been used in this project conducted in this company. The element used is manpower, that is, this is an exceedingly rare "cause", lean posits that "all labor is rightful labor". The next is the method where there are frequently processes found to have too many steps, too many signoffs, and integral activities that don't create value and for which a customer wouldn't pay known to be included.

Next is machine which tools and facilities with their underlying support systems are frequently mismanaged to achieve excellence or due to technical misalignment are simply incapable of delivering the intended output. Lastly is material which components and consumables are often incorrectly specified, mislabeled, stored improperly to conserve physical properties, are out of date or otherwise could be organized and managed better.

The Kaoru Ishikawa diagram has entries for all of the characters that are connected to 4'M. Elements such as Machine, Method, and Material can be found in places where the characters are contained in Kaoru Ishikawa. And the most important aspect is the challenge that is presented by the fact that the use of jigs does not facilitate the handling of components effectively. Taking a look at figure 7 down below will show you the progress that Kaoru Ishikawa has made in managing this project.



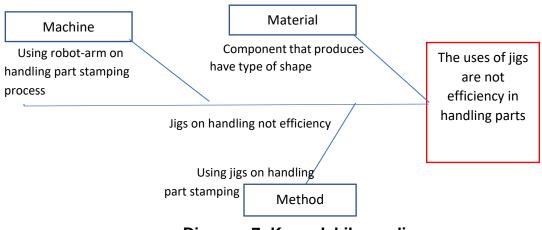


Diagram 7: Kaoru Ishikawa diagram

# 3.1 Current Jigs Design

According to the information presented in Figure 8, it can be seen that the design of jigs that were previously utilized to make modifications have been put to use as robotic arm jigs to move parts while the tiny stamping process is being carried out. According to this design, there are a few obvious flaws in it. The design also seems simpler but it can't support it for far too long during stamping part. There are a number of reasons for this, one of which is that the thickness of these jigs makes them unsuitable for lifting loads or products from one stamping machine to another. It is tough to do the installation since it is necessary to use screws and also small bolts. It is also simple to move and the



3 2 suction cup vacuum that attach on the jigs 1 1 2-holes that will lock the jigs 1 and jigs part 2

installation process takes quite a bit of time. In addition, the rod parts that are used are also from the same rod.

Figure 8: The Previous Jigs Used at Robotic Arm



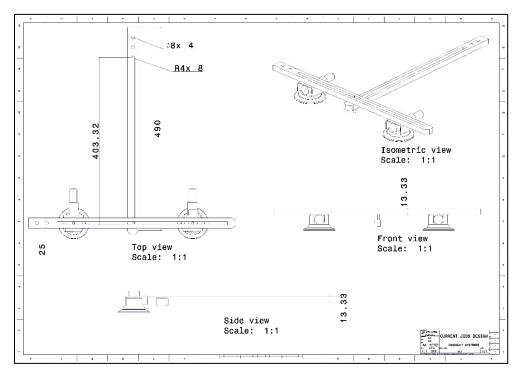


Figure 9: The Current Jigs Drawing with Measurement

3.2 New Jigs Design

The updated new design of the jigs for the robot arm may be seen in the Figure 10 that can be found below. These jigs have been redesigned as a result of the difficulties that were found in the earlier versions of these jigs, which are detailed in the problem statement. These new jigs appear to have a design that is more robust and is simple to change so that they can handle a range of different parts.



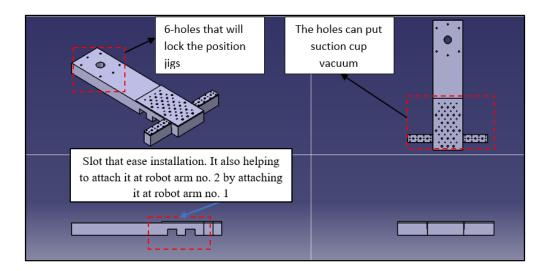


Figure 10: Jigs New Design for Robot Arm

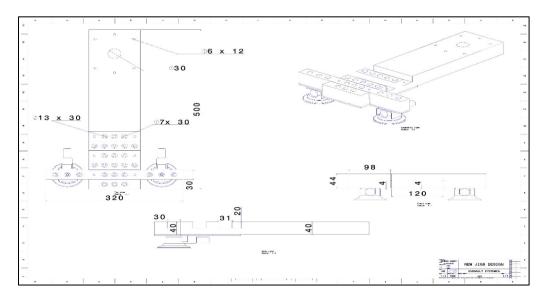


Figure 11: Jigs New Design Drawing with Measurement



#### 4.0 Comparison and Discussion

Based on table 2 below shows the data taken for the use of old jigs design. This testing is done for 3 hours because that time has been given by the production. Therefore, only 3 parts are samples for data collection such as "Bracket, Room Lamp", "Reinforcement, FR Floor Under", and "Brace, FR Floor, CTR".

Part name	Quantity (pieces, pcs)	Time taken (hours, hrs.)
Bracket, Room Lamp	500 pcs	3 hours
Reinforcement, FR Floor Under	600 pcs	3 hours
Brace, FR Floor, CTR	550 pcs	3 hours

Table 1: Quantity Part Produce by Current Jigs Design

Based on table 2 below shows the data taken to use the old jig design. This testing is done for 3 hours because that time has been given by the production. Therefore, only 3 sections were sampled for data collection such as "Bracket, Room Lamp", "Reinforcement, FR Floor Under", and "Brace, FR Floor, CTR".

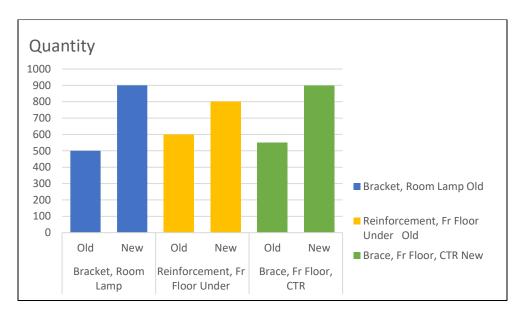
# Table 2: Quantity Part Produce by New Jigs Design

Part name	Quantity (pieces, pcs)	Time taken (hours, hrs.)
Bracket, Room Lamp	900 pcs	3 hours
Reinforcement, FR Floor Under	800 pcs	3 hours
Brace, FR Floor, CTR	900 pcs	3 hours

Based on the graph below shows a comparison from the study that has been done. The results of the study are taken with the number of product releases and also the type of jig used according to the parts that have been used as prescribed.



The results show that the use of these new jigs can increase product production compared to the previous jigs and hold the part to go through the stamping process from one machine to another more strongly.



# Figure 12: The Histogram Graph Comparison with Using Old Design and The New Jig

# 5.0 Conclusion

The stamping process is one of the most important processes for this company to manufacture the cars parts. The company X has used 5 robot arms, which are cylindrical manipulators. The robot uses a jig to lift parts or materials into a mold. This observation was continued by asking the leaders and industry supervisors to improve or facilitate the use of robots. The design of the jigs that are made requires a manufacturing process and must be made in as many as 5 sets. If the design is not accepted, then the design process will be done to achieve the objective.

In conclusion, the new jig design managed to increase product production through the stamping process. Bracket, Room Lamp by using old jigs design can only produce parts of 500 pcs compared to the production of new jigs design which is 900 pcs by 40% increase. RNF, FR Floor Under if using old jigs design can produce parts of 600 pcs compared to the use of new jigs design which is 800 pcs, an increase of 20%. Brace, Fr



Floor, CTR with the use of old jigs design can produce parts of 550 pcs compared to the use of new jigs design which is 900 pcs, an increase of 35%.

#### REFERENCES

- Knop, K., & Mielczarek, K. (2018). Using 5W-1H and 4M methods to analyse and solve the problem with the visual inspection process – Case study. *MATEC Web of Conferences*, 183, 1–6. https://doi.org/10.1051/matecconf/201818303006
- On, A. T. (2019). Six Degree Robotic Arm With Mimicking Mechanism.
- Poll, Y. (2019). *Ni Ve R Ay a Ve Rs I Ty*. 1946–1975.
- Radhwan, H., Effendi, M. S. M., Farizuan Rosli, M., Shayfull, Z., & Nadia, K. N. (2019). Design and Analysis of Jigs and Fixtures for Manufacturing Process. *IOP Conference Series: Materials Science and Engineering*, 551(1). https://doi.org/10.1088/1757-899X/551/1/012028
- Rahman, N. A., Masood, I., Rahman, M. N. A., & Nasir, N. F. (2017). Control chart pattern recognition in metal stamping process using statistical features-ANN. *Journal of Telecommunication, Electronic and Computer Engineering*, 9(3–2), 5–9.
- Tai, K., El-Sayed, A. R., Shahriari, M., Biglarbegian, M., & Mahmud, S. (2016). State of the art robotic grippers and applications. *Robotics*, 5(2), 1–20. https://doi.org/10.3390/robotics5020011

S. Mapping and T. A. Costing, "Process Optimisation of Metal Stamping Production Line Through Value International Conference on Design and Concurrent Engineering 2021 Process Optimisation of Metal Stamping Production Line Through Value Stream Mapping and Time-Driven Activity-Based Cost," no. September, 2021.

K. Knop and K. Mielczarek, "Using 5W-1H and 4M methods to analyse and solve the problem with the visual inspection process – Case study," *MATEC Web Conf.*, vol. 183, pp. 1–6, 2018, doi: 10.1051/matecconf/201818303006.



# DESIGN JIGS FOR FIN ASSY A/C REGISTER ON ASSEMBLY LINE

IZAM FAHHULLAH<sup>1</sup>, BAHARUDDIN BIN MOHD ZANGGI<sup>2</sup>

Department of Mechanical Engineering, Polytechnic Sultan Azlan Shah, 35950 Behrang, Perak *Izamfahhullah98@gmail.com baharuddin@psas.edu.my* 

#### Abstract

An assembly line is designed by determining the sequences of operations to manufacture components as well as the final product. Each movement of material is made as simple and short as possible. In the assembly line, the jig must be provided if the sequences of the process for that section are very difficult. The function of the jig is a special tool used for locating and firmly holding a workpiece in the proper position during the manufacturing or assembly operation. The current process assembly the fin assy A/C register side in workstation 1 using a manual process by hand. Based on the problem, This research was focused on designing a jig in the assembly process for the fin assy AC register side. This paper uses a few methods starting with the collection of data, brainstorming, proposing a concept, and finally selecting a design. This concept was developed using CATIA V5. Successful jig design was performed and was evaluated with a comparison between the two concepts. The objectives of this study were achieved at the end of this project through data collected.

Keywords: Assembly line, Jig, Design, Catia V5

# 1. Introduction

In the pre-globalization era of economic development, the automobile industry was considered the 'industry of industries' meaning that it had the potential to drive industrialization ahead due to its linkages and spill-over effects on other manufacturing industries (Dicken, 2007). However, during the last decades, the automotive market has shifted from sellers to buyer's market, and automobile manufacturers have become global players (Kern, 2015). An assembly line is designed by determining the sequences of operations to manufacture components as well as the final product. Each movement of



material is made as simple and short as possible, with no cross flow or backtracking. All operations performed along the line are balanced. The design of the assembly line plays the important role in manufacturing which will directly influence its productivity (Saprita, 2011).

Reliable assembly tooling must be able to hold components and subassemblies in an accurate and repeatable position, prevent undesired motion of components and avoid posing interference problems in assembly tasks (Rajan,1999). A jig is a special tool used for locating and firmly holding a workpiece in the proper position during the manufacturing or assembly operation (Hoffman, 2012).

This research was focused on designing a jig in the assembly process for the fin assy AC register side. Designing a jig requires a high level of understanding in terms of process, material use, and installation method for a part. If all that is mentioned is understood, then the process of designing the jig becomes very easy. By using the software CATIA V5 can design the jig in detail in terms of design parts and position to do the installation on the jig.

#### 1.2 Problem statement

This company produces a large number of different automotive plastic parts products every day. The company has faced several challenges in the mass production of new products. Especially in the production line for assembling child parts. Some of the child parts involved in workstation 1 are placed on the child part of the assembly jig to be glued to several parts before becoming a product. Manpower was used to place this side model child's parts A/C register. However, for this workstation, the corresponding jig must be in the assembly register section for mass production.

So, the problem statement in this paper is to design a suitable assembly jig for the A/C register. This makes it a major problem for designing a suitable jig according to the assembly concept. The installation method needs to be learned to get a faster and smoother installation process and give a positive impact on the use of the jig. Figure 1 below shows the fin assembly for the A/C register. To design the jig must follow the 3D data on the fin assy Rh/Lh A/C register



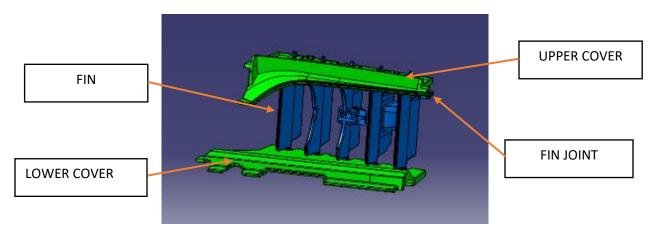


Figure 1: Fin assy rh for A/C Register.

# 2. Literature Review

#### 2.1 Jig

The jigs and fixtures are production-work holding devices used to manufacture duplicate parts accurately. The correct relationship and alignment between the cutter or other tool and the workpiece must be maintained. A jig is a special device that holds, supports, or is placed on a part to be machined. It is a production tool made so that it not only locates and holds the workpieces but also guides the cutting tool as the operation is performed.

It is a rigid and strong mechanical device that attaches to a machine and allows the stock to slide while being held firmly, consistently, and easy, supporting and clamping, blank against the cutting tool, and resulting in faster (Shailesh, 2014).

#### 2.2 Jig Development

Designing a functional fixture will reduce the working time by smoothing the transition and by allowing quick setup from part to part. A fixture's purpose is to create a secure mounting point for a workpiece, increase accuracy and allow support during operation, besides increasing reliability and interchangeability.

The general factors to be considered when designing jig and fixture are shape, material, and state of work part, pre-machined surface tolerance, type of operations and



the machine tools used, workpiece handling, ergonomics, and safety considerations (Radhwan, 2019).

2.3 Advantage of Jig to Enhance

The jig is very important to do many processes on one product. This makes the jig have certain advantages as below.

a) Improving Productivity at the workstation.

A jig increases productivity by eliminating the individual marking, positioning, and frequent checking. The operation time is also reduced due to an increase in speed, feed, and depth of cut because of high clamping rigidity.

b) Interchangeability and Quality.

A jig facilitates the production of articles in large quantities with a high degree of accuracy, uniform quality, and interchangeability at a competitive cost.

c) Reducing worker skills.

There is no need for a skillful setting of work on the tool. The jig makes it possible to employ unskilled or semi-skilled machine operators to make savings in labor costs.

#### 3. Methodology

#### 3.1 PUGH method

Pugh Method is a method to select the concept design and is used generally in the conceptual design stage which is developed by Stuart Pugh. A simple graphical method that revolves around a matrix with rows showing decision criteria and columns that shows concept is provided by Pugh Method (Von Teh, 2020). Hence, the Pugh method is used to decide the best concept design assembly jig for the fin assy A/C register. The concept design with the highest score of the Pugh method will be selected.



The study method design involves the study design, study subjects or samples, study procedures, data collection procedures as well as data analysis procedures. it is important as a principle for implementing a thesis project because it contains a theoretical analysis of the strategies and principles of information-related bodies. The figure 2 below show the overall research methodology on this paper.

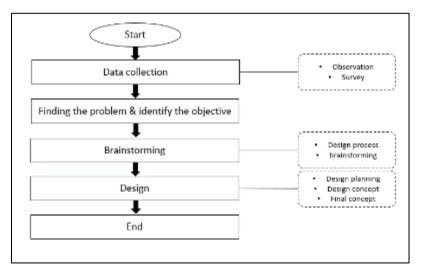


Figure 2: The overall research methodology.

#### 3.2 Data collection

Based on observations and surveys from several departments, the most significant problem that needs to be solved is in the assembly part which requires improvement in terms of installation of fin assy A/C register.

From observation, the A/C register side has several processes to be installed to produce a product. The first process on this assembly line is to install the fin assy A/C register side. Installation needs to be done daily to meet customer demand. According to customer demand, the highest demand needs to be done every day there are 210 pieces. Figure 3 below shows where the installation process is performed.





Figure 3: Assembly line area

The problem that can be detected by the survey on the team member is the installation of fin assy A/C register side is done manually. Doing the installation manually in large numbers will have an impact on team members. In the survey conducted, the problem needs to be resolved immediately to launch the installation process of the fin assy A/C register side. Data aggregation can be explained in Figure 4 below.

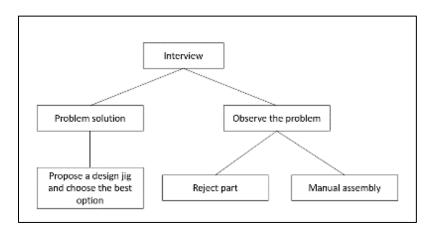


Figure 4: Survey data



#### 3.3 Brainstorming

Brainstorming is how to get an idea to sketch a design. One method for brainstorming is purpose related to design. The purpose can be learned from producing a product with the same function as designing a jig with the same methods and ways done in the installation. This can provide a solution to the problem encountered by finding common concepts and can be applied to new products.

Installation is a very thorough process and care must be taken when doing it. By sketching each sequence in a process, the sketch can be seen clearly to design a jig and fixtures. This makes the installation using jigs and manuals act in parallel.

PROSES	SEQ	ATURCARA KERJA
	1	AMBIL LOWER COVER RH/LH DAN LETAK PADA BAHAGIAN BAWAH JIG.
	2	MASUKKAN <b>FIN REG CTR 1/2/3/4/5 RH/LH</b> PADA JIG. PASANGKAN <b>PINION GEAR</b> 1 PC PADA FIN NO.3.
	3	AMBIL FIN JOINT RH/LH DAN LETAK PADA KEDUDUKANNYA-
1 FIN ASSY RH/LH	4	LETAK UPPER COVER RH/LH DI BAHAGIAN ATAS FIN REG CTR.
	5	TEKAN JIG UNTUK CANTUMKAN BAHAGIAN SAMBUNGAN PADA FIN ASSY RH/LH.
	6	MASUKKAN KE DALAM POLYBOX-

#### Figure 5: Sequences of Assembly Fin Rh/Lh A/C Register Side

The sketches made need to be edited to get a true picture and the correct function. By using CATIA V5, sketches can be transferred into this software to provide a clearer picture of the design according to a more detailed specification.

#### 3.4 Design selection

Design selection is a method where the design selection can be analyzed according to the specification, function, and criteria required. When comparing the relative strengths



and weaknesses of the concept, select the best concept that can be used for further investigation. Generally, concept selection is the process of narrowing the alternative concept that has been considered (Zaidi, 2017). To choose the final concept for the jig, the screening method was chosen (Zhafri, 2018). This method can help the designer decide on the selection of the best design. In the beginning, two jig shape designs were designed with different concepts. In design 1 (figure 6) and design 2 (figure 7), the design have a several part different which is clamping, support base and limitation on the upper block on this jig. Refer the figure 6 and figure 7 below of the design jig assembly.

# Stopper Usual Clamp Shaft Upper Block LMU 12 Linear Bearing Fin Block Spring Lower Block Linear shaft Support Base

#### Design 1

Figure 6: Assembly Jig Design 1



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#### Design 2

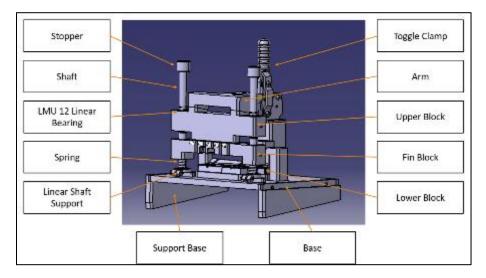
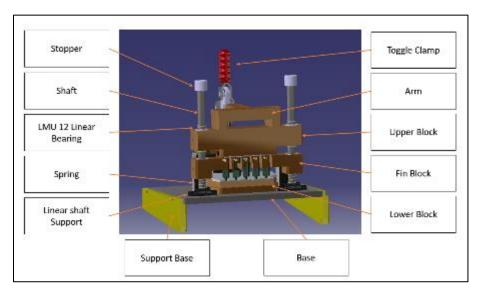


Figure 7: Assembly Jig Design 2



#### 3.5 Final concept

Figure 8: Final concept



After compared both of the design concepts, The final design concept in Figure 8 is selected based on the results that have been made in the concept selection where the second concept is the best choice. The final design concept is according to the complete specification and criteria. Simple design, easier to understand and operate for anyone who is not experienced in doing fin assy A/C register side installation work.

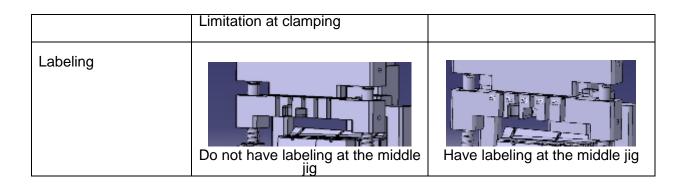
#### 4. Comparison and discussion

The selection in determining the new jig design is based on the criteria in table 1. This design is inspired by the design of the fin assy A/C register and sequences in the installation process. Clamping, base, limitation, and labeling on the jig design are shown in table 1 by doing the two comparisons between the 2 concepts.

Specification/Criteria	Concept 1	Concept 2
Clamping	Usual clamp	Toggle clamp
Base		
Limitation		Limitation at stopper

 Table 1: Comparison design based on specification.





The Pugh matrix's purpose is to compare a set of possibilities to a standard to determine which one is best suited. A basic matrix is made up of several ideas, and a set of criteria has been established, including analysis, appearance, assembly method, weight, and part count. Table 4.1 shows the design of the selection. The baseline part contains the criterion scale (1 for least important and 5 for most importance)

Criteria	Baseline	Design 1	Design 2
Clamping	3	1	1
Limitation	4	-1	1
Base	3	0	1
Labeling	5	-1	1
Easy to handle	5	0	0
Size	2	0	0
Total	-	1	4

#### Table 2: The Selection Design

Better than	1
Equal to	0
Worse than	-1

Based on the selection of the Pugh method, design 1 has brought merit to 4 points more than design 1 based on the criteria already stated. This makes design 2 was chosen because the best design is based on the Pugh table of the method without biased consideration.



#### 5. Conclusion

Today, assembly lines are designed to produce one particular car and in turn, enable its mass production. During manufacturing and assembly operations, a special tool used to locate and hold the workpiece firmly in the correct position is a jig. In conclusion, the objective of this project is to design a jig suitable for the installation of the fin assy A/C register side. By making a comparison between the two concepts that are highlighted and according to the criteria that have been carried out, among the criteria are in terms clamping, base, limitation, and labeling. The objectives of this study were achieved at the end of this project through complete data collected. Successful jig design was performed and was evaluated with a comparison between the two concepts.

#### Book:

Hoffman, E. (2012). Jig and fixture design. Cengage Learning.

#### Journal:

- Kern, W., Rusitschka, F., Kopytynski, W., Keckl, S., & Bauernhansl, T. (2015, August). Alternatives to assembly line production in the automotive industry. In *Proceedings* of the 23rd international conference on production research (*IFPR*).
- Saptari, A., Lai, W. S., & Salleh, M. (2011). Jig Design, Assembly Line Design, and Work Station Design and their Effect on Productivity. *Jordan Journal of Mechanical & Industrial Engineering*, *5*(1).
- S. P. Shailesh and P. R. Laukik, "A Review on Design of Fixtures," Int. J. Of Eng. Research and General Science, vol. 2, no. 2, 2014.
- Radhwan, H., Effendi, M. S. M., Rosli, M. F., Shayfull, Z., & Nadia, K. N. (2019, August). Design and Analysis of Jigs and Fixtures for Manufacturing Process. In IOP Conference Series: Materials Science and Engineering (Vol. 551, No. 1, p. 012028). IOP Publishing.

B.P. Shri, "Introduction of Method Study," Productivity Council, New Delhi, India, pp. 1, 1969.



- Zaidi, N. A., Muhamad Farizuan Rosli, M. S. M. Effendi, and Mohamad Hariri Abdullah. "Analysis of polyethylene terephthalate PET plastic bottle jointing system using finite element method (FEM)." In *AIP Conference Proceedings*, vol. 1885, no. 1, p. 020005. AIP Publishing LLC, 2017.
- Zhafri, Z. M., Effendi, M. S. M., & Rosli, M. F. (2018, November). A review on sustainable design and optimum assembly process: A case study on a drone. In *AIP Conference Proceedings* (Vol. 2030, No. 1, p. 020071). AIP Publishing LLC.
- Rajan, V. N., Sivasubramanian, K., & Fernandez, J. E. (1999). Accessibility and ergonomic analysis of assembly product and jig designs. *International Journal of Industrial Ergonomics*, 23(5-6), 473-487.
- Von Teh, C. Y., Aman, M. N. S. B. S., Mustafa, W. A., & Ahmad, S. A. B. (2020, September). Conceptual Design for Ankle Rehabilitation Robot by Using Morphological Chart and Pugh Method. In *IOP Conference Series: Materials Science and Engineering* (Vol. 932, No. 1, p. 012062). IOP Publishing.



## IMPLEMENTING USAGE OF HAND LIFTER MAGNET AT RECEIVING CHILD PART IN MTS DEPARTMENT

Movan A/L Ganesan<sup>1</sup>, Pn Eliza bin Shamsudin<sup>2</sup> and En Asmuni Bin Mohammed<sup>3</sup>

<sup>1</sup>,Department of Mechanical Engineering, Polytechnic Sultan Azlan Shah Behrang Perak *gvanrxz*@gmail.com eliza@psas.edu.my

<sup>2</sup> Department of MTS, Kumpulan Jebco (M) Sdn Bhd Sungai Buloh Selangor *asmuni@jebco.com.my* 

#### Abstract

This research is about implementing a hand lifting magnet in receiving area of MTS department Company J.The initial process was arranging the child part using hands from the cargo box to poly box and then transferring them to shotblast process and phosphating process is resulting in lack of efficient where it takes time to arrange the child part and this issue directly effecting on productivity. The implement of hand magnet lifter at the receiving area will be much easier for the work process to go on since the poly box will be placed on trolley and the child part will be arranged on the poly box with more lifting in single carriage of the magnet lifter. This research will be able to increase productivity and also make the work progress which is arranging the child part from cargo box to poly box much more efficient and also will result in saving time. The process of making the hand lifting magnet will be done with the concept of solenoid with the help of dc current which is motorbike battery and a switch will be connected to the device to turn on and off the current flow.

Keywords: cargobox,magnet lifter,arranging child part, poly box and solenoid.

#### 1. Introduction



Company J is one of the leading brands in Malaysia for automotive parts that are not made by original manufacturers. They are specializing in automotive anti-vibration rubber parts with over 43-year experience in providing quality goods that offer superior performance, efficiency and reliability. Their core products comprise rubber-to-metal antivibration products for the automotive, rail and agricultural sectors as well as other industrial applications, thermoplastic elastomer boots, high performance microcellular polyurethane jounce bumpers and dampers.

Generally, Company J has evolved into leading a biggest supply to Malaysia automotive industries especially Proton, Toyota, and Perodua. Parts such as engine mpunting, absorber mounting exhaust holder of local cars are made in this company. Since its a large manufacturing company there are certain problem occurs in the production. To be specific there is a delay in production at MTS receiving area since the operators are still using manual method for transferring process.

#### 1.1 Problem Statement

Company J produces large quantity of different metal products daily. The company also has their target of output daily in the same time; need to meet customer's demand. Company J received criticism from their main power regarding the work motion that they have to face for every day. In this production line, they face a problem which is arranging the child part from cargo box to poly box in receiving area of MTS is unsuitable. The problem occurs when the stocks or child part placed in front of MTS department using forklift, then the operators will arrange the child part in poly box from cargo box using their hands which is manually as shown in Figure 1 and bring the arranged child part in poly box to the metal treatment processing machine. The arranging proses by using a hand consume a lot of times even for a single parts in single carrier. Resulting using a hand lifter magnet can reduce a work energy of the operators, while the operator can focus on the others job that might be more important.

The process of carrying a weight in one kilograms for one meter, result to 9.8 Joules of energy, therefore while carrying in multiple of times using traditional way will result more energy losses.



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# Figure 1: The operator arranging the child part manually from the cargo box to the poly box.

1.2 Objective

Thus, the following research objectives is to reduce the time taken for the transferring process of the child part using hand lifter magnet.

1.3 Significance Of Project

With this study the process will be more efficient and give a positive impact on producing an efficient production line and will improve in finishing good products. The importance of this study will lead to changes and improvements for future activities.



#### 1.4 Scope Of Project

This study focuses on reducing operator's workload and improves cycle time to arrange the child part into the poly box from cargo box. Moreover, this study also focusing on improving efficiency of the production line in workstations that will contribute to increase of production in receiving area of MTS. To reduce time taken and enhance in production hand lifting magnet must be implemented in the workstation. This study also focuses to avoid repetitive task injuries such as carpal tunnel syndrome and maximize the ergonomics of this lifting magnet to ensure no injuries occur even under high repetitive frequency.

The scope of the project is related to PRO 111B. This study is conducted to ensure that the work is done efficiently and consistently for arranging the child part in the poly box from cargo box and delivering them to the next process. All the data is taken and compared with the objective of the study and the existing examples to create a helpful project design. This research project is related to improvement (kaizen).

#### 2.0 Literature Review

2.1 Kaizen

#### 2.1.1 Introduction To Kaizen

Kaizen is a process to manage with making continues improvement directly dependent on the minimal of changes either progressing positive changes can produce major or minor upgrades. In fact, it relies on participation and duty with stands to approaches those utilization radical changes. Kaizen is center to lean assembling, or The Toyota Way [1]. It was created in the assembling division to bring down imperfections, dispense with waste, support efficiency, energize specialist reason and responsibility, and advance development.



Kaizen is a Japanese word that means "improvement for the better" and is also known as the "Ceaseless Improvement" way of life. To put it another way, Kaizen is a daily work culture that focuses on continuously enhancing efforts in a procedure or system for working in all elements of the division and incorporates all representatives. Disposing of 'Squander' is an important goal that can increase quality and profitability [2].

2.2 Magnetic Lifter



Figure 2: Magnetic lifter

For years, magnetic lifters have been designed to reduce the amount of material handling necessary as well as the time spent doing so. The introduction of magnets in magnetic lifters has ushered in a new era of material handling. For years, magnetic lifters have been designed to reduce the amount of material handling necessary as well as the time spent doing so. The introduction of magnets in magnetic lifters has ushered in a new era of material handling necessary as well as the time spent doing so. The introduction of magnets in magnetic lifters has ushered in a new era of material handling necessary as well as the time spent doing so. The introduction of magnets in magnetic lifters has ushered in a new era of material handling [3].



#### 2.3 Electromagnetism

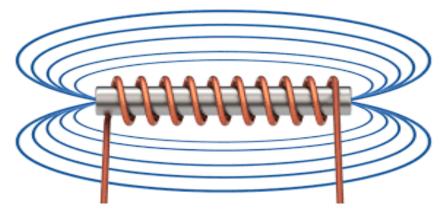


Figure 3: The concept of electromagnet

Using Oersted's discovery, both Ampere and Dominique Arago '(1786—1853) magnetized steel needles by placing them in a helix of wire carrying an electric current. This was the prelude to the construction in 1825 of the first electromagnet which could be so-called, by William Sturgeon (1783—1850) of Lancashire (Fig. 1). This was made of soft iron bent in the form of a horseshoe and wound with a loose helix of 18 turns of wire, and when excited by a wet battery could lift 20 times its own weight. Several years later Joseph Henry in the United States built a much improved electromagnet with many turns of wire eAiciently applied. While experimenting with this in 1829 he noticed the spark that occurred when the circuit was broken and was led to discovery of self-induction, a treatise on which he published in 1832. The same phenomenon was independently discovered.[3]

#### 3.0 Methodology

#### 3.1 Test Methods

This study focuses on the problem in which processes arranging the child part into the poly box from cargo box. Meetings and discussion were made with the supervisor, leader and operator and discovered that a hand lifting magnet will enhance the production line.



3.2 Quesntionaire Session With Operators Working In Receiving Area Of Mts

This method is one of an effective method to collect data regarding the problem occured. A questionnaire is prepared and distributed to the operators especially who in charge for the receiving are of MTS. The question is been asked for identify what is the problem that they faced during work at that workstation.

Survey Questionnaire								
I. Questions								
					greement with each mark in the box of y			
Questions	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree			
1. Is the environment in receiving area is good to work?								
2. Is the transferring process of child part is convenient ?								
3. Does the transferring ohild part process is done multiple time in a day?								
4. Do you think implementing another equipment is convenient for the work to be done ?								

5. Does the			
workflow will be			
much more			
facter in terms of			
time if a hand			
lifting magnet is			
implemented?			

Thank you for sharing your thoughts with us.

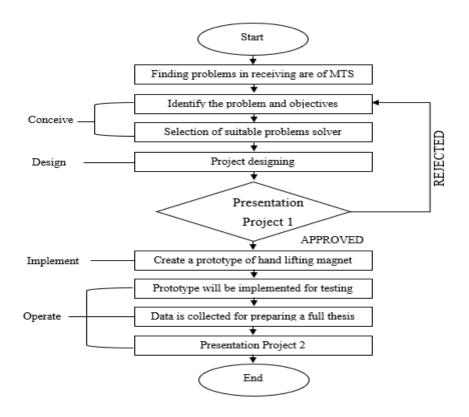
Figure 4: The questionnaire template

L



#### 3.3 Data Collection And Data Analysis

Collecting data is the process of getting or gathering and measuring current data that is related on the target variable issue that occurs. This is to ensure the accuracy of the data and result analysis. All scientific research which will be done must have the root cause and be a proven study from the data sheet. Data Collection is an important aspect of any type of research study. Inaccurate data collection can impact the results of a study and ultimately lead to invalid results. Data collection methods for impact evaluation vary along research. Discussion among the staff involved is an initial stage for the design development which is considered as the main role part in achieving the goal



#### Figure 5: The flow chart

The trial will be runned after implementing the magnetic hand lifter into the receiving area and the data will be recorded in the check sheet to compare with the previos data obtain without implementing the magnetic hand lifter. Besides that a stopwatch will be used to



measure the time taken to arrange the child part using the magnetic hand lifter to compare the time taken with the previous method.

The time taken for the operators for the transferring process from cargo box to poly box took in average 733.3, 733, 729.8 and 796.4 for 4 operators in morning shift and night shift. Since the operators can lift only four part in one cycle this directly contribute to waste of time and energy. To be concluded, production section has to push for output rate.

After implementation of hand lifting magnet for transferring process of child part from cargo box to poly box, the implementation of hand lifting magnet is reported 6 in a single carriage and average of 642.4, 640.8, 620.4 and 796.4 (refer Figure 4.7, figure 4.8 figure 4.9 and figure 4.10). Thus, there is much more difference in time taken for the transferring process and time taken for transferring child part process is decreased. This is because when manual method is used only 4 child part can be carried in a single carriage but in the implementation of hand lifting magnet for transferring process of child part, it can 6 child part in a single.

#### 4.0 Results

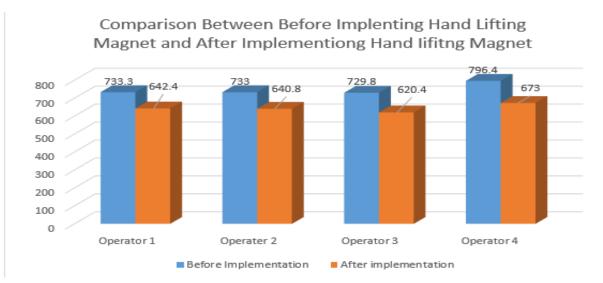


Figure 6: The comparison before and after implementation



Figure 4 shows in the bar chart the time of comparison of the graph bar between before implementation and after implementation. The bar chart highlights the time taken reduction of implementating the hand lifting magnet. The bar chart aslo represents that the average time in each data is more in before implementation compared to after implementation. The implementation of hand lifter magnet has decreased auto feeder fixture for adhesive system has decreased 19 seconds in a single cycle finish after implementation.

#### 5.0 Conclusion

These results obtained justifies with objective of this research and proven that reduction of time taken to transferi the child part from cargo box to poly box have been achieved since the results shows a positive outcome. The average time taken by 4 opeartors shows the after implentating the hand lfiter magnet is reduced.

It can be concluded from the finding and the data analysis that the implementation of hand lifting magnet for transferring process at receiving area of MTS reduced productivity. The installation of jigs and fixtures thus helps to reduce the time taken and directs the operator to make their job more effective and accurate. Therefore, this indicates that the newly designed hand lifting magnet has successfully solved the problem as mentioned in the introduction section, by reducing manual handling time and implementing better transferring process of child part from cargo box to poly box.

#### 6.0 References

- N. Ismail, S. S. Tai and Z. Leman, "Improving Productivity and Efficiency of a Vehicle Seat Assembly Line in a Manufacturing Company," *Conference on Research and Development*, Shah Alam, Malaysia, pp. 94-97, 2002.
- R. Simmons, "Gemba Kaizen: A Commonsense Approach to a Continuous



Improvement Strategy," 2nd edition, *Quality Management J.*, vol. 25, no. 1, pp. 65-66, 2018.

- Yuvraj Shinde, Kaustubh Jadha2, Ashok Todekar, Shubham Bhuchar and Girish Khope "Magnetic Roller for Lifting Toast Box Case" International Research Journal of Engineering and Technology (IRJET) Volume: 05 Issue: 06 | June 2018
- Bozorth, R. M. (1947). Magnetism. Reviews of Modern Physics, 19(1), 29–86. doi:10.1103/revmodphys.19.29

Interview session with department engineer Mr. Asmuni Bin Mohammed Nor.

Interview session with executive Mr Dahya about the implementation of hand lifter magnet in receiving area of MTS.

Interview session with operators regarding the implementation of hand lifter magnet.



# DESIGN AND DEVELOPMENT OF ROBOT JIG FOR PRODUCTIVITY IMPROVEMENT

Muhammad Dasukie Naim bin Mohd Noor<sup>1</sup>, Norashady bin Mohd Noor<sup>2</sup>

Mechanical Engineering Department, Politeknik Sultan Azlan Shah, Tanjong Malim, Perak naimdasukie1358@gmail.com norashady@gmail.com

#### Abstract

Jigs are work holders design to hold, locate and support process moving the part and gives a direction for the desired manufacturing operations. This project will be focusing to reduce cycle time by designing the jig for handling the injected part for model car D63D rear bumper from the moulding machine. The objectives of this project to reduce cycle time production on rear bumper for model D63D. Currently, the issue is the finish product from the injection moulding machine is handled manually for and increase cycle time for workers then can affect productivity. This study is conducted on production line for injection moulding part at workstation 3. The jig has been designed by using Catia V5 before implementation. The new jig design has been assemble with the robot to minimize the cycle time and improve productivity. As a result, the cycle time has been reduced after jig implementation from 65.2 second to 43.2 second and time reduced is 22 second (33 %) for every part during production process. This situation has resulted the jig can increase the productivity of the company by improving handling method.

Keywords: Jig, Handling Method, Catia V5, Injection Moulding, Cycle Time Reduce.

#### 1. Introduction

Company Z is the one of automotive manufacturer in Malaysia. A subsidiaries manufactures and sells injection plastic parts for the Automotive Industry such as Instrument Panel, Bumper, Ducting for Air-Conditioning System, Automotive Batteries as well as other medium and small automotive parts.



This company has specialized in plastic parts. Furthermore, Company Z have evolved into one of the leading and biggest suppliers to Malaysia automotive industries especially Proton and Perodua.

#### 1.1 Project Background

At the production line, the problem occurs when the cycle time and handling method not efficient for workers during production process. This project will focus on reducing cycle time when handle injected parts from the moulding machine for the model (D63D) rear bumper. The goals of this project are to offer a new jig design for a robot that will hold the bumper from the machine by using a robot and to reduce cycle time during the manufacturing process. This situation has resulted in a significant increase in movement and cycle time for workers, which has a negative impact on production.

#### **1.2 Problem Statement**

In this study, it also show that the uses of jig is really important on injection molding production line for rear bumper for model D63D. This is found when there have some motion waste found in injection process while workers must manually handle the injected part manually for rear bumper. In this situation, the workers have to make unnecessary movements to take out the injected part from machine and make the cycle time more higher for this workstation. The major problem found on this workstation is the process handling the part can affect cycle time of production for the Rear Bumper and and it also can cause motion waste of worker during handling the part. As conclusion, the problem can affect productivity and losses for company.



Based on figure 1 below has shown the situation worker at workstation during production process and current cycle time.



#### Figure 1 : Current handling method at production line

#### 1.3 Objective

• To reduce cycle time production on rear bumper for model D63D.

#### 2. Literature Review

Literature review is a scientific work, which includes the latest knowledge including substantive findings, as well as theoretical and methodological contributions to a particular topic. A literature review is a secondary source that does not report on the results of an original or fresh investigation.

#### 2.1 Jig and fixture

Jig is a work holding tool that supports a workpiece and gives a direction for the desired manufacturing operations. machining operations. Its main objective is to ensure high



degree of precision, interchangeability, and duplication in products manufacturing, it is also applied to manipulate the location and movement of tool (Shaikh & Abhang, 2020). Jig can decrease machine setup time and increase productivity by reducing the tasks of marking, orientating, alignment, levelling and setting for each workpiece. Based on previous research from (Aphale et al., 2021) jig and fixture was designed and implemented on assembly line to improve ergonomics along with reducing the required time and manpower. It reduced the required manpower in half and subsequently led improvement the productivity. Then, The task was to lift and hold the door and get it fixed with engine. Manual operation was taking more time for assembly with more workman engagement. According to the Aphale et al. (2021) the solution has been taken to overcome this problem is proposed a fixture to hold the part can help to reduce the cycle time and improve productivity. By using jigs, some heavy and complex design of parts can be handle easily by using robot to transfer the part from the machine to the workstation. However, according to the study from (Radhwan et al., 2019) for "Design and Analysis of Jigs and Fixtures for Manufacturing Process" has said this semi-auto insertion jig has added a lot of changes to the job handling in process operation. It help to ease the handling for the job by eliminate the manual insertion to semi-auto.

#### 2.2 Cycle Time

Cycle time is one of the important criteria that should be optimised as much as possible when the manufacturing firm strives to increase efficiency, cost base, and customer responsiveness. The goal of this comprehensive study is to reduce cycle time in the manufacturing industry in order to increase productivity. According to Taifa & Vhora (2019) reduction of the manufacturing cycle time for the aim of improving productivity in manufacturing industries necessitates to have and consider various methods which can be implemented . Cycle time should be prioritised in industries due to the high demand for balancing man, machine, materials, methods (Saptari et al., 2011) The productivity improvement approach covers various elements in order to obtain the maximum reduction of unnecessary time for greater improvement (Taifa & Vhora, 2019).

#### 3. Methodology



Methodology is a theoretical and systematic analysis of the methods used for the field of study It comprises both a theoretical and practical evaluation of the underlying ideas and procedures. The research procedure is equally important for the study to go smoothly and systematically

- **Project Start** Problem Identification **Brainstorm Idea Develop A Design** Ŧ Reject **Design Selection** Prototype Jig Fail **Testing A Jig Create Actual Product Data Collection** Т Data Analysis Fabrication Final Product Project End
- 3.1 Flowchart





#### 3.1.1 Problem identification

The issue has been found in the production line at injection moulding machine is for part Rear Bumper model (D63D). The major problem found on this workstation is the process handling the part can affect cycle time of production for the Rear Bumper. The problem has been identified based on observation and interview the worker . The current technique of handling was carefully analysed in order to fully understand and find a solution to the problem that had occurred.

#### 3.1.2 CAD Modelling

The current handling method was investigated properly in order to determine the critical areas for jig concept design, leads to the creation of an easy to use jig. The dimensions of the component has been studied. It was observed that in current manual handling operation. During the CAD modelling stage, Catia V5 has been used to the design jig and sizing jig must be compatible with the measurement of the Rear Bumper Size. It's because the jig has specific dimensions that must be meet in order for the product to fit. A CAD model of the jig was created to generate concepts for the jig is shown in figure 3 above. A concept sketch is also developed to plan the jig layout, utilities, and analyse the jig functionality. A main frame support is the important aspect must be consider during CAD modelling stage.

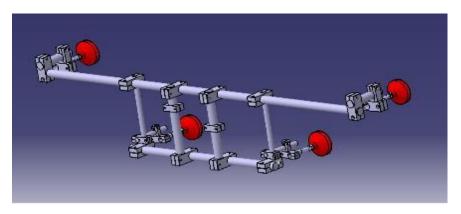


Figure 3: concept of jig for rear bumper model D63D



#### 3.1.3 Design Selection

Design selection is the method of choosing a design that has been analyzed against the specifications and criteria. It is the process of selecting the best concept for further investigation after comparing the relative strengths and weaknesses of the concepts. Concept selection, in general, is the method of narrowing down the alternatives that have been considered. The dimensions of the component were studied. It was observed that in manual handing operation

PRODUCT	DESIGN A	DESIGN B		
LENGTH OF FRAME	90 CM	100 CM		
HEIGHT	25 CM	10 CM		
MATERIAL	ALUMINIUM	STAINLESS STEEL		

#### 4. RESULT AND DISCUSSION

This topic will discuss the results obtained from the jig robot design that has been produced for the model (D63D) rear bumper product .In this case, the cycle time is also analyzed through the difference manual handling and after the implementation of the robot jig.

#### 4.1 Implimentation Jig

This analysis is carried out by implementing the jig on the production line. The figure 4 has shown the new jig implementation on workstation 3. Based on figure 4 below, the jig has been assemble with the robot 3 axis to help the operation of the jig. Futhermore, the jig will hold the rear bumper by using suction cup to move out the injection part and using air pressure to hold the injected part from machine. In this situation, handling method for



this part is improved from manual handling to robot handling by using the jig. Not about that, by implementation this jig the cycle time has been reduced.



Figure 4: Jig implementation at production

#### 4.2 Cycle Time Analysis

The table below has shown the data collection for the cycle time during production process before and after implementation of the jig on production process.

	REAR BUMPER MODEL (D63D) MEASUREMENT CYCLE TIME							
No. Worker	Process	1	2	3	4	5	Cycle Time Average (Second)	
Worker	Open machine door	6	6	6	6	6	6	
1	Take the part out from the machine	23	22	21	23	21	22	
	Close machine door	6	6	6	6	6	6	
Worker	Trim the runner gate	9	8	10	9	11	9.4	
2	Check the part	8	9	7	8	8	8	
Worker	Write the number of the part and date	4	3	4	3	4	3.6	
3	Packing the part	8	6	7	7	8	7.2	

Table 2	2: Cycle	e time da	ata before
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То	65.2 Second					
Place on the rack	3	2	4	3	3	3

	REAR BUMPER MODEL (D63D) MEASUREMENT CYCLE TIME						
No. Worker	Process	1	2	3	4	5	Cycle Time Average (Second)
Handled By Robot	Take the part out from the machine	12	12	12	12	12	12
Worker 1	Trim the runner gate Check the part	9 8	8 9	10 7	9 8	11 8	9.4 8
	Write the number of the part and date	3	4	4	3	4	3.6
Worker 2	Packing the part	7	6	8	8	7	7.2
2	Place on the rack	4	3	3	2	3	3
			43.2 Second				

#### Table 3: Cycle time data after

In order to reduce the number cycle time at production line machine 3 for rear bumper, a few ways are used to apply it. One of the methods is design the jig. When the jig is designed, it can increase the productivity of the production of rear bumper part. The table 2 has shown cycle time data before implementation , the operators need time 22 second to walk in the machine to take out the part from the injection moulding machine. Then, the cycle time to take out one part also increase. The next method to reduce cycle time for this workstation. Based on table 3, the data has been shown cycle time data after jig is applied on the robot, the jig shows the impact on productivity of the product. The robot only need to take 12 second to take the part out from the machine by using a jig.

In figure 5 below, it show the cycle time is reduced by compared the manual handling need 65.2 second and robot handling need 43.2 second after jig implementation. The figure 5 below show the cycle time for workstation 3 for rear bumper for model (D63D) before jig implementation on the robot. In this situation , we can see the highest cycle time by manual process because the worker has handle to take out the part from machine



manually and not has assist from robot jig. As a result, the cycle time has been reduced after jig implementation from 65.2 second to 43.2 second and time reduced is 22 (33 %) second for every part during production process.

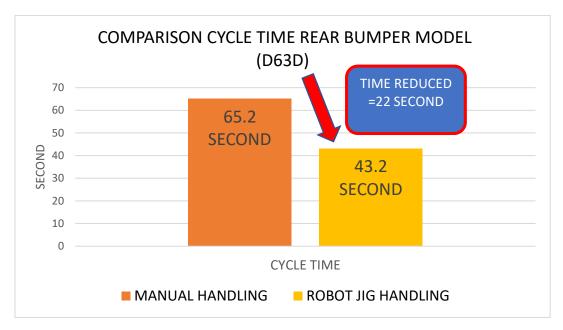


Figure 5 : comparison cycle time between before and afte

### 5. CONCLUSION

In conclusion, the jig can hold rear bumper (D63D) by using robot on the machine. Then, the usage of jig Can help reduce unnecessary movement to workers while handling the injected part from the machine. In addition, increase the productivity of the company by improving handling method for robots at injection molding machines in order to reduce the cycle time. Lastly, the cycle time has been reduced after jig implementation from 65.2 second to 43.2 second and time reduced is 22 second (33 %) for every part during production processThe use of a jig is the most important aspect in reducing the rear bumper's cycle time throughout the production process, as a result, reducing the total operating load on the production line.

#### Reference



- Aphale, S., Nandurdikar, V., & Desale, S. (2021). Design and Deployment of Fixture on Assembly Line to Improve Productivity. *Journal of Physics: Conference Series*, 1803(1). https://doi.org/10.1088/1742-6596/1803/1/012025
- Radhwan, H., Effendi, M. S. M., Farizuan Rosli, M., Shayfull, Z., & Nadia, K. N. (2019).
   Design and Analysis of Jigs and Fixtures for Manufacturing Process. *IOP Conference Series: Materials Science and Engineering*, 551(1).
   https://doi.org/10.1088/1757-899X/551/1/012028
- Saptari, A., Lai, W. S., & Salleh, M. R. (2011). Jig design, assembly line design and work station design and their effect to productivity. *Jordan Journal of Mechanical and Industrial Engineering*, *5*(1), 9–16.
- Shaikh, M., & Abhang, L. B. (2020). Design Development of Multipurpose Jig and Fixture of Injection Moulding Die. *International Journal of Engineering Development and Research (IJEDR)*, 8(2), 32–41.
- Taifa, I. W. R., & Vhora, T. N. (2019). Cycle time reduction for productivity improvement in the manufacturing industry. *Journal of Industrial Engineering and Management Studies*, 6(2), 147–164. https://doi.org/10.22116/JIEMS.2019.93495



# A STUDY ON IMPROVING DESIGN ERGONOMIC LAYOUT FOR MANUAL ROBOTIC STATION

Nur Iffah Nadhirah Ahmad Saidi<sup>1</sup>, Shaipul Anuar Mohamed Zainudin<sup>2</sup>

<sup>3</sup>Department of Mechanical Engineering, Polytechnic Sultan Azlan Shah, Behrang Stesen, Perak *iffahsaidi*@gmail.com shaipul@psas.edu.my

#### Abstract

Ergonomics is important in the daily routine of work; every worker's movement needs to be considered in designing the workstation because every movement of the worker can cause injury and fatigue. The productivity of workers greatly depends upon the ergonomic design of the workstation. This study was conducted to improve the ergonomics in manual robotic stations. The technique of lean manufacturing was adopted in this study to identify the causes of waste that occur in the work process of the frame. The wastage of manpower that occurs due to non-ergonomic working methods causes discomfort to the worker's body. The objective of this study is to redesign a manual robotic workstation that can help workers improve ergonomics and reduce movement while handling work. Redesigned and analyzed by using CATIA V5 software. Findings from RULA (Rapid Upper Limb Assessment) analysis using CATIA V5 software showed that the overall ergonomic score of body posture improved for the left side by 57% and the right side by 43%. In conclusion, these improved designs and methods are more ergonomic and can reduce the discomfort of the body in turn reducing wastage in the process of production.

Keywords: Ergonomic, RULA, Body Posture.

#### 1. Introduction

XYZ company is a popular motorcycle brand and has been known around the world and motorcycle manufacturing production XYZ company conducts lean manufacturing activities. Lean manufacturing is very important in the industry to prevent waste. Lean manufacturing improves production processes while also increasing worker satisfaction. The biggest one for ergonomics is the "Waste of Motion" (Kedproductivity, 2015). Any



unnecessary movement of people, equipment, or machinery is defined as waste in motion. Walking, lifting, reaching, bending, stretching, and moving are all examples of this. According to Skhmot (2017), excessive motion jobs should be changed to improve worker productivity while also increasing health and safety.

Awkward posture, static and sustained work posture, forceful exertion, repetitive motion, hands-arm, and whole-body vibration, and environmental risk factor (lighting, temperature, ventilation, noise) are among the ergonomic risk factors identified by the Industrial Hygiene & Ergonomics Division, Department of Safety and Health Malaysian jobs (2017). Manivel et al. (2017), the aim of ergonomics is to improve a worker's efficiency, comfort, and safety in the workplace.

This study was conducted to redesign workstations in manual robotic stations to reduce labor waste under the categories motion waste for work done by worker production with considered the ergonomic factors.

#### 1.1 Problem Statement

As a result of the observations and surveys that have been done in the manual robotic station, some problems can be seen in the station. The problem here is that the work done by the workers is not ergonomic because the workers have to do the work for loading and unloading for both jigs over long distances. Figure 1 shows the concept of work in a manual robotic station. The scope of work at this workstation requires the operator to place the unfinished frame part taken on the rack to be placed on the welding jig 1. After finishing placing on welding jig 1, repeat the same steps for welding jig 2, and meanwhile, welding jig 1 is being welded by the robot. After finishing welding on jig 1, the worker lifts the part to be placed on the rack and the same goes for jig 2. At the manual robotics station, there is only one worker to do the work on both the jigs and the output to be achieved is 160 for one booth according to the shift.



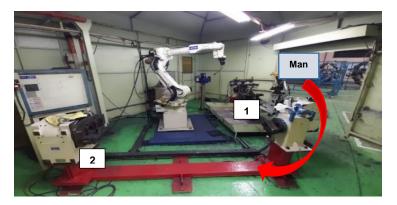


Figure 1: Manual robotic station

Not only that, a body posture position that requires bending the legs to step on the workstation continuously to lift a frame weighing 15 kg to 20 kg over a long period is cause discomfort on the body part of the worker. Figure 2 shows body posture position while lifting the frame from the jig. The average height of a man in Malaysia is 164.7cm (Ain Hamzah, 2022). The results of the answers given by ten respondents in the questionnaire form also show that the workers at the station as well agreed that the workers experienced discomfort with one body part after a certain period of working at this workstation as shown in table 1.

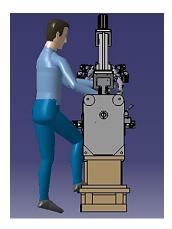


Figure 2: Body posture position



Body Parts		Frequency (%)
52	Neck	70%
25	Shoulder	70%
(	Middle to the lower back (lower back)	90%
$\langle \rangle$	Arm	80%
	Hands/ fingers	60%
	Hips, calf muscles, feet (lower extremity)	90%

Table 1: Musculoskeletal dis	scomfort problems based on body parts

#### 1.2 Objective

The main objectives of this study are to redesign a manual robotic station for workers based on principles of ergonomics.

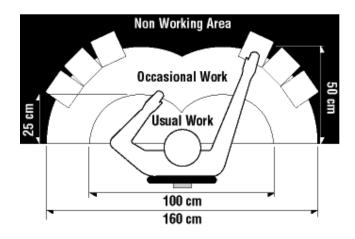
#### 2. Literature Review

The scope of the study focuses on how the project to be developed should be through reference sources to obtain relevant information. This literature review will explain the working area and ergonomic risk assessment tools.

#### 2.1 Working Area

Because people are a manufacturing organization's most valuable non-depreciable resources, manufacturing system designers must ensure that their designs promote a safe and healthy work environment. The design of a person's work environment and the tasks that perform while standing have an impact on the person's body and well-being. In most cases, the body postures that a worker can adopt while standing are determined and limited by the layout of the workstation. The measurements for the maximum and minimum work area in the standing position for workers are 160cm wide and 50cm long for occasional work and 100cm wide, and 25cm long for normal work as shown in figure 3.





#### Figure 3: Minimum and maximum working area - standing position

Source: Canadian Centre for Occupational Health & Safety (2016)

2.2 Ergonomic Risk Assessment Tools

In general, many reference sources can be referenced regarding ergonomic risk assessment tools, but for this study, the focus is on Inalcuk because Inalcuk studies in the field of occupational safety and health. A risk assessment can be performed using the following methods according to Inalcuk (2019):

#### i. The Ergonomics Workplace Analysis Method

The Ergonomic Workplace Analysis (EWA) was created to provide complete information about various factors that may directly or indirectly affect WRMSD while working with computers, based on the identified risk factors (Inalcuk, 2019).

#### ii. Quick Exposure Check Method (QEC)

This method was created by David, Woods, Li, and Buckle in 2008 (Inalcuk, 2019). It generates a weighted score that indicates the relative risk of a body region, task, or risk factor. The weighted score can also be used to demonstrate the impact of an intervention



prior to and after implementation. It is a tool designed for occupational safety and health professionals to assess the risk of work-related musculoskeletal disorders and provide a basis for ergonomic solutions (Inalcuk, 2019).

#### iii. The Rapid Entire Body Assessment (REBA)

It was designed by Drs. Sue Hignett and Lynn McAtamney in response to a perceived need for a practitioner's field tool that was sensitive to the variable working postures prevalent in the health care and other service industries (Hignett & Mcatamney, 2004). This ergonomic assessment tool analyses whole-body postural MSDs and task risk systematically (Middlesworth, 2017).

#### iv. The Rapid Upper Limb Assessment (RULA)

Based on Middlesworth (2017), the method was developed to assess the exposure of individual workers to ergonomic risk factors associated with upper extremity MSDs. RULA is ideal for training employees about high-risk postures and is appropriate for the majority of static tasks.

Among the risk assessments, RULA has been chosen as one of the risk assessments. RULA can assess the required body posture, force, and repetition. In addition, RULA is simple to use and does not require the purchase of expensive equipment. This study aims to use RULA as an outcome measure of the ergonomic analysis in the manual robotic station.

#### 3. Methodology

This methodology describes the method used to make the analysis of the data and the design for the workstation. The method used to obtain the data is RULA in CATIA V5 software and the design also uses CATIA V5 software to design a new workstation.



#### 3.1 Data Collection

Observations regarding working methods in manual robotic stations and obtaining information from production workers related to difficulties encountered while performing the frame process. Observations were also made to identify the way workers' production handles the work while lifting the frame from the jig. Information obtained during the observation process at the frame workstation was analyzed using two methods namely questionnaire form and Ishikawa diagram with 4M (man, material, method, and machine). The number of respondents to answer the questionnaire form is ten. The results of that analysis performed show production workers need to operate both jigs over long distances. The problem that has been identified is the distance to operate both the jig is not suitable and the method of lifting the frame from the jig performed by the production is not ergonomic. While the weight of the frame is approximately 15kg to 20kg. The working time for production workers is for 8 hours every day.

#### 3.2 Design

The proposed design is to create a workstation from static to a rotating workstation designed using CATIA V5 software. The improvement of the manual robotic station design is focused on welding jigs that can be rotated to robots and workers without workers needing a long distance to go to welding jigs. The workstation is currently in a static state and has a non-ergonomic workstation which causes discomfort to the body part of the worker due to the distance between the two welding jigs.

A new design is proposed to allow rotary welding jig using the turntable concept and this design is done using CATIA V5 Software. Modifications are made to the welding jig handle by designing a static welding jig handle into one that can rotate. This welding jig handle is designed to reduce the load for workers doing work for both jigs without having to walk over long distances and the height of the jig is also improved. Figure 4 is the design that has been improved in this study.



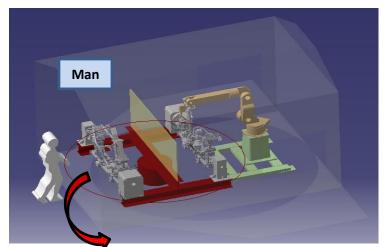


Figure 4: Manual robotic station – new proposed (isometric view)

3.3 Rapid Upper Limb Assessment (RULA)

The Rapid Upper Limb Assessment (RULA) (McAtamney and Corlett, 1993) is a workplace risk assessment technique based on ergonomics that allows calculating the risk of musculoskeletal loading in the upper limbs and neck. RULA was designed to evaluate individual worker exposure to ergonomic risk factors linked to upper extremity MSD. After studying the working conditions in manual robotic stations, the postures of workers were redesigned using CATIA V5 Ergonomic Design and Analysis software components. The CATIA V5 software was utilized to record all needed RULA analysis characteristics. The RULA approach includes completing an evaluation grid that divides the human body into two sections (Section A: upper arm, lower arm, and wrist; Section B: neck, trunk, and legs). It takes into account the body's load and muscle activity.

The RULA assessment generates a list of action categories, each with a code representing the level of intervention required to lower the risk of worker discomfort. The results are then divided into four action categories, each of which indicates when a risk control action should be implemented. The RULA scores were acquired, and the final scores for posture will be utilized to establish the necessary measures to improve working postures as indicated in table 2. The final RULA score, which is a single score that represents the level of MSD risk for the work task being analyzed, is the result of the RULA method.



Table 2: RULA analysis score			
Score	Level of MSD Risk		
1-2	Negligible risk, no action required		
3-4 Low risk, change may be needed			
5-6	Medium risk, further investigation, change soon		
7+ Very high risk, implement change			
Source: Middlesworth (2017)			

## . . . . . . .

#### 4. Result and Discussion

This study was conducted to achieve the objectives stated in section 1.2. The results are presented according to the main areas of concern namely to redesign manual robotic stations for workers based on principles of ergonomics. Throughout this chapter, the findings for each point will be discussed and elaborated on.

#### 4.1 Body Posture Analysis before Using the New Design

The posture position of the worker who performs the frame lifting process is analyzed based on Rapid Upper Limb Assessment (RULA) using CATIA V5 software. This analysis is done in two conditions, namely before and after the improvement is done against the design in the manual robotic station. Analysis this is important to know the effectiveness of the improved design. According to Middlesworth (2017), there are four categories of scores for analysis of RULA as shown in table 2.

Figure 2 shows the posture position of the worker's body while lifting the frame before improvements are made. Where the worker has to bend the right leg to step on the workstation part because of the need to reach and lift the frame from the jig. Table 3 shows the findings of the RULA analysis, this analysis applied to the body part. The posture chosen is of the intermittent type because the process of lifting the frame is repeated for a working period of 8 hours per shift. The specified frame weight is 20 kg, which is the maximum weight of the model run on the workstation that needs to be lifted by production workers. The average score of the RULA analysis results was 7 for the left and right sides of the body, this means the posture of the body is at high risk, so according to Middlesworth (2017), changes need to be implemented immediately.



The parts of the body that are at high risk (red zone) are the neck, trunk, leg, and wrist/ arm. This part of the body is at high risk due to the movement of the worker's body while lifting the frame is not ergonomic. This situation needs to be changed immediately for reducing discomfort on the body posture of the worker, which in turn, reduces musculoskeletal disorders, and the scores for the right and left sides are the same.

# Table 3: Findings of RULA analysis before using the new design (right and<br/>left)

No.	Body Parts	Score	Risk Level	Action
1	Neck, trunk, leg	7	High Risk	Very high risk,
			(Red Zone)	implement change
2	Wrist / arm	7	High Risk	Very high risk,
			(Red Zone)	implement change

4.2 Body Posture Analysis after Using the New Design

Figure 5 shows the posture position of the worker's body while lifting the frame after improvements are made. The position of the worker's body posture when using the design is seen to be more ergonomic where workers do not have to bend the body and knees to lift the frame.

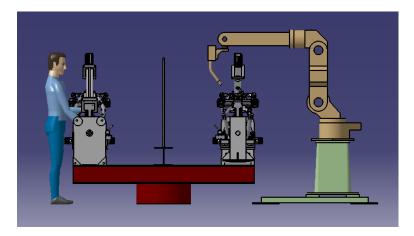


Figure 5: Body posture position after using a new workstation



Table 4 shows the RULA analysis findings after using a new workstation that has been improved on the left side. The part of the body that is before this is in the red zone for the left side i.e. neck, trunk, leg, and wrist/ arm has changed to the yellow zone i.e. low risk. This means parts of the body that were previously at high risk have changed to low risk. The average score of analysis findings RULA after improvement is on a scale of 3.

Table 4: Findings of RULA analysis after using the new design (left side)

No.	Body Parts	Score	Risk Level	Action
1	Neck, trunk, leg	3	Low Risk	Low risk, change may be
			(Yellow Zone)	needed
2	Wrist / arm	4	Low Risk	Low risk, change may be
			(Yellow Zone)	needed

Table 5 shows the RULA analysis findings after using a new workstation that has been improved on the right side. The body part on the right side meanwhile neck, trunk, and leg from the red zone have changed to i.e. low risk. As for the wrist/arm, it changed from red to orange zone. The average score of analysis findings RULA after improvement on the right side is on a scale of 4. Hence, the design improvement for the method of handling the process of lifting the frame in this workstation can reduce the discomfort on the body posture of the worker. In addition, making worker movement more ergonomic.

No.	Body Parts	Score	Risk Level	Action
1	Neck, trunk, leg	3	Low Risk	Low risk, change may be
			(Yellow Zone)	needed
2	Wrist / arm	5	Medium Risk	Medium risk, further
			(Orange Zone)	investigation, change soon

Table 5: Findings of RULA analysis after using the new design (right side)

Findings from the RULA analysis on the left side after the improvements were made show the readings for non-ergonomic body posture have dropped significantly from a score of 7 to 3 for neck, trunk, and leg and a score of 7 to 4 for the wrist/ arm. In terms of risk of injury to the body parts, before the improvement of the risk reading is at high-risk levels, (where changes need to be made immediately) have changed to low risk. Furthermore, the results of the study on the right side show that non-ergonomic body posture has



decreased significantly from a score of 7 to 3 for the neck, trunk, and leg, as well as a score of 4 to 2 for the wrist and a score of 7 to 5 for the wrist/arm.

4.3 Comparison of the Findings of the RULA Analysis

Body posture becomes more ergonomic after improvements on the workstation from a design in which the final RULA score shows a scale of 7 to 3 with 57% improved on the left side and a scale of 7 to 4 with 43% improved on the right side as shown in figure 6. Tables 6 and 7 show a comparison of RULA scores before and after improvements were made for the body part categories. The affected body part by giving a RULA score reading the highest and least ergonomic is the neck, trunk, leg, and wrist/arm during the frame lifting process. This is because the body needs to stretch to reach the frame and the right leg needs to be bent to step on the workstation as well as using a lot of force to lift the frame. Next, cause these body parts are outside the comfort zone.

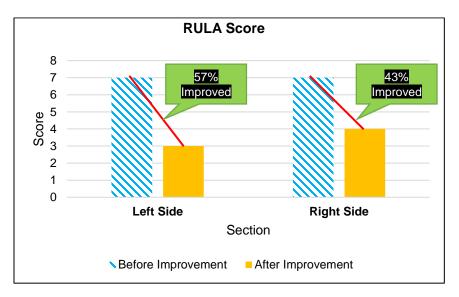


Figure 6: RULA score - final

No.	RULA Analysis	RULA Score (Before)	RULA Score (After)	Improve (Percentage)
1	Neck, trunk, leg	7	3	57%



2	Wrist/ arm	7	4	43%

Table 7: Comparison of RULA scores before and after improvement (right side)

No.	RULA Analysis	RULA Score (Before)	RULA Score (After)	Improve (Percentage)
1	Neck, trunk, leg	7	3	57%
2	Wrist/ arm	7	5	29%

#### 5. Conclusion

This study has identified the problems that are the cause of waste in the frame process in manual robotic stations. Based on the concept of lean manufacturing, waste of manpower under the category of waste motion is a major factor contributing to wastage in work processes in manual robotic stations. This waste of manpower is caused meanwhile by the work process of lifting the frame non-ergonomically. Rapid Upper Limb Analysis Assessment (RULA) using CATIA V5 software has identified a body posture not ergonomic during the process of lifting the frame ie neck, trunk, leg, and wrist/ arm. Therefore improvements to the redesign and method of handling the frame were made. The body posture improved after the workstation was improved, with a RULA score of 57 % on the left and 43 % on the right for the final score. The improved frame handling method uses the rotary concept for the jig to rotate on the robot as well as the worker to facilitate the worker without having to walk far to operate the two jigs. The design was also improved to lift the frame from the jig. This method does not require production workers to bend the foot to step on the base of the jig and can in turn reduce movement. These improvements can reduce the waste caused by labor in turn increases productivity in production.

#### References

- Ain Hamzah. (2022). Rakyat Malaysia lebih pendek daripada Singapura. https://www.edisi9.com.my/2022/05/rakyat-malaysia-lebih-pendek-daripadasingapura/
- Canada,. (2016). Working in a Standing Position Basic Information : OSH Answers. Ccohs.ca. https://www.ccohs.ca/oshanswers/ergonomics/standing/standing\_basic.html



- Department of Safety and Health Malaysian jobs. (2017). *Pengurusan Ergonomik Di Tempat Kerja.* https://www.dosh.gov.my/index.php/industrial-hygiene-ergonomicv/pamplet/2892-pengurusan-ergonomik-di-tempat-kerja
- Kedproductivitiy. (2015). *How Much Waste Are You Still Missing By Doing Lean Without Ergonomics.* https://www.kedproductivity.com/articles/how-much-waste-are-you-still missing-doing-lean-without-ergonomics
- İnalçuk, E. (2019). Investigation Of Ergonomic Risks In Manufacturing Sector Using Quick Exposure Check Method. 45(45), 19–21.
- Manivel, M., Arun, V., Sedhu, S., Arjun, K. (2017) Ergonomic Considerations for Design of Industrial Workstation: A Review. *International Research Journal of Engineering and Technology.* 4(10):276-281
- McAtamney, L., & Nigel Corlett, E. (1993). RULA: a survey method for the investigation of work-related upper limb disorders. *Applied Ergonomics*, 24(2), 91–99. https://doi.org/10.1016/0003-6870(93)90080-s

McAtamney, L., & Hignett, S. (2004). Rapid Entire Body Assessment. Handbook of Human Factors and Ergonomics Methods, 31, 8-1-8–11. https://doi.org/10.1201/9780203489925.ch8

Middlesworth, M. (2017). A Step-by-Step Guide to the RULA Assessment Tool.

https://ergo-plus.com/rula-assessment-tool-guide/

Skhmot, N. (2017). The 8 Waste Of Lean. https://theleanway.net/The-8-Wastes-of-Lean



# ISU DAN CABARAN BANGUNAN FASAD KACA TERHADAP SISTEM PENYEJUKAN DI DALAM BANGUNAN

Syahirah Mutaza<sup>1</sup> and Shahida Bt. Sharuddin<sup>2</sup>

<sup>1</sup>Jabatan Kejuruteraan Awam, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor syahirah.mutaza@gmail.com shahida.s@psa.edu.my

#### Abstrak

Rekabentuk bangunan fasad kaca mampu memberikan kesan psikologi yang baik terhadap keselesaan penghuni kerana impak ruang yang luas dan kemasukan cahaya matahari yang maksimum. Walaubagaimanapun, rekabentuk sebegini menyebabkan suhu di dalam bangunan menjadi tidak seimbang kerana kemasukan cahaya semula jadi tanpa kawalan mengakibatkan ketidakselesaan penghuni. Oleh itu, kajian ini dijalankan bagi mengenal pasti isu dan cabaran yang dihadapi pada bangunan fasad kaca di Menara Prisma, Putrajaya terhadap sistem penyejukan yang digunakan. Kaedah kajian secara gabungan telah dipilih bagi menjalankan kajian ini di mana instrumen soal selidik dan temubual telah dilakukan kepada penghuni Menara Prisma. Soal selidik telah diedarkan kepada 200 penghuni dan sebanyak 110 responden telah menjawab. Manakala temubual bersama 3 orang pekerja berpengalaman dalam bidang pengurusan bangunan juga telah dijalankan. Data kajian dianalisa menggunakan perisian excel dan transkripsi temubual. Hasil dapatan kajian menunjukkan bahawa penjimatan tenaga adalah isu dan cabaran utama bagi bangunan fasad kaca di mana kebanyakkan responden berpendapatan halangan pada tingkap membantu mengurangkan kemasukan cahaya matahari masuk ke dalam bangunan. Kajian ini juga merupakan tanda sokongan kepada agenda negara di dalam usaha menuju ke arah pembangunan lestari.

Kata Kunci: Fasad Kaca, Sistem Penyejukan, Keselesaan, Pengunaan Tenaga



#### 1. PENGENALAN

Arkitek dan jurutera menggemari dengan rekabentuk bangunan fasad kaca yang membenarkan cahaya semula jadi masuk ke dalam bangunan kerana ianya mempunyai kebaikan kepada psikologi manusia untuk melaksanakan aktiviti harian dengan lebih baik. Kemasukan cahaya semula jadi ke dalam bangunan menjadikan bangunan tersebut tidak perlu menyalakan lampu dan berlakunya penjimatan elektrik. Walaubagaimanapun, beban sistem penyejukan di dalam bangunan meningkat kerana haba dari cahaya matahari masuk terus ke dalam bangunan secara berlebihan.

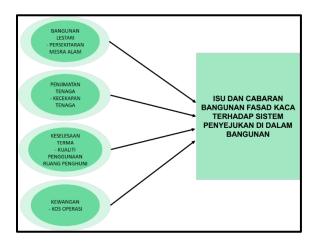
Antara masalah yang dikaji adalah ketidakselesaan pengguna di dalam bangunan fasad kaca berpunca daripada penerimaan kemasukan haba cahaya yang tinggi pada persekitaran bangunan (F.Beyhan, P.Ersan, 2020). Isu lain yang ditemui daripada pengkaji Mazzucchelli dan rakan-rakannya (2018) menyatakan sistem penyejukan dan teknologi fasad kaca yang digunakan kurang bersesuaian berdasarkan fungsi sesebuah bangunan.

Penyelidikan ini penting bagi merealisasikan penambahbaikan pada bangunan lestari yang boleh mengurangkan gangguan pada alam sekitar oleh arkitek dan jurutera. Selain itu, tanda sokongan kepada pihak kerajaan terutama kepada kementerian alam sekitar bagi membantu untuk memberikan idea terhadap pembangunan fasad kaca.

## 2. KAJIAN LITERATUR

Terdapat banyak kajian lepas telah dikaji oleh para penyelidik tentang pembangunan fasad kaca terhadap sistem penyejukan. Segelintir penyelidik telahpun menyelidik jenis fasad kaca padan digunakan dapat mengurangkan kemasukan haba cahaya matahari ke dalam bangunan dan ada juga pengkaji mengkaji sistem penyejukan bersesuaian untuk memastikan ruang di dalam bangunan dalam keadaan suhu yang stabil.





Rajah 1: Kerangka Konseptual Isu dan Cabaran Bangunan Fasad Kaca Terhadap Sistem Penyejukan di Dalam Bangunan

Rajah 1 menunjukkan empat faktor perubahan melibatkan isu dan cabaran bangunan fasad kaca terhadap sistem penyejukan di dalam bangunan. Empat faktor tersebut saling dikaitkan oleh para pengkaji untuk mengetahui sistem penyejukan, jenis fasad kaca atau kelakuan penghuni bangunan yang boleh memberikan kesan terhadap perubahan keselesaan suhu di dalam bangunan fasad kaca.

#### 2.1 Bangunan Lestari

Dalam hal ini,Zulkhairi bersama rakan penyelidiknya (2020) ada menyatakan sesebuah pembangunan kelihatan estetik menggunakan fasad kaca tetapi perlu mengambil kira faktor pemilihan kaca yang menyebabkan peningkatan suhu di persekitaran akibat daripada pantulan cahaya matahari secara berlebihan pada kaca. Terdapat banyak jenis teknologi kaca digunakan pada masa kini dan diantaranya fasad kaca berganda, perlindungan UV dan juga fotovoltaik yang membolehkan menjana sumber elektrik kerana mempunyai solar panel.

Selain itu, pokok juga antara satu elemen yang dapat mengurangkan penggunaan tenaga pada bangunan fasad kaca di mana sebuah bangunan fasad kaca di Jepun memberikan kesan baik pada kawalan suhu bangunan, bunyi hingar berkurangan, mengurangkan pulau haba serta pencemaran udara kerana penanaman pook pada bangunan (Farid et al., 2016).



Akhir sekali tentang bangunan lestari, Dzcreation,(2019) berkongsi pendapatnya tentang bangunan fasad kaca memerlukan aliran udara semula jadi bagi mengawal suhu dengan perolehan udara yang baik dan selesa di dalam bangunan. Ianya sangat penting kerana sekiranya di dalam sesebuah bangunan tidak mempunyai aliran udara baik, maka tekanan udara di dalam bangunan menjadi tinggi dan ini bermaksud suhu akan menjadi panas serta tidak selesa.

#### 2.2 Penjimatan Tenaga

Konsep penjimatan tenaga biasa ditekankan oleh para penyelidik kerana bahan semula jadi bumi yang semakin berkurang di bumi ini telah digunakan oleh manusia untuk menjalani aktiviti harian. Merabtinea dan rakan kajiannya, (2019) menerangkan bangunan fasad kaca memainkan peranan dalam penjimatan tenaga berkait dengan pengaliran cahaya, haba solar dan teduhan.

Sistem HVAC perlu dipilih dengan kesesuaian rekabentuk bangunan supaya beban penggunaan tenaga penyejukan adalah pada tahap yang optimum (Albab & Adi, 2019). Penggunaan tenaga cekap bergantung kepada pengagihan udara sejuk pada setiap ruang sama rata dan juga jenis fasad kaca yang digunakan mempunyai pantulan cahaya yang baik untuk menyingkirkan jumlah haba panas memasuki ke dalam bangunan.

#### 2.3 Keselesaan Terma

Bagi sistem penyejukan di dalam bangunan fasad kaca perlu mencapai suhu di antara 24°C sehingga 26°C bagi ruang yang selesa diduduki oleh para penghuni. Bagi menghalang radiasi solar pada beberapa ruang di dalam bangunan telah dikaji dengan beberapa pemilihan jenis kaca serta warna sebagai sistem teduhan pada bangunan (Sayed, M., Fikry,M., 2019).

Selain itu, keselesaan penghuni terhadap bunyi di dalam bangunan fasad kaca dititik berat pada bunyi bising terhasil daripada sistem HVAC yang menghasilkan frekuensi. (Jaini, 2018) menyatakan bahawa gangguan bunyi kepada manusia dibenarkan sebanyak 20 hingga 125Hz kerana getaran bunyi rendah. Dalam sistem HVAC yang menghasilkan gabungan bunyi mekanikal seperti motor, pemampat, pam, kipas, kotak isipadu udara berubah-ubah (VAV) dan saluran keluar udara.



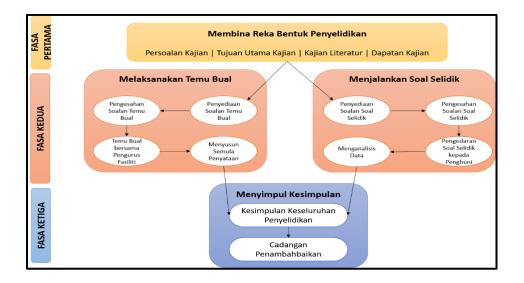
#### 2.4 Kewangan

Perbelanjaan bagi kos operasi diambil kira untuk penyelenggaraan sistem penyejukan dan perbelanjaan bil elektrik supaya pihak pengurusan bangunan dapat mengelakkan pembaziran kos pada sistem penyejukan di dalam bangunan. Dalam kajian (Zulkhairi, M serta rakan penyelidikannya (2020) memberikan kenyataan tentang kewangan yang perlu diselidik secara mendalam iaitu kos pergantungan terhadap teknologi pada sistem penyejukan dan fasad kaca mengikut kesesuaian bangunan.

Teknologi terkini yang digunakan pada fasad kaca ialah solar panel fotovoltaik di mana solar panel tersebut mempunyai sistem untuk mengumpul cahaya matahari untuk dijadikan tenaga elektrik serta dapat memantulkan cahaya. Kajian daripada Salameh dan rakan-rakannya (2020) menyatakan bahawa gabungan kaca fotovoltaik lutsinar dan juga pemilihan sistem HVAC yang padan akan menjadikan kecekapan tenaga lebih jimat sebanyak 27.7%.

#### 3. METODOLOGI KAJIAN

Untuk mengetahui sejauh mana empat perubahan faktor yang boleh memberikan kesan kepada isu dan cabaran bangunan fasad kaca terhadap sistem penyejukan di dalam bangunan. Kaedah digunakan adalah abduktif iaitu gabungan antara kualitatif dan kuanititatif untuk menyimpulkan data yang telah dikumpulkan.



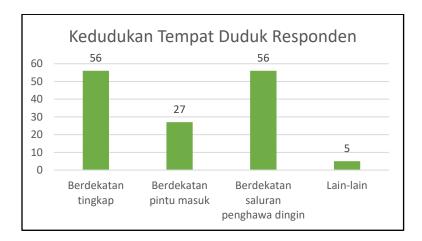


## Rajah 2: Carta Alir Reka Bentuk Kajian Penyelidikan

Instrumen pertama digunakan untuk mengenal pasti isu dan cabaran sistem penyejukan di bangunan fasad kaca dengan menganalisa kandungan dokumen yang dikumpul. Untuk menganalisa isu dan cabaran penghuni bangunan dalam aspek sistem penyejukan di bangunan fasad kaca menggunakan instrumen soal selidik dimana soalan tersebut dijawab oleh penghuni bangunan fasad kaca. Bagi kaedah analisis data, dilaksanakan dengan perisian Excel untuk mengetahui nilai min dan sisihan piawai

Selain itu, instrumen bagi mendapatkan cadangan penambahbaikan kaedah penggunaan tenaga di dalam aspek sistem penyejukan di bangunan fasad kaca menggunakan kaedah temu bual. Responden yang ditemubual adalah pekerja pengurus fasiliti bangunan fasad kaca dengan soalan temu bual secara berstruktur. setiap faktor pada soalan soal selidik. Kemudian, penyusunan ayat dibuat pada kenyataan responden.

#### 4. DAPATAN DAN PERBINCANGAN



#### 4.1 Demografik Responden

#### Rajah 3: Lokasi Tempat Duduk Responden

Terdapat empat faktor pilihan oleh responden iaitu berdekatan tingkap, pintu masuk, saluran penghawa dingin atau lain-lain. Responden dibenarkan untuk memilih lebih daripada satu faktor dan pilihan lain-lain dibenarkan untuk menyatakan kedudukan



tempat duduk responden. Rajah 3 menunjukkan faktor kedudukan responden yang paling banyak dipilih adalah berdekatan tingkap dan berdekatan saluran penghawa dingin.

#### 4.2 Analisis Data Soal Selidik

Data yang dikumpul daripada soal selidik untuk menganalisa isu dan cabaran sistem penyejukan bagi bangunan fasad kaca. Sebanyak 115 daripada 200 responden yang menghuni bangunan fasad kaca telah menjawab soalan yang diedarkan.

#### Jadual 1: Rumusan Bagi Faktor Isu dan Cabaran Bangunan Fasad Kaca Terhadap Sistem Penyejukan

Faktor	Min
Bangunan Lestari – Persekitaran Mesra Alam	2.59
Penjimatan Tenaga – Kecekapan Tenaga	3.12
Keselesaan Terma – Kualiti Ruang di Dalam Bangunan	2.91

Dengan memerhati Jadual 1, kajian ini dapat memberikan kesimpulan faktor penjimatan tenaga bagi kecekapan tenaga adalah tinggi sebagai isu dan cabaran sistem penyejukan bangunan fasad kaca. Manakala, faktor terendah adalah bangunan lestari bagi persekitaran mesra alam.

#### 4.3 Latar Belakang Responden

#### Jadual 2: Latar Belakang Responden Temu Bual

Nama	Latar belakang responden
Responden A	Pekerja berpengalaman dalam bidang Pengurusan
	bangunan fasad kaca selama 10 tahun
Responden B	Juruteknik Mekanikal
Responden C	Pengurus Fasiliti

Merujuk jadual 2, ketiga-tiga responden mempunyai pengalaman dan kepakaran masingmasing serta memegang tanggungjawab berlainan dalam bidang pengurusan bangunan fasad kaca

#### 4.4 Analisis Data Temu Bual

Temu bual yang dibuat untuk mencadangkan penambahbaikan kaedah penggunaan tenaga di dalam aspek sisten penyejukan di bangunan fasad kaca



## Jadual 3: Cadangan Penambahbaikan Sistem Penyejukan Bangunan Fasad Kaca Bagi Faktor Bangunan Lestari

Cadangan	Responden A	Responden B	Responden C	Catatan
<u>Bangunan</u> Lestari				
Penanaman pokok di dalam atau luar bangunan	Tidak setuju kerana menambah kos penyelenggaraan	Tidak setuju kerana pokok untuk keselesaan	Setuju untuk aras bawah kerana ketinggian pokok menghalang cahaya	Dua responden tidak bersetuju dengan cadangan

Cadangan penanaman pokok di dalam atau luar bangunan tidak disetujui oleh dua responden kerana merujuk jadual tiga responden A menyatakan penambahan kos penyelanggaraan dan responden B menyatakan pokok hanya untuk keselesaan sahaja.

## Jadual 4: Cadangan Penambahbaikan Sistem Penyejukan Bangunan Fasad Kaca Bagi Faktor Penjimatan Tenaga

Cadangan	Responden A	Responden B	Responden C	Catatan
<u>Penjimatan</u> <u>Tenaga</u>				
Pemasangan solar panel bagi menampung kecekapan tenaga	Tidak setuju	Setuju untuk menampung operasi unit FCU	Setuju dengan jumlah pemasangan banyak	Dua responden bersetuju dengan cadangan

Penjimatan tenaga sebagai cadangan penambahbaikan sistem penyejukan bangunan fasad kaca disetujui oleh responden B dan C. Pesetujuan dibuat kerana solar panel dapat menampung operasi unit FCU serta perlu dengan jumlah pemasangan solar panel yang banyak



## Jadual 5: Cadangan Penambahbaikan Sistem Penyejukan Bangunan Fasad Kaca Bagi Faktor Keselesaan Terma

Cadangan	Responden A	Responden B	Responden C	Catatan
<u>Keselesaan</u> Terma				
Sensor untuk memantau suhu stabil di dalam ruang bangunan.	Setuju untuk memastikan ruang yang selesa	Setuju untuk mengesan suhu yang tidak stabil.	Setuju dengan penyusunan sensor yang betul.	Ketiga-tiga responden bersetuju dengan cadangan

Merujuk jadual 5, ketiga-tiga responden bersetuju dengan cadangan sensor dapat memantau suhu stabil di dalam ruang bangunan sebagai penambahbaikan sistem penyejukan.

## Jadual 6: Cadangan Penambahbaikan Sistem Penyejukan Bangunan Fasad Kaca Bagi Faktor Kewangan

Cadangan	Responden A	Responden B	Responden C	Catatan
<u>Kewangan</u>				
Pemasangan solar panel untuk penjimatan kos perbelanjaan	Setuju kerana menjimatkan kos operasi dalam jangka masa panjang	Tidak setuju kerana kurang impak kepada bangunan.	Setuju kerana kos selenggara tidak tinggi dan menampung kos operasi	Dua responden setuju dengan cadangan



Dua responden bersetuju dengan cadangan pemasangan solar panel untuk penjimatan kos perbelanjaan yang ditunjukkan di dalam jadual 6. Responden B tidak setuju dengan cadangan tersebut kerana kurang memberikan impak kepada bangunan.

#### 5. KESIMPULAN

Keseluruhan kajian ini mendapati terdapat beberapa isu dan cabaran bangunan fasad kaca terhadap sistem penyejukan di dalam bangunan. Oleh demikian, faktor bangunan lestari, penjimatan tenaga, keselesaan terma dan kewangan saling berkait rapat bagi mengenal pasti isu dan cabaran tersebut

Isu yang dibangkitkan bagi faktor bangunan lestari antaranya pemilihan fasad kaca, pokok yang ditanam sekitar bangunan dan cara sistem pengudaraan semula jadi di dalam ruang bangunan. Seterusnya, pantulan kaca perlu dipadankan dengan sistem HVAC bagi penjimatan tenaga bangunan fasad kaca untuk kecekapan tenaga lebih baik.

Secara teoritikalnya bagi mencadangkan penambahbaikan sistem penyejukan dalam bangunan fasad kaca, para penyelidik perlu mengetahui isu dan cabaran bangunan fasad kaca terhadap sistem penyejukan. Oleh itu, di dalam kajian ini telah pun mengumpulkan beberapa isu dan cabaran tersebut untuk memudahkan para pengkaji seterusnya menyelidik lebih mendalam tentang sistem penyejukan bangunan fasad kaca.

#### RUJUKAN

- Albab, U., & Adi, T. J. W. (2019). Energy Efficiency of Cooling Load through The Glass Facade of Office Buildings in Surabaya. *IPTEK Journal of Proceedings Series*, 0(5), 600. https://doi.org/10.12962/j23546026.y2019i5.6443
- Beyhan, F., & Ersan, P. U. (2020). An approach to reduce cooling loads in transparent facades. *IOP Conference Series: Materials Science and Engineering*, *960*(4). https://doi.org/10.1088/1757-899X/960/4/042031

Dzcreation. (2019). Pengudaraan Semulajadi (Natural Ventilation) Dalam Bangunan.

Farid, F. H. M., Ahmad, S. S., Raub, A. B. A., & Shaari, M. F. (2016). Green "Breathing



Facades" for Occupants' Improved Quality of Life. *Procedia - Social and Behavioral Sciences*, *234*, 173–184. https://doi.org/10.1016/j.sbspro.2016.10.232

- Jaini, N. 'Afiqah. (2018). Our Environment, Our Earth Faktor IEQ (Keselesaan akustik @ noise ). 1–5.
- Mazzucchelli, E. S., Romano, R., Da Gloria, M., Gomes, G., Karlessi, T., Alston, M., & Aelenei, D. (2018). Passive Adaptive Facades. *Facade 2018, Adaptive*, 62–72. http://repositorio.lneg.pt/bitstream/10400.9/3132/1/Facade2018\_LauraAelenei\_63-72.pdf
- Merabtinea, A. A.-W. H. A., Troussiera, N., & Bennacer, R. (2019). Combined use of dynamic building simulation and metamodeling to optimize glass facades for thermal comfort. *Building and Environment*, 157(April), 47–63. https://doi.org/10.1016/j.buildenv.2019.04.027
- Salameh, T., Assad, M. E. H., Tawalbeh, M., Ghenai, C., Merabet, A., & Öztop, H. F. (2020). Analysis of cooling load on commercial building in UAE climate using building integrated photovoltaic façade system. *Solar Energy*, *199*(January), 617–629. https://doi.org/10.1016/j.solener.2020.02.062
- Sayed, M. A. A. E. D. A., & Fikry, M. A. (2019). Impact of glass facades on internal environment of buildings in hot arid zone. *Alexandria Engineering Journal*, *58*(3), 1063–1075. https://doi.org/10.1016/j.aej.2019.09.009
- Zulkhairi, M. K. R., Tahir, M. M., & Mahyuddin, M. R. (2020). Kesan Terhadap Penggunan Sistem Fasad Kaca Pada Bangunan Tinggi. *Journal of Design+Built*, 37–48.



# A STUDY OF SYSTEM SET-UP FOR PAINT SHOP CENTRALISED DATA STORAGE

Mariyah Binti Harib<sup>1</sup>, Hadi Bin Khalid<sup>2</sup> Mechanical Engineering Department, Sultan Azlan Shah Polytechnic, Behrang, Perak. *mariyaharib*@gmail.com *hadi.psa*@gmail.com

#### Abstract

There are numerous manufacturing systems in the factory. Furthermore, in order to reference any customer complaints, the system engineer or user must control and manage a large number of data manufacturing systems. As a result, they require an efficient management method or technique to handle the systems in their factory. This was accomplished through the use of cloud storage for the manufacturing system in global factory automation. System managers who work in the main office or in a remote location must also monitor the manufacturing system's production rate and data in the factory. They must all be in charge of the system data. With the addition of the third app in Google Drive, such as Google Forms and Spread Sheets, the system becomes more convenient for centralised data storage.

Keywords: Manufacturing System, Data Control, Cloud Storage, Google Drive.

#### 1. Introduction

The paint shop department is in charge of the painting process. The three main processes covered in the paint shop are body surface painting, ED (Electro Deposition) and 3 wet, NVH (Noise Vibrate Harshness), and UBC (Under Body Coating) and sealer (Kimio Toda, 2012). They must keep and manage data of parameters (NDC (Non-Defect Condition) and quality performance history properly based on the current running condition and the company principle of providing long-term warranty and quality assurance to customers, such as rust. This is because data control makes it simple to reference and check for customer complaints, as well as for future improvement. Paint Shop currently manages data on paper, but the paper was becoming too numerous and was occasionally missing.



They also saved scanned paper data in a shared folder, but they were unable to keep it for an extended period of time due to a lack of time to scan and upload it.

The goal of this project is to use system configuration to centralise data control and provide a single user for the paint shop, with use shared among the leaders. This system will make it simpler for team members to enter data and refer to other data controls on the production line. It can also help you identify and fix issues with each process. This paper proposed using a company's cloud storage, known as Google Drive, to store the data for an extended period of time for this project. Cloud storage systems can be configured to operate as a network of distributed data centres that employ cloud computing technologies similar to virtualization and provide a variety of data storage interfaces. Cloud storage includes network equipment, storage equipment, servers, applications, the public access interface, the access network, the client programme, and other system components (Bunkar, 2015).

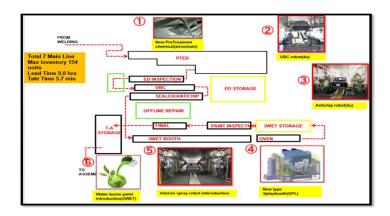
1. Project Background

One of the most important aspects of automobile production is the application of paint. The body surface is protected by a paint coating. The addition of colour and gloss to a product's visual appeal is an important selling point. The technology used must meet high quality and cost-efficiency standards while remaining environmentally responsible. The painting process begins after the vehicle's body is assembled in the body shop and then moves to the assembly shop. The goal of these processes is to improve the appearance of the vehicles while also providing a layer of protection against corrosion and weathering (Rodger Talbert, 2007).

Painting Process of Automotive Industries:

- i.Pre-treatment: removes and cleans metal dust after welding process.
- ii.Electro Deposition (ED): anti-corrosion layer.
- iii.Sealer Poly Vinyl Chloride (PVC): anti-corrosion, prevent of water leaks, and vibrational noise.
- iv.Primer; applied to promote adhesion between the surface and the basecoat; it also imparts a smoother surface for subsequent layers and has anti-chipping properties.
- v.Top coats (basecoat and clear coat): provide surface properties that are looking after, including colour, appearance, smoothness, and UV resistance (Nelson K, 2016).





## Figure 1: Painting process in automotive industry

2. Problem Statement

The problem statement of this study are there no specific and centralized data storage location because using manual key in on checksheet data control. The document paper always missing and because of that also company cant achieved the standard rule minimum 3 years saving data for actual customer.

#### 3. Objectives

The objectives of this project are to develop systematic documentation centralized data storage for keep minimum standard rule 3 years.

4. Significance of Research

A system for facilitating teams to key in data control online, as well as documents that are arranged and organised for the storage of standard rule 3 years for actual customers. Furthermore, this system makes it easier for teams to detect problems and refer to another data control production line.

#### 2. Literature Review

Paint Shop data control divide into two:



a. Parameter control base on man, machine, material, method for process NDC (Non Defect Condition). Non Defect Condition (NDC) is data taken for quality body to follow the item and their standard given to ensure that car production reaches the standard level. Example:

b.

- i.Machine oven temperature, tank temperature, booth temperature, booth humidity and etc.
- ii.Material viscosity material sealer and paint, temperature sealer and paint, paint batch and etc.

b. Quality performance result –Thickness, NVH (Noise Vibrate Harshness), Color Data and Wave Scan.

## 1. Problem Breakdown

There are several example explanation problem breakdown related to show importance data control.

- a. Equipment
  - i.Robot

The robot is the piece of equipment that can have a significant impact on the top coat. This is due to the fact that this robot has four arms. It has four independent control panels, which means it has four separate control panels. As a result, if the settings are not identical, the flow rate or volume of paint that is discharged varies.

ii.Booth

The spray booth also can give effect for the colour different. At the spray booth the important parameters that must control are temperature and humidity. These two things are related to each other. If the temperature and humidity is out of range the defects can be occurs. Other defect that can occur beside colour different is dry patchy and wet patchy.

b. Material

The material that can give effect is the paint. Maybe the paint that we used is good already but the problem is how we manage or control the paint parameters. The paint parameters are sensitive because they have related to each other. For example if the one of the parameter is out of range, so the bad defect still can occur. The parameters of paint that should be control are: i. Viscosity



Different colors have different viscosity. It depends to its paint. For the dark colour the viscosity should be more then the light colour.

ii. Paint Temperature

The paint temperature also different to each other depend to the paint. The temperature is important because it can give effect to the viscosity. If the temperature is higher the viscosity will become less. So it can affect the quality of paint that out from the robot.

2. Advantage Follow data control

Advantage of following the data control is to sustain good quality and reference for parameter use during line running. We can detect problem each process, measure component follow the standard, target to reduces defect, monitor equipment in good condition and fast action (countermeasure) if abnormality / recognise abnormality.

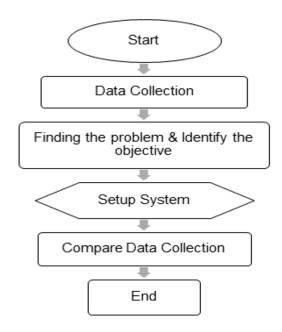
3. Effect Not Monitor Data Control

There are several effect for not follow the standard given and ignore data control is many defect detect on car body, rust, water leak and corrosion, paint on the body car will not durable and production will stop also customer satisfaction will down.

#### 3. Methodology

In order to meet the project's objectives, an overview of the overall research methodology and operation steps, as shown in Figure 2, is required.

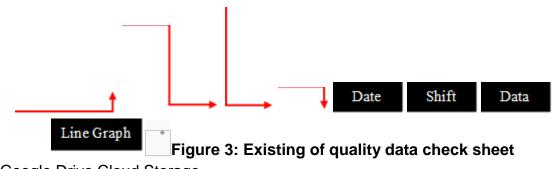




## Figure 2: Research methodology for meet goal of objective paper

## 3.1 Data Collection

Interviews and discussions with the organisation, observation of work activities, review of existing documentation, and gathering information from books, journals, and the internet were all used to gather data and identify problems. Figure 3 shows a paint shop team member entering data into an existing checksheet manual.





The best cloud storage recommendation for this study is to use Google Drive for developing online system documentation and data control of manufacturing and storage locations. Google Drive is Google's cloud storage service, which provides 15 GB of free storage while registering for a Google account. The continuous and automatic saving of this software (so you never have to think about a save button) will be used to collect data through their third apps. Some third-party app features can help with data collection, views, and responses. With free online editing tools, everything is in one place (Peng, 2011).

## 3.2.1 Google Forms

Google Forms are a free tool provided by Google. It's simple to use and one of the simplest ways to collect data and save it to a spreadsheet automatically. You could insert a form into a spreadsheet, format it on a separate sheet, and view the results on another sheet. It was simple, but it served its purpose. Google Forms is now a fully functional forms tool that is available for free with a Google account. Standard question types can be added, questions can be dragged and dropped into the desired order, the form can be customised with simple photos or colour themes, and responses can be collected in forms or saved to a Google Spreadsheet. Easy and accessible alternative to survey-based software like Surveymonkey, Airtable, and GravityForms. Google Forms also has a user-friendly interface that allows users to be creative with their outputs. This program allows the addition of images, URLs, files, and other audio-visual content ("Google Forms," n.d.).

#### 3.2.2 Google Spreadsheet

A spreadsheet programme similar to Excel that allows multiple people to work on the same spreadsheet. When it comes to handling data, Google Sheets is a powerful tool. A function is a calculation that the Google Sheets spreadsheet can run on your data. You can create a formula that performs calculations on data entered into specific spreadsheet cells by using functions. The use of functions allows you to perform calculations faster. You can apply functions to individual cells or a range of cells, even if the data in those cells changes, rather than having to write out exact formulas to perform calculations. When setting up your spreadsheet calculations, you can save time by using functions. Date functions Excel helps in adding the current date. Besides, the current time can also be added with it ("The Functions on Excel Spreadsheet," n.d.).



Both Google Forms and Google Spreadsheets are part of the Google Workspace which allows easier access for those who need them anytime, anywhere, and on any device. The availability of these two in one platform allows efficient and faster operations. Both of these platforms also allow hassle-free collaboration between different individuals in real-time. Since both are Google apps, they can be easily converted to other Google apps like Google Docs.

#### 4. Result and Discussion

This research project expects to have following outcomes by the end of the project is able to setup system documentation, reduce times to search document and reduce waste of the data storage.

#### 4.1 Setup System Documentation

Table 1 displays all processes under exploration by software functional area, identifies critical process points for control, suggests areas for improvement and problem resolution, and aids in the quick identification of data control.

No.	Items (Picture)	Details
1.	Standard range	Teams use a Google Form to submit their data. The form includes a standard
	ED-NDC-001	range for alerting teams.
	Degressing Temperature Un - 19, VD - 4	
	41.5	
	Free Abaine 10. 4. 4030 12	
	Total Alkaline 10, 10, 100, -23	

#### Table 1: Setup system on Google Drive cloud storage



2<sup>nd</sup>National Conference on TVET Undergraduate Students (NCTS) Politeknik Tuanku Syed Sirajuddin 19-20 July 2022

			Out of		
			range	$\subseteq$	$\supset$
F			DEGAE		
Am	Name Details #	t Temperature 40.0	Proc Aliatina 10.0	Total Alkalina 22.3	PH 124
Arri		41	10	22	124
Ages		411	98	21.5	124
09	04/01-A 05/02-A	43	9.7	21.5	104
Ann	4 (0163-B	43	8	16.0	124
Gg	0741A	45.2	9.1 9.9	214	108
Aaru Gg	06.02 A	41	9.0	21.5	124
Ages	00038	42.5	10	21.0	124
Og.	09/03 A	42.5	10	21.8	124
Arr	1003.0	44	10.5	21	124
Am	11/03 8	451	10	211	124
All	1503.A	**3	10	213	12.4
Arro		43	10	213	104
407	1555A	415	10	212	10.0
Ann		43	10	21.4	40.6
All	1561A	401	10	213	105
407	1103.4	e e	0.0	21.1	10.0
Ages		Q	90	21.8	10.0
Arr	1003.4	40.2	9.6	213	108
AIT	1962.4	413	10	218	10.5
Ann		409	10	21.8	10.5
4.07	2183A	61	10.2	21.0	10.0
407	20 83 A	40.0	10.1	22.9	10.6
	×	Out of	f range		
	*				
Name	Date Shift		sert not		Laline
Aarul	01/03 B	In Temperature 428	sertnot	es IGREASING Total Ab 10.3	22.3
Asrul Asrul	01/03 B 02/03 B	Temperature 42.8 42.8	sertnot	CGREASING Total AP 10.3 10	22.3 22
Aarul Aarul Aarul	01/03 B 02/03 B 03/03 B	Temperature 42.8 43.1	sertnot	CREASING TOTAL AR 10.3 10 9.8	22.3 22 21.1
Aarul Aarul Aarul Gg	01/03 B 02/03 B 03/03 B 04/03 A	Temperature 428 428 431 43	sertnot	CREASING (GREASING Total AD 10.3 10. 9.8 9.7	22.3 22 21.1 21.1
Aanul Aanul Aanul Gg Gg	01/03 B 02/03 B 03/03 B 04/03 A 05/03 A	Temperature 42.8 42.8 43.1 43 42.6	sertnot	CGREASING CGREASING Total AB 103 10 9.8 9.7 10	22.3 22 21.1 21.1 21
Aarul Aarul Gg Gg Aarul	01/03 B 02/03 B 03/03 B 04/03 A 05/03 A 07/03 B	Temperature 42.8 43.1 43 42.6 43.1 43 42.6 43	sertnot	IGREASING IGREASING 103 103 103 9.8 9.7 10 9.8 9.7 10 9.8 103 103 103 103 103 103 104 104 104 105 105 105 105 105 105 105 105	22.3 22 21.1 21.1 21 19.8
Aanul Aanul Gg Gg Aanul Gg	0103 B 0203 B 0303 B 0403 A 0503 A 0503 A 0703 B 0703 A	Temperature 428 428 431 43 426 43 432	Sert not	CREASING TOTAL AR 10.3 10 9.0 9.7 10 9.9 9.1	22.3 22 21.1 21.1 21 19.8 21.4
Aanul Aanul Gg Gg Gg Aanul Gg Aanul	0103 B 0203 B 0303 B 0403 A 0503 A 0703 B 0703 A 0603 B	Temperature 42.8 42.8 43.1 43 42.6 43.1 43 43.2 43.2 43.2 43.2 43.2 43.2 43.2 4	sertnot	CREASING TOTAL AR 10.3 10 9.0 9.7 10 9.9 9.1	22.3 22 21.1 21.1 21 19.8 21.4 20.8
Asnul Asnul Asnul Gg Gg Asnul Gg Asnul Og	01/03 B 02/03 B 04/03 A 05/03 A 05/03 A 07/03 B 07/03 B 08/03 B 08/03 B	Temperature 428 428 431 43 426 43 432 421	Sert not	CREASING TOTAL AR 10.3 10 9.0 9.7 10 9.9 9.1	22.3 22 21.1 21.1 21.1 19.8 21.4 20.8 21.1
Asrul Asrul Gg Gg Asrul Gg Asrul Gg Asrul Gg Asrul	0103 8 0203 8 0403 A 0503 A 0503 A 0703 B 0703 A 0803 B 0803 B 0803 B	Temperature 428 428 421 43 426 43 426 43 432 421 421 425	Sert not	CREASING TOTAL AR 10.3 10 9.0 9.7 10 9.9 9.1	22.3 22 21.1 21.1 21.4 20.8 21.4 20.8 21.1 21.3
Asrul Asrul Gg Gg Asrul Gg Asrul Og Asrul Gg	0103 B 0203 B 0303 B 0403 A 0503 A 0503 A 0603 A 0803 B 0803 B 0803 A 0903 A	Temperature 428 428 431 43 426 431 43 426 431 432 432 432 432 432 432 432 432 433 432 433 432 433 433	Sert not	CREASING Total AB 10.3 10 9.8 9.7 10 9.9 9.1 10 10 9.0 9.1	223 22 21.1 21.1 21.1 21.1 21.4 20.8 21.4 20.8 21.1 21.3 21.5
Asrul Asrul Gg Gg Asrul Gg Asrul Gg Asrul Gg Asrul	0103 8 0203 8 0403 A 0503 A 0503 A 0703 B 0703 A 0803 B 0803 B 0803 B	Temperature 428 428 421 43 426 43 426 43 432 421 421 425	Sert not	CREASING TOTAL AR 10.3 10 9.0 9.7 10 9.0 9.1	22.3 22 21.1 21.1 21.4 20.8 21.4 20.8 21.1 21.3

The spreadsheet will contain the results of the survey. Each of the range standards applied conditional formatting to every column. If the data is out of range, it will be automatically highlighted in red.

The data will appear in an automatically drawn line graph the next on checksheet, based on the data responses above. The line graph allows a leader to see production in a more customized way.

Every abnormal data point can be explained with a note from the leader. By tagging their e-mail on the check sheet, the manager can also leave a comment and mention the leader.



5.	My Drive > Paintshop	NDC & Quality Library 2022	Organize folder data by type of data control, process, and		
	Folders				month.
	1.60	2. UBC & SEALER	1.3-WET	4.FINALUNE	
			•		

#### 4.2 Comparison on Data Storage

Table 2 compares current research with Paint Shop's future system setup data storage.

Current	Future
<b>3</b>	Used Google drive cloud storage for keep data with
customer complaint.	standard rule 3 years.
	Centralised and organised of system data control.
document were missing.	
Limited visibility. (Need to go on production to	Everything on the finger. (Monitor data anywhere
see the smooth operation).	place).

# Table 2: Comparison on current checksheet and future data storage

#### 5. Conclusions

From the problem statement, literature review, and data collection, we know that this suggestion for system storage helps organisations avoid wasting money on paper check sheets and time for document searching. This system also allows teams to see how well the production is running. Based on the data, a leader can also take quick actions to counteract abnormal conditions. The system selected is based on the types of data control and software functions such as conditional formatting of range standards and calculation. The study's objectives were met at the conclusion of the system's setup and are now operational.



#### References

#### **Research Paper:**

- Bunkar, R. K., Mishra, B., & Rai, P. K. (2017). A Study of Secure Data Storage Analysis in Cloud Computing JOURNAL OF COMPUTER SCIENCE AND ENGINEERING A Study of Secure Data Storage Analysis in Cloud Computing (Issue September 2015).
- Kimio Toda, Abraham Salazar, Kozo Saito (21 December 2012). Automotive Painting Technology: A Monozukuri-Hitozukuri Perspective. Springer Science & Business Media.
- Nelson K. Akafuah, Sadegh Poozesh, Ahmad Salaimeh, Gabriela Patrick, Kevin Lawler and Kozo Saito (13 June 2016). Evolution of the Automotive Body Coating Process. Page 1-13
- Peng, C., & Jiang, Z. (2011). Building a Cloud Storage Service System. In Procedia Environmental Sciences (Vol. 10). https://doi.org/10.1016/j.proenv.2011.09.111
- Rodger Talbert (27 Sept. 2007). Paint Technology Handbook: Quality control of painting process. Page 189.

#### Website:

- Google Forms What is Google Forms? Definition, Uses, Tutorials. (n.d.). Template.Net; www.template.net. Retrieved June 19, 2022, from https://www.template.net/google/google-form/
- The Functions on Excel Spreadsheet. (n.d.). Excel Tip; www.exceltip.com. Retrieved June 19, 2022, from https://www.exceltip.com/tips/the-functions-on-excel-spreadsheet.html



# DESIGN AND FABRICATION OF JIG FOR IMPROVING THE PRODUCTIVITY OF REAR STORAGE PART

Muhammad Afiq Bin Sulaiman<sup>1</sup>, Zureena Binti Abu Samah<sup>2</sup>

Department of Mechanical Engineering, Polytechnic Sultan Azlan Shah, 35950 Behrang, Perak. *md.afiq0809@gmail.com zureena@psas.edu.my* 

#### Abstract

Jig is one of the special tools used in the manufacturing sector to facilitate operator in completing their work. The design and fabrication of a rear storage jig are the main focus of this project. As they use manual wrapping without using a jig for this process, the wrapping process for rear storage parts currently takes too long and has a high cycle time to finish the part. If the alignment of the central hole between the leather and the substrate is not satisfactory, the process must be repeated until it is. The goal of this project is to investigate a jig design for a rear storage component in order to increase productivity. The research methodology used for this project includes data collection, brainstorming, fabrication of a design and a jig, as well as a time study. Software called Catia V5 is being used for jig design. The data can be examined based on a comparison of the time period prior to and following the improvement. By the time this project is finished, it will be possible to demonstrate how crucial jigs are to the manufacturing process and how making jigs increases productivity of the rear storage part by 46%.

Keywords: Rear storage Jig, Cycle time, Design, Catia V5.

#### 1. Introduction



High productivity is the goal of manufacturing production in order to lower unit costs and ease the assembly process. This necessitates production devices to increase the rate of manufacture and inspection device to speed-up inspection procedure.

Jigs are special purpose tools which are used to facilitate production like machining, assembling and inspection operations. Jigs provide a means of manufacturing interchangeable parts since they establish a relation with predetermined tolerances, between the work and the cutting tool (Chikwendu Okpala, 2015). Once the jig is properly set up, any number of duplicate parts may be readily produced without additional set up.

Jigs is important in the manufacturing industry as it is required to ensuring that the manufacturing process in the production line runs smoothly and can ease for the operator to do their job. Jigs assist operators in holding parts that will be processed or used. In terms of productivity, using jigs can increase productivity because it will reduce production time (Mahendra & Jasmin, 2017). Furthermore, jig is vital for cost reduction (Wan Saidin et al., 2015), interchangeability (Shukla et al., 2015) and skill reduction (Mahendra & Jasmin, 2017).

Based on this research, rear storage is one of interior parts of the Lucid car. The wrapping process is necessary to create a rear storage component. One of the steps in making a car look nice and elegant is the wrapping process, but it takes too long to complete. The two components of the wrapping process were the substrate and the leather. Due to manual wrapping and the lack of a jig, this issue arises during the wrapping process, which takes too long to finish. If the alignment of the central hole between the leather and the substrate is not satisfactory, the process must be repeated until it is.

The research is aimed at increasing productivity at the Lucid production line which focuses on the wrapping process. The purpose of this project is to design and fabricate a jig for rear storage part to improve productivity. This jig also fabricated to improve the setting process during wrapping. It is because the operator incharge of wrapping needs to set the leather and substrate again until everything is satisfactory. With this new development of a jig, the wrapping process for the rear storage part will be simpler for the wrapper to complete, and the productivity for the rear storage part will increase.



#### 2. Methodology

In order to accomplish the goals of this project, it is necessary to have a general understanding of the research methodology and operational steps as shown in Figure 1.

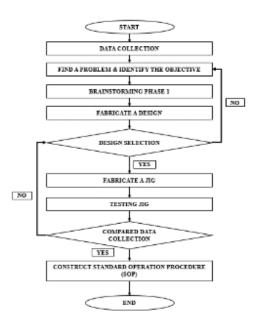


Figure 1: The research methodology.

#### 2.1 Data Collection

The design planning is based on the data collected from the observation and using the fishbone diagram. A jig needs to be fabricated for the production of the rear storage part because it can ease the wrapper to wrap the part.



Based on the observation, the wrapper requires a long cycle time to produce a single part and is unable to meet its target because the part is manually wrapped during this process without the use of a jig.



Figure 2: Wrapping rear storage part.

Data was collected following the fishbone diagram. The problem at the production line could be evaluated using the fishbone diagram. The fishbone diagram is as be shown in Figure 4.

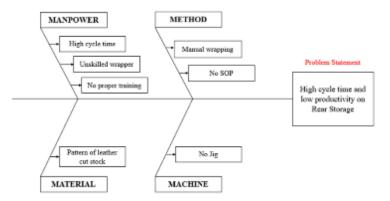


Figure 3: Fishbone diagram.

The fishbone diagram shows that there was insufficient training given to the wrapper, which resulted in a high cycle time to finish wrapping the part. It may turn into a major problem with inexperienced wrappers. When the part is wrapped manually, it can result in



a high cycle time because the wrapper is not using a machine or jig to reduce the cycle time. Additionally, since no jig was prepared to facilitate the wrapping processto

#### 2.2 Fabricate a Design

This study focusing on the design and fabrication of the jig for rear storage part. Before fabricating a jig, design of jig is required to facilitate the manufacture of the jig. Then, by using 3D software, the intended design is created. The software used to create the design is Catia V5.

Design A

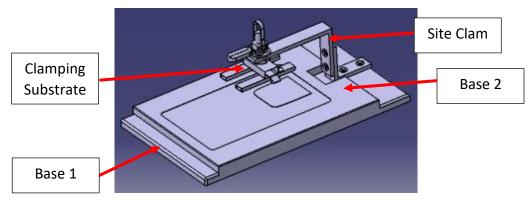


Figure 4: Isometric view for design A.

Base 1 Base 2 Clamping Substrate

Design B



#### Figure 5: Isometric view for design B.

Specification		Design A			Design B	
	Н	W	L	Н	W	L
Base 1	20mm	360mm	610mm	20mm	320mm	600mm
Base 2	20mm	360mm	480mm	20mm	320mm	400mm
Substrate Clamp	155mm	135mm	160mm	155mm	135mm	160mm
L Clamp 1	10mm	40mm	135mm	10mm	40mm	135mm
L Clamp 2	10mm	40mm	110mm	10mm	40mm	110mm

#### Table 1: Dimension of rear storage jig.

2.3 Fabricating a Jig

Jig is essential to all manufacturers worldwide. The purpose of creating a jig is to make the worker's job easier and to cut down on any extra work that is required when wrapping or performing any other task that the jig is suitable for. Figure 6 illustrates the bases 1, 2, and 3 as well as the L clamp and substrate clamp.

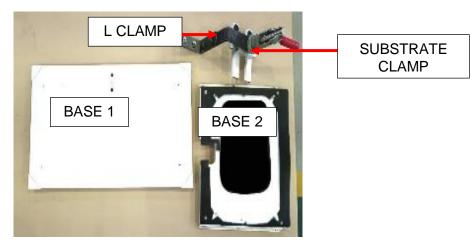


Figure 6: Parts of jig.



#### 3. Result and Discussion

#### 3.1 Design A and B

Comparison of designs A and B for rear storage jig is presented in Table 2. This comparison consider the workability of these two designs of jigs.

Design A	Design B			
Flexibility				
Limited space for wrapper to set the substrate	Easy to access for substrate especially at clip area.			
especially at the clip area.				
Setting	g View			
Wrapper uses side view during setting. Probability	Wrapper can observe the part using main view			
material not to remain in the centre is high.	(front view) during setting.			
Leather Pin				
This design does not use pins, hence it can cause	This design use pins and it can prevent the cut			
the material to easily to move out from jig during	stock from moving to the other side and it the ease			
setting.	the wrapper to set the substrate on the leather.			

#### Table 2: Comparison design.

Based on Table 2, the design had been selected is design B due to its workability efficiency. The wrapper will be more comfortable with design B jig compared to design A jig as described in the table above. Design B is found to be the most acceptable option based on the criteria listed.



# 3.2 Final Design

The final design, as shown in Figure 7, is chosen based on the decision during the design selection process and discussion with the Kaizen department. This final concept design for design B is better than design A, as design B provides more comfort and is easier to use. Then, design B is more ergonomic and uuser-friendly compared to design A because base 1 in design A is too long compared to those in design B and most importantly, design B provides a more suitable support area to locking the cut stock from moving at the base.

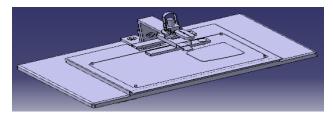


Figure 7: Final design.

# 3.3 Final Product

The jig for design B that has already been manufactured for use in production is shown in Figure 8. The wrapper uses this finished jig to make the wrapping process for the rear storage part simpler, and the aim of its fabrication was to shorten the cycle time and boost the productivity of that part.

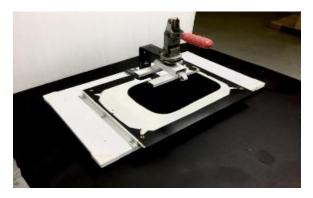


Figure 8: Final product.



3.4 Analysis and Discussion

# 3.4.1 Before improvement

The data was collected from Oktober 2021 until December 2021. The data includes the output for each month as well as the cycle time for wrapping the rear storage part. Additionally, the calculation prior to productivity improvements for the rear storage part will be displayed.

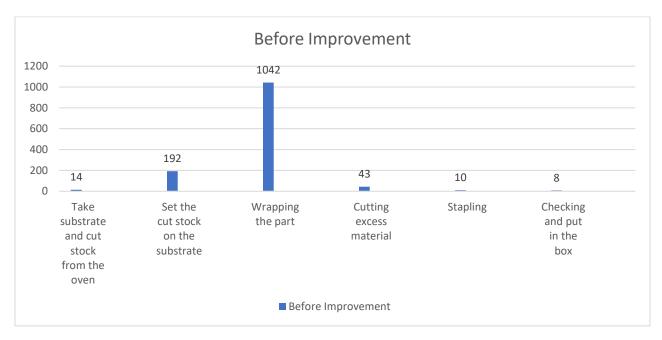


Figure 9: Time measurement before improvement.

Figure 9 depicts the production process for a single rear storage part while collecting five measurements of cycle time. As a result, the cycle time to create a single rear storage part is 1,309 seconds, or 21.82 minutes. 2.2 pieces can only be produced by the wrapper in a single manhour based on this cycle time. Figure 10 also depicts productivity prior to improvement.





Figure 10: Data productivity before improvement.

Calculation example:

October 2021 monthly calculation: calculation:	October 2021 week 2
$Productivity = \frac{Output per Month}{Working Hour}$	$= \frac{Output \ per \ Week \ 2}{Working \ Hour}$
$=\frac{450}{202}$	$=\frac{113}{50.7}$
= 2.2	= 2.2



#### 3.4.2 After Improvement

The cycle time is based on after improvement in this section. Data was gathered between February 2022 and April 2022. The cycle time for the rear storage part's wrapping process will be shown in the data after it has been improved, along with the output for each month. Additionally, the calculation following productivity improvements for the rear storage part will be displayed.

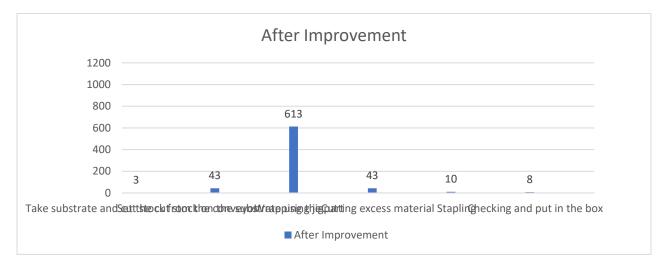


Figure 11: Time measurement after improvement.

Figure 11 displays the work sequence to produce one rear storage part and time measurement of cycle cycle time data is gathered five times. The total cycle time to produce a single piece of the rear storage part is 720 seconds, or 12 minutes. The wrapper can already produce 5 pieces per manhour based on this cycle time. Additionally, Figure 12 displays the productivity following an improvement.



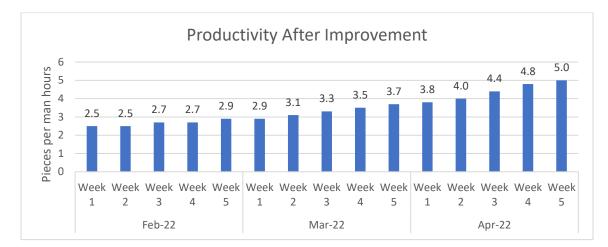


Figure 12: Data productivity after improvement.

# Calculation example:

February 2022 monthly calculation:February 2022 week 2calculation:February 2022 week 2

$Productivity = \frac{Output per Month}{Working Hour}$	$= \frac{Output \ per \ Week \ 2}{Working \ Hour}$
$=\frac{510}{202.8}$	$=\frac{128}{50.7}$
= 2.5	= 2.5

# 3.5 Data Comparison

In contrast to Figure 13, steps 2 and 3 require a significantly longer amount of time to complete. As seen in table 3, the use of a jig would speed up the process of the wrapper setting the cut stock on the substrate. The time gap between these two-cycle time is 149 sec. Besides, the wrapping process after using jig is also shorter than before the using jig. The difference in cycle time before and after implementation of a jig is 324 sec.



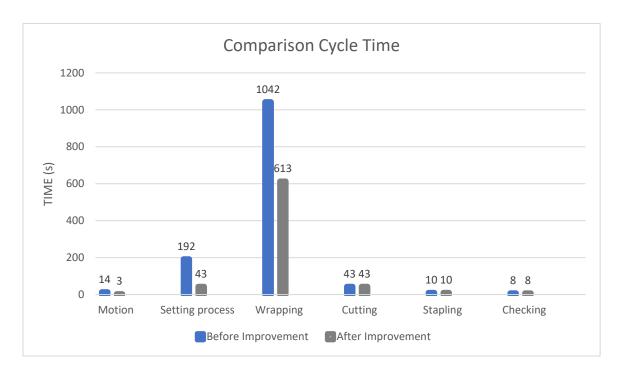


Figure 13: Time measurement after improvement.

Figure 14 displays a graph comparing the productivity of jig and manual wrapping. According to the data, the wrapper's output was maintained between an average of 2.3 pcs/mhr from October to December 2021 without the use of jig. There was no appreciable increase in productivity between those months. After the improvement, which was made using a jig, the output continued to rise after just three weeks. As shown in graph 1, in the end of April 2022, the wrapper managed to achieve 5.0 pcs/mhr. Thus, with these data, it can be concluded that by using the jig, the productivity of wrapping process has significantly improved by 46%.



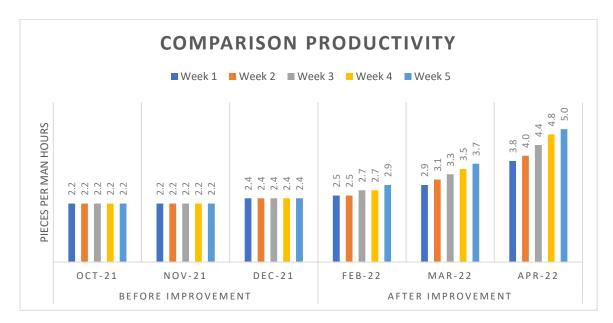


Figure 14: Productivity before and after improvement.

# 4. Conclusion

The jig plays a major function in the manufacturing industry and is the most important tool for supporting workers in making their production process easier. The goal of this project is to propose design of jig for rear storage part. The data can be studied based on the time study before and after the improvement has been done. The goal of this project which is to collect all the necessary data, develop a successful jig design, and fabricate a jig that can shorten cycle time during the wrapping process has been successfully accomplished.

# References

Access, O. (2019). Design and Analysis of Jigs and Fixtures for Manufacturing Process Design and Analysis of Jigs and Fixtures for Manufacturing Process. https://doi.org/10.1088/1757-899X/551/1/012028

Chikwendu Okpala, C. (2015). The Design and Need for Jigs and Fixtures in<br/>Manufacturing.ScienceResearch,3(4),213.



https://doi.org/10.11648/j.sr.20150304.19

- Mahendra, K. B., & Jasmin, B. (2017). Design and Development of Jig for an Auto Part. International Journal of Engineering Development and Research, 5(1), 748–753.
- Shukla, H. M., Puttewar, A. S., & Ikhar, S. R. (2015). Design of jig and fixtures for productivity improvement of stirrup making activity. *Int. J. Sci. Res. Dev*, *3*(02), 138– 140. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.838.6689&rep=rep1&type =pdf
- Wan Saidin, W. A. N., Mohd Idris, A. Z., Ravi, S., Ahmad Zaidi, A. M., & Kasim, N. I. (2015). Detection of Nut Welding Using Poka-Yoke Roller Coaster Jig. *Applied Mechanics and Materials*, 761, 170–174. https://doi.org/10.4028/www.scientific.net/amm.761.170



# IMPLEMENTATION OF KARAKURI IN INJECTION MOULDING LINE PRODUCTION (SMALL PART)

Amir Iqbal Bin Ismail<sup>1</sup>, Norashady Bin Mohd Noor<sup>2</sup>

<sup>1, 2</sup>Department of Mechanical Engineering, Polytechnic Sultan Azlan Shah, 35950 Behrang, Perak. *amriqbal4@gmail.com*<sup>1</sup> *norashady@gmail.com*<sup>2</sup>

#### Abstract

Karakuri are mechanical devices used to assist in the completion of tasks that require little or no electric, pneumatic, or hydraulic power. The company Z Sdn Bhd have been produce plastic product as bumper,instrument panel,panel fin lower from small to big tonnage. Throughout the analysis of the existing condition of the production process, the current material handling method is unefficient base on the research that have been done. Motion waste is very crucial in production efficiency as it included in 7 muda's of manufacturing system, to eliminate the waste method of using karakuri as a material handling base on the reba investigation and risk assessment to overcome the circumstance. Thus the result of th implementation proof in the end of the research. This improvement is to increase the productivity of the manufacturing system.

Keywords: Lean manufacturing, karakuri kaizen, ergonomics, material handling.

# 1. Introduction

The history of manufacturing can be traced back to the Industrial Revolution during the 19th century, where raw materials were converted into finished goods. The period marked the transition from human labor technology into machinery and chemical manufacturing processes, turning artisans into wage laborers. The compony of Z Sdn Bhd are one of the



company that produce plastic injection moulding product in all shape and sizes. The company emphasize in producing quality product generally and decreasing unproductive activities to achieve maximum efficiency and performance. They became one of the vendor that manufacture proton, Toyota, Nissan honda and perodua parts and feature.

Kaizen implementation has proven to be beneficial to the organisation because it assists them in maintaining their credibility when it comes to generating small incremental changes in every product.Kaizen has the potential to be a powerful tool for influencing and improving expenses over time, Incourage them to create a better working environment.This study aimed to create karakuri kaizen that would aid in polybox transportation and reduce fatigue in the workstation process of removing the empty and full polybox in the injection moulding production line for small parts. This purposed of the design of the karakuri kaizen also to improve the material handling of the workstation and improve workstation productivity.

# **1.2 Problem Statement**

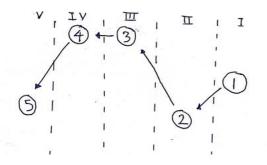
The the distance between the station and the packing accumulate time lost and increase the time for one operator to finish packing the process. This is because of the workstation layout creating a repetitive motion in transporting the finish good product from the workstation to the box. The operator also needed to bend their body to arrange the parts and cause poor ergonomic posture. The distance from the machine to the packing area is around 4 meter, more of steps required for shorter people to reach the station. This cause fatigue when repetitive activities happened and increase the risk assessment of the station. This working motion is not ergonomic and efficient for the operator that needed to run the machine. Furthermore it can cause fatigue in back pain and can cause longer time to recover or finish the operation.



## 2.0 Literature review

#### 2.1 Precedence diagram

The precedence diagram method (PDM) is a tool for planning project tasks. It is a method of creating a network diagram of a project schedule that utilises boxes to represent tasks and connects them with arrows to highlight dependencies. When determining the sequence of tasks in a project, you must consider the relationships between these activities[3]. Some actions may necessitate the completion or initiation of predecessor or successor activities before they can be begun or completed. According to the Guide to the Project Management Body of Knowledge, this is accomplished through the use of a methodology known as precedence diagramming (PDM).



# Diagram 1: precedence diagram of old workstation layout.

# 2.2 Layout optimization

Layout is critical for production efficiency. We can utilise discrete event simulation to find different layouts by using an arena. Obviously, different layouts will result in varying levels of efficiency. The worker and line balancing are inextricably tied to the efficiency of the production line. Worker happiness and capability at each workstation will effect efficiency, and the fairness of work distribution to workers will make the production line more balanced. An effective layout can help an organization achieve a strategy that supports differentiation, low cost or response while wrong layout planning will lead to lack of space in key areas, poor placement of key activities, excessive material handling, and increased operating costs[7]



## 2.3 Reallocate resources

Begin by considering task precedence, which is the order in which tasks must be completed. For example, if a step requires a specific part, you must ensure that portion is done before proceeding to the next step. A Precedence Diagram can be useful. Company Z engineer reorganises work to decrease surplus capacity and bottlenecks. In this instance, remove resources, employees, and equipment from areas of the line with excess capacity to avoid bottlenecks, or reorganise the resources and equipment.

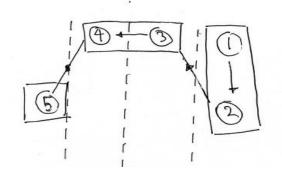


Diagram 2: relocated precedence diagram

2.4 Karakuri activities

Karakuri activities benefits in Low-Cost (Intelligent) Automation (LCIA) typically costs around 80 to 90 percent less than comprehensively automating production processes – but delivers a similar level of efficiency[9]. Improvement is beneficial in more ways than one. Employees, customers, and organisations all profit from it. The benefits of implementing the Kaizen approach are outlined in detail below :

- People are more satisfied
- Improved retention
- Improved competitiveness
- Improved customer satisfaction



- Improved problem solving
- Improved team

## 3.0 Methodology

3.1 Rapid entire body assessment (REBA) Investigation

The Rapid Entire Body Assessment (REBA) was designed to evaluate the risk of musculoskeletal disorders (MSD) linked with specific job duties "rapidly." The Rapid Entire Body Assessment tool employs a systematic procedure to assess both the upper and lower musculoskeletal systems for biomechanical and MSD risks connected with the employment task under consideration[12]. MSDs are musculoskeletal system and connective tissue diseases and disorders that occur as a result of a biochemical reaction to an event or exposure, according to the Bureau of Labor Statistics.MSDs do not include disorders caused by slips, trips, falls, or similar incidents. Examples of MSDs include:

- Sprains, strains, and tears
- Back pain
- · Carpal tunnel syndrome

#### 3.2 Risk Assessment

Risk assessment is one method for identifying the dangers of ergonomic posture for a worker. The method is widely used in the industrial sector. The risk analysis data is obtained by observing and measuring worker movement while executing the job task[15]





# Figure 2 : bending & neck twist motion of operator

#### 3.3 Risk Assessment

The risk assement generated as a result of observing and measuring worker movement while performing the job task. A higher severity rating may have an impact on the operator's health and safety. In numerous event its affect the cycle time of the operation. The working posture of the of the operator experience shows the unergonomics process. Based on the MSD level of risk, this working process can indulge in back pain, neck pain and sprains. This can be proof with the REBA investigation that have been given to the responded as research purpose for data collection. This will lead to high risk investigation and needed improvement with the guide of REBA score.

# 3.3 Karakuri concept studies

To perform effective analysis, relations among attributes of each Karakuri case are intended to categorise and useful information for its reinforcement, e.g. what kind of elementary contributors are chartered for successful construction of specific essential mechanism, is anticipated to extract in terms of proximity data among them[13]. Base on the analysis of the workstation the distance between the packing process and finish good product is 1.2meter. The karakuri need to act as a transportation item for transporting finish good product from the packing to the material handling operator.

# 3.4 Conceptual Design

Planning of constructing the design is based on karakuri concept that were studied based on reference of karakuri method. the structure was been planned, drawn and calculated for the best design concept. CATIA V5 programming is used to stimulate research on the project to be completed. The karakuri design can be divided into two parts: top and bottom. Once the FG elements are arranged in the polybox, the operator can move the FG polybox to the back part of the karakuri by placing the polybox on the upper section of the karakuri and allowing it to slide automatically to the front part.





Figure 3: isometric & side view of the design

# 4.0 Data risk analysis ( before implementation )

Risk analysis data are taken from observation and measurement of the worker movement behaviour while they doing the job task. The data is taken in aspect of lifting height as shown below.

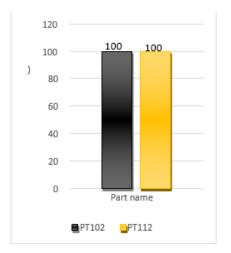


Diagram 5: lifting height data

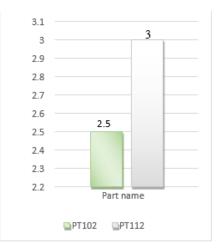
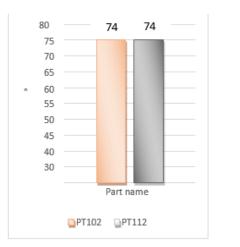


Diagram 6: load carry data





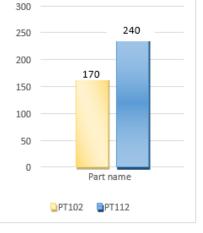


Diagram 7: Bending angle data

Diagram 8: Lifting frequency data

# 4.1 Data risk analysis (after implementation)

The post data result was obtained following the addition of Karakuri to the injection moulding area for both the PT102 and PT112 parts. The data revealed a significant reduction in lifting height, distance travelled by the worker, and bending angle of the worker's body posture. As illustrated in Figure 4.4.1, the lifting height is reduced by 90% from 100cm to 10cm due to worker movement. The Karakuri is used to support the job; now, the operator simply needs to place the part into the polybox that is already on the karakuri and send the polybox back to the runner after it is loaded.

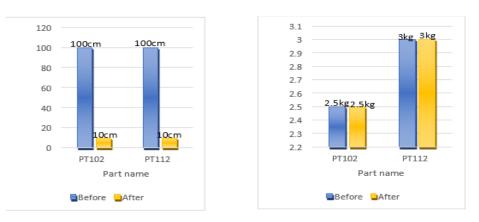
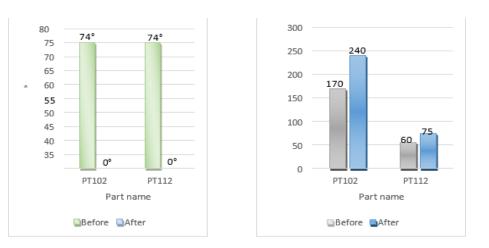


Diagram 9: Lifting height data





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# Diagram 11: Bending angle data frequency data



# 4.2 Rapid entire body analysis (Before& After)

To conduct a fast complete body analysis, the worker's movement behaviour was observed throughout the employment process. The REBA worksheet's body segment sections are determine by the worker investigation before and after implementatrion.

Based on the risk assessment the figure shows the improvement in ergonomics of the workers.



Figure 4 : REBA score for table (before&after)



# 4.3 Cycle time (Before)

The time spent working on creating an item or providing a service, measured from the start of the first task to the finish of the final task, is referred to as cycle time. Both value-added and non-value-added time are included in cycle time. Because many organisations use cycle time to indicate the expected time spent working on creating the item, the essential word in the definition is actual. These two timeframes are frequently not the same.

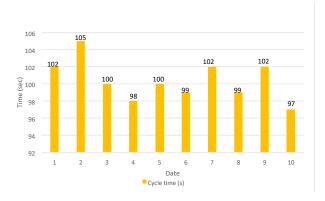


Diagram 13 cycle time (before) implementation

# 4.4 Cylce time (after)

In order to determine differences in the motion behaviour that impact the time, the post cycle time data have been recorded. There are huge different in result after implementing karakuri compare to before. In the other hand, the result showed improvement in cycle time after implement of karakuri for the work process.



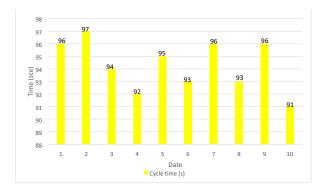


Diagram 14 : cycle time (after) implementation

# 4.5 Productivity analysis

The productivity had also increased after the ergonomic problem are solved, followed by the cycle time. Cycle time is the main factor that allow the productivity to increase. The productivity is increased by 20.13% per day. In the other hand, the production of part is increased 26% of finish good part.Base on the observation from 3 months, the data table 1 show average productivity and not showing an increase in trend. The target per week that have been set by production department is 430 per day as per week 2580 parts . before the improvement been implemented the average production rate per week is around 1402 parts produce.

	Oct-21				Nov-21				Dec-21						
Week	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Output	170	32 1	33 3	21 4	35 4	41 2	26 9	34 7	21 0	12 0	23 0	27 3	36 9	15 6	31 1
Total Working	9.5	50. 7	50. 7	40. 4	50. 7	40. 4	50. 7	50. 7	50. 7	20. 6	30. 1	50. 7	50. 7	50. 7	50. 7
Hours			202	L				213.1		L			232.9		
Productivi ty	3.5	6.3	6.6	5.3	7.0	10. 2	5.3	7.6	4.1	2.6	7.6	5.4	7.3	3.1	6.1

# Table 1: data of production productivity (before)



Average Productivi ty	5.7	7.4	5.9
Total Output per Month	1392	1407	1339

Base on the observation from 3 months, the data show average productivity and not showing an increase in trend. The target per week that have been set by production department is 430 per day as per week 2580 parts . before the improvement been implemented the average production rate per week is around 1402 parts produce.

	Feb-22				Mar-22				Apr-22						
Week	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Output	19 2	28 4	31 2	27 6	13 4	21 7	41 2	39 2	42 1	43 0	232	43 2	44 0	43 7	42 4
Total Working	40. 4	50. 7	50. 7	50. 7	10. 3	40. 4	50. 7	50. 7	50. 7	41. 2	9.5	50. 7	50. 7	50. 7	50. 7
Hours	202.8			233.7				212.3							
Productiv ity	4.8	5.6	6.2	5.4	13. 0	5.4	8.1	7.7	8.3	10. 4	24. 4	8.5	8.7	8.6	8.4
Average Productiv ity	7.0				8.0					11.7					
Total Output per Month	1198				1872			1965							

# Table 2: data of production productivity (after)

As shown in table 2 productivity per week increase month increase to average of 26% the highest rate of productivity is on April 2022 as the worker have been adjust of the karakuri design and addition of improvement design increase the production process.



# **5.0 Conclusions**

This study's conclusion is that the problem can be overcome by continuously monitoring and collecting data for future analysis. The most important thing to do to address the problem is to meet objective. Karakuri technology is a unique method that attempts to contribute to environmental and labour issues by employing natural physical occurrences and related helpful elemental mechanisms. time-related difficulties can be resolved by ongoing research using karakuri to reduce process time and increase ergonomics. To determine the outcome, pre- and post-data should be comparable.According to the findings, operator process of arranging part and refilling polybox without a supporting device like karakuri is one of the causes of poor performance, influencing production planning to reach the regular target. The research for design simulation and testing was completed, and the results were good using karakuri as a material handling device in order to improve ergonomic posture, cycle time as well as production rate. The new karakuri configuration for the injection moulding line for small part will assist in resolving the workstation problem and hence boost efficiency.

# REFERENCE

- 1. Müller-Mehrbach H (1981). Heuristics and their design: a survey. European Journal of Operational Research 8 :1-23.
- 2. Foulds L R (1983). The heuristic problem-solving approach. Journal of the Operational Research Society 34: 927-934.
- "Determination of Critical Pattern of 60 Meter Ship Construction Project Using Precedence Diagram Method (PDM)," Int. J. Syst. Appl. Eng. Dev., vol. 14, 2020, doi: 10.46300/91015.2020.14.14.



- 4. Assembly Line Balancing Using Fuzzy Logic: A Case Study of a Tricycle Assembly Line AUTHORS: Anthony I. Unuigbe, Henry A. Unuigbe, Eddy O. Aigboje, Polycarp A. Ehizibue: Open Journal of Optimization, Vol.5 No.2, June 15, 2016
- N Ismail, G. R. Esmaeilian, M. Hamedi, and S. Sulaiman (2011) "Balancing of parallel assembly lines with mixed-model product," International Conference on Management and Artificial Intelligence IPEDR Vol.6 IACSIT Press, Bali, Indonesia pp(120-124)
- 6. M. D. Kilbridge and L. Wester, "A Heuristic Method of Assembly Line Balancing," The Journal of Industrial Engineering, Vol. 12, No. 4, 1961, pp. 292-298.
- 7. Nazif A, Kamar D, Dahan , "improving Productivity by Simulate Facility Layout: A Case Study in a Car Component Manufacturer" June 2016
- R. Arnott, A. De Palma, R. Lindsey, Information and time-of-usage decisions in the bottleneck model with stochastic capacity and demand Eur. Econ. Rev., 43 (3) (1999), pp. 525-548
- Gowler, D & Legge, K 1983, 'The Meaning of Management and the Management of Meaning: A View from Social Anthropology', Perspectives on Management, cited in Karsten, L 1996, 'Writing and the Advent of Scientific Management: The Case of Time and Motion Studies', Scandinavian Journal of Management, vol. 12, issue. 1, pp. 41-55.
- 10. Katayama, H.; "On design and analysis of "KARAKURI" contrivance -template form development for analysis and its application- (in Japanese: KARAKURI no kaiseki to sekkei ni kansuru kenkyu-kaisekiyou template kaihatsu to tekiyourei ni tsuite-)," Proceedings of 16th Annual National Meeting of Japan Society of Logistics Systems (JSLS), pp. 25-28, 11th-12th May, 2013, College of Industrial Technology, Nihon University, Narashino City, Chiba Prefecture, Japan.



- 11. Clary, S. D. (2020). Kaizen, mastering Eastern business philosophy. Medium. Retrieved from https://scottdclary.medium.com/kaizen-masteringeasternhttps://scottdclary.medium.com/kaizen-mastering-eastern-businessphilosophy-661f2508db90business-philosophy-661f2508db90.
- 12. Thanaphum L, Wichai A, Paibul S, Chanunporn T, Chathaya W " The prevalence and risk factors of musculoskeletal disorders among subcontracted hospital cleaners in Thailand "Journal of Health Research 25 May 2021
- Sawaguchi, M. (2016). How does Japanese "Kaizen activities" collaborate with "Jugaad innovation"? 2016 Portland International Conference Management of Engineering and Technology (PICMET). Published. https://doi.org/10.1109/picmet.2016.7806683
- 14. Bruce P. Bernad, Vern P, "A Critical Review of Epidemiologic Evidence for Work-Related Musculoskeletal Disorders of the Neck, Upper Extremity, and Low Back" 2-11.
- 15. Singh, J. P., Grann, M., & Fazel, S. (2011). A comparative study of violence risk assessment tools: A systematic review and metaregression analysis of 68 studies involving 25,980 participants. Retrieved from Clinical Psychology Review, 31(3), 499–513.



# ADAPTING ELECTRICAL POWER TOOL WITH POKA-YOKE SYSTEM: A CASE OF MOTORCYCLE ASSEMBLY PROCESS.

Sri Haree A/L Subramaniam<sup>1</sup>, Mohammad Al-Bukhari Bin Marzuki<sup>2</sup> <sup>1</sup> Department of Mechanical Engineering, Polytechnic Sultan Azlan Shah Behrang Perak Sriharee71@gmail.com mohammad@psas.edu.my

#### Abstract

Tightening fasteners (nuts and bolts) requires a specific torque. When torque is applied to a fastener, more torque is required to tighten it further. Critical points of the motorcycle, such as the engine assembly, shaft pivot assembly, and stay engine assembly play an important role in the safety of the motorcycle, and each of these points has its own torque requirements. Inaccurate torque delivered by existing pneumatic tools at critical points result in low tightening quality and affect the safety of the motorcycle. This research focused on improving the tightening quality for the critical points of the motorcycle on the assembly line by using electric power tools with Poka-Yoke system. The tightening quality can be improved by achieving a torque that is close to the torque requirement and by reducing tightening errors during the tightening process. The electric power tool is tested on the assembly line for the C, D, E and F motorcycle models. The result starts with the analysis of the torgue achieved at the critical point of the motorcycles between the pneumatic power tool and the electric power tool by testing 100 motorcycle models for C, D, E and F models. The overall result of the data analysis shows a 20% improvement in tightening quality, a 35% increase in accuracy in reaching the required torque, and an 82.9% reduction in tightening errors for all motorcycle models by using power tools.

**Keywords:** Fasteners, Power Tools, Poke-Yoke, Safety, Tightening Torque, Tightening quality

#### 1. Introduction



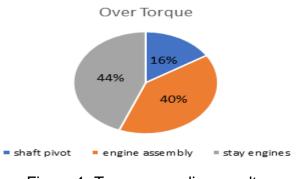
Tightening quality at critical point of motorcycle plays a major role in producing a quality motorcycle and ensuring the overall safety of the motorcycle and rider. Tightening quality is determined by the achieving torque close to the torque requirement targeted at critical point of motorcycle. Poor safety qualities of motorcycle can lead to defects resulting in malfunction to the motorcycle ending up in accident (Zovak, 2018). The tightening process has a major impact on the quality of the fasteners. This tightening error occurs due to the wrong method of tightening fasteners (Wu et al., 2020). Although experienced operators can tighten bolts empirically, the important tightening torque is obviously hardly that accurate (Wu et al., 2020).

Company X produces moped category motorbikes such as models C, D, E and F on the assembly line. The assembly line currently uses pneumatic power tools driven by an air compressor to tighten the bolt and nuts (fasteners) at critical points. Unlike other tightening points on motorbikes, more importance is given to this critical point to achieve accurate torque. The critical point of motorbike focuses on the area where the bolts are tightened, such as the engine assembly, the engine mount on the frame of the motorbike and the shaft pivot on the rear wheel of the motorbike. Electric power tool is installed in this research to analyse its tightening quality at critical point of motorcycle.

#### 1.1 Problem Statement

Tightening is a very important matter in the manufacturing industry, where accurate torque must be achieved when tightening fasteners to ensure motorbike safety and avoid poor tightening quality. Each tightening point has its own torque requirement. If the delivered torque of the fasteners does not match the torque requirement, this can affect the tightening quality. Since the tightening technique is complicated, assemblers are forced to pay close attention to it. Inaccurate tightening quality (Tsuji & Nakano, 2016). Due to the low tightening quality in Company X, missing bolts and nuts and cracks in the frame occur in critical areas of the motorbike. One of the causes of this problem is the inaccuracy of the torque when tightening the fasteners. This is because the pneumatic tools used on the assembly line have low torque capability, which results in the fasteners being over-tightened and there is no visual indication to indicate an incorrect tightening method. Figure 1 below shows the sampling result of overtightened fasteners at critical points.





# Figure 1: Torque sampling results

#### 1.2 Objective

From the discussed problem statement the main objective of this research is to improve the tightening quality at critical point of motorcycle by using electric power tool with pokayoke system.

#### 2.0 Literature review

Creating research can be a daunting task, as it involves many steps and resources to reach the intended goals. This chapter will help the researcher identify the various types of articles and reports that are useful for the study of this research.

#### 2.1 Tightening Quality

Tightening quality plays a major role in product quality is very much considered by consumers. Quality has a direct impact on product or service performance, so quality is closely related to customer value and satisfaction(Hapsoro & Hafidh, 2018). Various methods have been developed by previous researchers to improve the quality of fastener. Research done by Hareyama et al. (2020) has improve tightening quality of the fasteners using calibrated wrench method by using a torque wrench. In addition, research by Fukuoka & Nakano (2017) on improvement of tightening accuracy of torque control method states that the preload of the bolt can deviate by up to plus or minus 10 % of the nominal value due to the flatness deviation of the fasteners.



Previous studies show a new tightening technique is conducted by researchers Hagiwara & Ohashin (2014) on the torque difference and the relative rotation angle in tightening and loosening of fasteners to improve the torque accuracy. Bickford (2007) and Oberg et al. (2012) provide and discuss five different bolt preload control methods: torque control of preload, torque-angle control of preload, stretch control, direct preload control, and bolt tensioner to improve the tightening quality of bolted joints.

2. Poka-Yoke Tool system

Poka-Yoke are integrated into manufacturing processes, adding explicit steps to workflows that instruct operators to use Poka-Yoke devices to eliminate the possibility of a defective part being passed on to the next stage of production (Kozikowski, 2021). Researcher Kurhade (2015) explains that error occurs when carrying out an operation incorrectly and having wrong tooling or setting machine adjustments incorrectly. Many types of poka-yoke method are presented in applications used in assembly process in to fix a repetitive task in a processing phase where error tend to occur.

Warning Poka-Yoke method works when the devices signal to a worker that a defect has been produced. The worker must intervene to correct the processes responsible for causing the defect, since otherwise the processes will output further nonconforming product (Singh & Tiwana, 2019).

Shutdown Poka-Yoke works when the joint reaches its target torque value (tightening torque), the tightening tool automatically shuts off (Mazaheri & Rose, 2021). The control poka-yoke does not allow a process to begin or continue after an error has occurred. For example, a part on a machine may be equipped with a sensor that will not allow the process to continue unless the part is properly implanted (Singh & Tiwana, 2019).

# 2.3 Power Tools

Operators employ power tools, either pneumatically (air) or electrically (Direct-Current), to help fasten various parts during vehicle assembly. Pneumatic tools have traditionally been the most widely used power tools (Steingraber, 2017). Automotive manufacturers, on the other hand, have steadily replaced pneumatic equipment with electric power tools as technology advances (Steingraber, 2017). Transducers in electric power tools allows to record tool angle and torque for better control and feedback from each fastening (Steingraber, 2017).



## 3.0 Methodology

Pertaining to the literature review, the use of electric power tool for quality improvements at critical point of motorcycle seems effective and applicable in this research case. The methodology is done on testing the electric power tool to determine whether the objectives are met and find possible solution for the problem statement.

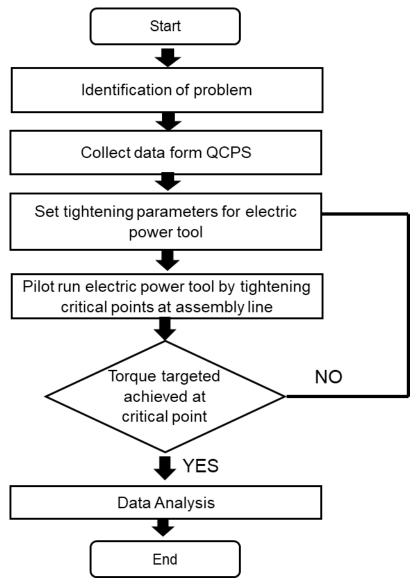


Figure 2: Steps of setting tightening parameters



# 3.1 Data Collection

Data of torque requirement for the critical points is collected form Quality Control Process Standard (QCPS) for each motorcycle model C, D, E and F. QCPS is a list of work which states the torque requirement for every critical point of motorcycle, stations of specific tightening points, indicates critical point, and process of tightening sequence at critical point. Torque requirements for all critical points are derived from QCPS for setting tightening parameters for electric power tool and for data analysis.

# 3.2 Method to improve torque accuracy

Based on the collected data, a tightening programme is created for each critical point with the corresponding torque requirements. This programme commands the electric screwdriver to tighten the screws at the critical points with the desired torque. Tightening programmes are assigned and tightening programme parameters are changed via the control of the power tool to which it is coupled. This tightening strategy is programmed for all critical points based on the torque requirements. By selecting the tightening strategy, it is possible to choose the method for applying clamping force (torque) to the fasteners. Previous researchers Nguyen (2015) and Steingraber (2017) have applied similar tightening strategy which is called joint fastening strategy which allows shortest fastening time by implementing a high initial speed followed by a decreasing RPM as target torque increased.

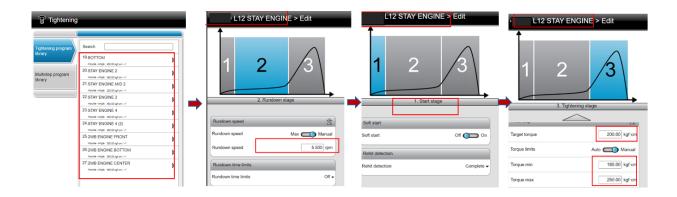


Figure 3: Steps of setting tightening parameters



The Poka-Yoke system is analysed to investigate fault detection and the visual indicator that warns the operator during the bolting process. For analyse poka-yoke system the electric power tool is tested by requesting few operators to tighten a fastener. Electric power tool in Figure 4 (i) indicates in red light that the operator has tightened the fastener wrongly with and Figure 4 (ii) indicates in green light that the operator has tightened the fastener the fastener correctly



i. (ii) Figure 4: Steps of setting tightening parameters

The error detects and is recorded at the log file in the database for analysis. These errors are categorised according to the causes for preventive measures as listed in Table 1.

Tightening Errors	Cause of the error
Rehit detection	An attempt to tighten an already tightened bolt.
Trigger lost	The tool trigger was released before target was reached.
Slip off	The socket has slipped off the nut.
Final step torque above max	Torque achieved is higher than maximum value
First step torque	Torque lower achieved is higher than minimum
below min	value



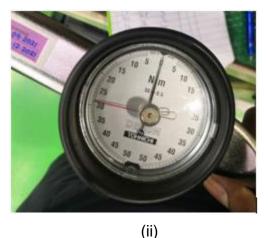
## 3.3 Pilot Run

With a pilot study there is generally a high degree of uncertainty and there needs to be recognition on the part of counter measure at assembly line. The electric power tool will be tested for all four motorcycle models at its critical point after completing setting the torque parameter setting based on the torque requirement. Purpose of pilot run is to program back the tightening parameters till an accurate torque is achieved for all critical points.

#### 3.4 Method for data analysis

For data analysis, the data is collected by measuring the torque achieved at the fasteners by using dial wrench as shown in Figure 5 (i). The torque of every critical point is measured after the fasteners is tightened and reading of this torque at the dial wrench is taken as shown in Figure 5 (ii). This method is done for both electric power tool and pneumatic power tool to compare the torque differences achieved at the fasteners and analyse whether the tightening guality has improved by using electric power tool. The tightening quality of the fasteners can be determined by achieving torque closest to the tightening requirement for every critical points. To gain a better average data, this torque measurement method is repeated for the 100 sample motorcycle models. The average of torque data is calculated for each critical points for both electric and pneumatic power tools. This data collection method is applied for motorcycle model C, D, E and F.









# 4.0 Results and discussion

The results of data collected of analysing data relating to the question of the targeted variable. It is to ensure the accuracy of the data and result from the analysis can be acceptable to the target objectives stated initially for the research.

4.1 Comparison of average torque between pneumatic and electric power tool

The data collected for the average torque for 100 motorbikes with pneumatic power tools shows a high increase in torque, which is due to the fact that the bolts on models C, D, E and F were overtightened at critical points. After tightening with electric power tool, the average torque shows a reduced torque value to reach the required torque. The average torque achieved with both pneumatic and electric tools was calculated and the result shows that the torque achieved with the electric tool is improved.

Findings from the result shows electric power tool has improved the torque in model C to 17.4%, model D to 26.6%, model E to 23.3% and Model F to 12.5%. One of the main factors for this improvement is the low torque reaction of the electric power tool, which reduces the torque impulse and prevents overtightening of the fasteners(Steingraber, 2017).

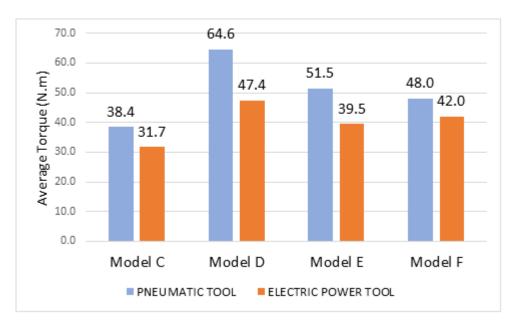


Figure 6: Average torque collected for 100 motorcycle model



From the findings the total percentage of improvement in achieving torque at critical point of motorcycle by electric power tool compared to pneumatic power tool is 20% as shown in table 2.

Models	Percentage
Model C	17.4%
Model D	26.6%
Model E	23.3%
Model F	12.5%
Average	20%

Table 2: Total percentage improvement

# 4.2 Accuracy between power tools

Based on the torque data collected for 100 motorbikes, the tolerances of pneumatic and electric power tools are calculated. A lower tolerance value indicates better tightening quality, as the torque achieved deviates only slightly from the target torque. Table 3 below shows the tolerance of both power tools when reaching the target torque. Based on the calculated data, the electric power tool has a better tolerance range of 4.4% - 11.5%, while the pneumatic power tool has a range of 26% - 40%. The results show that the electric power tool achieves the target torque at critical points more accurately than the pneumatic tool.

	Accuracy in achieving torque target				
Tightening points	Pneumatic Tool	Electric Tool			
Shaft Pivot	26%	11.5%			
Stay Engine	30.3%	5%			
Top engine assembly	26.7%	11.2%			

Table 3: Accuracy in achieving torque targeted



Middle engine assembly	36%	5.3%
Bottom engine assembly	40%	4.4%

Based on the tolerance, accuracy of the pneumatic and electric power tool is analysed. Analysis results show that electric power tools are more accurate than pneumatic power tools in meeting critical point torque requirements, like 20% more accurate at shaft pivot, 27% more accurate at stay engine, 21% more accurate at top engine assembly, 48% more accurate at middle engine assembly and 60% more accurate for bottom engine assembly. Electric power tool has an overall of 35% more accuracy in achieving the torque targeted. Higher accuracy can be achieved by electric power tool because of its greater torque control in tightening fasteners (Steingraber, 2017).

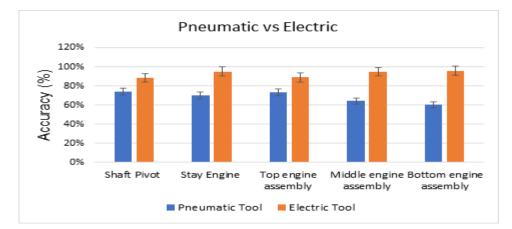


Figure 7: Accuracy in achieving torque target

# 4.3 Tightening Error Reduction

A tightening error is determined when the fastener is not tightened properly and affects the quality of tightening. Data was collected over a 4-month period to determine the frequency of fastener tightening errors at the critical point of the motorcycle.

The data recorded every two weeks from February till May and the tightening error has a decreasing slope form February to May, the errors have decreased, for example, 65.6% for the trigger lost error, 95.6% for the rehit error and 87.5% for the final torque above the max error, and there is no error in slip off.



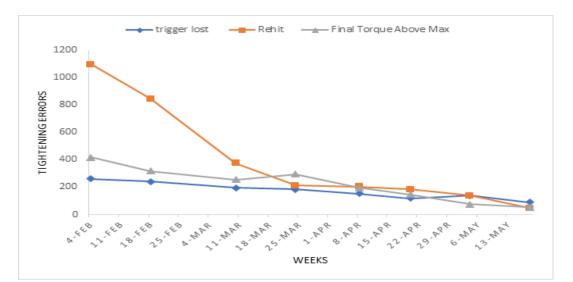


Figure 8: Average tightening error

The reduction in tightening errors is achieved using the Poka-Yoke system, which visually displays to the operator while tightening, preventing the operator from making the same mistake for next tightening process. The overall percentage of reduced tightening errors is 82.9% for the 4 months.

Tightening Errors	Error reduction
Rehit detection	95.6%
Trigger lost	65.6%
Slip off	0%
Final step torque above	87.5%
max	
Average	82.9%

# 5.0 Conclusions

The implementation of electric power tool shows a significance difference in producing a improve tightening result. Based on the data output, it can be concluded that tightening



quality at critical point motorbike has been improved up to 20%, this improvement is based on testing 100 motorcycle models. Hence, with this improvement the electric power tool achieved 35% more accuracy in achieving torque close to torque requirement at critical point of motorcycles. Moreover, the overall tightening error at the early stage have been reduced to almost 82.9% which is huge enhancement to ensure tightening quality. This reason to achieve this due to the torque control and poka-yoke system of electric power tool. These results obtained justifies with objective of this research and proven electric power tool perform better in improving the tightening quality of fasteners at critical point of motorcycle on assembly line.

#### References

- Bickford, J. H. (2008). Chapter 1, 2, 6-9, 17, 18. In Bickford, J. H. (Ed), Introduction to the Design and Behavior of Bolted Joints, Fourth Edition Non-Gasketed Joints. Hoboken: Taylor and Francis. Retrieved from http://www.crcnetbase.com.ezproxy.lib.purdue.edu/isbn/9780849381768
- Christian Steingraber. (2017). Three Direct-Current Right Angle Power Tool Tightening. A Physical Demands Comparison of Three Direct-Current Right Angle Power Tool Tightening Strategies.
- Steingraber, C. L. (2017). Scholarship at UWindsor A PHYSICAL DEMANDS COMPARISON OF THREE DIRECT-CURRENT RIGHT ANGLE POWER TOOL TIGHTENING STRATEGIES.

http://scholar.uwindsor.ca/etd%0Ahttp://scholar.uwindsor.ca/etd/6018 Fukuoka, T., & Nakano, K. (2017). *PVP2016-63083*. 1–8.

- Hapsoro, B. B., & Hafidh, W. A. (2018). The Influence Of Product Quality, Price, And Brand Image On Motorcycle Purchase Decisions (A Case Study On Yamaha Motorcycle Customers At The Johar Baru Dealer Jakarta Center). *Journal of Business and Entrepreneurship*, 7(1), 40–50.
- Hareyama, S., Manabe, K. I., & Kobayashi, S. (2020). Improvement of Tightening Reliability of Bolted Joints Using Elliptical Confidence Limit in Calibrated Wrench Method. SAE Technical Papers, 2020-April(April). https://doi.org/10.4271/2020-01-0218
- Kozikowski, E. (2021). DEVELOPMENT AND EVALUATION OF A DIGITAL SYSTEM FOR ASSEMBLY BOLT PATTERN TRACEABILITY AND POKA-YOKE by. May.
- Kurhade, A. J. (2015). Review on "POKA-YOKE: Technique to Prevent Defects." International Journal Of Engineering Sciences & Research Technology, 4(11), 652– 659. www.ijesrt.com



Mazaheri, A., & Rose, L. M. (2021). Reaction load exposure from handheld powered tightening tools: A scoping review. *International Journal of Industrial Ergonomics*, 81(June 2020), 103061. https://doi.org/10.1016/j.ergon.2020.103061

Nguyen, P. Van. (2015). Torque Coefficients in Automotive. January.

- Oberg, E. & Jones, F. D. & Horton, H. L. & Ryffel, H. H. (2012). Fasteners. In Oberg, E., Jones, F. D., Horton, H. L., Ryffel, H. H. (Eds), Machinery's handbook (29th edition) & Guide to machinery's handbook. (pp. 1521 1537). Industrial Press. Retrieved from http://app.knovel.com/hotlink/toc/id:kpMHEGMH24/machineryshandbook-29th/machinerys-handbook-29<sup>th</sup>
- Wu, Z., Zhang, G., Du, W., Wang, J., Han, F., & Qian, D. (2020). Torque control of bolt tightening process through adaptive-gain second-order sliding mode. *Measurement* and Control (United Kingdom), 53(7–8), 1131–1143. https://doi.org/10.1177/0020294020932354



# A STUDY ON IMPLEMENTATION OF DEFECT DATA SHEET TO MONITOR QUALITY OF SUPPLIED PART

Muhamad Bukhari Hakim Bin Mohamad Rodzi<sup>1</sup>, Izwan Bin Hamid<sup>2</sup>

Department of Mechanical Engineering, Polytechnic Sultan Azlan Shah, 35950 Behrang, Perak. muhdbukhary98@gmail.com izwan\_hamid@psas.edu.my

# Abstract

As an assembler company, they works with a variety of vendors, in which both domestic and international, involve to supply automobile parts to assembly lines in order to manufacture the vehicles. When dealing with various parts, the most concern of every manufacturer is quality of the supplied part. So, lack of system on following up the progress of supplier's commitment toward quality become the current issue that need being highlighted. The purpose of this study is to propose the defect database sheet for monitor the quality progress that related to the quality of supplied part. The introduction of defect database that initiate the Excel application in this project which act as a main platform for documentation of data and conducted monitoring process. The defect data base will measure the supplier capabilities to obligate toward quality assurance on their supplied parts.

Keywords: Quality of supplied part, Defect data sheet, Excel application

# 1. Introduction

Becoming an assembler company, usually know will works and interact with a variety of vendors either both domestic or international, to supply automobile parts into assembly lines in order to produce a single vehicle. When dealing with various parts, the most concern of every manufacturer is quality of the supplied part. This is because the significance of the contemporary quality of supplied products and materials plays an undisputable role in the manufacturing and assembly processes running smoothly (Dian, 2019).



In order to guarantee the high quality of the finished product, the manufacturer must develop wise plans to monitor and document quality progress for every supplier involved.

Everyone is aware that each supplier has their own quality management system in place to ensure that their end product reaches the customer's hands in perfect condition. In contrast, the defect still outflows into assembly line and it show how fluctuate supplier commitment towards quality. This situation will make any manufacturer need to reconsider before dealing with the supplier regarding the problem in their product. So, it important to ensure that the supplier quality is secure and well maintain by the manufacturer especially for Quality Control Department by developing a systematic monitoring system that briefly can be used to documentation and monitoring process in order to control the quality progress on affected parts and supplier commitment toward zero defect outflow.

In order to control quality of supplied part that involving various supplier meaning that there will be enormous amount of data gained regarding to the part itself that required to be record and monitor by the manufacturer. This will testing out the efficiency of document management systems that manufacturer have whether their capable to execute wisely for both processes or not. According to research and observations, some companies have failed to keep up with the most recent software developments and new technologies that can help in simplifying their data systems and procedures by simply accepting document instability as a necessary component of a digital workplace (Fung et al., 2020). This refers to some companies that continue to rely on paper documentation due to the high costs associated with creating, storing, and managing a digital document management system. They prefer to stick with the previous method, which results in a high reliance on paper for documentation purposes.

Another issue that some company encounters when integrating paper-based documents is the time required to access the information or data. They must search for specific documents and go through them one by one in order to refer back to the data and information when needed. There will undoubtedly be more time spent on activities such as documentation and filing. Paper-based documents that have been lost, misplaced, or unintentionally thrown away are signs of poor documentation or a data management system (Denkena et al., 2019). Dealing with the mess that results when papers are misclassified or out of date, however, is more than just a suffering. The operations, earnings, and productivity of a company may suffer in the long run if they don't make the investment in effective document management strategies.



Therefore, in this study, the concern is given to the capabilities of defect data sheet to identified directly troublesome supplier by checking at their progress toward quality improvement through this docementation and monitoring process conducted. This defect data sheet also can be used as a reference source if the same issue comes up again in the future. Due to the convenience of how the defect data sheet interprets the information about the defect, this will assist the manufacturer in quickly identifying the repetitive problem that occurs and save a significant amount of time. The most important thing is that there are no repetitive previous defect reoccurrences in the new model, which indicates that zero defect outflow can be achieved by the manufacturer in the future if the defect data sheet is implemented.

The objective of this study is to create a database sheet or check sheet for defective supplied parts that can document the information about the affected part in terms of supplier name, type of model, part name, and other important details that become crucial items inside it. Then, the defect data sheet becomes a monitoring device to monitor supplier progress toward quality improvement towards their defective product only. Other than that, the defect data sheet also briefly visualizes the supplier's progress and makes it easier for the user to locate their progress stages. As a result, every supplier included in this defect data sheet will have their improvement progress toward quality progress immediately recognized, and troublesome suppliers will be quickly identified if the manufacturer benefits from this implement.

#### 1.2 Problem Statement

The Z Company manufactures a large number of car models. At the same time, the company has a daily output target based on customer demands. Based on the observations made, the issues that motivate this study must be addressed, beginning with the lack of a system for tracking down current parts that have issues or defects that have a significant impact on the manufacturer's quality when dealing with various suppliers. As a result, the manufacturer is dealing with a challenging supplier.

In this case, the quality of supplied part will be questioned because there is no futher specific monitoring system that pay attention toward the part problem after delivered into assembly line or already attached to the complete vehicle. Figure 1 below shows the rear headlamp that received is defected and being compared to the standard one.





Figure 1: Comparison OK/NG condition of headlamp

Based on the figure 1, it clearly can be see that supplier commitment toward quality is fluctuate and need to be taken action in order to ensure no repetitive issue occur. If there no further action, it will only cost for the Z company and produce a lot of waste in term of money, resource and time. As a result, the goals toward zero defect outflow into customer hands cannot be achieve because there is no precaution action established when dealing with the problematic supplier for development of new part in the future.

# 2. Literature Review

# 2.1 Quality

Quality is the most important factor in determine customer satisfaction able to achieve or not. The quality in production involved various need aspect to consider starting with understanding the customer needs correctly, designing the product according to the perceived needs, precisely designing the production process, and delivery time according to the desired time of the customer. So, in order to maintain the quality, the quality contain two components that crucial which is Quality assurance (QA) and Quality control (QC).

QA is more like prevention method to avoid any problem occur. QA is a way of preventing mistakes and defects in products and includes the actions needed to provide confidence that the service satisfied the requirements (Sreedher et al., 2021). Meanwhile, QC' task is to ensure the correction action being conducted and perform activities used to measure the quality requirement achieve or not (Broadhurst et al., 2018).



# 2.2 Database/ Monitoring System

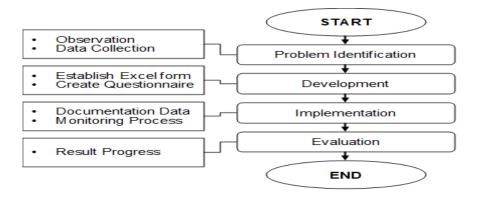
A database is a collection of data that are interconnected with each other that is stored on computer hardwareserver and required a software to manipulate the data. The database is usually stored on the server in charge of providing various kinds of client computer needs including for documentation of data and monitoring process (Setiyadi & Setiawan, 2018).Page Break

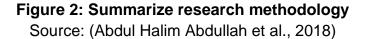
2.3 Excel application

In recent years, Excel has increasingly been used as a computational tool in science and engineering education and also in other fields related. The advantages of this tool are the simplicity and the affordability of the software. Even the very basic common utilization of Excel oftentimes in the creation of tables and graphs for reports and other office applications such as documentation data and establisih a time-schedule. Excel allows the user to perform advanced operations such as matrices inversion, root-finding, numerical derivation and integration, data analysis, modeling and visualization of results (Musimbi & Jean Paul Mulanza, 2018).

# 3. Methodology

The overview on the overall research methodology and operation steps as shown in Figure 2 are required in achieving the objectives of this project.







# 3.1 Problem Identification

The problem identified through observation and interviewing is the originating cause that led to the conduct of this study. It found that the problem is related to no specific method of following the issue that occurred on the current supply that the quality of the product was compromised.

When a quality inspector (QI) discovers a defect and determines that it originated from the part itself. So, a sheet called a Part Defect Countermeasure Sheet (PDCS) will be created by the Quality Control (QC) department in order to notify the supplier about the problem with their product. The supplier then comes up with their findings and countermeasures, including the improvement that is being made, and replies to the PDCS by presenting it to the Z company. Figure 3 below illustrates the example of PDCS that will be utilised to issue the problem.



Figure 3: Example of PDCS

When the supplier responds to the PDCS, the Z company evaluates it to ensure that the problem has been resolved and that the delivery can proceed as usual. The problem that motivated this study is that there is no further monitoring process in place for the issue to ensure that it does not recur in the next batch because all PDCS resolutions end with documentation. When the problem occurs again and there is no system in place to help track down the root cause, the company will encounter difficulties.

3.2 Development



To overcome the challenges, a defect database will be established using Microsoft Excel as the primary platform for documenting data and conducting the monitoring process. The app's widespread use and accessibility are the reasons for its popularity. Then, create a questionnaire to get user feedback, and then use the defect database to measure its capabilities to help the QC department deal with the supplier about the quality of their own product.

#### 3.3 Implementation

All PDCS cases will be collected and recorded as documentation the data in one form by Excel application, which is ready to use as a defect database. The supplier's name, defect types, and problem description will all be recorded in the database, as will their progress in responding to the PDCS until it is resolved. Ten local suppliers will be used as a sample for this study in order to track their progress. Figure 4 on following page shows defect database being establish.

Page Break

[	DEFECT DATABASE MONITORING SHEET					STATUS SUPPLIER PROGRESS         Employee (25%)         Employee (25%)           DESCRIPTION         New Case Register         Under study by Supplier		(100%) / measure pprove & closed	
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# Figure 4: Defect Database

The user can track supplier progress using the defect database, starting with the PDCS being issued and ending with their response and approval. As a result, the user will be able to identify which suppliers have had difficulty answering the PDCS related to their



commitment to quality or at what stage their progress is, whether it is slow or on track. Figure 5 below potrays status progress indicator used to measure the supplier progress.

STATUS SUPPLIER PROGRESS	(25%)	(50%)	(75%)	(100%)
DESCRIPTION	New Case Register	Under study by Supplier	Counter measure	C/ measure approve & closed

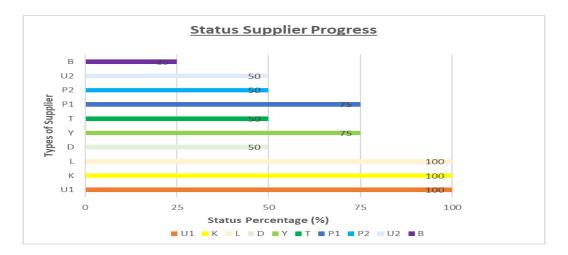
Figure 5: Status progress indicator

# 3.4 Evaluation

The summary from the implementation of the defect database will be projected into a graphical method for the evaluation phase, with a bar chart used to briefly describe the entire supplier progress. As a result, the user can see that supplier capabilities will be the main focus either their struggle to achieve a zero defect target or become an insufficient quality supplier. Figure 7 no following page in result and discussion will explain more about the outcome from the implementation.

#### Page Break 4. Result and Discussion

Figure 7 below indicates the result of implementation defect data sheet that preview the status supplier progress toward quality improvement.





# Figure 7: Status Supplier Progress

Based on the defect database, the result being obtain shows that it can be proof that every supplier that involve have their own capacity to fulfil the exactly flow of the process when PDCS being issued.

Figure 7's status percentage aids the user in determining which phase the supplier is in, and refer to figure 5, which is the indication for supplier progress status, can be used to better understand the status of supplier progress. The 100 percent status indicates that the supplier is capable of completing the entire process, from the initial problem to providing a great countermeasure that allowing their work toward quality improvement to be approved by QC. Suppliers U1, K, and L passed the quality requirement, allowing them to obtain a 100 percent progress status.

Meanwhile, 75percent represents the supplier at the stage where they are developing a countermeasure for their impacted part and in preparation before being audited by QC to see if their improvement is effective in preventing the problem from recurring. Countermeasure that their propose must make sure that their using blocking and preventive method in order to ensure that the problem vanish from their line production. As shown in Figure 7, the suppliers P1 and Y in the stage come out with own countermeasure to prevent the defect reoccur.

The 50% achieved by suppliers D, T, P2, and U2 indicates that they are currently researching the issue related to their part and attempting to identify the root cause of the problem. After the study is conducted, the findings on the nature of the defect will explain how the problem originated and be recorded inside the defect data sheet. Other than that, for supplier B, that only achieves 25 percent, it indicates that the problem for their part is just being issued and registered in the defect data sheet. So, the supplier will have three more steps to complete the quality improvement process through this monitoring process by utilizing the defect data sheet.

As a result, all the supplier's progress status is stated clearly through the illustration in figure 7 based on the percentage achievement, and table 1 below briefly portrays the description for better understanding for the user.

Type of Supplier	Status Percentage	Description			
U1	100	Approved			

# Table 1 Description on Supplier Status Percentage



K	100	Approved
L	100	Approved
D	50	Under study
Y	75	Countermeasure
Т	50	Under study
P1	75	Countermeasure
P2	50	Under study
U2	50	Under study
В	25	New Register

#### 4. Conclusions

Conclusion on overall, the project has achieved its first objectives which to create the defect database. This project provided an organised system called defect database and it was succesfully built using Microsoft Excel application. It provides a more convenient way and accurate method for worker to gain information or data as a reference for when repetitive defect reoccur. It also able to become traceability document to trace out the cause of defect quickly and analysis which supplier that have previous issue. This will eventually prevent defect outflow towards customer. In view of time saving, it will save much time as they can recognize which problematic supplier that need to extra cautious when dealing with them for next project. By defect database, they just simply open it and all the information regarding the documents will appeared there. As the defect database was developed and proposed, the next hope it will be of project implemented in real working scenario that involve confirmation and monitoring on the supplier progress through certain phase will determine the quality take care by the supplier. Through this process, it will preview the supplier's commitment toward quality of their product and become aware to ensure their product at the best quality.

#### References

Broadhurst, D., Goodacre, R., Reinke, S. N., Kuligowski, J., Wilson, I. D., Lewis, M. R., & Dunn, W. B. (2018). Guidelines and considerations for the use of system suitability and quality control samples in mass spectrometry assays applied in untargeted clinical metabolomic studies. Metabolomics, 14(6). <u>https://doi.org/10.1007/s11306-018-1367-3</u>

Dian, M. (2019). The quality of supplied parts and their influence on manufactured quality in serial production. Quality Production Improvement-QPI, 1



Page Break

Denkena, B., Nyhuis, P., Bergmann, B., Nübel, N., & Lucht, T. (2019). Towards an autonomous maintenance, repair and overhaul process: Exemplary holistic data management approach for the regeneration of aero-engine blades. Procedia Manufacturing, 40, 77-82.

Fung, A. W. (2020). Utilizing connectivity and data management system for effective quality management and regulatory compliance in point of care testing. Practical Laboratory Medicine, 22, e00187.

Hassan, M. N., Abdullah, A. H., Ismail, N., Suhud, S. N. A., & Hamzah, M. H. (2019). Mathematics Curriculum Framework for Early Childhood Education Based on Science, Technology, Engineering and Mathematics (STEM). International electronic journal of mathematics education, 14(1), 15-31.

Musimbi, O. M., & Jean Paul Mulanza. (2018, March 25). Using Excel as a Tool to Teach Manufacturing and Heat Transfer. Asee.org. <u>https://peer.asee.org/using-excel-as-a-tool-to-teach-manufacturing-and-heat-transfer</u>

Sreedher, G., Ho, M.-L., Smith, M., Udayasankar, U. K., Risacher, S., Rapalino, O., Greer, M.-L. C., Doria, A. S., & Gee, M. S. (2021). Magnetic resonance imaging quality control, quality assurance and quality improvement. Pediatric Radiology, 51(5), 698–708. https://doi.org/10.1007/s00247-021-05043-6

Setiyadi, A., & Setiawan, E. B. (2018). Information System Monitoring Access Log Database on Database Server. IOP Conference Series: Materials Science and Engineering, 407, 012110. <u>https://doi.org/10.1088/1757-899x/407/1/012110</u>



# STUDY ON THE IMPORTANCE OF MACHINERY IN REDUCING WASTE FOR COST CONTROL.

Muhammad Adlan Bahagian<sup>1</sup>, Hainol Akbar Zaman<sup>2</sup>

Mechanical Engineering Department, Sultan Azlan Shah Polytechnic, Behrang Stesen, Perak halmustahak@gmail.com hainol@psas.edu.my

#### Abstract

In this study, it will be focusing on the understanding on the types of machine that is used in reducing wastage to reduce cost. Die Cutting and Numerical Control Cutting (NC) processes are the two types of cutting processes that are now in for material cutting process. The objective of this study will focus on analysing the efficiency of machine on controlling the amount of waste produce. In this analysis, the wastage will be referred by using the Lean production System. During examination, the wastage will be measured by calculating the material consumption from the process of both machines. Following, the NC process has shown significantly efficient in controlling wastage rather than the Die Cut process which are 0.509 sqm/pcs and 0.701 sqm/pcs, respectively. In conclusion, it is very important in choosing the most efficient machine in material process to reduce cost by controlling the produce wastage.

Keywords: machine process study, wastage, material consumption, cost.

#### 1. Introduction

#### 1. Background.

The cost of raw materials is rising, posing issues for enterprises throughout their supply chains. Manufacturers are still struggling with the two supply chain headwinds that have



plagued the industry during the epidemic, which have slowed supplier deliveries and limited labour availability.

In the past years, the growth in manufacturing has been slowly declining from 2019 to 2020. This happens due to the supply chains of material throughout the year. Whilst in last year, according to a report by MIDF Amanah Investment Bank Bhd, the IHS Markit Malaysia Manufacturing Purchasing Managers' Index has dropped to 50.5 in January 22 compared to 52.8 in Dec 21, falling lower than its October 21 reading, (Azalea Azuar, 2022). The inconvenience occurs due to the increase of inflation from the shortage of raw material

In this day and age, the implication of machinery has help tremendously in the smoothen the manufacturing operation throughout the world. Machining has been a pivotal point in manufacturing processes mainly on the controlling waste during operation. This can be based on the Material Controlling in reference to major topic of supply chain. Materials management applies to all spheres of functioning of manufacturing companies and largely determines quality, time, flexibility and many other factors essential in the parameterization of main pro-cesses, (Ewa Kulińska, 2014).

In a certain manufacturing company, ZX Company, they are involve in an assembly production process which require a material processing operation before assembly. Material that are in use is a form of sysnthetic leather or vegan leather called Polyurethrane leather (PUR). From 2014, the organization has been using a Die cutting machine in order to process their raw material. However in 2021, ZX Company has invested in the use of a new machinery which called Numerical Control Cutting (NC) machine. The expenditure was purely in reducing waste during material cutting process. This is due to the increases of cost towards raw material has been increasing globally.

In this paper, an analization of material consumption rate between the Die Cut machine and Computer Numerical Control Cutting machine will be conducted. The consumption will be calculated and measured to identify the impact of machinery towards material control. A certain formula will be use as a guide in measurement method in reference to analyze the total uses of material.



2. Problem Statement.

Currently, the vegan leather material or PUR is being processed by Die Cutting process. By the installation of the new machine, Numerical Control Cutting machine (NC), there are a sets of differences in the amount of output produced by both machines. As a result, there are concerns about excessive waste caused by mismatched machine output. Due to this, there are possibility that the increase of output might have an effect on the wastage of the process and distrupts the cost within the material processing operation.

 Table 1: Monthly output between Die Cut process and Numerical Control Cutting process.

No.	Model	Appendix	Plan Output (Month)
1.	Die Cut		July: 37432 pcs August: 43896 pcs September: 40817 pcs
2.	Numerical Control		October: 60087 pcs November: 71192 pcs September: 69851 pcs

3. Research Objective.

Based on the issues that has been stated, a study will be performed on the material consumption rate to identify the better machining process at reducing wastage and lowering the cost of material.

# 2. Literature Review.



In this chapter, the relevance or key point of the study will be explained and presented through research on the topic material based on this study. The majority of this explanation will concentrate on the manufacturing process and the various processes that affect production productivity and waste.

# 2.1 Lean Production.

The phrase lean manufacturing provides a mental image of a slim, well-toned body capable of efficiently functioning. This can also refer to your slimmed down processes which can efficiently and productively produce your organization's product. In this article, we will define the elements of lean manufacturing, its benefits, and tips for best practices. Lean principles define the value of the product/service as perceived by the customer and then making the flow in-line with the customer pull and striving for perfection through continuous improvement to eliminate waste by sorting out Value Added activity (VA) and Non-Value-Added activity (NVA), (Priya, R. S., & Aroulmoji, V., 2020).

Within lean production, there are several types of wastage that can be detected during or at the work line. Based on an article, "20% of every dollar spent in the industry is wasted adding up to \$8 trillion, or 10% of the global GDP". \$8 trillion is produced each year in the form of waste.", (Andrews L, March 2022). These wastage from manufacturing industry is a very important topic as it effects the environmental state which harms both the natural habitat and us human.

# 2.2 Cutting Process.

According to this research, there are two main machines used in the cutting process. Die cutting machines and computer numerical control cutting machines are the machines in question (CNC). The die cut machine and the CNC cut machine are described in detail below.

# 2.2.1 Die Cutting Process.

Die cutting is the process of utilising a die to shear low-strength materials such rubber, fibre, foil, cloth, corrugated fiberboard, paperboard, plastics, pressure-sensitive adhesive tapes, foam, and sheet metal. In the metalworking and leather sectors, the operation is known as clicking, and the machine is sometimes referred to as a clicking machine. The usage of a dinking die or a dinking machine is characterised as the process of dinking. In



its most basic form, die cutting is a procedure that involves cutting shapes from sheets of plastic (similar to cookie cutting) with a shaped knife and pressing the edge into one (or more) layers of sheeting.

2.2.2 Computer Numerical Control Cutting Machine.

To begin with, there are two types of control cutting machines: numerical control (NC) and computer numerical control (CNC). These machines are conceptually similar, yet their functions differ in several ways. First and foremost, these machine descriptions are distinct, as follows:

a. Numerical Control Machine.

Numerical control is the process of controlling a manufacturing activity by directly entering numerical codes into the machine tool (NC). It's critical to understand that this is a machine control concept rather than a machining technology.

b. Computer Numerical Control Machine.

It's the next stage after the NC machine. A Computer Numerical Controlled machine has machines that are linked to computers. This makes them more adjustable if the dimensions of a part need to be altered. In an NC machine, you'd have to update the tape's programme before feeding it back in. To update the programme on a CNC machine, all you have to do is change a variable in the computer. It has memory and the ability to store programmes under its command. In current CNC systems, the design of a mechanical part and its manufacturing programme are highly automated.

2.3 Lean Manufacturing.

Lean Manufacturing is a commerce proposal to reduce waste in manufactured goods. The fundamental plan is to reduce the cost scientifically, throughout the product and fabrication development, by means of a succession of business reviews, (Bhasin S., 2016). Within this topic, there is a principal or method that can be use to identify root cause from an ongoing issues in the workline or station. This method is called Ishikawa's Diagram or Cause-Effect Diagram. This diagram is in form of fishbone diagram that holds the 4M's analysis process. The bones

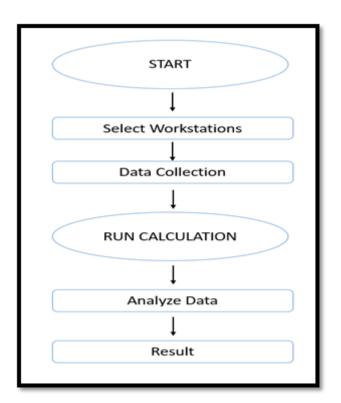


build up of several genre of issue possibility which are Man, Material, Machine and Method. The important point to remember is that the majority of costs are allocated when a product is conceived. Rather of cheap, competent materials and methods, an engineer will often choose familiar, safe and sound ones. This lowers project risk, i.e. the engineer's cost, while raising economic hazards and lowering income. To analyse manufactured goods designs, good organisations expand and evaluate checklists.

# 3. Methodology.

3.1 Methodology Process Chart.

First and foremost, any form of research must have a strategy for analysing the data. This procedure is required mostly because to the lack of a legally binding research method and a guide to follow or refer to during the data collection, comparison, and conclusion phases. The methodology flow procedure for this project is depicted in Figure 1.







3.1 Select work line/workstation.

For this study, there will be two workstation that will be involve for the analysis which are Die Cut machine and Numerical Control machine. Both workstation are involves in the cutting process of the synthetic leather. A monitoring will be undergo towards these work line while collecting the data that produce or compute from both process.

#### 3.2 Data Collection.

# 3.2.1 Material Dimension.

A measurement will be conduct throughout the timespan of several month. The data collection method measurement will be focused on the consumption of material based on the dimension of material cut design and dimension of material slab. As for the dimension of design, there are no changes except for the size of material slab.

No.	Model	Appendix	Size Average (m <sup>2</sup> )
1.	Die Cut		Length = 950 mm Width = 1500 mm Meter Square = 1.35 m²
2.	Numerical Control		Length = 2700 mm Width = 1500 mm Meter Square = 4.05 m <sup>2</sup>

# Table 2: Matrix table of material Slab Size

3.2.2 Design of cutting blade design.

In terms of material design, both cutting procedures use the same cut stock design but a distinct cutting pattern. The number of outputs is determined by the size of the material to be sliced. The method will be visually displayed in Figures 2 for die cutting while Figure 3 for NC cutting.



i.Die Cut Blade and board design.



Figure 2: Die Cut Sahara Rear Upper and Lower Blade Board Design (Armrest).

ii.NC cutter design.

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3.2.3 Limitation of machines for cuts.

Limitations are important to understand for placing research findings in context, interpreting the validity of the scientific work, and ascribing a credibility level to the conclusions of published research (John P A Ioannidis, 2007). This can be relate towards the operation of both machines as its has their limits in performing their task. Table 4 and 5 visualized the dimension of material for each process.



TARGET	MODEL	LENGTH (mm)	LENGTH (M)	WIDTH (M)		
	SH FR RH UPPER	950	0.95			
	SH FR RH LOWER	950	0.95	1.5		
PLAN	SH FR LH UPPER	950	0.95			
	SH FR LH LOWER	950	0.95			
	SH RR RH UP&LW	900	0.9			
	SH RR LH UP&LW	900	0.9			

# Table 4: Estimation of types of models and dimension for Die cutting process.

#### Table 5: Estimation of types of models and dimension for NC cutting process.

TARGET	MODEL	LENGTH (mm)	LENGTH (M)	WIDTH (M)
	SH FR RH UPPER	2530	2.53	
	SH FR RH LOWER	2870	2.87	
PLAN	SH FR LH UPPER	2530	2.53	1.5
	SH FR LH LOWER	2870	2.87	
	SH RR RH UP&LW	2700	2.7	



SH RR LH UP&LW	2700	2.7	
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# 3.2.3 Consumption of material.

In measuring material consumption, there are few steps that must be taken to have an accurate assessment of the differention of process. The sets of formula will be use in this study.

Formula of material consumption: -

i.Material Slab Size (m<sup>2</sup>):

Length of slab ×Width of slab

ii.Material Part Size (m<sup>2</sup>):

Length of part ×Width of part

iii.Total material utilization: [Equation] iv.

#### 4. Result and Discussion.

Based on the analysis and monitoring, there has been significant improvement with the uses of Numerical Control cutting process. The amount of output and material consumption has been utilized almost fully compare to the die cutting process. Table 6 shows the contrast of productivity of the two processes.

4.1 Design of cutting blade design.

Based on the formula above, Table 6 bear the measurement and information of the dimension of slab size and part size.

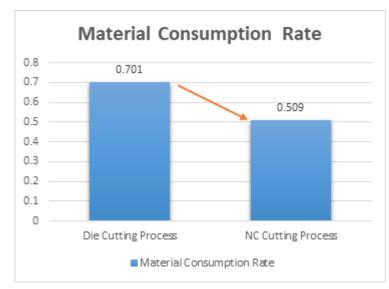


PROCESS	MODEL	SLAB SIZE (m <sup>2</sup> )	PART SIZE (m <sup>2</sup> )	Volume of design
	PART1	1.425	0.14	
	PART2	1.425	0.14	
DIE CUT	PART3	1.425	0.14	12
DIE COT	PART4	1.425	0.14	12
	PART5	1.35	0.08	
	PART6	1.35	0.08	
	PART 1	3.795	0.14	
	PART 2	4.305	0.14	60
NC	PART 3	3.795	0.14	00
CUTTER	PART 4	4.2495	0.14	
	PART 5	4.05	0.08	35
	PART 6	4.05	0.08	30

# Table 6: Dimension of material of both processes.

PROCESS	PCS/SQM	BY SET	TOTAL	
	0.11875	0.2375	-	
DIE CUT	0.11070	0.2375	0.7	
	0.1125	0.225		
	0.06325	0.135		1
	0.07175	0.135		
NC	0.06325	0.134075	0.500503571	
CUTTER	0.070825	0.134075	0.000000071	
	0.115714286	0.231428571		





Graph 1: Total material consumption rate of die cutting process and NC cutting process.

From graph 1, the overall consumption of material for die cutting process is significantly bigger than the rate of numerical control cutting process which are 0.70125 and 0.5089, respectively.

The implication of the NC cutter machine has notable development of material consumption and wastage reduction while taper the cost wise of the whole process of operation towards that particular product.

It also shows that the changability of machinery can absolutely aids in increasing the productivity rate, consumption of material and the reduction of process costing. The application of NC cutting machine can be useful in other form of cutting process that involves the use of fabric and leather in other model of workline.

# 5. Conclusion.

In this analysis, it can be deducted that the utilization and implementation of a new form of machinery thus proves to be beneficial in the reduction of processing cost. The study of this particular issue of wastage has led in the understanding of the importance of



material consumption within the operating process. Productivity can easily be improved by the design limit of the hardware that are in use. Based on the objective, this research has cover the monitoring of process for productivity sake and the wastage percentage from the consumption rate of material for each process. As for the problem statement, it can be convey that the Die cutting process proves to hold more wastage and costing by the referring to the result of this analysis. To summarize, this project analysis has proven positively beneficient in strengthening the knowledge of the importance of cost down in manufacturing by improving the consumption rate from the reduction of wastage by administering a new form of machinery.

#### References.

Journal:

- B.S.B.P. (2016). Journal of Manufacturing Technology and Management. *Lean viewed* as a philosophy, 2016, 66.
- Kulińska, E. (2014). Importance of Costs of Risks in Material Management. *Foundations* of Management, 6(1), 7–20. <u>https://doi.org/10.1515/fman-2015-0001</u>
- Priya, R. S., & Aroulmoji, V. (2020). A Review on Productivity and its Effect in Industrial Manufacturing. *International Journal of Advanced Science and Engineering*, *06*(04), 1490–1499. <u>https://doi.org/10.29294/ijase.6.4.2020.1490-1499</u>



Website:

- Andrews, L. (2022, 31 maart). *What Waste in Manufacturing is Costing You*. Mingo | Manufacturing Productivity. Geraadpleegd op 6 juni 2022, van <u>https://gomingo.io/what-waste-in-manufacturing-is-costing-you/</u>
- April factory output down 32% the biggest drop on record. (2020, 11 juni). The Edge Markets. Geraadpleegd op 31 mei 2022, van <u>https://www.theedgemarkets.com/article/malaysias-ipi-slumps-32-april-</u> improvement-seen-coming-months-economy-reopens
- Just a moment. . . (2022, 7 februari). Https://Themalaysianreserve.Com/. Geraadpleegd op 6 juni 2022, van https://themalaysianreserve.com/2022/02/07/malaysias-manufacturing-sector-falls-the-lowest-in-january/



# IMPROVEMENT ON FRONT AXLE SUB-ASSY PROCESS

MOHAMMAD FIRDAUS<sup>1</sup>, IZWAN BIN HAMID<sup>2</sup>

<sup>1</sup>Mechanical Engineering Department politeknik Sultan Azlan Shah 35950 Behrang, Perak Darul Ridzuan *dauzsulaimans* @gmail.com *izwan\_hamid* @psas.edu.my

#### Abstract

In the automotive industry, waste has been a common issue for manufacturing companies. Waste in manufacturing is not good because it will make the productivity of the main production at a lower rate. This study will show the waste and problems that happened in the front axle sub-assy process are countered by using lean tools. The front axle sub-assy process is assigned to assemble the front axle' parts or components to a complete module of the front axle. To complete the workflow, the process is involving two workstations which are a logistic area and assemble area. The current workflow has problems that harm the main production productivity at 89% efficiency. The problem was on repeated handling that cause the waste of motion. Other than that, the current cycle time is higher than the takt time. The value of takt time for the normal production rate is 4.3 min. the cycle time is above the takt time by 4.8 min. to encounter the issue, fabricate a new design of trolley that can reduce handling for the process. Next, implement the lean technique which is the 5s method to optimise the workflow for the process which will improve the cycle time issue.

**Keywords:** Cycle time, lean manufacturing, 5s method

#### 1. Introduction

The company undertook a study to uncover faults that happened on the assembly line. After a month of observation, a process faced a difficulty that lowered the company's productivity. This process is a front axle sub-assy whose aim is to assemble and finalise the front axle components. A front axle assembly is a unit that connects two wheels on



the front of the vehicle and allows them to rotate freely and in some cases independently. The assembly process for the front axle uses two types of trolleys and one assembly table to complete the process assembly.

The trolleys are used to move the front axle components from the Logistic Area to the assembly station. There was a problem that cause the process to face delay issues for the current process. The problem is caused by the cycle time issue that has been higher than takt time. Other than that the problem is also caused by motion waste that happened during the process is running. As a result, this situation has decreased productivity by 11% which means the production only can run at 89% of efficiency. This is not good for production made the target cannot be achieved.

#### 1.2 Problem statement

The current assembly process workflow from the logistics area to the front axle assembly workstation to the main assembly line. The current process seems to have some issues that need to be identified to keep productivity at a high level at all times. The problems that happen in the workflow process are shown below:

- i.Waste of motion caused by repeated job or handling has made the main production delayed.
- ii.Cycle time is higher than takt time which lowers the production rate to 89% efficiency and causes delays to the main production.

# 1.3 Objectives

This project aims to eliminate motion waste caused by issues that arose throughout the work process, such as repetitive handling. All of the issues will be resolved by creating a new trolley design that incorporates an all-in-one concept as well as line balancing to enhance productivity and eliminate the waste which is the reason for the problem. As a result, the impact of the new trolley must be assessed by looking at the number of handlings and efficiency, which includes cycle time. As a result, these targets must be archived to encounter the problem.

i.Develops and fabricates a new trolley design that incorporates an all-in-one approach to eliminate waste of motion.



ii.By using the lean manufacturing method, optimised the workflow of the process to overcome the cycle time issue.

#### 2. Literature Review

#### 2.1 Motion Waste.

Motion waste is defined as a human motion that is pointless and work-in-process (WIP) moving extensive distances (Rose, A. N. M. 2017). Waste is an activity that wastes resources such as expenditure or extra time but does not add any value to the activity (Laksono, P. W. 2019).

#### 2.2 Lean manufacturing.

Lean management is first practised in the automotive industry as means to optimize the flow of production by reducing waste in any process to generate the maximum possible amount of value. Lean wastes are (DOWNTIME) defects, overproduction, waiting, not utilising talent, transportation, inventory excess, motion waste, and excess processing (Valunjkar, S. 2020). Lean manufacturing is a valuable innovative tool to eliminate different industrial waste. Waste can be assumed as three types: value-added waste, non-value-added waste and necessary non-value-added waste. Waste is undesirable for industry and can be eliminated but is too difficult to eliminate. So it is required to find out the optimum solution which will help to eliminate. Page Break

#### 2.3 Lean technique

Lean assembling is bound together with a framework that is involved a lot of ways of thinking, rules, instruments and strategies, which whenever forced, take out critical burnthrough and loss of time in all business formats for constant enhancement (Saifudheen, M. 2020). Lean is a systematic approach toward reducing waste, continuously attempting to improve further and maintaining the production rate as per the requirement of the customer (Kumar, K. 2020). There are many different techniques of waste reduction and thereby cycle time reduction like 5S methodology, Production levelling by Heijunka, SMED, PDCA cycle, Takt time, Total Productive Maintenance (TPM), Kaizen etc. The 5S is one very important lean tool that improves environmental performance and thus relates primarily to the reduction of waste in manufacturing (Pandya, N. 2017).



# 3. Methodology

#### 3.1 Observation method

To identify the problem that's happening in the front axle sub-assy process, Gemba walks method has been used to collect the information and data. The Gemba Walk is a common Lean Manufacturing technique. The concept of Gemba is that problems in various business processes are frequently observable but hardly noticed. That is why managers must visit the workplace in-person to examine the situation of the workflow. This is known as the Gemba Walk. During a Gemba Walk, the manager must watch, ask, and display respect. Managers, leaders, and supervisors are required to be able to quickly monitor and analyze process improvements. As part of the Kaizen technique, there is also an emphasis on communication, openness, and trust across all levels of employees and management. Adopting this strategy provided them with important insights into manufacturing cycle times, waiting time, inventory, and rework. They trace the origins of Gemba walks back to Ohno and Shingo in Lean manufacturing, who documented several visits to the workplace to gain clear insights into major situations and associated behaviour (Hanahoe, J. 2019).

#### 3.2 Problem Discovery

Ishikawa Diagram Method is used to identify the items or problems that need to be recovered in this project. A cause and effect diagram, often known as a "fishbone" diagram, can aid in brainstorming to find potential causes of a problem and in categorising ideas. A fishbone diagram is a graphic representation of cause and effect. It is a more systematic technique than some other tools for brainstorming issue sources. The problem or consequence is visible in the fish's head or mouth. On the smaller "bones," potential contributing reasons are mentioned under several cause categories. By promoting the team to look at the categories and think of alternate reasons, a fishbone diagram can aid in uncovering plausible explanations for an issue that might not otherwise be examined. The Ishikawa diagram has the advantage that it offers the possibility to identify and analyze all factors of an objective and subjective nature, which relate to the studied problem (Brancu, C. 2017).

Agree with the problem statement. This is written at the mouth of the "fish." Be as clear and specific as can about the problem. Analyze major categories of causes of the problem (written as branches from the main arrow). Major categories often include equipment or supply factors, environmental factors, rules/policy/procedure factors, and



people/staff factors. Brainstorm all the possible causes of the problem. Ask "Why does this happen?" As each idea is given, the facilitator writes the causal factor as a branch from the appropriate category (places it on the fishbone diagram). Causes can be written in several places if they relate to several categories. Again asks "Why does this happen?" about each cause. Write sub-causes branching off the cause branches. Continues to ask "Why?" and generate deeper levels of causes and continue organizing them under related causes or categories. This will help you to identify and then address root causes to prevent future problems.

#### 3.3 Designing Method

The current process is facing a handling issue because of transferring the component from trolley to trolley. This process needs 2 types of trolleys and 1 unit table of sub assy. the idea is to make a new design of a trolley that can function the same as the current situation. The concept is all the work just on one trolley to make this happen.

The main item that needs care is the jig composition. Position of the front axle when the assembly process run needs to be maintained. By choosing the table jig as the constraint for the design of the trolley. The designing process started with collecting the data, a measurement for the new trolley. Sizing is important that will assure the weight of the new trolley. After that, the product is designed using Catia.





# Figure 1: Trolleys and sub-assy table used for current workflow.



Figure 2: The new design for the trolley that approaches all in one concept.

From figure 5, the new design for the trolley has been created by keeping the constraint which is the jig configuration. The item that includes in the jig that had been maintained was, the distance and location of the components of the front axle. The trolley is designed to make sure that the picking process at logistic has no problem by maintaining the constraints of the table jig.

3.4 5s method

Many manufacturing facilities nowadays have opted to follow the path in the direction of a "5S" workplace organizational and housekeeping methodology as part of continuous improvement or lean manufacturing processes. 5S is a system to reduce waste and improve productivity through maintaining a neat workplace and using visual signs to achieve more consistent operational results. The term 5S refers to five steps – sort, set in order, shine, standardize, and sustain – that are also sometimes known as the 5 pillars of a visual workstation. 5S programs are regularly implemented by small teams working together to get materials closer to operations, right at workers' fingertips and structured and labelled to facilitate operations with the smallest amount of wasted time and materials. The 5S system is a good starting point for all improvement efforts aiming to drive out waste from the manufacturing process, and lowering costs. Many companies are seeking to make operations more efficient, and the concept is especially attractive to older manufacturing facilities looking to improve the bottom line by reducing their costs. **4. Data and Analysis** 

# 4.1 Gemba walk

To get more understanding of the problem and process, the Gemba walk technique is implemented to collect the data from the workstation. From the table below, the issue that



needs to take care of is motion waste caused by handling the issues and delayed issues caused by higher cycle time.

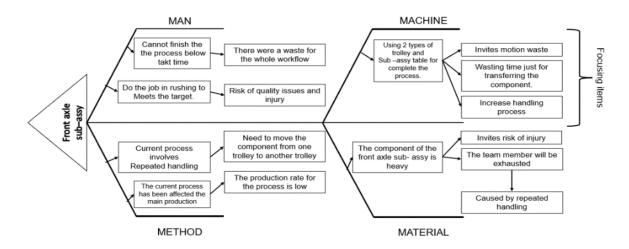
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# Table 1: Data from an interview session with the leader and team member

	Interview session
Team	The leader informs that the delay issue in the main production line is from
Leader	the front axle sub-assy process.
	Current workflow causes the team member to delay finishing the process
	under takt time.
Team	Inform that the process of transferring the components that have been
Member	taking much time that makes them delayed to complete the process.

# 4.2 Ishikawa diagram

Ishikawa diagram is implemented in this study to analyse the problem that needs to be encountered in solving the main problems. From the diagram below, the focusing item for this study is repetitive handling caused by the current handling system that is not efficient. To overcome the handling issue, design and fabricate a new trolley that can be applied in all current processes.



# Figure 3: Ishikawa diagram for identifying the focusing problem in this project.

# 4.3 Production rate



To prove that the current process had lowering the production rate, the calculation is shown below:

```
twh = total working hours (min)

Production target = twhtakt

twhtakt timetwhtakt time

= [Equation]

122.8 unit @ 123 unit per day

=

Fr axle production rate = [Equation]

= [Equation]

110 units per day

=

The efficiency of the front axle process = [Equation]

89 %
```

From the calculation above, the current workflow had only 89% efficiency from the main production target. The process can lower the main production by 11% which can make the production target cannot achieve.

# 4.1 Data collection

The project is measured by cycle time that will prove before and after making improvements. From the data collection, the process has passed the limit of takt time that has been set at the logistic workstation. All the data that had been collected is shown in the table below.



D700000	time (s)			
process	manpower A	manpower B	manpower C	
picking knuckle L	56	8		
picking knuckle R	50.67		8.33	
picking differential	45.33		7.33	
picking arm L	38	5.33		
picking arm R	10		5	
picking driveshaft L	15	5.33		
picking driveshaft R	15		6.66	
part delivery	29.67	29.67		
trolley picking	33	33		
temporary set		34.33	27.33	
picking module		25.33	26.33	
assy process		149	163	
total	292.67	227.32	243.98	

From table 2, manpower B have to repeat the process from manpower A which has 5 types of process. It also happened with manpower C repeated the manpower A process which 4 types of process. From this situation, the handling issue can be detected and will help to focus on solving the problems. The current workflow is facing motion waste that affected the cycle time.



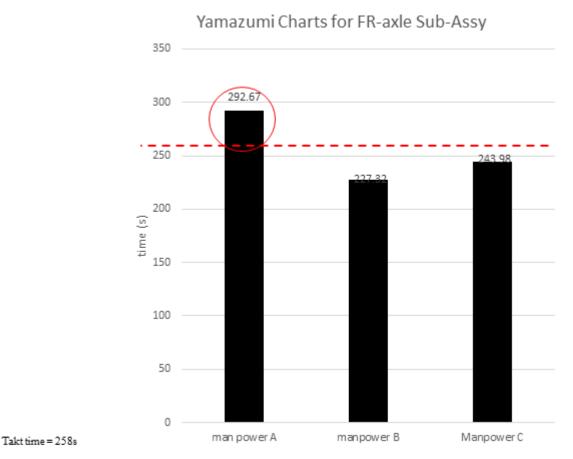


Figure 4: Yamazumi charts for the current workflow.

From the yamazumi chart, the main issue is happening at manpower A which the cycle time for the process is upper the takt time by 34s. Implementing the new design of the trolley and 5s method to the process will improve the cycle time and motion waste for the workflow.

# 4.2 5S method

The 5S methodology is a methodical way to organise the workplace. Sort, Set in Order, Shine, Standardize, and Sustain are the five phases in this process. In general, the 5S processes entail looking through objects in a workplace, removing what is superfluous, organising goods, cleaning, conducting maintenance, and ensuring that these activities become habits. The way to implement the method is shown below in table 3. Page Break



#### Table 3: Implemented 5s method to solve the problems at the workstation.

Method	Description
Sort	<ul> <li>Analyse the equipment and racking system that use in the current process.</li> <li>From the current process, there was a racking system that is no longer used in the working area. From the observation, the rack that can eliminate from the process is two types of rack which can increase the working area and working flow for the process.</li> </ul>
Set in order	<ul> <li>Re-arrange the current layout set up to smooth the flow of the process.</li> <li>Making a new plan layout for the process shown in figure 5.</li> <li>From the new layout, the movement for the worker is optimised and reduces the waste of motion in the process.</li> </ul>
Shine	<ul> <li>Maintaining the current working area such equipment.</li> <li>Making railway to ease the worker push or moving the new trolley.</li> <li>Move the equipment to give comfort to the worker completing the process.</li> <li>Modification process of the racking system to optimise the working area.</li> </ul>
Standardize	<ul> <li>Rearranged the process flow and manpower that suits the layout setup.</li> <li>Logistic area is assigned with 2 workers that can reduce the cycle time at the workplace.</li> <li>Assigning only one worker to complete the assy process which is only a tightening process.</li> <li>New process flow is shown in table 4.</li> </ul>
Sustain	<ul> <li>Maintain discipline by maintaining new procedures and conducting audits.</li> <li>This step will be conducted by the team leader in charge of the team member.</li> </ul>

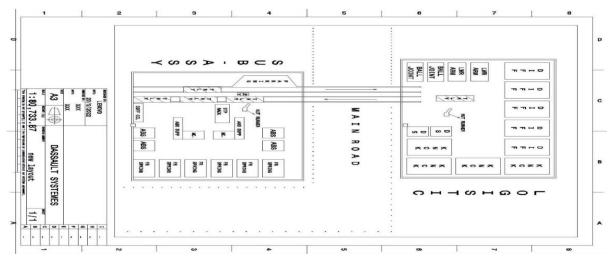


Figure 5: New plan layout for the front axle sub-assy process



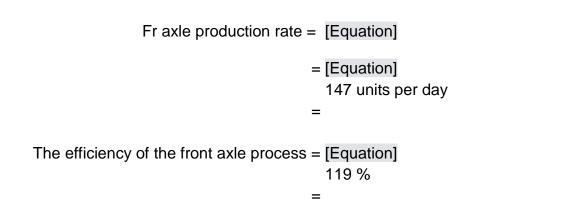
Workstation	Number of manpower	Task
Logistic area	2	Manpower A: • picking knuckle L • picking knuckle R • picking differential • part delivery • trolley picking
		Manpower B: • temporary set • picking arm L • picking arm R • picking driveshaft L • picking driveshaft R
Assembly area	1	Manpower C: <ul> <li>tightening process</li> <li>delivery trolley</li> <li>picking up the trolley</li> </ul>

# Table 4: New process for the workstation

#### 4.3 Analysis

Before improving on the process, the cycle time for the logistic area is above the takt time. The process needs to be improved. By having a new trolley, the handling issue is solved by reducing from 15 handling items to 9 handling items. This situation has improved the cycle time under the takt time and also the motion waste instead. Cycle time for logistic workstation has been improved from 292 s to 214 s. normally the takt time for the main production is 4.3 min or 258 s. from the new data collection the cycle time has been reduced to 78s. this situation has proven the trolley and 5s method is the solution to improved cycle time for the process and the motion waste issue. Lean manufacturing is suitable for solving this kind of problem that caused waste and delayed issues. The efficiency also increases from 89% to 119% and this situation also increases the productivity of the process.





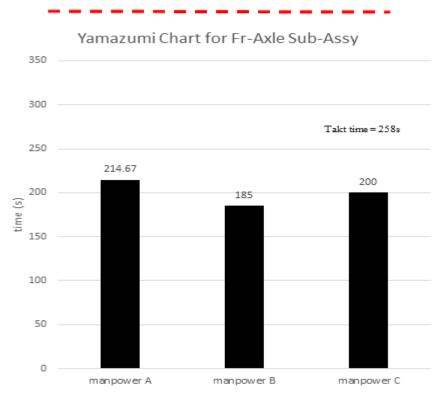


Figure 6: Yamazumi charts for the new process.



Dragona	Time (s)		
Process	Manpower A	Manpower B	Manpower C
picking knuckle L	56		
picking knuckle R	50.67		
picking differential	45.33		
part delivery	29.67		
trolley picking	33		
temporary set		95	
picking arm L		25	
picking arm R		25	
picking driveshaft L		20	
picking driveshaft R		20	
tightening process			200
Total	214.67	185	200

#### Table 5: Cycle time for the new process setup

Based on a new setup for the process of front axle sub assy, the new design of trollehasve reduces the material handling thareducesce waste for the process these table 5, the table shows that there was no one is repeating the process or handling for the new setup.

## 5.0 Conclusion

To conclude that the project has achieved its objective which, develops and fabricate a new trolley design that incorporates an all-in-one approach to reduce motion waste caused by repeated handling jobs and using the lean manufacturing method which is the 5s method to improve the process cycle time. By implementing the new design of the trolley, the workflow can be re-arranged to get a better cycle time than below from takt time. The new design of the trolley also improves productivity from 89% to 119%. This situation looks good for the company's target and achievement.

## References

Soliman, M. (2017). A comprehensive review of manufacturing wastes: Toyota production system lean principles. Emirates Journal for Engineering Research, 22(2), 1-10.



- Tsolas, I. E. (2021). Performance Evaluation of Electric Trolley Bus Routes. A Series Two-Stage DEA Approach. Infrastructures, 6(3), 44.
- Timbadia, V. A., Khavekar, R. S., & Vijayakumar, K. N. (2017). Design and Development of a Multi-Purpose Trolley. *Global Journal of Enterprise Information System*, *9*(1), 90-94.
- Fajriati, N., Yudiarti, D., & Muchlis, M. (2019). Redesigning A Trolley for The Stairs Building Based on Material Aspect. In 6th Bandung Creative Movement 2019 (pp. 201-206). Telkom University.
- Ameen, W., AlKahtani, M., Mohammed, M. K., Abdulhameed, O., & El-Tamimi, A. M. (2018). Investigation of the effect of buffer storage capacity and repair rate on production line efficiency. Journal of King Saud University-Engineering Sciences, 30(3), 243-249.\
- Zakaria, N. H., Mohamed, N. M. Z. N., Ab Rahid, M. F. F., & Rose, A. N. M. (2017). Lean manufacturing implementation in reducing waste for the electronic assembly line. In MATEC Web of Conferences (Vol. 90, p. 01048). EDP Sciences.
- Brahmane, J. (2019). Work-Study to Reduce the Stressful Work by Redesigning of Material Handling Process. International Journal of Operations Management and Information Technology, 9(1), 15-21.
- Parvez, M., Amin, F., & Akter, F. (2017). Line Balancing Techniques To Improve Productivity Using Work Sharing Method. IOSR Journal of Research & Method in Education (IOSRJRME), 7(03), 07-14.
- Chiarini, A., Baccarani, C., & Mascherpa, V. (2018). Lean production, Toyota Production System and Kaizen philosophy: A conceptual analysis from the perspective of Zen Buddhism. The TQM Journal.
- Taggart, M., Willis, C., & Hanahoe, J. (2019). Not seeing the wood for the trees-a Gemba Walk through a timber-framed housing development. In *Proceedings of 27th Annual Conference of the International Group for Lean Construction (IGLC)* (pp. 1209-1218).
- Luca, L., Pasare, M., Stancioiu, A., & Brancu, C. (2017). Study to determine a new model of the Ishikawa diagram for quality improvement. *Fiability & durability*, *1*, 249-54.



# DESIGN OF JIGS WITH HIGH DURABILITY TO FACILITATE THE MAP LAMP ASSEMBLY PROCESS

Muhammad Syakir Najmi Mohamad Fuzi<sup>1</sup> and Hainol Akbar Zaman<sup>2</sup>

<sup>1,2</sup> Mechanical Department, Politeknik Sultan Azlan Shah, Behrang, Perak Syakirs2e @gmail.com akbarhainol @gmail.com

#### Abstract

This paper describes how the Assembly Workstation under the Polybond Line's jig was designed and implemented. Child part installation processes are carried out at the Assembly Workstation which involves parts namely map lamp bracket external microphone, foam, and wire hardness. This project focuses on improving job handling to install the map lamp bracket on the headlining. Currently, the map lamp bracket installation runs without support. Since the operator's skills vary, the cycle time and neatness of this process will fluctuate between 17 and 19 seconds for expert operators and 34 and 37 seconds for non-expert operators. The goal of this paper is to create a jig that will serve as a hot glue gun nozzle guide in order to enhance the quality of the work. Before the jig prototype is made for the testing process, the designing process will be carried out on the Catia V5. When the prototype performs as expected, the actual jig will be made using the appropriate material to ensure that it can function durably on the production line.

**Keywords:** Jig, Catia V5, Car Interior Part, Headlining, Map Lamp Bracket, Assembly Workstation.

## 1. Introduction

Over the past year, the manufacturing sector has seen rapid growth and an increase in competitors. From November 2020 to November 2021, Malaysia's manufacturing production index increased by 11.30 percent (Department of Statistics Malaysia et al., 2021). This situation causes many companies to compete in producing high product quality with fast rate production system.



Consequently, a variety of tools and equipment, including a jig, are added to the production line. The company must have a plan in place in order to accomplish its goal. One method to reduce manufacturing costs, increase product quality, and shorten production cycles is to use jigs.

The jig is a common manufacturing device used to hold, support, and locate the workpiece and guide the cutting process or any types of tools for a specific operation (Charles Chikwendu Okpala et al., 2015). This device helps to improve the accuracy during the operation on the workpiece. It is also known as a significant component in production operations since it is used in industries such as automated manufacturing, inspection, and assembly section (H Radhwan & M S M Effendi et al., 2019).

XYZ Company has eleven main workstations for the production of headlining namely Incoming Inspection, Material Cutting, MDI Coating, Catalyst Spray, Material Layering, Forming, Cooling, Waterjet Cutting, Assembly, Final Inspection, and Packing & Racking. The issue occurs in the process of installing the map lamp bracket at the Assembly Workstation, especially for models P213A, P230D, and P231C. This part needs to be glued with hotmelt on the surface of the headliner with a hot glue gun. The hotmelt filling process on the map lamp bracket surface is done manually without any guidance on the nozzle of the hot glue gun. Therefore, it produces uneven bracket surfaces that are influenced by the operator's skills.

This paper focuses on the design of a jig with high durability to handle the hotmelt filling process on the map lamp bracket surface. The design of the jig will be carried out to replace the manual method used on the assembly workstation. This jig will restrict the map lamp bracket movement and has a groove design on its upper surface to guide the hot glue gun nozzle during the process. This jig design is developed using Catia V5 and ANSYS software is used to analyze the durability of the design. It is anticipated that this jig will serve as a guide for all operators, preventing reliance on just two highly skilled individuals to handle the process across all models.

#### 1. Problem Statement

Currently, only two corrugated boards are used to support the map lamp bracket during the hotmelt filling process (Figure 1). This method can only restrict the Z-axis movement of the map lamp bracket. Besides, the surface width of the map lamp bracket, which must be filled with the hotmelt, is relatively thin, measuring  $10\pm$  inches (Figure 2). In order to achieve a good and smoother result, a hot glue gun can only be used by a skilled operator.



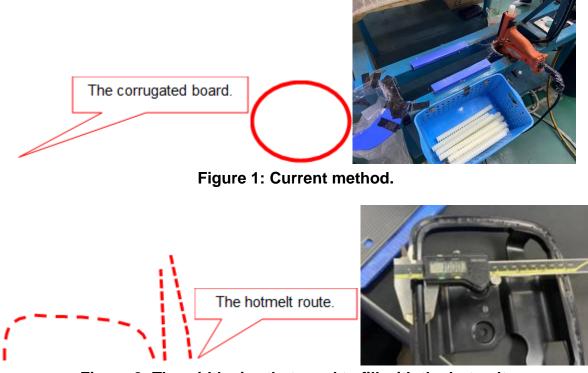


Figure 2: The width size that need to fill with the hotmelt.

## 2. Literature Review

This section expands on prior research on a particular subject and, in essence, identifies, assesses, and summarises the pertinent literature in a particular area of study.

## 2.1 Jig

A jig is a device used to hold and locate the workpiece while guiding the tool during a machining process (*Sridharakeshava K. B, 2016*). A perfect jig may function with accuracy and interchangeability to produce many products with the same specifications. Jigs and fixtures are the most crucial devices in the manufacturing industry for assisting the operator in making their production process easier (*H Radhwan & M S M Effendi, 2019*). When developing this device, it must be made sure that it is simple, cost-effective, and easy to use (*Rudrapati R & Mulugeta L, 2017*).



## 2.2 Degree of Freedom (DOF)

The degree of freedom on the jig is directly related to the success or failure of the designing process. Basically, the constraint Degree of Freedom of the datum on the product can be divided into three types, which are line translation, line rotation, and plane translation (Figure 3). (Wang X, 2017). Usually, this pin or datum is in fixed position, so it will affect the loading and unloading of the workpiece on the jig. It must be in the right position to ease the loading and unloading processes (Diksha R. Bahadure & Dr. Subhash, 2017).

line translation	
line rotation	
plane translation	
	-

Figure 3: Three types of datum location. Source by Wang X, 2017

## 3. Methodology

The following Figure 4 illustrates the overall flow chart, which outlines the procedures for developing this project, fabricating it, and applying it to an assembly line.



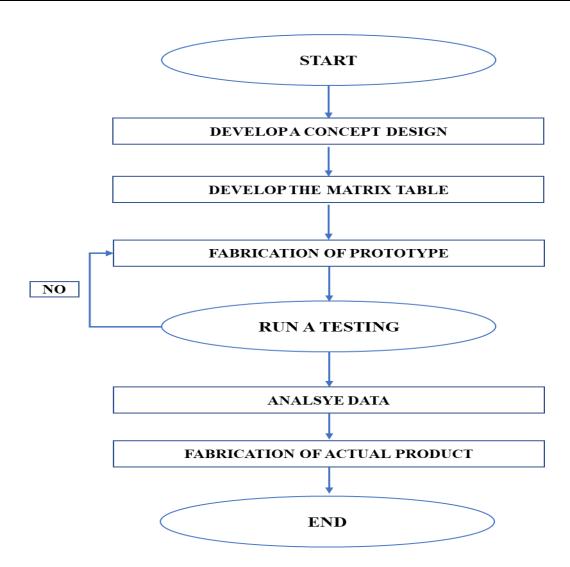


Figure 4: The overall project flow chart.

## 3.1 Developing A Concept Design

Catia V5 was used to create the project's concept design. The project design must be durable during production, be able to accommodate the workers, and have reasonable costs. This section also allows for the suggestion of material choice. The three main components of this jig are the jig body, the jig template, and the jig mould (Figure 5). Three different types of concept designs will be developed for this project.



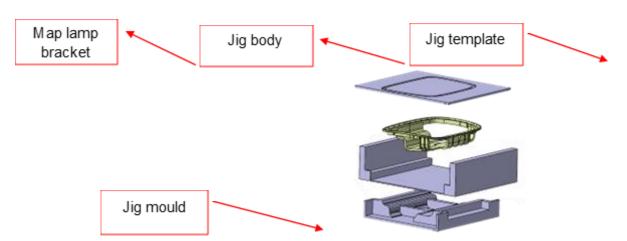


Figure 5: The basic part of the Map Lamp Bracket Jig.

# 3.2 Developing the Matrix Table

After all the three concept designs were produced, the matrix table for these concept designs were also developed (Table 1). The concept design and its characteristic will be stated on the matrix table. For this matrix table, the operator from the assembly line will give a score based on their interest in the specifications offered for each concept design.

Table 1. The concept design matrix table.			
	CONCEPT DESIGN 1	CONCEPT DESIGN 2	CONCEPT DESIGN 3
DESIGN	are la		and the los
LENGTH	265MM	265MM	265MM
WIDTH	210MM	210MM	210MM
TEMPLATE STYLE	SLOT ON EACH SIDE AND USED GROVE DESIGN	DOUBLE HINGE AND USED GROVE DESIGN	DOUBLE HINGE AND USED POCKET ON THE MIDDLE DESIGN
MATERIAL	TEMPLATE: STAINLESS STEEL BODY: PETG+ MOULD: PETG+	TEMPLATE: STAINLESS STEEL BODY: ALUMINIUM MOULD: PETG+	TEMPLATE: STAINLESS STEEL BODY: ALUMINIUM MOULD: PETG+
HOT GLUE GUN NOZZLE SUITABILITY	2.0MM DIAMETER OR 3.2MM DIAMETER, EITHER ONE	2.0MM DIAMETER OR 3.2MM DIAMETER, EITHER ONE	2.0MM DIAMETER AND 3.2MM DIAMETER, BOTH.
OPERATOR 1	3/5	4/5	5/5
OPERATOR 2	2/5	5/5	2/5
OPERATOR 3	1/5	4/5	3/5
OPERATOR 4	2/5	4/5	2/5
OPERATOR 5	4/5	5/5	4/5
TOTAL	12	22	16

# Table 1: The concept design matrix table.

# 3.3 Fabrication of The Prototype

The jig prototype (Figure 6) will be developed based on the concept design selected on the matrix table. The jig prototype will be used for the operation testing process. For this project, the same design will be used for the prototype, but with cheaper materials compared to the actual jig, such as a wooden block, plywood, and polyurethane block.



This prototype will be tested by the EEC department first before the operator. The main objective of this prototype is to identify if it has any weak points based on the design. This step can also help save the cost of developing this project.



Figure 6: The jig prototype.

# 3.4 Run A Testing

After the product prototype has been produced, the testing must run by using the actual operation on the assembly line. During the operation, the data must be collected to assess the parts that need improvement. If the product prototype shows a negative result, the design selected needs to undergo a minor change. It is also necessary to examine the component that demands precision and care.

## 3.5 Analyse The Data

After all the minor changes have been decided, the final design needs to be produced. This model design will be analyzed using ANSYS software. If the design stated an excellent result on the ANSYS, the current design would be used for the actual jig. The actual material will be applied to the design model during this analysis process. The analysis process is conducted to predict the critical part of the model design. This section is crucial because it will demonstrate the outcome that was not visible during the prototype testing process. Data based on the actual material will also be displayed in the analysis's findings.



#### 3.6 Fabrication of Actual Product

The actual product can be made using the real material if the product prototype and the ANSYS analysis data show a good result without any problems occurring. At this point, a fix is required for each weak spot on the jig prototype. The final design is displayed on (Figure 9) prior to fabrication.

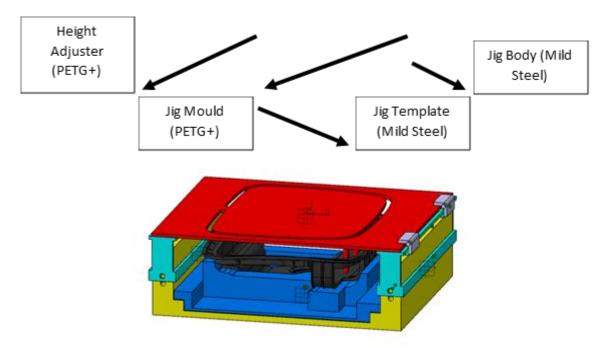


Figure 9: The map lamp bracket jig final design.

## 4. Result & Discussions

A static structural analysis will calculate and show the impact that will be received by the design model based on the value of force. This type of analysis is focused on the total deformation and stress result on the jig. In this project, the force has been added on the jig design model. For the force value, the weight of the hot glue gun will be used as the force. The total force from the hot glue gun is 4.032N, so the total force has been applied on the jig template surface (Figure 10).



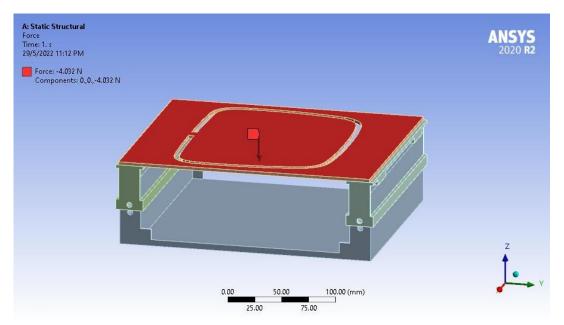


Figure 10: Area of force application.

In this section, the analysis process will be run for two designs. The first design is chosen from the matrix table, and the second used the same design, but with minor changes. The minor change design idea came out when the design from the matrix table yielded dubious result during the prototyping process. Design 1 has only one supporter to support the centre of the template jig, while design 2 has two pillars under the jig template to support the jig template as shown in Table 2.



Table 2 displays the overall deformation outcome for each design. The part that experienced the greatest deformation was indicated by the colour red, while the part that experienced the least deformation was indicated by the colour blue. Design 1 has a higher maximum deformation value than design 2, with a value of 8.6778e-002 mm compared to 2.0509e-003 mm for the latter. This indicates that Design 1 has the highest risk in the centre when the jig template is bent. This risk can be eliminated by including two pillars underneath the jig template (design 2). Additionally, the centre of the jig will be stronger to withstand the force of the hot glue gun.

	Design 1 (before minor change)	n 1 (before minor change) Design 2 (after minor change)	
Figure	ANSYS 2020/2		
Minimum	0 mm	0 mm	
Maximum	8.6778e-002 mm	2.0509e-003 mm	
Average	6.4935e-003 mm	2.0002e-004 mm	

 Table 2: The result of deformation before and after minor change is made.

To conclude the result for this project, the average value needs to be compared with the material tensile stress value. The material will be at risk of yielding or fracture if the average value of the result is higher than the tensile value of the material. Since stainless steel was used for each of the template jig materials in this analysis, the tensile stress value is 621 MPa. Based on Table 3, the average equivalent stress value for Design 1 was 7.4977e-002 MPa, and design 2 was 1.9771e-002 MPa. Therefore, design 2 has been proven to yield better result in handling the force that is received during the production activity.



# Table 3: The equivalent stress results before and after minor change is made.

	Design 1 (before minor change)	Design 2 (after minor change)
Figure	ANSYS 2020/2 100 100 100 100 100 100 100 100 100 10	Record Record     ANSYS       The record Reco
Minimum	7.2887e-011 MPa	4.9697e-010 MPa
Maximum	5.9569 MPa	0.27826 MPa
Average	7.4977e-002 MPa	1.9771e-002 MPa

## 5. Conclusion

The assembly of map lamp bracket headlining was meant to be made simpler by the map lamp bracket jig. The Assembly Workstation currently uses two corrugated boards to support the map lamp bracket. Designing this jig will help facilitate the operator during the hotmelt filling process. This design can also restrict the 12 degrees of freedom (DOF) of the map lamp bracket, so the accuracy of the hotmelt to fill the map lamp bracket surface will be improved. The durability stage for this design can accommodate force during the production process by selecting suitable materials. Lastly, by using this jig, the hotmelt filling process on the map lamp bracket surface can be handled by other operators and not depend only on two expert operators.

#### References

Bahadure, D. R., & amp; Waghmare, S. N. (2020). Design and analysis of jig and welding fixture for car panel to shift the locate pin. International Journal of Innovations in Engineering and Science, 5(10), 01. https://doi.org/10.46335/ijies.2020.5.10.1

Index of Industrial production Malaysia, November 2021 Department of Statistics Malaysia, 2022



Radhwan, H., Effendi, M. S. M., Farizuan Rosli, M., Shayfull, Z., & Nadia, K. N. (2019). Design and Analysis of Jigs and Fixtures for Manufacturing Process. IOP Conference Series: Materials Science and Engineering, 551(1). https://doi.org/10.1088/1757-899X/551/1/012028

Rudrapati, R., Mulugeta, L., Yalew, G., Beyan, A., & Ahmed, A. (2018). Design and Development of Jig and Fixture for Machining Processes. International Journal of Industrial Engineering and Design, 4(2), 16-20.

Sridharakeshava K B, Ramesh Babu. K, "An Advanced Treatise on Jigs and Fixture Design" International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181Vol. 2 Issue 8, August – 2016

Shahparvari, M., & Fong, D. (2018). The review of rework causes and costs in housing construction supply chain. IGLC 2018 - Proceedings of the 26th Annual Conference of the International Group for Lean Construction: Evolving Lean Construction Towards Mature Production Management Across Cultures and Frontiers, 2(0), 1375–1384. https://doi.org/10.24928/2018/0514

Taifa, I. W. R., & Vhora, T. N. (2019). Cycle time reduction for productivity improvement in the manufacturing industry. Journal of Industrial Engineering and Management Studies, 6(2), 147–164. <u>https://doi.org/10.22116/JIEMS.2019.93495</u>

Wang, X., Song, F., Wang, Y., & Lan, G. (2017). A method for determining the degree of freedom of workpiece based on developed geometry theorem. The International Journal of Advanced Manufacturing Technology, 92(9), 4553-4560.



# THE IMPACT OF HVAC SYSTEM TOWARDS ELECTRICITY CONSUMPTION IN TERM OF ENERGY SAVING

Nur Farahin Mazelan<sup>1</sup>, and Dr.Sr. Fadhilah Mohd Noor<sup>2</sup>

<sup>4</sup> Civil Department, Polytechnic Sultan Salahuddin Abdul Aziz Shah, Selangor farahin\_mazelan@yahoo.com fadhilah@psa.edu.my

#### Abstract

The HVAC system has evolved into a valuable asset that affects a building's performance in terms of the services it provides. A building fault can be defined in a variety of ways. Based on personal experience and observation, a building flaw was linked to energy waste, which resulted in unsatisfactory living conditions. There are a lot of reasons for this, including faulty control programming, design defects, mechanical degradation, and occupant behaviour, and etc. This research study intends to recommend the best practices to reduce the electricity consumption on HVAC system. The factors that impact on HVAC system is; the technology or system of hvac, users and cost that involve during operation and maintenance activities. The respondent's information was gathered using a descriptive survey technique. The target population, there were 60 respondents who represented all management levels, including facility managers, energy managers, and mechanical teams. The sample size was 57 respondents. A combination of qualitative and quantitative approaches will be used in this study in the form of graphs. The findings suggest that, the Variable Speed Drive (VSDs) controller was able to reduce electricity consumption, provide maximum comfort, ensure good HVAC equipment conservation and, most importantly, can save more than 34% of energy consumption.

**Keywords:** HVAC system, electricity consumption, energy saving and Variable speed drive (VSDs).



#### 1. Introduction

Today's attempts to reach the objective of Near Zero Energy Building Conditions have resulted in high levels of thermal insulation for building envelopes and high-efficiency HVAC systems for both hot and cold production (Paoletti et al., 2017). Although electricity is utilised to assist in the movement of HVAC components such as fans and pumps, the proportion of energy quota is particularly important in achieving the environmentally friendly according to the building occupants' need, which is previously discussed in term of improvements.

The household and business sectors consume the majority of energy. Heating, ventilation, and air-conditioning (HVAC) energy demand accounted for 30% of commercial building primary energy consumption and 39% of residential building primary energy consumption in 2018 (Chen et al., 2018). The implications are on energy usage and occupant quality of life, and one of the key goals of this study is to reduce energy use while maintaining thermal comfort. (2016, Isa et al.) The goal of this study is to enhance energy efficiency in HVAC systems, which is an important goal in the facility management (FM) business, by using Building Management Systems (BMSs) to control HVAC operations as well as other assets in the building.

Except in HVAC systems, a fundamental present to energy savings can be gained by installing a device that can adjust the motor speed based on the real requirement and building demand based on the size of the HVAC system. Variable speed drives (VSDs) are used to modify the rotational speed of electric motors and, as a result, the equipment that is powered by the motor (fans, pumps etc.). Apart from that, the VSD technology allowed the components to run in parallel and independently using Building Management Systems (BMSs), confirming the capacity to ensure quality. Variable speed motors, such as fans, pumps, and compressors, have components that perform differently depending on their speed changes.

Furthermore, the BMSs can be used to save data that is needed to assess the performance of the building-plant system, particularly the status of all operative systems and the resulting energy consumption. All of these data are used to model the likely results of several alternative operation procedures, with relevant comparisons and improvements has been made.



Finally, in the field of HVAC system service, a comfortable aspect was a basic element of energy conservation, environmental friendliness, the use of natural energy, lower the energy load, and should be the direction of future architectural design. The main purpose of this study is to attain zero energy consumption through reducing building energy consumption, as well as to create and promote new energy as a future resource replacement (Pang et al., n.d.)

#### 2. Literature Review

In the past years, the researchers have examined studies on the impact of HVAC system towards electricity consumprion in term of energy saving. Figure 1 shows the conceptual framework that influence the electricity consumption on HVAC system in building facility.

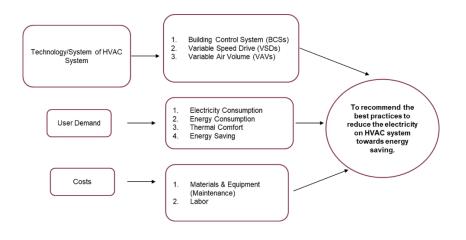


Figure 1: Conceptual Framework

## 2.1 Description of Technology/ HVAC system

Nowadays, due to rising costs for fossil fuel and reduction of resources, producing electrical energy from renewable sources and lowering the electrical usage in the government building become a huge topic addressing in the globe.



A building management system (BMS) is a complete platform that are currently installed to monitor and control a building's mechanical and electrical systems; it is used to manage loads and improve efficiency, reducing the amount of energy required to light, heat, cool, and air a structure (HVAC). The electric motors consume a significant amount of energy on a daily basis because most motors are used in HVAC (Heating, Ventilation, and Air Conditioning) systems as Air Handling Units (AHU) or Fan Coil Units (FCU) to provide comfort environment for their occupant. AHU is a huge metal box with blowers, motor, filter, cooling coil, heating coil, damper, and ductwork. It is responsible for supplying air to various regions of structures. But, the structure and the quantity of AHU components such as fans, ducts, and dampers should be designed based on the cooling load and zone capacity of the building.

The outside air can mix with return air from a room in the duct before being filtered. The air is then sucked into the heating or cooling coil by a fan or blower. Different zones of cool or hot air in the supply air duct might be created. FCUs are likewise part of an HVAC system and perform the same functions as AHUs. However, FCUs are often positioned in rooms and do not have ducts, whereas supply air from an AHU is delivered to rooms by ducts. Because the AHU system is more comprehensive and larger than the FCU system, the blower motor power (hp) in the AHU is substantially higher than in the FCU. To provide a comfortable environment for structures. The high energy consumption of the blower, dehumidification, and fresh air utilisation all contribute to the enormous amount of energy used.

The HVAC systems are powered by hot or cold water generated by heat exchangers in the building and are found in practically in government buildings, with mechanical space heating and cooling systems accounting for over 90% of floor space (Ru et al., 2018). By the exception of thermally triggered systems that use natural gas or district heating for space cooling system is driven by electricity (in the form of steam or hot water). The activities of the facility, building size, layout, climate, geographic region, existing equipment or distribution system, and other factors are influence the type of HVAC equipment utilised in a building.



The air flow rate of the AHU provides enough ventilation in the rooms. The CO2 sensor system is present. Each room has its own supply and return air ducts, allowing for independent ventilation control depending on CO2 concentrations detected by a CO2 probe installed in the return air duct of each room. Air dampers were installed in the supply and return air ducts immediately attached to the AHU. Static pressure sensors are installed downstream of the supply fan and upstream of the return fan, and linked to the fan speed controller (VSD) to maintain a constant air pressure in those areas. As a result, the control relies on the inverter devices that controlled the AHU's fans. A conventional PID algorithm controls synchronised movement of the air dampers and the fan speed controller. The performance of the system (VSD's) significant reduction in energy consumption. Many efforts have been made to develop the best practices for controlling HVAC systems in order to cut energy costs. This study has been conducted on small-scale for HVAC control issues (Dezfouli et al., n.d.).

#### 2.2 User Demand

One of the biggest causes of uncertainty in simulation systems' predictions of building energy usage is user which is the occupant behaviour. Building operation and, consequently, energy usage are strongly influenced by how occupants establish the comfort requirements (including thermal, visual, and acoustic), interact with building energy and services systems, and react to uncomfortable environmental conditions.

By opening and closing windows, dimming lights, turning on and off office equipment, operating HVAC systems, and establishing interior thermal, auditory, and visual comfort standards, occupant behaviour directly and indirectly influences the building's energy usage. Even amongst buildings serving the same purpose and situated in similar climes, measured energy usage of structures revealed significant variations. Behavioral studies that encourage changes in occupant behaviour resulted in energy savings of 5 to 30 percent.



Daily electricity consumption profiles from smart meters are explored as proxies of active behaviour regarding space heating and cooling. The influence of the environment air temperature on electricity consumption (Rahman et al., 2018).

## 2.3 Costs

The total investment costs of an HVAC system include both direct and indirect costs associated with transforming material and equipment design ideas into operational projects. The cost of all HVAC equipment, as well as the materials and labour needed in the actual installation of HVAC systems, account for the majority of direct costs. Indirect costs are associated with the support of direct construction required for a project's timely completion. Many design aspects influence investment cost, including an HVAC price index, HVAC technology, building type, building quality, and building regionality. Buildings that are constructed to satisfy the same or similar needs often necessitate varying costs due to design differences.

Cost modelling, according to (Cho et al., 2018), is a current methodology for estimating the projected cost of a proposed building project. Cost modelling, according to Ferry and Brandon, is a symbolic representation of a system that communicates the contents of that system in terms of factors that determine its costs. Clients will influence business decisions in anticipation of reliable projections at the early stage of construction projects, and investment cost is a key measure of the project's success.

Because of the rising importance and complexity of modern structures, which have a substantial impact on the relative costs to the total cost of building projects, effective cost management of HVAC systems in buildings is highly desirable for industry stakeholders. The demand for specialised quantity surveyors, who are responsible for cost control of HVAC systems, has increased as a result of the rising complexity and cost sensitivity of HVAC systems.



## 2.4 The Conclusion

Based on the article, the independent variables are shown that the HVAC system is the main factor that influence on reducing the electricity consumption for HVAC system in term of energy saving. In the field of air conditioning, comfortable and become a basic subject in today's architecture and design of energy conservation, environmental protection, use of natural energy, reduce the energy load, become the direction of the future architectural design. Reduce building energy consumption has also been a HVAC researchers goal, strive to achieve zero energy consumption, and also has a lot of scholars have made great contributions in this area. At the same time, we should also actively develop new energy, and promote new energy such as solar energy, geothermal energy, and atomic energy.

# 3.0 Research Methodology

## 3.1 Research Design

This research used a mixed method approach (quantitative & qualitative) in combination to provides a better understanding for research problems. The mixed method study uses for the research design is to analyze the impact of HVAC System on electricity consumption in terms of energy saving.



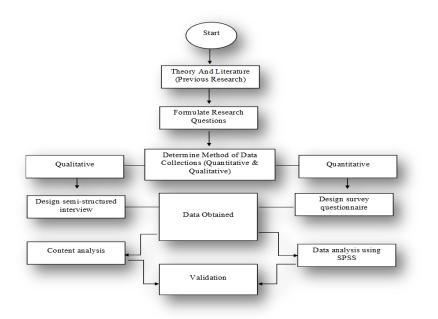


Figure 2: Research Design

## 3.2 Research Instrument

The research instrument used to recommend the best practices to reduce the electricity consumption on HVAC system by conducting the questionnaire and interview survey to the respondent for each building that was selected.



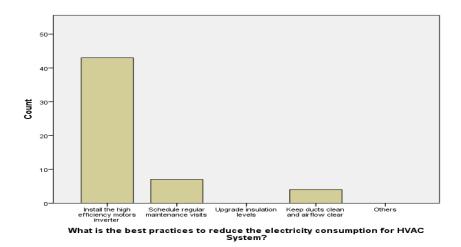
#### 4.0 Findings and Discussion

Building	Total	Total
	Population	Respondent
Menara Usahawan	(MU) <b>15</b>	14
Kementerian	10	9
Perumahan	dan	
kerajaan temp (KPKT)	batan	
Kementerian I Tinggi (KPT)	<sup>D</sup> engajian <b>15</b>	14
Kementerian Pela dan Kebudayaan (MOTAC)	ancongan <b>10</b>	10
Kementerian Wila Persekutuan (KWP)		10
Total	60	57

## Table 1: Target Population

This research involved 5 buildings, it includes, Menara Usahawan, Kementerian Pengajian Tinggi, Kementerian Perumahan dan Kerajaan Tempatan, Kementerian Pelancongan dan Kebudayaan and Kementerian Wilayah dan Persekutuan. Out of 57 from 60 participants answered this survey.





# Figure: What is the best practices to reduce the electricity consumption for HVAC system.

From the diagram, it shows more than 40 respondent agree that install the high efficiency motor inverter are the best practices to reduce the electricity consumption for HVAC system for each building involve.

Besides that, less than 10 respondent chose schedule regular maintenance visits could reduce the electricity consumption on HVAC system due to Indoor air quality (IAQ) factor that requires regular maintenance in order to remain the HVAC system in good operating order.

Apart from that, About 5 respondents believe that keeping ducts clean and airflow clear will minimise the electricity usage. It's because a clear ducting allows for unrestricted ventilation and improves air quality for consumers and preventing from sick building syndrome occurred in the building.

The inference that can be drawn from finding is that variable speed drive (VSDs) is importance to reduce the electricity consumption on HVAC system because the VSDs allows to control motor speed which promote for energy saving. The implication of the



result is most of the respondent was agreed that the variable speed drive use to reduce the bills of electricity for HVAC system. Therefore, it is recommended that essential for the building to installed the variable speed drive to other equipment that use electricity to power on. Besides that, VSDs also may enhance the efficiency of equipment and its life expectancy.

## 5.0 Conclusions

In conclusion, the striking variables in results obtained that most of respondents agreed with the level of thermal comfort, the amount of power used, and the efficiency of VSDs to meet the user comfort. Additionally, it reduces the building owner's monthly power bill expenses. Besides that, from respondents' opinions and responses, the study concluded that the respondents perceive the impact of HVAC systems on power usage to reach the energy saving requirement. These results demonstrate that the respondents' level of awareness for energy saving and environmental-friendly is good according to the positive feedback from respondent in this survey question.

The author discovered that studies of the impact of HVAC system towards electricity consumption in term of energy saving have been efficiently explored. This study's purpose was achieved. This has been demonstrated through data analysis obtained.

## 6.0 References

## Website:

Miu, Y. (2017, May 13). Analysis of HVAC Energy Saving Technology. Atlantis Press. <u>https://www.atlantis-press.com/proceedings/icmeit-17/25876617</u>.

Pang, Z., Chen, Y., Zhang, J., O'Neill, Z., Cheng, H., & Dong, B. (2020). Nationwide HVAC energy-saving potential quantification for office buildings with occupant-centric controls in various climates. Applied Energy, 279, 115727. <u>https://doi.org/10.1016/j.apenergy.2020.115727</u>.

Paoletti, G., Pascual Pascuas, R., Pernetti, R., & Lollini, R. (2017). Nearly Zero Energy Buildings: An Overview of the Main Construction Features across Europe. Buildings, 7(4), 43. <u>https://doi.org/10.3390/buildings7020043</u>.



Rahman, A., Srikumar, V., & Smith, A. D. (2018). Predicting electricity consumption for commercial and residential buildings using deep recurrent neural networks. Applied Energy, 212, 372–385. <u>https://doi.org/10.1016/j.apenergy.2017.12.051</u>.

Schibuola, L., Scarpa, M., & Tambani, C. (2018b). Variable speed drive (VSD) technology applied to HVAC systems for energy saving: an experimental investigation. Energy Procedia, 148, 806–813. <u>https://doi.org/10.1016/j.egypro.2018.08.117</u>.

Shi, W., Jin, X., & Wang, Y. (2019). Evaluation of energy saving potential of HVAC system by operation data with uncertainties. Energy and Buildings, 204, 109513. <u>https://doi.org/10.1016/j.enbuild.2019.109513</u>.

Watcharapongvinij, A., & Therdyothin, A. (2017). Energy cost saving evaluation of VSD installation in compressor rack of refrigeration system for the retail and wholesale building. Energy Procedia, 138, 8–13. https://doi.org/10.1016/j.egypro.2017.10.036.



# A STUDY ON IMPROVING THE DESIGN OF THE INSPECTION TABLE

Rais Rosli<sup>1</sup>, Hainol Akbar Zaman<sup>2</sup>

<sup>1,2</sup>Department of Mechanical Engineering, Polytechnic Sultan Azlan Shah, 35950 Behrang, Perak. <sup>1</sup>muhamaraisrosli@gmail.com <sup>2</sup>hainolzaman@gmail.com

#### Abstract

The first stage of the cowhide is to process the cowhide into a wrapping material which is called as cut stock. The cowhide will go through initial cowhide inspection before going through any cutting processes and cut stock inspection will be conducted to inspect the cut stock after the cutting process to make sure that the cut stock produced is free from defect. The natural defects, such as healed scars, growth lines, and rough surfaces, prevented the cowhide inspection process form accurately identifying flaws on the leather surface. The observation of the cowhide inspection process demonstrates that when inspection is conducted without proper lighting or lighting equipment, the operator is unable to effectively identify leather defect. Therefore, this research will help with the design of the inspection table.

Keywords: Leather, Inspection Table, Design

## 1. Introduction

Leather has always been the symbol of luxury which can come in the form of variety of products such as handbags, clothes, furniture, and footwear. Leather is a natural product that is made from animal skin like snake, cow, goat, and crocodile. Exporting can increase country's earnings in export sector, like in Bangladesh (Shahriar et al., 2019).



Even though it is a lucrative industry, leather typically has natural flaws that occur during production or as a result of the animal's lifestyle during its lifetime, which lowers the quality and cost of the leather.

Lucid Production Line is one of the production lines in Company Z which producing center console as shown in Figure 1.1. The majority of the vehicle components, including the side panel, reare storage, bezel, air vent, and the armrest, are made from cowhide. Cowhide that has been processed into "cut stock", or cowhide that has the shape of the console part, is needed. Before becoming cut stock, the cowhide must go through several processes, including cowhide inspection, marking, pre-cutting, die cutting, and cut stock inspection. The ready-to-use cut stock is depicted in Figure 1.1.



Figure 1.1: Lucid cut stock

This research focuses on designing the Inspection table for the Cowhide Inspection Process. Besides, the project also aims to make sure that the marking table and lighting source are appropriate for marking cowhide. The purpose of the proposed new design inspection table is to improve the working condition for the operator during inspection of the cowhide. The scope of this study is Cowhide Inspection Process. The concept design of the inspection table is redesigned using CATIA V5.

1.2 Problem statement

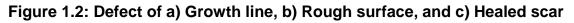
The cowhide inspection process's inability to successfully screen out cowhide defects was the root of the issue. This is due to the fact that the most common types of reject are caused by growth lines, healed scars, and rough surfaces, all of which are inherent



defects. This type of defect should be filtered during the cowhide inspection process before going through other processes.



a) Growth line b) Rough surface c) Healed scar



Based on the observation, it was found that the operator inpecting the cowhide without proper lighting sources caused the defect to spread to other processes. Additionally, the lighting was reduced as the operator examined the cowhide from top to bottom due to the table' current angle of 80<sup>o</sup> verticals as portrayed in Figure 1.3



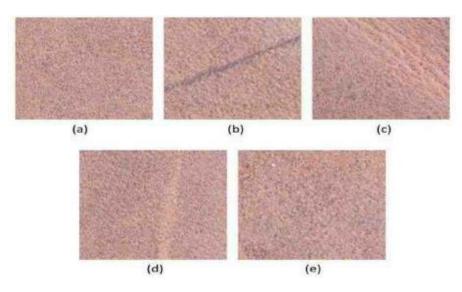
Figure 1.3: Cowhide Inspection Process

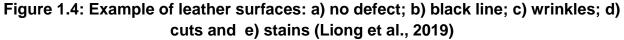


#### 2. Literature review

#### 2.1 Natural Defects of Leather

It is necessary to guarantee that the leather used is defect-free to ensure that the product is of high-quality leather goods. Most leather pieces, usually show signs of their natural provenance, such as bug bites, cuts, stains, and wrinkles. Figure 1.4 shows an example of a natural leather surface. During the filtering process, these flaws should be recognized and eliminated (Liong et al., 2019).

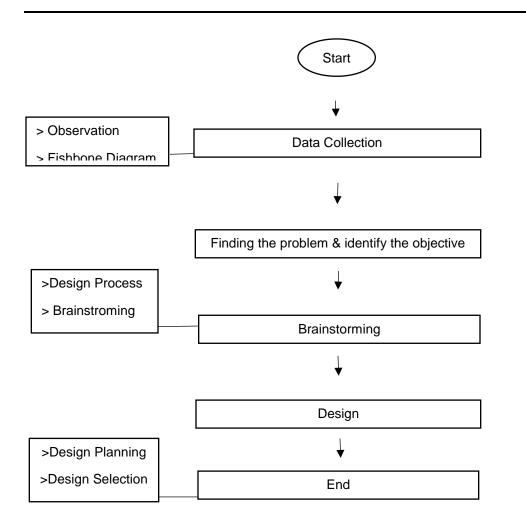




#### 3. Methodology

The overview on the overall research methodology and operation steps as shown in Figure 1.5 are required in achieving the objectives of this project (Radhwan et al., 2019).





## Figure 1.5: The overall research methodology (Radhwan et al., 2019).

## 3.1 Data Collection

#### 3.1.1 Observation

Data was gathered through observation method. Using this method, researchers must be present at the research location to gather data. Observational data collecting techniques are categorized as participatory studies. The study involves gathering information about the cowhide inspection procedure through observation. The information obtained shows the operator doing the inspection process without proper lighting equipment and angle of



the table was not ideal for the inspection process. The implementation of new inspection table is expected to reduce the rejection rate for the cowhide cut stock.

#### 3.1.2 Fishbone Diagram

One of the seven quality control tools is the fishbone diagram, which helps people organise their thoughts into useful categories and discover probable sources of the issues. This tool is helpful for identifying issues with the inspection cowhide process. The fishbone diagram gives a summary on the difficulties that occur during the Cowhide Inspection Process. The Figure 1.6 depicts the problem with the inefficient cowhide inspection process that results in a high rate of rejection of cowhide cut stock.

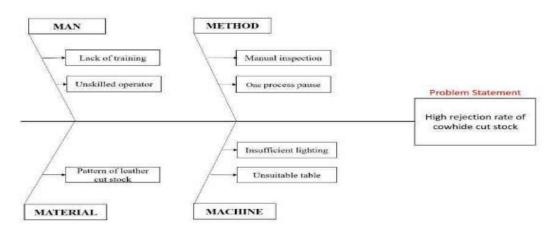


Figure 1.6: Fishbone Diagram

#### 3.2 Brainstorm

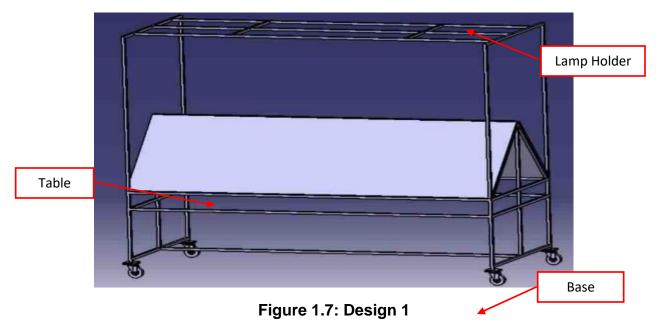
Design teams often employ brainstorming to come up with answers to particular design problems. One method of brainstorming involves enhancing similar items over time continuously. Studying existing goods that are similar to those being developed or the specific challenges that need to be solved allows for continuous improvement. Continuous improvement might bring light to ideas that have been employed in the past to address a specific issue. To generate broad concepts that may be used in the new product, the designer gathers comparable items.



The engineering design process is one of the stages in the product development process that deals with design. The problem that needs to be solved and what needs to be accomplished at this point should be made crystal clear during the inspection table design phase. Following the report, a design that satisfies the requirements for creating an inspection table that supports the operator's daily work has been selected. The design is enhanced, and the 3D sketch design is created using CATIA software. Plans, drawings, and algorithms that describe how something will be accomplished are all parts of the design process.

#### 3.3 Design selection

The process of choosing the best thought for more research comes after assessing the relative strengths and weakness of the concepts. The process of reducing the possibilities that have been explored is often known as idea selection. The final table design was evaluated using the screening method as shown in Table 1.1. this method will ease the designers in choosing the best design. The design concept for the inspection table is depicted in Figure 1.7 for design 1 and Figure 1.8 for design 2. Each concept consists of three main parts which are lamp holder, table, and base that are designed using Catia V5.





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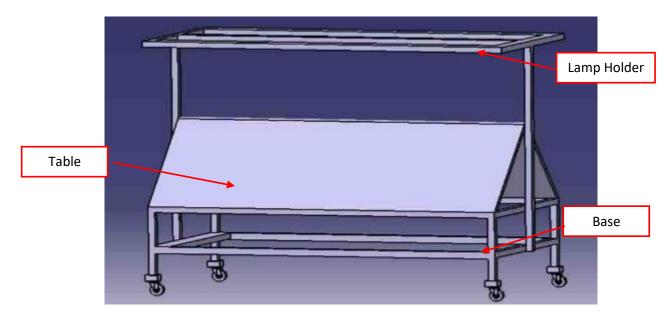


Figure 1.8: Design 2

Criteria	Design 1	Design 2
Ease of Handling	/	/
Ease to Maintenance	/	/
Durability	/	/
Portability	/	/
Ease of Manufacture		/
Quantity material used to manufacture		/
Total Score	4	6

#### 3.4 Final Concept

The final design concept, as shown in Figure 1.9, is chosen based on the score of the screening method, where the design 2 is opted. This final concept design, makes it simple to handle the cowhide by allowing for more space under the table without the lampholder stand getting in the way. The table in design 2 uses less material to manufacture. This will make design 2 easier to manufacture because of the simplicity of the design. The



base for design 2 uses less material, which also lowers the cost of manufacturing the inspection table.

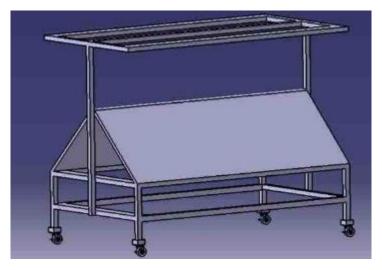
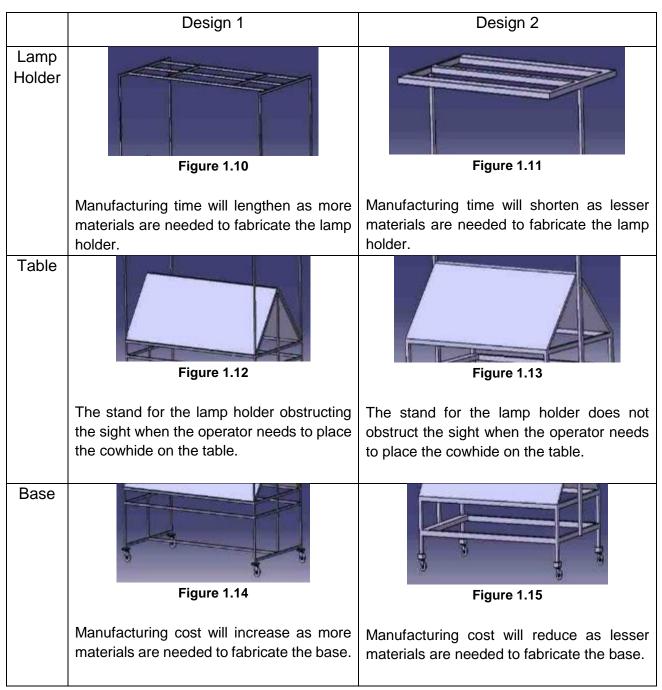


Figure 1.9: Final concept

#### 4. Result and Discussion

Based on the factors in Table 1.2, a new inspection table design is chosen. Table 1.2 compares design 1 and design 2 based on the characteristics of lamp holder, table, and base.





### Table 1.2 Comparison between design 1 and design 2

Table 1.2 shows that lamp holder in design 2 is uses lesser material to manufacture. This reduces the time to manufacture. Moreover, the table in design 2 have bigger working



space than Design 1. The stand for lamp holder will not obstruct the operator when placing the cowhide on the table. In terms of the specification of the base, design 1 has more complex design that uses more materials to manufacture. This will cause the cost of the inspection table to increase.

#### 5.0 Conclusion

The main function of the inspection table major function is to ease the operator during inspection of cowhide. The goal of this project is to provide a new design for a Cowhide Inspection Process. By comparing each design base on the three criteria, which lamp holder, table and base, the final design of inspection table, which is design 2 has been selected as the best design. The design simplicity is a criterion for selection. The objectives of the study is successfully achieved at the end of this project where the data are completely collected, the design of the inspection table is successfully developed and finally, all the comparison between both designs has been successfully presented.

#### References

- Liong, S.-T., Gan, Y. S., Liu, K.-H., Binh, T. Q., Le, C. T., Wu, C. A., Yang, C.-Y., & Huang, Y.-C. (2019). *Efficient Neural Network Approaches for Leather Defect Classification*. http://arxiv.org/abs/1906.06446
- Radhwan, H., Effendi, M. S. M., Farizuan Rosli, M., Shayfull, Z., & Nadia, K. N. (2019). Design and Analysis of Jigs and Fixtures for Manufacturing Process. *IOP Conference Series: Materials Science and Engineering*, 551(1). https://doi.org/10.1088/1757-899X/551/1/012028
- Shahriar, A., Zohra, F.-T.-, Murad, A. B. M. W., & Ahmed, S. (2019). Enhancement of Waterproofing Properties of Finished Upper Leather Produced from Bangladeshi Cow Hides. *European Journal of Engineering Research and Science*, 4(7), 63–71. https://doi.org/10.24018/ejers.2019.4.7.1426



# FACTORS AFFECTING ON EMPLOYEES' PERFORMANCE IN AN ORGANIZATION

Rashika Nair Paramasveran and Raja Nurul Waheeda Binti Raja Zilan

Civil Engineering Department, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor rashikanair97@outlook.com

#### Abstract

This survey was conducted to determine the effect of employee performance on the organization. The study used four variables: employee motivation, job design, management style, and working conditions. This survey used a descriptive survey design and used surveys to collect data. The target population consisted of 235 respondents from all selected management levels and categories selected by respondents using stratified random sampling techniques. The sample size was 140 respondents. The findings were analyzed and presented using quantitative methods in the form of charts, tables, and graphs. The results show that employee motivation, work design, management style, and working conditions are positively related to employee performance. The purpose of this study is to recommend the most appropriate strategies to improve the performance of employees in your organization.

**Keywords:** Employee Performance, employee motivation, job design, management style, and working conditions

#### 1. Introduction

In today's corporate world, there are numerous problems. Due to the arrival of new competitors and the implementation of novel business methods by established organizations, corporate houses are facing intense competition in the market. There are many tools that have been used in many organizations in order to manage employee performance such as The 360-Degree Appraisal, Manager Performance Appraisal,



Employee Self-Assessment, Sales Performance Appraisal, and Management by Objectives (MBO), and many more. This research examines and investigates the factors affecting on employee performance in an organization

Employee efforts are managed by performance management, which is based on measured performance outcomes. As a result, establishing what constitutes good performance and how to measure the various facets of high performance is crucial to the development of an effective performance management strategy.

. Companies must rethink how they hire, train, and reward their personnel in orderorganizenise themselves successfully (Ying, 2012).

Employee performance is critical to the success of a firm. Originally, employee performance was defined as what an employee did or did not do. Quantity of output, quality of output, timeliness of output, presence at work, and cooperativeness are all examples of employee performance.

The reason I chose this research topic is that more oganizationsions today rely on their employees for success and competitiveness especially in a commercial building like all the Ministry building in Putrajaya. Employees, according to the resource-based perspective, are an organization's resources and assets. As a result, organisations must devise strategies for identifying, encouraging, measuring, evaluating, improving, and rewarding employees' work performance. As we all are probably aware, good and efficient facilities management has a lot of advantages. Many of these advantages are self-evident, such as increased health and safety, equipment longevity, reduced chance of shutdown, and greater cost effectiveness. However, there are some benefits that are less evident, such as employee and productivity benefits. According to a study, happy employees might result in a 20 percent improvement in production. Employees will profit as well as the organisation when they feel important and their job has a positive influence. The demand for facility management is more than ever before, thanks to the modern workforce. Workplaces are now being used to attract and retain top personnel while also increasing overall productivity.



#### 2. Literature Review

Performance management is a corporate management technique that assists managers in monitoring and evaluating the performance of their staff. The purpose of performance management is to create an atmosphere in which people can perform to their full potential and deliver the highest-quality work in the most efficient and effective way possible. It is a process of developing and implementing motivational tactics, interventions, and drivers with the goal of transforming human resource potential into performance." Every human being has the capacity to excel in one or more functional domains. However, for a variety of reasons, the exploitation and conversion of this potential into deliverable performances is frequently suboptimal. According (Rindi Nurlaila Sari, 2014) that by reducing intermediate hurdles and encouraging human resources, performance management functions as an agent in converting potential into performance. Performance is defined as deploying and managing the components of the causal model that lead to the timely attainment of stated objectives within constraints specific to the firm and to the situation (Rindi Nurlaila Sari, 2014).

According to the AMO model, employee performance is a product of their ability, motivation, and opportunity to engage. This means that an organisation will benefit the most if it organises the work process in such a way that non-managerial employees have the opportunity (O) to contribute discretionary effort, which can be accomplished by giving them decision-making autonomy, providing good communication, and allowing employees to join self-directed and/or off-line teams. Employees must have the necessary skills and knowledge to be effective in their efforts (A). As a result, businesses can do this by attracting individuals who already have this knowledge or by giving formal and/or informal training to staff. Finally, the corporation must motivate these personnel to put up their best effort on behalf of the company. A general performance management considers such problems: What are the key objectives that are central to the organization's overall future success, and how does it go about evaluating its achievement for each of these objectives? What strategies and plans has the organization adopted and what are the processes and activities that it has decided will be required for it to successfully implement these? How does it assess and measure the performance of these activities? What level of performance does the organization need to achieve in each of the areas defined in the above two questions, and how does it go about setting appropriate performance targets for them? What rewards will managers (and other



employee) gain by achieving these performance targets (or conversely, what penalties will they suffer by failing to achieving them).

Work facilities are a means or vehicle or tool to facilitate the activities of the company and also for the welfare of employees so that employees can carry out their work properly (Pratiwi et al., 2019). A review of literature in FM over recent years indicates a trend towards performance measurement, particularly for strategic development. Performance measurement in FM will be seen in two ways, according to a review of FM literature. The first is as a "critical success factor" in strategic planning, and the second is as a learning process within the FM firm. The latter is a process by which an FM organisation aligns itself with its environment by acquiring information from the marketplace or through scientific knowledge generation and applying it to organisational development activities. Similarly, the satisfaction of a successful performance is an intrinsic reward."" This will be followed by the next performance, and so on. Volunteerism, personal development, the creation of mutually beneficial cooperation, and full engagement must all be cultivated in order to attain professional performance.

### 2.1 Expectancy theory

Parijat & Bagga, (2014) focused on the mental process that occurs within an individual when it comes to change. This theory places a strong emphasis on self-interest in relation to expected actions, rewards, and organizational objectives. This paradigm separates effort and general performance, as well as the outcome. It interprets the action as the outcome of a subconscious decision to maximize pleasure while avoiding suffering. Expectancy is introduced, which is the strength of an employee's preference for a specific type of reward.

#### 3. Research Methodology

#### 3.1 Research Design

Quantitative research is defined as a systematic investigation of phenomena by gathering quantifiable data and performing statistical, mathematical, or computational techniques. Quantitative research collects information from existing and potential



customers using sampling methods and sending out online surveys, online polls, questionnaires, etc., the results of which can be depicted in the form of numerical. According to Kothari and Garg (2014), research design is an arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure (Kothari & Garg, 2014). For this research will be using the quantitative method and the instrument that is used is questionnaire.

#### 3.2 Population

The research involved 225 respondents randomly selected from a total population of 235 employees of the six building which is Menara Usahawan, Kementerian Perumahan dan Kerajaan Tempatan and Kementerian Pengajian Tinggi, Kementerian Wilayah Persekutuan, Kementerian Pelancongan dan Kebudayaan Malaysia and Kementerian Perdagangan Dalam Negeri dan Hal Ehwal Pengguna Malaysia. 10 respondents were also randomely selected for pilot test. Therefore, only 225 responded were involved in the survey. This sample size has been selected given the limited time and financial constraints of this study.

#### 4. Data Analysis and Findings

#### Likert Scale Questions

Respondents were subjected to a number of statements regarding motivation where they were required to indicate their extent of agreement on them using a five-point scale where 1 was Strongly Disagree (SD), 2 was Disagree (D), 3 was Neutral (N), 4 was Agree(A) and 5 was Strongly Agree (SA).

#### **Employee Motivation**



Items	SD	D	Ν	А	SA
Recognition by my manager/supervisor for a job well-done is very important to me	0	0	55(25%)	75(34%)	90(41%)
I am motivated by our reward system and it makes me perform better	66(30%)	88(40%)	11(5%)	4(2%)	53(24%)
Our company uses monetary rewards like base pay, commissions, bonus incentives and health allowances to make us perform better	154(70%)	66(30%)	0	0	0
I regularly receive constructive feedback from my superiors	0	0	0	103(47%)	117(53%)
The challenges that my job provides motivates me to perform better	59(27%)	84(38%)	24(11%)	20(9%)	33(15%)

Table 4.1 above shows the results of employee motivation

They were asked to indicate their extent of agreement on whether recognition by my manager/supervisor for a job well-done is very important to them. 55(25%) were neutral, 75(34%) agreed while 90(41%) strongly agreed to it. They were also asked to indicate whether they are motivated by the reward system and it makes them perform better. 66(30%) strongly disagreed, 88(40%) disagreed, 11(5%) were neutral, 4(2%) agreed while 53(24%) strongly agreed. They were to indicate whether the company uses monetary rewards like base pay, commissions, bonus incentives and health allowances to make them perform better. 154(70%) strongly disagreed, while 66(30%) disagreed. They were also to indicate whether they regularly receive constructive feedback from their superiors. 103(47%) agreed while 117(53%) strongly agreed. They were also to agree whether challenges that their jobs provide motivates them to perform better. 59(27%) strongly disagreed, 84(38%) disagreed, 24(11%) were neutral, 20(9%) agreed while 33(15%) strongly agreed.



#### Working Condition

Items	SD	D	Ν	А	SA
My furniture is comfortable enough to enable me perform my job without getting tired	48(22%)	70(32%)	42(19%)	42(19%)	18(8%)
My workplace provides an undisturbed environment without any noise that gives me alone time to perform my duties	0	0	51(23%)	134(61%)	35(16%)
There are no cases of harassment and bullying at the workplace	0	0	33(15%)	139(63%)	51(23%)
I love my work environment	0	0	68(31%)	101(46%)	48(22%)
The culture and emotional climate of the organization is generally positive and supportive	88(40%)	68(31%)	31(14%)	15(7%)	18(8%)

Table 4.2 above shows the results of working condition

Respondents were asked their extent of agreement on whether their furniture was comfortable enough to enable them perform their jobs without getting tired. 48(22%) strongly disagreed, 70(32%) disagreed, 42(19%) were neutral about it, 42(19%) agreed while 18(8%) strongly agreed. They were also to agree whether their workplace provides an undisturbed environment without any noise that gives them alone time to perform their duties. 51(23%) were neutral, 134(61%) agreed while 35(16%) strongly agreed. They were also asked to indicate their extent of agreement on whether there were no cases of harassment and bullying at the workplace. 33(15%) were neutral, 139(63%) agreed while 51(23%) strongly agreed. They were also asked to agree on whether they love their work environment. 68(31%) were neutral, 101(46%) agreed while 48(22%) strongly agreed with this statement. They were finally asked to indicate their extent of agreement on we generally positive and supportive. 88(40%) strongly disagreed, while 68(31%) disagreed, 31(14%) were neutral about it, 15(7%) agreed whereas 18(8%) strongly agreed with this statement.



#### Job Design

Items	SD	D	Ν	А	SA
I am required to use a number of high-level skills while conducting my job	20(9%)	22(10%)	13(6%)	158(72%)	7(3%)
This job involves completing a piece of work that has no beginning and end	0	0	48(22%)	75(34%)	97(44%)
My job gives me the opportunity to organize how I should do it	0	1(0.45%)	57(26%)	154(70%)	7(3%)
The work activities themselves give coordinated and clear data approximately the adequacy of my work performance in terms of quality	0	0	51(23%)	48(22%)	121(55%)
This work barely gives me the chance to characterize it	46(21%)	99(45%)	20(9%)	42(19%)	20(9%)

Table 4.3 above shows the results of job design

They were asked their extent of agreement on whether they are required to use a number of high-level skills while conducting their job. 20(9%) strongly disagreed, 22(10%)disagreed, 13(6%) were neutral, 158(72%) agreed while 7(3%) strongly agreed. They were also asked to indicate their extent of agreement on whether their jobs involve completing a piece of work that has no definite beginning and end. 48(22%) were neutral, 75(34%) agreed while 97(44%) strongly agreed. They were also asked to indicate whether their jobs give them the opportunity to organize how they should do it. 1(0.45%)disagreed, 57(26%) were neutral, 154(70%) agreed while 7(3%) strongly agreed. They were also asked to indicate their extent of agreement on whether the work activities themselves provide direct and clear information about the effectiveness of their job performance in terms of quality. 51(23%) were neutral, 48(22%)agreed while 121(55%)strongly agreed. They were to finally indicate whether their jobs hardly provide them the chance to define it. 46(21%) strongly disagreed, 99(45%) disagreed, 20(9%) were neutral, 42(19%) agreed while 20(9%) strongly agreed.



#### **Management Style**

Items	SD	D	Ν	А	SA
The department has a clear division of responsibilities	0	0	68(31%)	121(55%)	29(13%)
Senior management give staff a clear picture of the direction in which the organization is headed hence about it motivating me to perform better	18(8%)	88(40%)	20(9%)	70(32%)	24(11%)
I am actively involved in the decision-making process	88(40%)	66(30%)	22(10%)	26(12%)	20(9%)
The internal dealings of my company with employees are done with integrity	68(31%)	110(50%)	11(5%)	7(3%)	24(11%)
The organization encourages us to always come up with innovative ideas.	84(38%)	92(42%)	11(5%)	11(5%)	22(10%)

Table 4.4 above shows the results of management style

An extent of agreement was required on a statement that asked whether the department had a clear division of responsibilities. 68(31%) were neutral about this, 121(55%) agreed while 29(13%) strongly agreed. They were asked whether senior management give staff a clear picture of the direction in which the organization is headed hence motivating them to perform better. 18(8%) strongly disagreed, 88(40%) disagreed 20(9%) were neutral about it, 70(32%) agreed about it while 24(11%) strongly agreed about it. They were also asked whether they are actively involved in the decision-making process. 88(40%) strongly disagreed, 66(30%) disagreed, 22(10%) were neutral, 26(12%) agreed while 20(9%) strongly agreed. They were asked their extent of agreement on whether the internal dealings of the company with employees are done with integrity. 68(31%) strongly disagreed, 110(50%) disagreed, 11(5%) were neutral 7(3%) agreed while 24(11\%) strongly agreed. Finally, they were also asked whether the organization encourages them to come up with innovative ideas. 84(38%) strongly disagreed, 92(42%) disagreed, 11(5%) were neutral, 11(5%) agreed while 22(10%) strongly agreed.

#### 5. Conclusion, Discussion and Recommendation



#### Discussion

#### What are the factors that impact on employees' performance?

This research aims to find factors that affect the performance of employees working in facility management. Employee motivation, job design, management style, and working conditions were the factors of this research. The target population for this study was 225, while the sample size was 136 employees at the headquarters of the organization. The data was collected through a self-administered questionnaire sent to respondents. Of the 225 questionnaires, 220 (98%) are often answered as, which is suitable for analysis. The results were presented quantitatively using tables, graphics, and figures.

#### How to analyze the factors that impact on employees' performance?

#### **Employee Motivation**

Respondents were asked to show whether employee motivation impacts the performance of the

employees in the facility management organization. Most of the total of respondents say it actually affects employee performance. This clearly shows that there is a positive relationship between employee performance and employee motivation, which is also consistent with previous study, which reached the same conclusion. Motivation within an organization increases efficiency and enables employees to meet their personal needs, achieve organizational goals, and build good relationships with themselves within the organization.

#### **Working Conditions**

Most respondents said that working conditions affect employee performance. This was consistent with previous researchers who suggested a positive link between management style and employee performance. Companies need to improve the working conditions of their organizations in order to improve employee performance. Such positive attributes include: Good emotional climate and generous work environment for employees.



#### Job Design

Respondents were asked to comment on whether job design impacts employee performance. From the data, we can conclude that most respondents said they were actually affecting employee performance. This is in fact consistent with previous research, suggesting that there is a positive link between employee performance and job design. There were goals for each employee to be achieved in the organizational environment. Some want the to succeed in a rewarding job, some want the opportunity to introduce their innovations to the organization, and some are very familiar with their day-to-day operations. The nature of an individual's work depends on the individual's personality, and productivity is achieved when these needs are met.

#### Management Style

Respondents were also asked to show whether their management style had a positive relationship with employee performance. The majority of respondents agreed that it would actually affect the performance of employees. This is consistent with previous researchers who concluded that there was a positive link between management style and employee performance. A balanced management style is critical to an organization's ability to achieve better employee performance and competitive advantage. However, the research also showed that participatory management styles have a more positive relationship to employee performance when compared to other management styles.

# What are the most effective strategy which could be implemented to improve employees' performance?

Most of the respondents are not very satisfy of the reward system that is offer by the company. Therefore, increasing or enhancing the rewarding system like incentives, payfor-performance.

Not only that, employee does not feel motivated due to less involvement in the company and less development activities that is provided by the company. Thus, most of the respondents suggest to enhance the training and development program or activities in the company.



#### Conclusion

From the above survey, it is clear that there is a certain relationship between employee motivation and the performance of employees. The majority of employees find it important for managers to admit that their work was successful. Most employees are not happy with the compensation system. This could be due to management using bonus which does not apply to everyone. Management style has a positive relationship with employee performance. Organizations have a clear division of responsibilities, and their managers are motivated to perform better with clear information and instructions. Working conditions have something to do with employee performance. The environment within the organization is well-enhanced and promotes the performance of people within the organization. Job design is also actively associated with employee performance. Most of the work of employees requires high qualifications and is not routine.

#### References

Asih, I. P. (2020). Key Performance Indicators: A Systematic Literature Review. Journal of Strategy and Performance Management, 8(4), 142-155. Retrieved from <u>Https://Www.Researchgate.Net/Publication/344493860\_Key\_Performance\_Indicators\_</u> <u>A Systematic\_Literature\_Review</u>

Awan, S. H., Habib, N., Shoaib Akhtar, C., & Naveed, S. (2020). Effectiveness of Performance Management System for Employee Performance Through Engagement. SAGE Open, 10(4). <u>https://doi.org/10.1177/2158244020969383</u>

Amaratunga, D., & Baldry, D. (2002). Moving from performance measurement to<br/>performance management.Facilities,20,217–223.https://doi.org/10.1108/02632770210426701

Achieng, O. E., Ochieng, I., & Owuor, S. (2014). Effect of Job Redesign On Employee Performance in Commercial Banks In Kisumu, Kenya. Greener Journal of Business and Management Studies, 115-137.



Aroosiya, M., & Ali, H. (2013). Impact of Job Design on Employees' Performance;With Special Reference to School Teachers in the Kalmunai Zone. Journal of Management, Volume VIII No. 1,

Chandra, R. G., & Saraswathi, A. B. (2018). Impact of performance management system on employee performance- a conceptual framework for it organizations. International Journal of Civil Engineering and Technology, 9(6), 412–420.

Irtwange, S. V., & Orsaah, S. (2009). Impact of management style on performance indicators of Academic staff. Educational Research and Review Vol. 4 (12),, 602 615.



# THE ROLE OF LINE BALANCING METHOD IN PRODUCTION IMPROVEMENT: A CASE OF MOTORCYCLE PRODUCTION LINE.

Muhammad Irfan Fariel Danial Bin Mohd Sukri<sup>1</sup>, Mohammad Al Bukhari Bin Marzuki<sup>2</sup>

> Department of Mechanical Engineering, Polytechnic Sultan Azlan Shah Behrang, Perak farieldanial82 @gmail.com mohammad @psas.edu.my

#### Abstract

Line balancing is a production method that involves balancing the number of workers and time to match the total output to the cycle time. An assembly line is considered balanced when the production time and the cycle time are exactly equal. This paper is conducted to increase the productivity of the assembly line by balance the working task on each workstation. Particularly, an unbalanced workload on the specific workstation has led to the line stoppage that occurs on the assembly line. Therefore, bottlenecks and excess capacity should be reduced by rearranging production components such as the process, machinery, materials, and workers. To put it another way, the amount of manpower allocated to each activity on the assembly line has been rebalanced to maximize production. A result from the process optimization shows that the improvement of workload on the workstation with the average stoppage time reduced from 68 minutes to 52 minutes. In addition, the production output improved by 29% compared with the earlier unoptimized production process.

Keywords: Line Balancing, Assembly Line, Bottlenecks, Balance Workload,

#### **1.0 Introduction**

The automotive industry is one of the most important industrial companies over the world. In Malaysia, the use of motorcycles is becoming more popular from time to time. This is



conducted at company X located in Malaysia. Company X is one of the biggest automotive industries in Malaysia that produced parts and assembled motorcycles.

This paper will be focusing on the efficiency of the assembly line based on six models of the motorcycle. The two-sided assembly line is currently being used for the motorcycle assembly at company X and is known as R and L sided workstation. The two-sided assembly line is

a sequence of paired stations, each having opposing and opposite workstations, that must be shared and processed (Li et al., 2017).On both the left and right sides, two cooperative employees at each matched station perform the jobs in parallel (Rachmawaty et al., 2018).

Assembly is a crucial industrial activity, and designing assembly lines is a requirement that is essential to put it in place (Dolgui et al., 2017). An assembly line is one of the critical parts that need to be considered in the automotive industry to gain the target planned output. Assembly lines are manufacturing systems with sequentially arranged workstations where operations (tasks) are performed in a continuous manner (Dolgui et al., 2017). The assembly line consists of a sequence of workstations connected by a transporter system, such as a conveyor or an autonomous guided vehicle (Naderi et al., 2018). The assembly line is utilized for the high-volume production of standardized goods. The assembly of goods is divided into several tasks. The finished product will be separated into multiple parts on the assembly line, with each part assigned to a specific workstation. (Kharuddin et al., 2020). The current production line has a total of 18 stations that currently performing the assembly process and there is a connection between tasks on a two-sided assembly station. Initially, the model of the motorcycle will move between workstations and a specific task will be carried out. The process of motorcycle assembly at company X consists of a two-sided workstation starting from station 1 until 18. This process is being run based on the conveyor that currently moving along the station until it is complete.

Production output is the critical part that needs to be concerned. High demand from customers day by day is one of the challenging problems that need to be solved. This problem has occurred since the demand from customers increased every month. Hence, the production output needs to be increased followed by the demand from customers. To obtain the desired performance, an improvement needs to be made to the current



performance of the assembly line. According to Hindriyanto et al., (2013), the assembly line must be balanced by assigning a task to each workstation in a way that meets demand while also maintaining the requirement.

The bottleneck effect occurred during the production process as a result of an unbalanced workload allocation across workstations and the time required by each workstation to complete its task (Kharuddin et al., 2020). Based on the task given on the specific workstation, the workload is unbalanced on a specific workstation which has led to the line stoppage time that occurs on the assembly line. Figure 1 shows the daily line stoppage for the production line in September 2021.

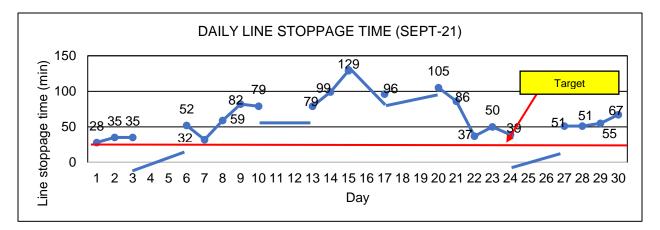


Figure 1: Daily stoppage time

In this paper, by clarifying the problem statement that is currently happening on the assembly line, the objective has been set by optimizing the production line by utilizing the line balancing method focusing on working tasks at the motorcycle assembly process. Two parameters are essential for this study, which are production output and line stoppage which directly affect the output at the assembly line.

#### 2.0 Literature Review

The scope of the study focuses on how the project to be developed should be through reference sources to obtain relevant information.



#### 2.1 Production Line Balancing

Production line balancing is a great model for improving the production process. Line balancing ensures that all operators and machines work together in a balanced workload. Hence, no machine or operator should be overworked or idle. By eliminating downtime on the production line, line balancing helps to prevent waiting waste.

Therefore, a balanced production line is stable and adaptable enough to accommodate workers and machines that perform in a fully synchronized manner.

The production line balancing is good since it can Maximizes workforce utilization and production capacity, Reduces the amount of idle time in workstations, Improves the rate of production and the output quality of the produced items, and finally helps to create the right number of workstations and the number of operations to have in each station.

The Assembly Line Balancing (ALB) can differ from one manufacturing company to another. Each company faces its specific characteristics and requirements to utilize the available resources with more productivity. Hence, a customized procedure for each assembly line must be developed to meet all these unique requirements (Naderi et al., 2018). Developing a mathematical model for realistic variants of the ALB problem has been still attracting the attention of many researchers.

The Assembly Line Balancing Problem (ALBP) has developed over time in the manufacturing industry. If production-line configuration is improved, then costs will be reduced and each workstation's workload will be balanced (Chen et al., 2018). Common types of production lines include one-sided, two-sided, and multi-manned assembly lines. This differentiation is depending on the number of operators at each workstation. Due to its simplicity and industrial applicability, the ALB family of combinatorial optimization has been widely investigated intensively.

#### 2.2 Assembly Line

An assembly line is a type of manufacturing method that is commonly used to massproduce standardized commodity items (Eduardo et al., 2020). Assembly lines are



production systems in which work-in-progress moves sequentially from station to station. At each workstation, new parts are assembled or new processes is performed, eventually resulting in a final product. Particularly, unfinished items pass through a series of workstations on an assembly line.

The two-assembly line is currently being used for the motorcycle assembly at company X. Two-sided assembly line is a set of tasks that must be shared and processed on a set of the mated station, each containing two opposing and opposite workstations (Li et al., 2017). Two cooperative workers on each mated station operate the tasks in parallel on both left and right sides (Rachmawaty et al., 2018). Figure 2 shows the working operation of the two-sided assembly line.

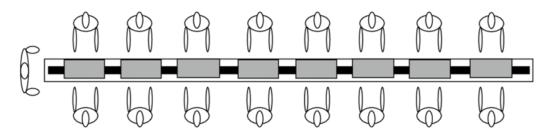


Figure 2: Two-sided assembly line

Source: Jurado y Taborda, 2006.

#### 2.3 Assembly Line Balancing Problem (ALBP)

The assembly line is a sequence of workstations containing work elements (Jha et al., 2017). Each work element has a task time, which is the average amount of time required to perform the elemental task. The collective time of all the workstations is the total work content that determines the total time for the assembly. Assembly Line Balancing Problem (ALBP) refers to the distribution of tasks to each station using a particular optimization technique under constraints such as procedure relationship, cycle time, and so on. A well-balanced assembly line can maintain an efficient production and operation system (Zhong et al., 2019)



Accordingly, the Two-Sided Assembly Line Balancing Problem (TALBP) has grown increasingly attractive to researchers worldwide (Li et al., 2017). With the development of logistics automation, the assembly line balancing technology and optimization theory are constantly being improved and matured. The ALB is to assign all the work units of the product to each workstation on the assembly line so that each workstation is busy during the cycle time to achieve the most operations and minimize the idle time of each workstation. The ALB directly affects the productivity of the manufacturing assembly line balance system (Jiao et al., 2021).

### 3.0 Methodology

The line balancing method has been done for six models of the motorcycle. This paper is being conducted by classifying the part name, task, and workload on each station. The method for collecting data has also been identified in this section. Based on the problem statement that has been obtained, a few methods and analyses have been done to achieve the objective. The methodology used in this research work consists of the assembly balancing technique as performed by Jha et al., (2017), Naderi et al., (2018), and Eduardo et al., (2020).

3.1 Line Balancing Technique

In this research, the line balancing method has been used to analyze the pitch time, total task time, and the efficiency of the flow process for the model motorcycle on the assembly line. The method has been conducted based on the total task time, pitch time, neck time, and the operation ratio of the worker to find the line efficiency on the specific model of a motorcycle at the assembly line. The following formula is described.

3.1.1 Total Task Time,  $T_t$ 

The time that is needed for the specific motorcycle to complete the whole process. The total task ( $T_t$ ) time is measured in minutes (min).

3.1.2 Pitch Time,  $P_t$ 



Pitch time ( $P_t$ ) is the time required for each process to complete its task on each station. This term is currently described in minutes. 85% of workers' working operation has been considered.

 $P_t = \frac{P_T P_D}{OPD} \times 85\%$ 

Production time per day =  $P_T P_D$ 

Output per day = OPD

3.1.3 Line Balance Ratio, LBR

Line balance ratio ( $LB_R$ ) is also known as the efficiency of the flow production line for a specific model. The line balance ratio is being calculated to analyze the efficiency and the work balance on each workstation during the assembly process is being run.

$$LB_R = \frac{T_t}{No \text{ of worker x Nt}} \times 100$$

#### 3.2 Method use

The workstation for the assembly line has a total of 18 stations for both left and right. In detail, the one workstation consists of one worker to do the task. Each station has its own process and task that need to do by the worker for each model of the motorcycle at the production line. Each workstation has a specific distance that separates the station before and after. This distance is currently called the pitch distance. Currently, the pitch distance is 2.6 meters on the production assembly line.

Based on the method and step that has been classified before. The method that is being performed to do is by rearranging the task on each workstation to be well balanced. By considering the objective that has been stated, the current workstation will be added from



18 to 24 stations. This method is being used to reduce the workload and time on each station by adding 6 more stations on the assembly line.

This method is utilized to reduce the cycle time on each workstation. According to (Bon et al., 2018) Manufacturing industry is focused on reducing cycle time on the assembly line. Therefore, to achieve this, the pitch distance between workstations needs to be rearranged. According to (Zhang et al., 2007), adding more workstations will increase the length of the production line. However, in this project, the method is done by reducing the pitch distance between workstations to 2.4 m/pitch for 24 stations. This is reliable since the total distance of the conveyor is 60 m. Figure 3 shows the distance between workstations after being improved. According to (Tamura et al., 2011) the conveyor speed and station lengths can be adjusted to avoid the line stoppage.

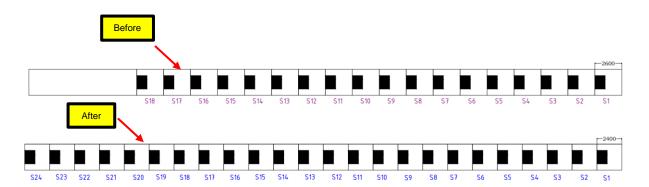


Figure 3: Distance between workstations - before and after

To obtain the best result, the comparison has been made before and after improvement based on the line balance ratio, total task time, line stoppage, and the production output.

#### 4.0 Result and Discussion

The implementation of line balancing techniques is the most important part of solving the line assembly problem. The use of line balancing techniques is the best since the workload on each workstation can be classified. By updating the current process that is



being done by the worker on each workstation, the calculation has been recorded and the result is being discussed.

$$P_t = \frac{P_T P_D}{OPD} \times 85\%$$

 $P_t = \frac{480}{250} \times 85\%$ 

= 1.6 min

The target of output has been set by 250 units of motorcycle per day by the 480 min of the production time. Hence, the pitch time required is 1.6 min on each station for all six models of motorcycles. Figures 4 and 5 show the result has been obtained before and after adding six more workstations to the assembly line. After adding six more workstations to the assembly line. After adding six more pitch time required to follow the output of 250 units per day. In detail, to ensure that the assembly line is running without or a little stoppage, the total task time must not exceed too much than the pitch time required which is 1.6 min per pitch.

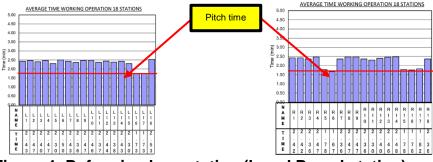
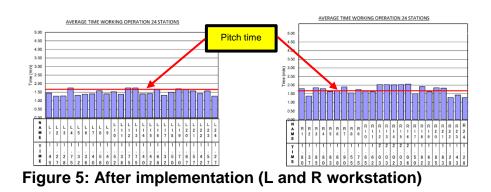


Figure 4: Before implementation (L and R workstation)





The result for all six models by using a line balancing method has been compared. The calculation has been made based on the line balance ratio and the total task time to complete the whole process. The comparison has been made before and after the improvement, table 1 and 2 show that the total task time is slightly reduced before and after improvement. Even though, the line balance ratio or the work balanced has not too much different. However, the time required for each workstation is reduced by following the 1.6 min pitch time.

	18 Workstations					
	Left workstation		Right workstation			
Model	Line Balance Ratio	Total Task Time (min)	Line Balance Ratio	Total Task Time (min)		
Model 1	92.70%	42.20	89.90%	40.14		
Model 2	83.30%	43.20	82.00%	42.80		
Model 3	81.20%	36.98	92.10%	38.18		
Model 4	78.50%	31.08	72.80%	27.24		
Model 5	81.50%	21.71	82.20%	24.11		
Model 6	89.60%	31.92	88.20%	31.74		

Table 1: Line balance ratio and total task time – before

Table 2: Line balance ratio and total task time – afte



#### r

	24 Workstations					
	Left workstation		tion Right workstation			
Model	Line Balance Ratio	Total Task Time (min)	Line Balance Ratio	Total Task Time (min)		
Model 1	85.10%	35.75	83.90%	33.6		
Model 2	85.60%	32.47	87.00%	31.95		
Model 3	83.80%	32.20	87.10%	30.12		
Model 4	81.10%	26.21	83.40%	24.78		
Model 5	91.30%	19.13	90.00%	20.12		
Model 6	81.30%	25.67	82.60%	24.54		

#### 4.1 Daily Line Stoppage

Daily line stoppage is being recorded based on the average line stoppage time that occurs during the assembly process on the production line for all six models of motorcycles. The data has been recorded based on the four months as shown in figure 6. It is shown that the line stoppage has been reduced after the implementation of six more workstations on the assembly line.

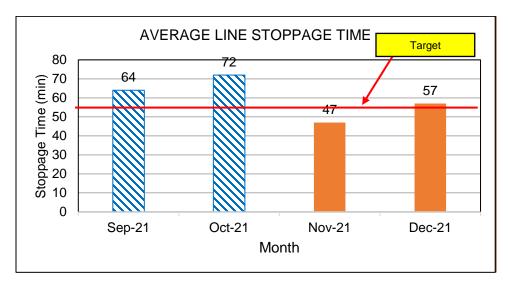


Figure 6: Average line stoppage comparison



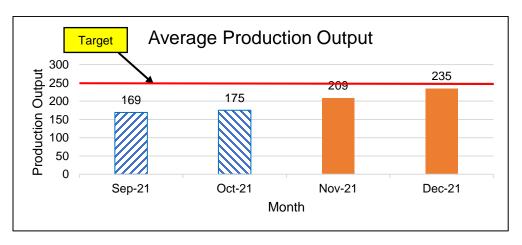
Line stoppage becomes an important objective function for the production sequencing problem in the assembly line (Okamura et al., 2004). Table 3 shows the result has been obtained that the line stoppage is being reduced from an average of 68 min to 52 min after improvement is made. The improvement is 23.5%.

	Before		Af	ter
Month	Sep-21	Oct- 21	Nov-21	Dec-21
Line Stoppage time (min)	64	72	47	57
Average (min)	68 52			2
%Difference	23.5%			

# Table 3: Line stoppage time – before and after

# 4.2 Production Output

Data for total production output has been collected to see the improvement of the production unit that has been produced by the assembly line after the implementation is being done. Figure 7 shows the average daily production output for the four months.







The comparison has been made to differentiate the average total output that has been produced after line balancing for six models is done. The improvement can be seen in that the total production output is being increased to reach the target output. Table 4 shows the average difference of the target that before and after improvement. Assembly line will not increase or effect the line output unless additional workstations are added (Zhang et al., 2007). The result has been obtained from an average of 172 to 222 units after improvement by 29% compared with the earlier unoptimized production process.

	Bef	ore	Af	ter	
Month	Sep- 21	Oct-21	Nov-	Dec-	
WORT	21	001-21	21	21	
Output	169	175	209	235	
Average	172 222				
%Difference	29%				

Table 4: Output average (monthly)

#### 5.0 Conclusion

The line balancing technique is an effective technique that can be used to reduce the cycle time, increase the production output and reduce the line stoppage on the production assembly line. By using the line balancing technique for six models of motorcycles on company X to improve the efficiency of the production, the data has been shown that a significant improvement can be achieved to improve the daily production output and reduce the line stoppage. Based on the task given on the specific workstation, the workload is unbalanced on a specific workstation which has led to the line stoppage time that occurs on the assembly line. Hence, the improvement has been made by adding six more workstations on the production assembly line to reduce the workload and cycle time on each workstation for L and R workstations. The result has been obtained by reducing the workload on each workstation, reducing the line stoppage from an average of 68 min to 52 min, and finally increase the production output by 29%.



#### References

- Bon, A. T., & Samsudin, S. N. A. (2018). Productivity Improvement in Assembly Line by Reduction Cycle Time using Time Study at Automotive Manufacturer. In Proceedings of the International Conference on Industrial Engineering and Operations Management Bandung, Indonesia, March (pp. 6-8).
- Chen, Y. Y., Cheng, C. Y., & Li, J. Y. (2018). Resource-constrained assembly line balancing problems with multi-manned workstations. Journal of Manufacturing Systems, 48, 107-119.
- Dolgui, A., and Gafarov, E. (2017). Some new ideas for assembly line Balancing. International Federation of Automatic Control. p2255–2259
- Eduardo Álvarez-Miranda, Sebastián Chace & Jordi Pereira. (2020). Assembly line balancing with parallel workstations. International Journal of Production Research. DOI:10.1080/00207543.2020.1818000
- Eduardo Alvarez-Miranda, Jordi Pereira. (2019). On the complexity of assembly line balancing problems. International Journal of Production Research. DOI: https://doi.org/10.1016/j.cor.2019.04.005
- Hindriyanto, D, P., Wee, H, M., Raua, H. (2013). Two-sided assembly lines balancing with assignment restrictions. Mathematical and Computer Modelling. p189–199
- Li, Z., Kucukkoc, I., & Nilakantan, J. M. (2017). Comprehensive review and evaluation of heuristics and meta-heuristics for two-sided assembly line balancing problem. Computers & Operations Research, 84, 146-161.



Jha, P. S., & Khan, M. S. (2017). An experimental study on the automotive production line using

assembly line balancing techniques. Int J Mech Eng Technol, 8(3), 22-33.

- Jiao, Y, L., Jin, H, Q., Xing, X, C., Li, M, J., Liu, X, R. (2021). Assembly line balance research methods, literature and development review. *Concurrent Engineering: Research and Applications.* Vol. 29(2) 183–194. https://doi.org/10.1177/1063293X20987910
- Kharuddin, M, H., Ramli, M, F. (2019). A Review on Methods to Improve and Balance the Assembly Line. *Conf. Series: Materials Science and Engineering.* doi:10.1088/1757-899X/767/1/012022
- Naderi, B., Azab, A., & Borooshan, B. (2018). A realistic multi-manned five-sided mixedmodel assembly line balancing and scheduling problem with moving workers and limited workspace. *International Journal of Production Research*, DOI:10.1080/00207543.2018.1476786
- Tamura, T., Okumura, T., Singh Dhakar, T., & Ohno, K. (2011). Optimal production sequencing problem to minimise line stoppage time in a mixed-model assembly line. International Journal of Production Research, 49(14), 4299-4315
- Zhang, R., Chen, D., Wang, Y., Yang, Z., & Wang, X. (2007). Study on Line Balancing Problem Based on Improved Genetic Algorithms. 2007 International Conference on Wireless Communications, Networking and Mobile Computing. <u>https://doi.org/10.1109/wicom.2007.508</u>
- Zhong, Y., Deng, Z., Xu, K. (2019). An effective artificial fish swarm optimization algorithm for two-sided assembly line balancing problems. Computers & Industrial Engineering. https://doi.org/10.1016/j.cie.2019.106121



# EFFECT OF WORKPLACE ENVIRONMENT ON FACILITIES MANAGEMENT EMPLOYEES' PRODUCTIVITY

Nur 'Azlynda binti Mejeli<sup>1</sup> and Sumaini binti Che Maid<sup>2</sup>

Civil Engineering Department, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor alyn.mejeli@gmail.com sumaini06@gmail.com

#### Abstract

A positive working environment is one that fosters employee safety, progress, and achievement of goals. When it comes to employee satisfaction and productivity, the workplace environment has been a major influencing element. The most prevalent reason for poor productivity at work may be traced back to workers' failure to get enough training, lack of management support, poor workplace design, low work incentive and outdated tools and equipment. This research objectives aims to identify and analyse the factors of workplace environment that affect the facilities management employees' productivity and to suggest an improvement of workplace environment in enhancing the facilities management employees' productivity. This research will use the deductive method in the form of quantitative approach. The instruments used in this study was questionnaire for data collection.

**Keywords:** Workplace Environment, Employees' Productivity, Facilities Management Employee

#### 1. Introduction

Every organisation, in general, aspires to boost staff productivity. When there are fewer absences, fewer workers depart early, and fewer breaks, productivity is assessed in certain circumstances (Atmaja & Puspitawati, 2018).



Employee performance is influenced by a variety of elements, the most significant of which is training, which improves workers' skills. Employees with more on-the-job experience tend to perform better since their abilities and competences improve as a consequence of their increased on-the-job experience (Kenny S, 2019). Every day, workers conduct out job tasks in their work environment. A pleasant working atmosphere gives workers a feeling of security and helps them to perform at their best. Employee emotions are influenced by their work environment (Atmaja & Puspitawati, 2018).

Facility management, or facilities management as it is more generally known, has been labelled as inner service, business infrastructure management, including building asset management. It has evolved into a diverse industry in most nations as a result of the merger of building maintenance management and business support services (Atkin & Bildsten, 2017). Facilities management is vital to any institute's huge infrastructure's long existence. The higher education institution's core objectives of teaching, learning, and research would be supported by these facilities. Human resources rely on facilities to achieve the organizational objectives. Acquiring the top students and sustaining great employees were indeed two crucial aims for institutions. FM is defined as a multifunctional profession that integrates people, location, process, and technology in order to assure the operation of the built environment (Oladokun & Ajayi, 2018).

In terms of employee work productivity, there are two aspects that may be influenced by quality and physical ability of workers, as well as the supporting facilities that are made available. Workplace and employee wellbeing are examples of supporting amenities (Setiyanto & Natalia, 2017). It is the organization's job to define procedures and to communicate them via documentation and communication. The business should determine what drives its workers and should have official and informal procedures in place to reward employees who act appropriately. Internal incentives, such as difficult tasks, may be combined with external benefits, such as increased remuneration and peer recognition (Massoudi & Hamdi, 2017). Also, space components such as office furniture, which includes desks and chairs, as well as the file system, shelves, and drawers, among other things, have a specific role to play in the productivity and efficiency of workers, as well as the proper operation of any office (Hamidi et al., 2020).



The most prevalent reason for poor productivity at work may be traced back to workers' failure to get enough training in their respective fields (Fida-E Zaheer, 2019). According to a research conducted by the Society for Human Resource Management, approximately one-fifth of workers have left their positions in the previous five years. The cause for this was a hostile workplace environment (Anuradha Mansinghka & Namratha Mohan, 2021). When a worker's efforts are not properly recognised, he or she might get depressed and this can lead to suicide. They get demotivated, which results in a drop in production (Rabbir Shad, 2021). This research objectives aims to identify and analyse the factors of workplace environment that affect the facilities management employees' productivity and to suggest an improvement of workplace environment in enhancing the facilities management employees' productivity.

#### 2. Literature Review

A literature review is a written summary of significant texts and other materials on a certain subject. This chapter will discuss the theoretical underpinnings of research measures. Review of the literature will serve as a foundation for developing the research model. A conceptual framework is developed that focuses on the factors affecting the workplace environment. Numerous earlier studies have examined the influence of the workplace environment on the productivity of facilities management employees. Figure 1 shows the following sub-topic in this chapter is based on the five constructs that have been developed in the research conceptual framework.

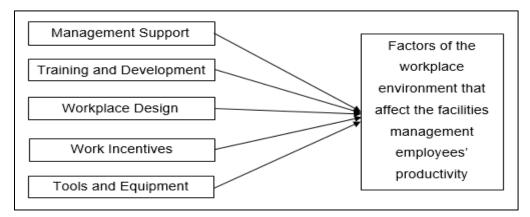


Figure 1: Conceptual Framework



#### 2.1 Management Support

(Wangechi & Ndeto, 2019) study on influence of workplace environment on employee productivity in Nairobi City County, stated that having a constructive two-way communication will ensure that there is the greatest possible interaction between supervisors and their employees, resulting in a clear understanding and an improved personal such as working connection between them. Additionally, holding periodic meetings with employees can assist in addressing any grievances that may have been brought to the attention of management. (Zafar et al., 2017) study on factors of workplace environment that affects employee performance in an organization, stated that the leadership role is critical to the development of strong interpersonal relationships and individual self-confidence on a personal level, which implies that firms must select highly talented and informed persons for these positions. (Maduka & Okafor, 2014) stated that the influence of motivation on staff productivity is of critical importance to the business. It is imperative that management of manufacturing firms in Nnewi strives to adopt good and positive motivational techniques in order to keep up with the current dynamic rate of business trends. This is especially true in order to increase the morale of the workers towards productivity and performance.

#### 2.2 Training and Development

(Sabir et al., 2014) stated that training provides advantages for both the person and the organisation by favourably affecting employee performance through the development of employee knowledge, skills, ability, competences, and behaviour. Training is beneficial to both the employee and the company. It has been shown that the more intensely motivated a trainee is, the more rapidly and methodically he or she will learn a new skill or information. (Zafar et al., 2017) stated that the three major reasons why a company gives training and development to their workers are to boost employee productivity and performance, fulfil corporate goals, and enable individuals to succeed in situations where they would have failed without the training. The capacity of any business to develop its human resource to be creative, innovative, and imaginative is critical to its survival in a competitive society. This will inevitably result in improved performance and increased competitive advantage for the firm. (Sani Abdullahi et al., 2018) stated that training and development are critical components of an organization's overall efficacy and efficiency. It is one of the most often used approaches for boosting employee performance and increasing the productivity of an organization's workforce. Informally, new employee are trained by trial and error, self-assessment and reflection, and questioning.



# 2.3 Workplace Design

In today's world, firms must realise the value of their workforce and focus more on the needs of their workers. In this setting, firms must place a greater emphasis on the layout and design of the workplace. Actually, it should be set up in such a way that people are sufficiently motivated to perform effectively in the firm. (Hansika & Amarathunga, 2017) stated that the office environment has an immediate and direct influence on employee productivity, both favourably and adversely. If the office environment can be improved, it will lead to increased employee productivity. On the other hand, if the workplace atmosphere is not well organised, it will reduce staff productivity. Better results and higher productivity are expected as a result of a more positive workplace environment. A better physical atmosphere in the office will motivate employees and, as a result, increase their productivity. (Burbar, 2021) stated the layout of the facility, which is the organisation of workplace, encourages interaction. In general, it can free up access to facilities that must interact with one another in comparison to allowing employees access to tools, processes, and persons. Also, the layout of a facility serves comparable tasks in both service and manufacturing businesses.

# 2.4 Work Incentives

(Wangechi & Ndeto, 2019) stated that the reward system motivates workers to be timely at work and work even harder since the county government's management takes their well-being into account, and by recognising their contribution, they feel appreciated by the organisations they serve. (Zafar et al., 2017) study on factors of workplace environment that affects employee performance in an organization, stated that rewards are benefits that employees receive from their employer in addition to their salary for completing a specific task or responsibility. These benefits, such as cash, verbal or written praise, recognition, or any combination of these, are a key element for their motivation, increasing levels of productivity, and playing a role in employee retention. The majority of businesses consider incentives as a technique of inspiring certain behaviours in their personnel. Specifically, awards are meant to incentivize workers to work successfully and efficiently in order to achieve corporate objectives. (Eshun & Duah, 2018) observe that, regardless of the kind of organisation under consideration, incentives play a significant role in fostering and sustaining the commitment among employees that is necessary to maintain a high level of performance and workforce stability. Rewards are one of the most significant components in motivating employees to put forth their best effort in order to



produce innovative ideas that will improve business operations and ultimately improve the financial and non-financial performance of the organisation

# 2.5 Tools and Equipment

When materials are not available in time for use during normal production, it has an adverse effect on productivity. Any delay results in a disruption, which has a negative impact on productivity. In the same way, not having the proper tools and equipment, or having to wait for them, has an impact on the guality and progress of the work, and thus on its productivity (Ailabouni, 2010). According to (Holly McGurgan, 2017) stated employees' degree of familiarity with equipment and software might also have an impact on their productivity. It is impossible to achieve peak performance and production if staff do not understand how to use equipment and software, or if they use it incorrectly. Problems can also arise when your existing equipment is insufficient to meet the demands of your department. It is expensive to upgrade equipment and tools, as well as to provide continual training to personnel, yet it is necessary for sustaining or boosting overall production. According to (Qualee, 2021) stated providing employees with the appropriate tools has a direct influence on their productivity at work. Employees who are not properly taught may cause delays in the job and mismanagement of resources, which may result in financial losses for the organization. Employee disengagement is caused by poor management tactics and a lack of access to critical equipment. This results in decreased individual production performance, efficiency levels, and overall productivity in the workplace.

# 3. Research Methodology

To find out the factor of workplace environment that can affect the facilities management employees productivity, this research will use deductive method which is a quantitative to collect data.



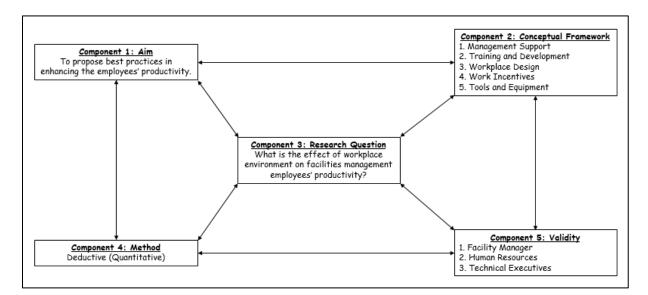


Figure 2: Research Design

Figure 2 shows the research design for the study effect of workplace environment on facilities management employees' productivity. The study aims to propose best practices in enhancing the employees' productivity. There are five factors of workplace environment that may affect the facilities management employees' productivity such as management support, training and development, workplace design, work incentives and tools and equipment. The study main research question is what is the effect of workplace environment on facilities management employees' productivity. The research method that will be use in this study is deductive method, which purely utilize quantitative approach. The research instrument that will be use in this study is questionnaire. Last but not least, for the validity will be verify by the Facility Manager (FM), Human Resource (HR) and Technical Executive.

#### Conclusion

The goal of any organisation is to increase employee productivity. Productivity is measured in certain situations when there are fewer absenteeism, fewer employees leave early, and fewer breaks. A number of factors, including training, which enhances employees' abilities, have an impact on employee performance. Employees with more on-the-job experience often perform better because as a result of their greater on-the-job experience, their talents and competencies grow. Workers do their job duties at their



workplace every day. A positive work environment offers employees a sense of security and encourages them to deliver their best effort. Workplace environments have an impact on employee feelings. Building asset management, inner service management, and corporate infrastructure management have all been used as labels for facility management, or facilities management as it is more often known. Building maintenance management and business support services have merged, creating a varied market in the majority of countries. The long-term viability of any massive infrastructure depends on effective facility management. Facilities management is described as a multifunctional profession that combines people, place, process, and technology to ensure the built environment operates as intended.

#### References

- Ailabouni, N. (2010). Factors Affecting Employee Productivity In The Uae Construction Industry Nabil Ailabouni A thesis submitted in partial fulfilment of the requirements of the University of Brighton for the degree of Doctor of Philosophy September 2010 School of Environment. University of Brington, September, 396.
- Atkin, B., & Bildsten, L. (2017). Editorial: A future for facility management. *Construction Innovation*, *17*(2), 116–124. https://doi.org/10.1108/CI-11-2016-0059
- Atmaja, N. P. C. D., & Puspitawati, N. M. D. (2018). Effect of Physical Work Environment Through Productivity Employess Job Satisfaction As An Intervening Variable. *International Journal of Business, Economics and Law*, 17(5), 98–104.
- Burbar, M. Y. (2021). The Impact of Work Environment on Employees' Performance in Banking Sector in Palestine. *International Business Research*, 14(8), 85. https://doi.org/10.5539/ibr.v14n8p85
- Hamidi, N. N. E., Mansor, F. A., Hashim, M. Z., Muhammad, N., & Azib, W. N. H. W. (2020). The Relationship between Physical Workplace Environment and Employees' Performance. *Journal of Contemporary Social Science Research*, *4*(1), 56–67.



- Hansika, W. A. M., & Amarathunga, P. A. B. H. (2017). Impact of Office Design on Employees' Productivity; A Case Study of Banking Organizations of North Western Province in Sri Lanka. SSRN Electronic Journal, 622–636. https://doi.org/10.2139/ssrn.2910255
- Holly McGurgan. (2017). *Top Problems That Affect Employee Productivity*. https://careertrend.com/top-problems-affect-employee-productivity-13627.html
- Kenny S, V. (2019). Employee Productivity And Organizational Performance: A Theoretical Perspective. *Munich Personal RePEc Archive*, 93294, 1–11.
- Maduka, C. E., & Okafor, O. (2014). Effect of Motivation on Employee Productivity: A Study of Manufacturing Companies in Nnewi. *International Journal of Managerial Studies and Research*, 2(7), 137–147. www.arcjournals.org
- Massoudi, D. A. H., & Hamdi, D. S. S. A. (2017). The Consequence of work environment on Employees Productivity. *IOSR Journal of Business and Management*, *19*(01), 35– 42. https://doi.org/10.9790/487x-1901033542
- Oladokun, S. O., & Ajayi, C. A. (2018). Assessing users' perception of Facilities Management services in a Public University: A case study approach. *Journal of Facility Management Education and Research*, 2(2), 62–73. https://doi.org/10.22361/jfmer/00071
- Qualee. (2021). 6 Factors Affecting Productivity & Engagement In The Workplace. https://www.qualee.com/blog/6-factors-affecting-workplace-productivityengagement
- Sabir, R. I., Akhtar, N., Ali, F., Bukhari, S., Nasir, J., & Ahmed, W. (2014). Impact Aof Training on Productivity of Employees. *International Review of Management and Business Research*, *3*(2), 595. www.irmbrjournal.com



- Sani Abdullahi, M., Lawan Gwadabe, Z., Bature Ibrahim, awiyya, & Author, C. (2018). Effect of Training and Development on Employee'S Productivity Among Academic Staff of Kano State Polytechnic, Nigeria. *Asian People Journal (APJ)*, 1(2), 264–286. www.journal.unisza.edu.my/apj/www.journal.unisza.edu.my/apj/264%7C
- Setiyanto, A. I., & Natalia. (2017). Impact of Work Environment on Employee Productivity in Shipyard Manufacturing Company. *Journal of Applied Accounting and Taxation*, 2(1), 31–36. http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=128869928&site= ehost-live
- Zafar, M., Karim, E., & Abbas, O. (2017). "Factors of Workplace Environment that Affects Employee Performance in an Organization": A study on Greenwich University of Karachi. *Munich Personal RePEc Archive*, 78822, 1–24. https://mpra.ub.unimuenchen.de/id/eprint/78822%0A



# FAKTOR – FAKTOR YANG MEMPENGARUHI KOS PENYELENGGARAAN DI DALAM KERJA – KERJA PENGURUSAN FASILITI

Ali Ikram Kusnin<sup>1</sup> and Zuriati Abdul Majid<sup>2</sup>

<sup>1</sup>Jabatan Kejuruteraan Awam, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor aliikram.dub@gmail.com zuriati@psa.edu.my

#### ABSTRAK

Setiap bangunan mempunyai fungsi tertentu yang bersesuaian dengan tujuan bangunan tersebut dibina. Setiap bangunan yang sedang digunakan perlu diselenggara dengan baik agar bangunan tersebut dapat terus berfungsi dengan baik untuk tempoh yang lama. Namun begitu, timbul isu terhadap kos penyelenggaraan yang terlalu tinggi untuk memastikan sesuatu bangunan terus berfungsi dan boleh mempengaruhi prestasi pengurusan penyelenggaraan untuk sesuatu bangunan. Oleh hal yang demikian, kajian ini telah mengenalpasti serta menganalisa faktor - faktor yang mempengaruhi kos penyelenggaraan seterusnya memberikan cadangan kaedah yang boleh diimplikasikan untuk mengurangkan kos penyelenggaraan serta cadangan untuk menambah baik prestasi pengurusan penyelenggaraan. Kajian ini menggunakan data yang dikumpul secara kualitatif iaitu kaedah pemerhatian dan kaedah temubual separa struktur. Analisis yang didapati berdasarkan pengumpulan data dapat dilihat bahawa kos bahan, kos upah tenaga kerja dan lantikan kontraktor pihak ketiga menjadi faktor yang mempengaruhi kos penylenggaraan. Dapatan kajian menunjukkan penggunaan bangunan dan fungsi bangunan menjadi faktor peningkatan kos penyelenggaraan untuk sesebuah bangunan. Sumbangan kajian ini menjadi rujukan kepada pasukan pengurusan fasiliti untuk mengurangkan kos penyelenggaraan sesebuah bangunan.

**Kata Kunci:** Kos penyelenggaraan, pengurusan fasiliti, pengurusan penyelenggaraan, fungsi bangunan



#### 1. PENGENALAN

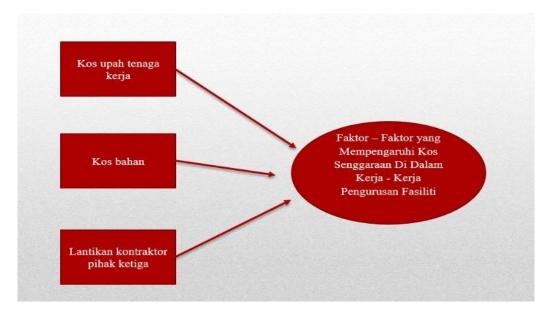
Usia bangunan yang sudah lama menjadi faktor terhadap prestasi sesebuah bangunan untuk memenuhi fungsinya kepada pengguna. Mengambil kira penggunaan yang tinggi untuk sesebuah bangunan akan menjadikan kitaran hidup bangunan tersebut termasuk kemerosotan peralatan, perubahan iklim dan proses penuaan menjadi lebih singkat (Cheong, 2019). Penyelenggaraan adalah penting untuk mengekalkan prestasi keseluruhan bangunan dan menjamin kitaran hayat bangunan dalam keadaan yang boleh diterima untuk mengekalkan nilai hartanah dan memaksimumkan pulangan pelaburan (Tiun, 2009). Dalam kajian yang dilakukan oleh Syahrul, beliau menegaskan bahawa matlamat pengurusan fasiliti seharusnya tidak hanya menumpukan pada mengoptimumkan kos operasi bangunan sahaja, tetapi juga harus meningkatkan kecekapan dan kesesuaian pengurusan ruang dan aset lain yang berkaitan dengan proses penyelenggaraan (Syahrul, 2009). Menurut kenyataan yang diterangkan oleh Arcom (2015), kos adalah salah satu cabaran utama yang perlu dihadapai dalam projek bangunan. Memandangkan kepentingan kos menjadi faktor dalam menentukan kejayaan sesuatu projek bangunan, terdapat keperluan untuk meningkatkan prestasi kos yang terancang dalam projek bangunan (Arcom, 2015).

Penyelidikan ini penting kepada pasukan pengurusan fasiliti untuk mengurangkan kos penyelenggaraan secara keseluruhan dan juga untuk menambah baik prestasi pasukan pengurusan penyelenggaraan untuk sesebuah bangunan.

#### 2. KAJIAN LITERATUR

Terdapat pengkaji yang menyatakan bahawa kos adalah pemboleh ubah yang paling ketara bagi prestasi projek bangunan. pasukan pengurusan fasiliti harus mengambil perhatian terhadap kos anggaran awal yang tepat, data – data terdahulu yang boleh diguna sebagai rujukan untuk menganggar kos sesuatu kerja amatlah berguna untuk mencapai prestasi kos yang baik.





Rajah 1: Kerangka Konseptual Faktor Yang Mempengaruhi Kos Penyelenggaraan di dalam Kerja – Kerja Pengurusan Fasiliti

Rajah 1 menunjukkan tiga faktor yang mempengaruhi kos penyelenggaraan di dalam kerja – kerja pengurusan fasiliti.Kos bahan, kos upah tenaga kerja dan kos lantikan kontraktor pihak ketiga menjadi faktor terhadap kos penyelenggaraan secara menyeluruh di dalam kerja – kerja pengurusan fasiliti.

#### 2.1 Kos Upah Tenaga Kerja

Dalam sebuah kajian yang dilakukan oleh Naila Hamzah pada tahun 2011 berkenaan upah buruh dan produktiviti, teori upah kecekapan mengatakan bahawa produktiviti buruh adalah berkorelasi positif dengan upah yang mereka terima. Sebaliknya, teori konvensional mengusulkan bahawa upah boleh menyebabkan produktiviti berlebihan. Teori produktiviti marginal pula menunjukkan bahawa buruh yang dibayar dengan upah yang tinggi adalah buruh yang sangat produktif. Oleh kerana itu, terdapat hipotesis yang mengatakan produktiviti akan mempengaruhi upah dan juga sebaliknya secara positif. Kajian ini menggunakan data siri masa upah dan produktiviti buruh antara tahun 1985 hingga 2008 yang melibatkan 22 sub sektor pembuatan di Malaysia.



Kajian ini dilakukan bagi mengkaji secara emperikal hubungan antara upah dan produktiviti buruh dengan menggunakan ujian penyebab Granger versi vektor pembetulan ralat (VECM) dan ujian penyebab Granger versi Toda Yamamoto. Hasil dalam ujian VECM menunjukkan wujud hubungan satu hala antara pembolehubah upah dan produktiviti buruh dalam jangka panjang dan jangka pendek (Hamzah, 2011). Kerja – kerja penyelenggaraan di dalam pengurusan fasiliti memerlukan tenaga kerja untuk menjalankan aktiviti penyelenggaraan.

# 2.2 Kos Bahan

Kos bahan adalah sebahagian besar dalam jumlah kos keseluruhan sesuatu perniagaan atau aktiviti. Merancang perbelanjaan kos bahan adalah tugas penting dalam proses perancangan perniagaan. Prosedur dan ciri perancangan pengelasan kos bahan perlu diteliti dengan baik agar tiada pembaziran kos bahan dilakukan semasa melaksanakan aktiviti senggaraan (Bazil, 2018)

Kos bahan mempunyai dua komponen asas, iaitu kos pembelian bahan dan kos penggunaan bahan. Kos pembelian bahan adalah kos yang dikeluarkan oleh syarikat, organisasi atau individu untuk membeli atau mendapatkan bahan tersebut dari pengeluar. Manakala kos penggunaan ialah kos yang ditanggung syarikat, organisasi atau individu semasa melakukan kerja – kerja atau aktiviti dengan menggunakan bahan tersebut. Contohnya lebihan bahan – bahan yang tidak digunakan, dan bahan – bahan yang rosak seperti pecah (Anwar, 2013). Selain itu, kos bahan terpisah kepada dua, iaitu kos bahan langsung dan kos bahan tidak langsung. Kos bahan langsung ialah kos yang dikeluarkan untuk sesuatu bahan. Kos bahan tidak langsung adalah tidak bahan yang digunakan dalam proses pengeluaran tetapi tidak dapat dikesan secara langsung ke produk. Contohnya kos yang dikeluarkan untuk membeli set lampu untuk melakukan kerja penyelenggaraan menukar lampu (Kos bahan langsung), dan pita wayar elektrik adalah contoh kos bahan tidak langsung yang digunakan untuk kerja – kerja penyelenggaraan lampu tersebut.

# 2.3 Kos lantikan kontraktor pihak ketiga (Penyumberluaran)

Lantikan kontraktor (pihak ketiga) atau ia juga disebut sebagai lantikan vendor secara teorinya ialah satu ikatan perjanjian diantara pelanggan dan pihak pembekal perkhidmatan untuk membekalkan perkhidmatan kepada pelanggan berdasarkan syarat



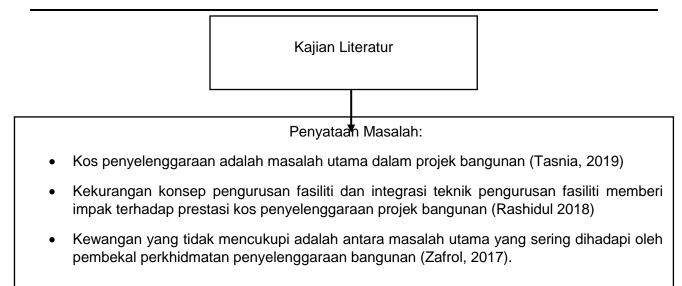
kontrak tersebut (Azmi, 2010). Ini kerana pemilihan kontraktor adalah satu proses yang sangat penting sebelum melaksanakan pengurusan fasiliti. Pelaksanaan kerja – kerja pengurusan fasiliti yang dilakukan kontraktor (sumber luaran) adalah salah satu kaedah pengurusan yang strategik.

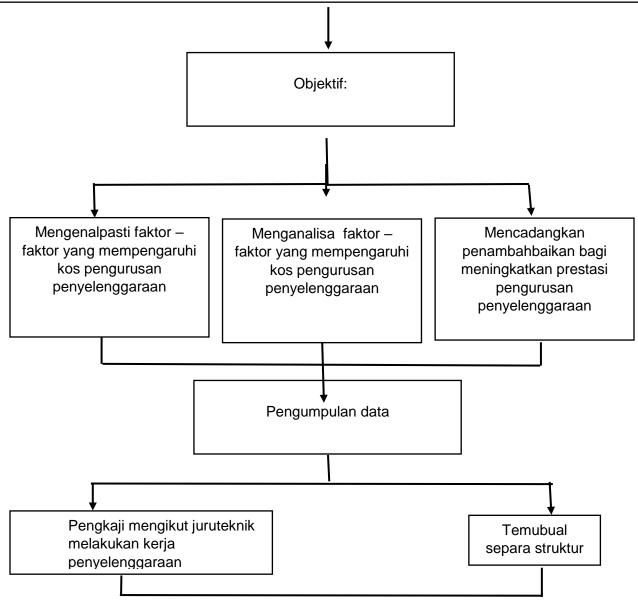
Organisasi pada masa kini lebih gemar mengamalkan kontak luar (lantikan pihak ketiga) dari segi aktiviti perkhidmatan dari mempraktikkan kontrak dalaman. Ini telah di dorong akibat dari perubahan persekitaran perniagaan yang terarah pada operasi kerja yang lebih berkesan (Ismail, 2016). Selain itu, beliau menegaskan persaingan sengit, upah yang tinggi, faktor ekonomi dan kekurangan tenaga kerja dalaman memaksa sesebuah organisasi untuk mencari alternatif untuk mengurangkan kos dan dalam masa yang sama masih mengekalkan prestasi bangunan yang sedia ada. Begitu juga dengan pengurusan fasiliti sesebuah bangunan terutama sekali melibatkan bangunan milik kerajaan dan bangunan – bangunan korporat yang sering menjadi mercu tanda untuk sesebuah organisasi. Perubahan persekitaran perniagaan yang terarah pada operasi kerja yang berkesan telah mendorong perkhidmatan penyumber luaran menjadi pilihan kepada pengurus – pengurus bangunan

# 3. METODOLOGI KAJIAN

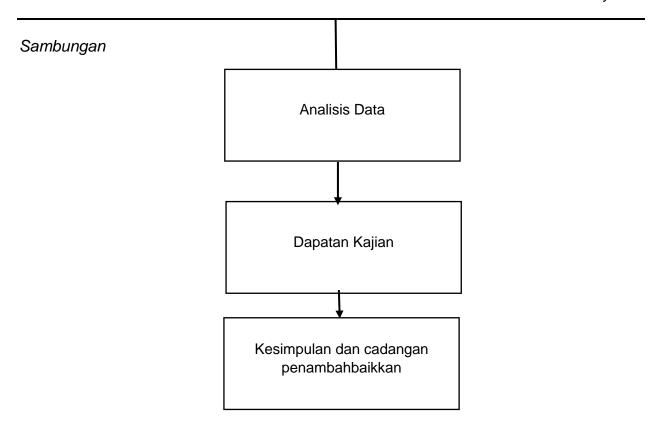
Untuk mengetahui tiga kesan faktor yang mempengaruhi kos penyelenggaraan di dalam kerja – kerja pengurusan fasiliti. Penyelidikan ini menggunakan kaedah metodologi kualitatif dengan menggunakan instrument temubual dan pemerhatian untuk mendapatkan data di dalam penyelidikan ini. Rujuk pada rajah 2.









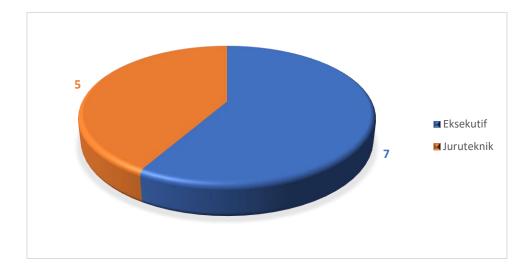


Rajah 2: Carta Alir Reka Bentuk Kajian Penyelidikan

Instrumen pertama yang digunakan untuk mengenalpasti faktor – faktor yang mempengaruhi kos penyelenggaraan ialah menerusi kaedah temubual separa struktur terhadap responden yang terlibat secara langsung di dalam kerja – kerja pengurusan penyelenggaraan di kawasan kajian dijalankan dan disokong oleh beberapa kajian literatur. Instrumen yang digunakan untuk mendapatkan objektif kedua ialah dengan kaedah pemerhatian yang dilakukan sepanjang tiga bulan pertama untuk tahun 2022 di empat buah bangunan di dalam kawasan kajian dilakukan. Akhir sekali, untuk mendapatkan jawapan objektif ketiga sesi temubual separa struktur dilakukan dan dikaitkan bersama hasil dapatan kaedah pemerhatian yang dijalankan.



# 4. Dapatan Kajian dan Perbincangan



Dapatan kajian disertakan dalam bentuk graph dan carta pai untuk lebih difahami.

Rajah 3: Menunjukkan jumlah responden yang ditemubual untuk mendapatkan data.



Rajah 4: Menunjukkan dapatan analisis data dari kaedah pemerhatian yang telah dilakukan terhadap faktor – faktor yang mempengaruhi kos penyelenggaraan di dalam kerja – kerja pengurusan fasiliti di kawasan kajian.





Rajah 5: Menunjukkan hasil dapatan kaedah temubual separa struktur untuk soalan berkenaan cadangan untuk mengurangkan kos penyelenggaraan.



Rajah 6: Menunjukkan hasil dapatan kaedah temubual separa struktur untuk soalan berkenaan cadangan penambaikkan prestasi pengurusan penyelenggaraan di kawasan kajian dilakukan.



#### 5. Rumusan

Keseluruhan kajian ini mendapati terdapat beberapa faktor yang mendorong kepada peningkatan kos penyelenggaraan secara keseluruhan dan memberi kesan kepada prestasi pengurusan penyelenggaraan secara langsung. Seterusnya, langkah – langkah untuk mengurangkan kos penyelenggaraan juga disimpulkan di dalam kajian ini. Selain itu, cadangan penambahbaikkan juga diberikan di dalam penyelidikan ini untuk meningkatkan prestasi pengurusan penyelenggaraan di kawasan kajian dilakukan.

Berdasakan kajian yang dilakukan, pengkaji mendapati bahawa saiz sesebuah bangunan dan kadar penggunaan bangunan akan menyebabkan peningkatan kos penyelenggaraan sekali gus akan meningkatkan faktor kos bahan, kos upah tenaga kerja dan juga kos lantikan kontraktor pihak ketiga. Selain itu, berdasarkan sesi temubual yang dijalankan penyelidik mendapati bahawa kekurangan tenaga kerja mahir akan mengurangkan prestasi pengurusan penyelenggaraan untuk sesebuah bangunan. Oleh itu, pengkaji ingin mencadangkan kepada pasukan pengurusan fasiliti di kawasan kajian supaya menfokuskan kepada penambahan tenaga mahir sama ada menggaji pekerja mahir baru ataupun memberi kursus tambahan kepada pekerja sedia ada.

Kajian ini dapat membantu pasukan pengurusan fasiliti untuk menambahbaik prestasi pengurusan penyelenggaraan dan juga menjadi rujukan kepada mana – mana pemilik bangunan dalam melakukan bajet penyelengggaraan tahunan.

#### RUJUKAN

Ali, A. S., Azmi, N. F., & Timothy Kurannen, B. (2017). Cost performance of building refurbishment works : the case of Malaysia Article information : To cite this document : About Emerald www.emeraldinsight.com Emerald is a global publisher linking research and practice to the benefit of society . The company. In International Journal of Building Pathology and Adaptation.

#### ARCOM. (2015). ANNUAL September 7-9 Lincoln (Vol. 1).

Islam, R., Nazifa, T. H., & Mohamed, S. F. (2019). Factors Influencing Facilities Management Cost Performance in Building Projects. *Journal of Performance of Constructed Facilities*, *33*(3), 04019036. <u>https://doi.org/10.1061/(asce)cf.1943-5509.0001284</u>



- Nizam Kamaruzzaman, S., & Marinie Ahmad Zawawi, E. (2010). Development of facilities management in Malaysia. *Journal of Facilities Management*, 8(1), 75–81. https://doi.org/10.1108/14725961011019094
- Rashudul. (2018). Integration of building maintenance cost model into the design stage md rashidul islam universiti teknologi malaysia.

RMTB. Pelaksanaan Sistem Pemodelan Maklumat Bangunan (BIM) bagi Mengurangkan Kos dalam Pengurusan Fasiliti - PDF Free Download.pdf. (n.d.).

- Sazali, A. F. (2013). Data kos yang digunakan oleh perunding ukur bahan di peringkat pra tender.
- Shohet, I. M., & Lavy, S. (2017). Facility maintenance and management: a health care case study. *International Journal of Strategic Property Management*, 21(2). https://doi.org/10.3846/1648715X.2016.1258374
- Zakaria, H., Arifin, K., Ahmad, S., & Aiyub, K. (2010). Pengurusan Fasiliti Dalam Penyelenggaraan Bangunan:Amalan Kualiti, Keselamatan dan Kesihatan. *Journal* of Techno Social, 2(1), 23–36.



# THE DEVELOPMENT OF SMART DEVICES FOR COVID USING IOT

Amir Aizat Bin Abdul Wahid, Pn. Nurul Maisarah Binti Kamaruddin, Ts Dr. Hj. Zunuwanas Bin Mohamad, Nuruliman Binti Ahmad Moktar, Norazlina Binti Roslan. Department of Electrical Engineering, Polytechnic Sultan Salahuddin Abdul Aziz Shah, Selangor Malaysia

<sup>1</sup>Amir40872@gmail.com, <sup>2</sup>nmsarah87@gmail.com, <sup>3</sup>zunuwanas@yahoo.co.uk, <sup>4</sup>nuruliman.ahmadmoktar89@gmail.com, <sup>5</sup>norazlinaroslan@gmail.com.

#### Abstract

The development of smart devices for covid using lot is a device that is placed on a fingertip. This device uses to determine the blood's oxygen saturation and pulse rate. The amount of oxygen carried in the blood is determined by oxygen saturation. The traditional Oximeter can only be read briefly, and the data cannot be recorded automatically. Besides that, the traditional Oximeter device can only be seen by the person who uses it. The development of smart devices for covid using lot is to design the tool that doctor can make online monitoring of the patient. Next, to develop the tool that can also make it easier for other family members to monitor. Lastly, to evaluate record patient data from home. The development of smart devices for Covid includes a portable and cost-effective heart rate and SpO2/level sensor device based on the Internet of Things. The proposed system has an integrated OLED display and simple internet connectivity. The development of the prototype is a succeed and produce relatively accurate results. The expected result in this project is hybrid method using pulse oximeter and IoT system combine to make one medical device. The project's findings on human blood pressure and oxygen have provided a direction for the project's development.

Keywords: Smart devices for covid using IoT, Covid, IoT.

# 1. Introduction



COVID-19 is caused by a novel coronavirus that enters the body through the respiratory system, causing direct harm to the lungs through inflammation and pneumonia, both of which can impair oxygen transmission into the bloodstream. Fluid collects in the lung tissue causing pneumonia.

This impairs the transfer of oxygen between air sacs and blood. This oxygen deficiency can happen at any stage of COVID-19, not just in severely sick patients on ventilators. The virus can spread from an infected person's mouth or nose in small liquid particles when they cough, sneeze, speak, or breathe. These particles range from larger respiratory droplets to smaller aerosols.[2] The prototype oximeter allows for the quick assessment of the body's oxygen saturation level without the need for needles or blood samples. The red blood cells' oxygen saturation is represented by the measured amount that is displayed on the screen by using the sensor. The sensor uses a cold light source that shines light through the fingertip, giving the impression that it is red. The apparatus can calculate the amount of oxygen in a red blood cell by examining the light from the light source that passes through the finger [1]. Lastly, it connected to the lot system which display the measurement of the oxygen saturation level.

#### 2. Literature Review

#### 2.1 Human body temperature

The average human body temperature stays around 36.5 C to 37 C, regardless of the external temperature or weather. Each person's body is different, but generally, when muscles are primed and ready to go, the body's optimum core temperature falls within a specific range; it is right around 37.5 degrees Celsius.[3] Normal body temperature, on the other hand, can range from 97 degrees Fahrenheit (36.1 degrees Celsius) to 99 degrees Fahrenheit (37.2 degrees Celsius) or higher. The temperature of your body varies based on how active you are and the time of day. The body temperatures of older persons are often lower than those of younger ones. Fever is indicated by the following thermometer reading. Temperatures of 100.4 (38 C) or greater in the rectal, ear, or temporal arteries. Oral temperature of 100 degrees Fahrenheit (37.8 degrees Celsius) or higher A temperature of 99 degrees Fahrenheit (37.2 degrees Celsius) or greater in the armpits.[4]



#### 2.2 Human pulse and blood pressure

The effect of blood pumped by the heart causes the cyclic expansion and contraction of an artery. The pulse can be felt with the fingers at various pulse pressure sites throughout the body, and it can also be heard with a stethoscope. The radial pulse (at the wrist) and the brachial pulse (on the inside of the arm at the elbow) will be used to acquire pulse and blood pressure measures in this survey.[5] The force produced by blood on the wall of a blood vessel when the heart pumps (contracts) and relaxes is known as arterial blood pressure. The degree of force when the heart is pumping is called systolic blood pressure (contracting). The diastolic blood pressure is the force exerted by the hearts when they are relaxed.

# 2.3 Covid-19 detect using traditional pulse oximeter

COVID-19 patients may experience a wide range of symptoms, ranging from no symptoms to mild symptoms to severe sickness. Low oxygen levels are common in COVID-19 patients, which can be fatal. However, not everyone who has a low oxygen level will have trouble breathing. A pulse oximeter is a gadget that you place on a patient's finger, toe, or earlobe to test their oxygen level. It's a quick and painless exam that takes less than two minutes to complete. A pulse oximeter is composed of the sensor (or probe) and the monitor with the display. The probe is on the finger and is detecting the flow of blood through the finger. This is displayed as a pulse wave on the monitor. A pulse wave must be present to demonstrate that a pulse is being detected.

#### 2.4 Technology based on lot

Remote patient monitoring is the most common application of IoT devices for healthcare. IoT devices can automatically collect health metrics like heart rate, blood pressure, temperature, and more from patients who are not physically present in a healthcare facility, eliminating the need for patients to travel to the hospital.The Internet of Things (IoT) keeps promising us a smarter future, The internet of things, or IoT, is a system of interrelated computing devices, mechanical and digital machines, objects, animals, or people that are provided with unique identifiers, and smart gear that monitors your health

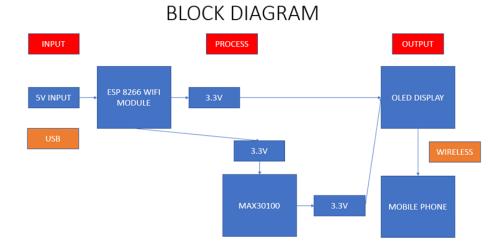


and sends real-time data to your doctor's smartphone. An IoT ecosystem consists of webenabled smart devices that use embedded systems, such as processors, sensors, and communication hardware, to collect, send and act on data they acquire from their environments. IoT devices share the sensor data they collect by connecting to an IoT gateway or other edge device where data is either sent to the cloud to be analyzed or analyzed locally.[8]

# 3. Methodology

# 3.1 Block diagram

Based on Figure 1, The USB cable provides 5V power. The ESP 8266 module is powered by 3.3V and coupled to the MAX 30100. The OLED display will receive the output and display the reading, as well as connect wirelessly to the mobile phone via Wi-Fi.



# Figure 1: Block diagram of the development of smart devices for covid using lot.

#### 3.2 Hardware



ESP8266 is module enables microcontrollers to connect to 2.4 GHz Wi-Fi, using IEEE 802.11 ban. It can be used with ESP-AT firmware to provide Wi-Fi connectivity to external host MCUs, or it can be used as a self-sufficient MCU by running an RTOS-based SDK. MAX30100 is an integrated pulse oximetry and heart rate monitor sensor solution. It combines two LEDs, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse oximetry and heart-rate signals. MAX30100 is an integrated optics, and low-noise two LEDs, a photodetector, optimized optics. It combines two LEDs, a photodetector, optimized optics, and low-noise two LEDs, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse oximetry and heart-rate signals. MAX30100 is an integrated pulse oximetry and heart rate monitor sensor solution. It combines two LEDs, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse oximetry and heart-rate signals. MAX30100 is an integrated pulse oximetry and heart rate monitor sensor solution. It combines two LEDs, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse oximetry and heart-rate signals. MAX30100 is an integrated pulse oximetry and heart rate monitor sensor solution. It combines two LEDs, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse oximetry and heart rate monitor sensor solution. It combines two LEDs, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse oximetry and heart-rate signals.

#### 3.3 Software

This project was created with the Arduino Software (IDE), Arduino is an open-source platform used for building electronics projects. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, by using the Arduino the project program can test and do on the software.

#### 4. Result & Discussion

The results of prototype pulse oximeter have taken from different patient and the analysis showed in table 1.

# Table 1: Comparison between prototype pulse oximeter and conventional pulse oximeter



	CONVENTIONAL PULSE OXIMETER		THE DEVELOPMENT OF SMART DEVICES FOR COVID USING IOT	
Age/gender	Врт	SpO2	Bpm	SpO2
24/Male	99	90	98	89
23/Male	98	89	97	87
20/Male	99	97	96	89
58/Male	97	90	98	89
57/Female	98	89	97	100
10Months/Female	99	98	100	99

Table 1 shows the comparison between of prototype and normal pulse oximeter based on the patient the age and gender. MAX30100 sensor (measuring oxygen saturation in the blood and heart rate) against Industry standard measuring instruments (Oximeter), Testing the accuracy of the MLX90614 Sensor (measuring body temperature) against Industrial standard measuring devices (digital thermometers), and testing at some maximum distance Bluetooth performance sends information on measurement results to a Smartphone.

Tests on the accuracy of the Oxygen Saturation detection sensor and Heart Rate each of which is tested for its accuracy value and carried out as many as 5 tests in patients who are different. Test results that have been obtained are then compared with the industry standard measuring instruments (Finger Oximeter (FO)) to obtain the level of accuracy of the measuring instrument.

# 5. Conclusions

The goal of this project, a pulse oximeter, is to assist patients with COVID in receiving heart rate and oxygen saturation readings connected to an IoT system. Because this device is less expensive for patients to purchase than the currently available, more expensive assistive spoon on the market, it can help the community become more independent. At the end of this project, with the development of smart devices for covid using lot, it can be detecting the heart rate by a Max 30100 sensor that can receive input from the patient pulse and the output receive from the heart rate. Power supply is



connected to the USB port so the device can be power up and activated the device. In addition, the device is consisting of a display panel to display the reading oxygen level of the patient. The ESP 8266 Wi-Fi module can be transmitting the data to the lot cloud.

# References

- I Putu Anna Andika, Triana Rahmawati, and M. Ridha Mak'ruf, "Pulse Oximeter Portable," *J. Electron. Electromed. Eng. Med. Informatics*, vol. 1, no. 1, pp. 28–32, 2019, doi: 10.35882/jeeemi.v1i1.6.
- W. Zhao, J. Zhang, M. E. Meadows, Y. Liu, T. Hua, and B. Fu, "A systematic approach is needed to contain COVID-19 globally," *Sci. Bull.*, vol. 65, no. 11, pp. 876–878, 2020, doi: 10.1016/j.scib.2020.03.024.
- M. L. Hoang, M. Carratù, V. Paciello, and A. Pietrosanto, "Body temperature—indoor condition monitor and activity recognition by mems accelerometer based on IoTalert system for people in quarantine due to COVID-19," *Sensors*, vol. 21, no. 7, Apr. 2021, doi: 10.3390/s21072313.
- London Medical College, "Guidance for practices Guide to using pulse oximetry during Covid-19 pandemic Role of pulse oximetry during Covid-19 pandemic," pp. 1–6, 2021, [Online]. Available: https://www.lmc.org.uk/visageimages/Covid-19/Guide to using pulse oximeters during Covid-19 pandemic.pdf.
- Westat Inc., "Pulse and Blood Pressure Procedures," *Blood Press.*, no. July, pp. 1–3, 1993.
- Ontario Ministry of Health and Long-Term Care, "COVID-19 Reference Document for Symptoms v7.0," pp. 19–22, 2020.
- WHO, "COVID-19 weekly epidemiological update," *World Heal. Organ.*, no. 58, pp. 1–23, 2022, [Online]. Available: https://www.who.int/publications/m/item/covid-19-weekly-epidemiological-update.
- G. Narmadha, M. Ramasamy, H. Prasad, and P. Nair, "Design of Smart Pulse Oximeter using ATMEGA 328 Microcontroller," *Int. J. Emerg. Technol.*, vol. 11, no. 3, pp. 696–700, 2020.
- T. M. Kadarina and R. Priambodo, "Monitoring heart rate and SpO2 using Thingsboard IoT platform for mother and child preventive healthcare," in *IOP Conference Series:*



*Materials Science and Engineering*, Nov. 2018, vol. 453, no. 1, doi: 10.1088/1757-899X/453/1/012028.

E. A. Suprayitno, M. R. Marlianto, and M. I. Mauliana, "Measurement device for detecting oxygen saturation in blood, heart rate, and temperature of human body," *J. Phys. Conf. Ser.*, vol. 1402, no. 3, 2019, doi: 10.1088/1742-6596/1402/3/033110.



# DESIGN AND FABRICATE CHECKING JIG FOR REVERSE SENSOR HOLE AT COVER REAR BUMPER FOR CAR MODEL X

# Mohammad Zulhilmi Bin Zamri<sup>1</sup>, Baharuddin Bin Mohd Zanggi<sup>2</sup> and Mohd Asmedi Bin Yaacob<sup>3</sup>

<sup>1,2,3</sup> Department of Mechanical Engineering Politechnic Sultan Azlan Shah, 35950 Behrang, Perak <sup>1</sup> zulhilmingah @gmail.com, <sup>2</sup> baharuddin @psas.edu.my, <sup>3</sup> asmedi81 @gmail.com

# Abstract

The use of checking is to facilitate and streamline production work. The checking jig is a very useful tool that can make sure the quality outcome of the product will be good. The checking jig is a fool-proofing in checking process where, when the checking jig can locate at the hole, the hole is good, and when the checking jig cannot locate in the hole, the hole is not good. At the production line, the team member didn't have a proper checking tool to check the position of the reverse sensor hole at rear bumper after punching. Observation at the production line to identify the problem. Brainstorming and generating some design ideas. Making the design of the jig is using the software Catia V5 and refers to 3D data from the customer. The design was selected based on the criteria which can facilitate team members, has functionality well, and can be used in the long term. The fabrication of the selected design using 3D rapid prototype and made trial using the checking jig at the reverse sensor hole to study the workability. Lastly, the making design and fabrication of the checking jig to facilitate the team member in the checking process at the cover rear bumper has full filled.

Keywords: Jig, Fool proofing, Catia V5, Fabrication.

# 1.0 Introduction

In this era of increasingly sophisticated automotive, the automotive manufacturing sector plays an important role in producing quality products.



Especially in demand in fabrication car bumper is very high. To make a quality part needs a special tool to make sure the part produced is in good condition. A jig is a tool that holds and positions a component or workpiece while also guiding one or more cutting tools. The workpiece is held in place and the tools are guided in such a way that they are in perfect alignment with one other (Farzin KP., 2017). Checking jig is a tool used in industry to provide easier production work especially in making the checking process. Rigid checking jigs can determine product quality more accurately. The checking jig are used as fool proofing to detect not good part after production.

According to Radhwan, etc el. (2019) Jigs and Fixtures are devices used to aid in the manufacturing of goods in industry, particularly those involving machines. To generate the same parts in production, the perfect jigs and fixtures can work reproducibility and interoperability. Jigs and fixtures are the most important devices in the manufacturing industry that can help workers make their production process easier. Jigs and fixtures are useful tools in industry.

AB Company has participated in the development project for car model X, where AB company needs to make a study in producing quality components to make this project successful. One of the components that AB company participates in this project is the Cover Rear Bumper component, which needs to be studied to produce a flawless product according to the specifications and also the customer's requirements. The bumper is produced with injection molding. And the reverse sensor hole will be punched manually using a puncher jig. This study aims to design and fabricate a jig that is able to function well when used to check the holes that have been punched. So, the position of the punched hole may not be in the desired location. Team production needs to check the hole before supplying it to the assembly line.

# 1.1. Problem statement

Based on the current situation, the demand for automotive manufacturing is increasing, the production of components needs to be faster. Increased demand for the automotive component part, especially bumper components is due to improved performance and lower costs. The Design and Development Department should develop critical components for new products in the shortest possible time. This requires an understanding of new technologies and rapid product development absorption.

Various problems can be detected and found in the production line in producing and supplying components in large quantities. Besides that, in the production bumper part,



the production does not have the checking tools to check the location of the reverse sensor hole. So, this project only focuses on the design and fabricating the checking jig. So, the jig is guiding the production to check if the hole is at the position or has offset to another way. In Figure 1 below shows the cover rear bumper that has been drill using a punching jig.

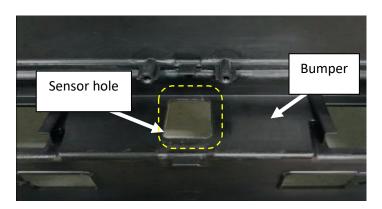


Figure 1: Cover rear bumper

Based on the figure 1 above shows the hole after being punched, and it has possibilities to offset to another direction. So, the design of the checking jig must be fixed to the bumper and do not have free play. The jig must be located through the guide hole.

# 1.2. Objective

In general, the objective of the study is to design the checking jig for reverse sensor hole at cover rear bumper and fabricate the checking jig for reverse sensor hole at cover rear bumper.



# 2.0 Literature Review

2.1. Jig

It is a work holding structure that holds, strengthens, and locates the work piece while also guiding the cutting tool during a particular process. The jig may or may not be fastened to the machine table, whereas the fixture must be precisely fastened to the machine table.

When it comes to jigs, the total output in terms of overall units, manufacturing time, labour required, and ease of operation is much more crucial (RD Bhosale, etc el, 2017).

The primary purpose of a jig is to provide repeatability, accuracy, and interchangeability in product manufacturing. When a key is duplicated, the original is often used as a jig so that the new key has same way as the old one. Jigs are no longer required with the advent of automation and computer numerically controlled (CNC) machines because the tool path is digitally developed and stored in memory. Plastic reforming jigs can be created (Wikipedia).

# 2.2. Foolproofing

Any detected in the area need to aggressively discourage the improper attachment of a work item in a fixture or locator. It is referred to as the Foolproof approach. These rules are mostly used with elements that are similar or identical, like our difficulties. By modifying the workpiece's drills, projections, and grooves, we can create locators. Finally, the workpiece cannot be wrongly filled due to the foolproofing. Finding error-proofing methods will therefore help to stop the occurrence of such problems (K. Velmanirajan, 2013).

In today's production environment, using the right resources and perfecting the process are crucial. Lean manufacturing techniques and ideas can be applied to solve these problems. The goal of lean manufacturing is to minimise waste throughout the production



process. The project, the product, and the entire supply chain continue to gain value as waste is eliminated across the value chain (Vijay, S.; Gomathi Prabha, M, 2020).

# 2.3. Quality

Quality assurance is defined as "the collection of internal or external policies, procedures, systems, and practises designed to achieve, maintain, and improve quality." Internal and external quality assurance processes are both possible. However, it has become a colloquial term for "all forms of external quality monitoring, evaluation, or review," and many commentators actually mean "external quality assurance." There are various emphasises placed on quality assurance. According to several authorities, the goal of quality assurance is to confirm that higher education meets predetermined standards. However, some authorities place a premium on transparency, a term that is rarely defined in the context of higher education. Indeed, many colleagues and institutions appear to interpret quality assurance as a synonym for "accountability" (James Williams, 2016).

#### 2.4. Kaizen

According to Carnerud etc el. (2018) Kaizen as the foundation of Japan's competitiveness. Since then, the message has been repeated, adding to a Kaizen success story, which became an accepted key concept of twenty-first-century management. The concept of Kaizen is frequently using it as a synonym for continuous improvement (CI), but there are significant disputes in academia and practise about the definition and (in)compatibility.

Kaizen is critical for increasing its success rate in real-world applications. Kaizen is frequently examined in relation to various quality initiatives, strategies, and perspectives, example QC, quality control, quality management (QM), and total quality management (TQM).



# 3.0 Methodology

In general, project methodology refers to the order in which procedures or methods are carried out from the beginning to the finish of the study. In order for the research to function smoothly and systematically, the research methodology is equally critical. Figure 2 shows the flow chart of this study.



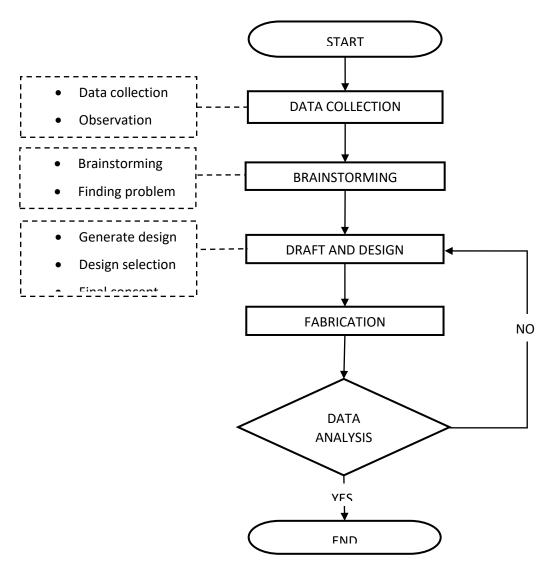


Figure 2: The overall methodology



# 3.1. Data Collection

The study planning is based on the data collection by observation at the production from the current process. The observation is done at the punching jig for bumper workstation. The function of the punching jig is to drill the hole at the rear bumper. Figure 3 below shows the punching jig workstation.

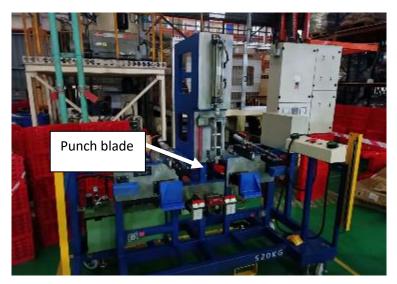


Figure 3: Punching jig workstation

From the observation at the punching jig workstation, the method to check the hole is using a manual which uses a vernier caliper. The problem is, the production does not have proper tools to check the hole after being drilled.

# 3.2. Brainstorming

Through brainstorming, the design team will discuss to come out the proper ideal. During the brainstorming, the design team will sketch the design idea to get a solution. Brainstorming is a strategy for developing group creativity in which members freely share ideas and thoughts in order to find answers to real challenges (AI-Samarraie H, 2018).



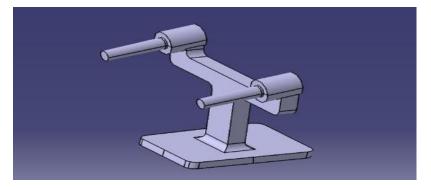
In this phase, the designer must be clear about the problem and must clearly know how the jig works. The jig design must be able to use and function smoothly to solve the problem that has been stated and archived to the next stage. The designing process needs to analyze its function.

For the design process, the checking jig is designed by referring to 3D data of the cover rear bumper using Catia software. The process of making a design, using wireframe and part design, includes using lines, points, planes and fill to finish the design.

# 3.3. Design Selection

Design selection is the process of selecting a design based on its analysis of the specifications and criteria. After evaluating the relative strengths and weaknesses of the concepts, it is the process of picking the best concept for further exploration. In general, concept selection is the process of reducing down the options that have been explored. The screening method was utilised to assess the jig's final design. This method will make it easier for designers to choose the finest design.

3.3.1.1. Design 1



# Figure 4: Checking Jig Concept 1



# 3.3.1.2. Design 2

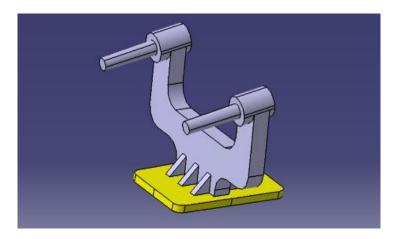


Figure 5: Checking Jig Concept 2

# 3.4. Final concept

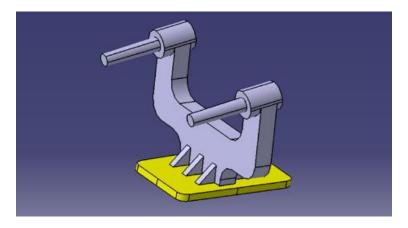


Figure 6: Final concept



Figure 6 above shows the final concept who has been chosen based on decision during the final concept selection where the second concept opted.

# 3.5. Fabrication

The jig is fabricated using the rapid prototype based on the design that has been selected. Use ABS material as material for the jig. The figure 7 below shows the checking jig that has been produce using rapid prototype.



Figure 7: Checking jig that have been produced using rapid prototype

#### 3.6. Prototype experiment



Figure 8: Experiment using prototype



In the figure 7 above, the prototype experiment uses rapid prototype 3D printing to study the workability of the jig at rear bumper. From 3D data, the design of the checking jig can be located at the hole of the bumper. So, from the actual experiment, the checking jig surely can locate at the hole of the bumper.

# 4.0 Comparison and Discussion

Specification	Concept 1	Concept 2
/ criteria		
Holder		
Base		
Body		

### Table 1: Comparison design based on specification



Table 1 above shows the comparison of the 2 designs, which is concept 1 and concept 2. Firstly, the holder for concept 1 can be held by 1 hand, and concept 2 can be held by two hands. So, holding with two hands is more efficient than one hand. Secondly, base design for concept 2 is more stable compared to concept 1, because concept 2 has support at base and body. Lastly, body concept 1 has one pole (T shape) and body concept 2 has two poles (U shape). So, the durability of the body concept 2 is more durable than concept 1. In the long term using the jig , the probability the jig concept 2 to bend is lower than concept 1.

# 5.0 Conclusion

In the conclusion, this checking jig plays a major function in maintain quality in manufacturing industry and the most important tool to make workers work easy. When the worker work easy, the production flow process become smooth. The goal of this project is to design and fabricate the checking jig. Using method comparison design, which is holder, base and body, can make checking jig work easy and can be use in long term.

#### Reference

- Farzin, K. P., Miyad Ali, K., D Gowda, L. R., & Mohamed Mishal, K. (2018). Process Planning, Design of Jig and Fixture, and Manufacturing of Flying Control Stop Bar. Retrieved by http://hdl.handle.net/123456789/9505
- Radhwan, H., Effendi, M. S. M., Farizuan Rosli, M., Shayfull, Z., & Nadia, K. N. (2019).
   Design and Analysis of Jigs and Fixtures for Manufacturing Process. IOP Conference Series: Materials Science and Engineering, 551, 012028. doi:10.1088/1757-899x/551/1/012028
- RD Bhosale, etc el. (2017). *Study & Design Of Jig And Fixture For Base Frame Of Canopy Fabrication Of Generator*. International Research Journal of Engineering and Technology (IRJET). Retrieved by shorturl.at/oILV7



- James Williams. 2016. *Quality Assurance And Quality Enhancement: Is There A Relationship?* Quality in Higher Education, 22:2, 97-102, DOI: 10.1080/13538322.2016.1227207
- Wikipedia. The Free Encyclopedia. Jig (tools). https://en.wikipedia.org/wiki/Jig\_(tool)
- S. Vijay and M. Gomathi Prabha, (2021). "Work standardization and line balancing in a windmill gearbox manufacturing cell: A case study," Materials Today: Proceedings, vol. 46, pp. 9721–9729, doi: 10.1016/j.matpr.2020.08.584.
- K. Velmanirajan, G. Rajaraman, S. K. Karthikeyan, and D. Dinesh, 2013. *Lean Manufacturing In Chassis Assembly Through Poka-Yoke*, International Journal Of Technology Enhancements And Emerging Engineering Research.
- Carnerud, Daniel; Jaca, Carmen; Bäckström, Ingela (2018). *Kaizen and continuous improvement trends and patterns over 30 years*. The TQM Journal, (), TQM-03-2018-0037–. doi:10.1108/TQM-03-2018-0037
- Al-Samarraie, H., & Hurmuzan, S. (2018). *A review of brainstorming techniques in higher education*. Thinking Skills and Creativity, 27, 78–91. doi:10.1016/j.tsc.2017.12.002



# ELECTRONIC WORKFORCE INTEGRATION TRACKING SYSTEM

# (E-WITS)

Muhammad Azmeer Bin Bakar<sup>1</sup>, Ts. Dr. Azuin Binti Ramli<sup>2</sup>

Civil Engineering Department, Politeknik Ungku Omar, Ipoh, Perak http://www.puo.edu.my

# Abstract

The involvement of technology in construction has grown and increased widespread. Civil Engineering Technology involves planning, design and construction of roads, subdivisions, buildings, municipal services, and heavy infrastructure. This study aims to develop E-Workforce Tracking System (e-WITS) for real industry needed. The scope of this project is dedicated to a civil engineering consulting company, namely, Prima Reka Consultant based in Ampang Baru, Ipoh, Perak. This project is expected to assist in each project's launch by tracking and recording the work done for each project. Workforce Integration Tracking System (e- WITS) is included in the 'Internet of Things' category where it is based on websites that perform tracking, recording, and alerts. Quantitative data were statistically examined using descriptive analysis (mean/ standard deviation) internal consistency using Cronbach's Alpha value and paired T- test. The value of Cronbach's Alpha is .75 for the 28 numbers of questions which mean that the questionnaire has excellent consistency. The effectiveness of the product was evaluated using paired t-test, analyzed by SPSS. The result shows that E-WITS has a significant different (t (13) = 4.90; p=0.00029, p < 0.05) as respondent preferred using e-WITS (Mean = 4.02, SD = 0.66) compare with existing method (Mean= 2.32, SD = 0.67). This mean that e-WITS was more effective compare with the existing method. This product was highly recommended to be used by personnel in the industry since the users are highly satisfied with this user-friendly website tracking system.

**Keywords:** E-Workforce Integration Tracking System (e-WITS), Tracking System, Website, Civil Engineering Technology, Industrial Revolution 4.0



#### 1. Introduction

New technologies are being applied to streamline routine procedures. However, technology in civil engineering has been adopted to expedite day-to-day labor and can resolve and simplify issues that arise when doing work. Thus, several facilities in the form of technology have been established to begin work in construction. Numerous sorts of technology are used in this industry, including materials, machines, and document management.

New materials and energy, design approaches, advances in digital technology, and big data create a wave of innovation within the construction industry (Felicia, 2018).

With the introduction of intelligent roads and more energy-efficient housing, the need is there for construction to get more competent and more efficient. While more innovative tools and techniques appear, much industry-changing new technology is used in civil engineering today.

Many people continue to miss out on opportunities and encounter difficulties pursuing this technology. As a result of this difficulty, new ideas are generated to meet periodic needs. It should be known that developing technology is not a simple task that must be done meticulously and correctly. This ensures that the project is implemented smoothly and to the best of its ability. Researchers and investors must collaborate effectively to identify the best strategies for implementing and resolving the constraints associated with a new project or technology.

Based on the observations, most Malaysian consultant companies take the method of controlling and tracking work by using Microsoft project 2010 software with comments through Gantt charts. Project control and tracking via Gantt chart can be a conventional method because observations through this method are minimal. Some issues can be linked through project monitoring, such as no warning system and team miscommunication. The operation department or the person in charge can't recognize the details in the software used in the form of a schedule. Some things or problems arise through this method, such as unsystematic work progress sometimes, make work progression delay and submission clash and no integration platform become miscommunication. Meanwhile, reviewing and storing documents is also done on paper, which raises sustainable issues. This is due to much waste of paper and causes a big problem when trying to find or refer to files that have been prepared before.



Therefore, after looking at the failures and problems that occur in our country and abroad, the idea arose to create a website-based platform named 'Electronic Workforce Integration Tracking System (e- WITS)' that is expected to help and address related problems. E- WITS are created to resolve such issues and weaknesses by way of monitor and track work progress and storing documents digitally. It can become an integration platform between the person in charge and workers involve in every single project. It also acts as an alert to the individuals involved to complete the work according to the planned time and ensure that the project journey is always on track. While at the same time, it also can solve sustainable issues as it can bring savings in the

use of paper, which causes waste and danger to the environment. This study aims to develop a Workforce Integration Tracking System (e- WITS) for the project's work breakdown structure. Hence to achieve this aim, the objectives determined are:

- i. To identify the information required in project tracking and monitoring works.
- ii. To develop Workforce Integration Tracking System (e- WITS) using visual basic.
- iii. To evaluate the effectiveness of the Workforce Integration Tracking System (e-WITS).

# 2. Literature Review

Technology advancement is a requirement for the sustainable growth of the construction industry. Only by relentless technical advancement can a company achieve continuous growth. In the scope of the construction needs of main fields, anorganization should perform fundamental, supportive, and forward-looking technological analysis, improve its overall arrangement and integration capability and apply 29 technical advancements to both the construction phase and the strategic growth period (Zhou, 2010).

Therefore, scientific and progressive theories should be established, new technologies, new processes, new materials, new operational concepts, and new management modes should be adopted. This is to order by promoting, developing, and constructing buildings that protect the environment, save energy and materials, and harmonize with the ecological environment, intending to achieve harmonious development between human beings and nature (Anguilar,2018).

Every organization or department involve in project construction needs to implement project management processes and phases to control workflow and organize project management processes and steps (Heagney, 2015). Project management is



accomplished by applying and integrating the processes of initiating, planning, executing, monitoring and controlling, and closing. Based on 28 years of experience in project management, project consulting, and training, the more things change, the more they stay the same (Heagney, 2016). Large or small, software, R&D, or administrative, successful projects rely on good planning. Too many project managers take a ready-fire-aim approach to complete a task quickly. This often results in more time and effort reworking errors, soothing unhappy stakeholders, and backing out of blind alleys. It should be acknowledged that the need to go back to basics, i.e., tracking and monitoring, should be implemented at the planning stage again. It is well known that consultant companies play a lot with documentation and design.

Website development refers to the work that goes into building a website. This could apply to anything from creating a single plain-text webpage to developing a complex web application or social network. While web development typically refers to web markup and coding. It includes all related development tasks, such as client-side scripting, server-side scripting, server, and network security configuration, ecommerce development, and content management system (CMS) development.

The Industrial Revolution ushered in an era of economic development on a percapita basis in capitalist states. In a word, the Internet of Things is a concept that connects any device (with an on/off switch) to the Internet and other connected devices. The Internet of Things (IoT) is a massive network of related things and people that collect and share data about their use and environment. Database programs, word processors, Web browsers, and spreadsheets are examples of applications software (sometimes referred to as end-user programs). More commonly referred to as an application, a program is a piece of software that runs on your computer.

# 3. Methodology

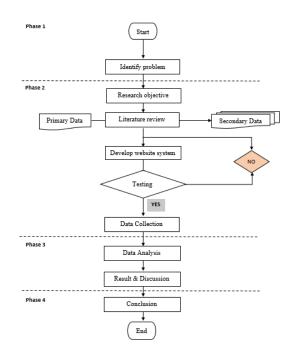
#### 3.1 Research Design

It is critical to present simple information about our project, describing, explaining, and predicting events is referred to as methodology. This part will discuss the technique used to complete and complete this project. Numerous approaches or findings from this subject are primarily published in journals for others to benefit from and enhance in future studies.



The method is used to accomplish the project's objectives in the most efficient manner possible. Based on chart 1 below show the research framework for this study. In general,

they consist of four primary steps: planning, process, data collecting, and data analysis. The research design used was the survey method through the use of questionnaire as an instrument. Total 30 respondents will be sampling in completing this study who is the employees involved in each project. Statistical analyses were performed using the statistical package for the social science (IBM SPSS Statistics, version 20.0). This research is analyses using descriptive study and paired t- test which aims to compile information about the effectiveness of e-WITS compare to existing method.



**Chart 1: Research Framework** 

# 3.2 Prototype Design

This project is expected to assist in each project's launch by tracking and recording the work done for each project. Workforce Integration Tracking System (e- WITS) is included in the 'Internet of Things' category where it is based on websites that perform tracking, recording, and alerts. The planning design of E-WITS is implemented through a visual basic coding template and using a Hypertext Preprocessor-PHP as a programming scripting language. E- WITS responded to the call of the Malaysian government to



highlight the elements of the 'Industry Revolution 4.0' where the system is specified to move digitally. Being digital is about using data to make better and faster decisions, devolving decision-making to smaller teams, and developing more iterative and rapid ways of doing things. As shown in figure 1 below e-wits interface where the main display of this system contains information about the company. There are also several menu provided, namely projects that contain departments in the company. This main display is an important display where it contains the main board that serves as integration and reminder to users. Meanwhile for figure 2 below also shows the project overview. On this display is where the user can load the ongoing project. The project completion percentage display will be displayed where this has an impact on project completion monitoring. While for figure 3 where the user will load the small tasks found in a project. The breakdown of the project into small jobs helps the user with more ease and detail. Users can also upload files that have been prepared which will facilitate future searches.

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Figure 1: E-WITS Interface



2<sup>nd</sup> National Conference on TVET Undergraduate Students (NCTS) Politeknik Tuanku Syed Sirajuddin 19-20 July 2022

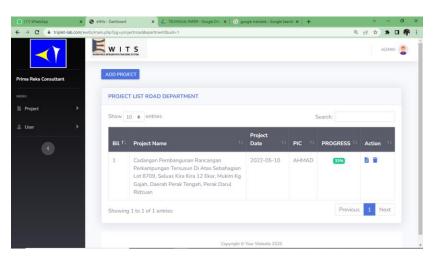


Figure 2: e-WITS project overview

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Figure 3: project progress detail

#### 4.0 Results and Discussion

A complete needs assessment was conducted by sending questionnaires to the target population during the design process. The website's design will be based on the needs and desires of responders. This step is critical since without proper planning, this project will not run smoothly, and our product will be unable to be established. The deadline for completing an application will be estimated. Then the website's creation will begin. Additionally, the website provides specific designs and images that serve as a review for users.



In addition, to ensure the sincerity of this survey reliability test had be done also. The purpose of the reliability analysis is to know the internal consistency of the questionnaire that distributed to the respondent. The Cronbach's Alpha have the range between 0-1. But, many experts saying that the result of reliability analysis must more than 0.7 to get conformity of consistency for the questionnaire. Based on Nunnaly (1980), the score below 0.6 is poor, between 0.60 and 0.70 is acceptable, between 0.8 and 0.9 is good and above 0.9 is excellent. The value obtained for the coefficients Cronbach's Alpha is greater than 0.7. Therefore, from the Table 1 below showed the value of Cronbach's Alpha is 0.78 for then 28 numbers of questions which mean that the questionnaire has excellent consistency

Paired samples statistics is the tests to compare the effectiveness of tracking system by using existing method with Electronic Workforce Integration Tracking System (E-WITS). In order to evaluate the effectiveness of E-WITS in the real industry use, a paired sample t test was performed. Results as shown in below, respondent preferred using E-WITS in figure 4 (Mean = 4.02, SD = 0.66) compare with existing method in figure 5 (Mean= 2.32, SD = 0.67). A paired sample t-test found this difference to be significant, t (13) = 4.90; p=0.00029, p < 0.05. Together this suggests that using E-WITS was more effective compare with the existing method. This mean that E-WITS was more effective compare with the existing method

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.75	.78	28



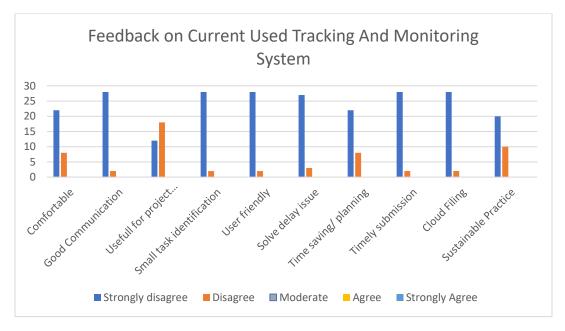


Figure 4: feedback on current used system

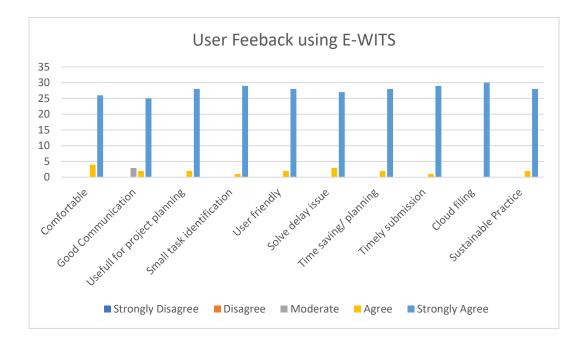


Figure 5: effectiveness of using E-WITS



#### 5.0 Conclusion

The main objective of the study is to identify information needed for project tracking and monitoring system. From the findings, it shows that the problems when current used system is not specific to their need based on industrial requirement. It's believe sometime the existing system is misunderstanding and really need a high commit learning. Also, identify that no system specific for small task monitoring and tracking sometime cause delay and late submission. Due of that, E-WITS was design form of breakdown project into small task and percentage value to give user more easy in view their task and submission file. After the information well covered, the result comes out with the second objective of the study which is to develop the Workforce Integration Tracking System (E-WITS) using a website platform. E-WITS was develop by using website which is easier for user to complete the small task and overall project. It also friendly user that can be access everywhere without any document needed. In order to evaluate the feedback of the effectiveness of the system during tracking system, survey is distributed as for the last objective to target respondent. From the result, it can be concluded that respondents are strongly agree that Electronic Workforce Integration Tracking System is really effective for personnel tracking system compare to existing method. Overall, from the results of observations and questionnaires, it can be concluded that they have approximately problems that occur during the tracking system. The respondents have agreed that all the problems related at the industry are giving an impact to their work. E-WITS was testing at civil engineering consultation company namely Prima Reka Konsultan and it is giving a good effectiveness for tracking system. The E-WITS is also helps to improve the effectiveness of tracking system especially on communication skill, faster tracking and solve the delay submission which is gain majority by respondents.

#### 6.0 References

Kramer, S. W. & Jenkins, J. L. (2006). Understanding the basics of CPM calculations: what is scheduling software really telling you? Paper presented at PMI® Global Congress 2006—north America, Seattle, WA. Newtown Square, PA: Project Management Institute.

Cooper Ordoñez, Robert Eduardo, Vanhoucke, Mario Coelho, Jose Anholon, Rosley Novaski, Olívio ARTICLE Scheduling, PMO, Program



Management 1 June2019AStudy of the Critical Chain ProjectManagement Method Applied to aMultiproject System

- Neill GatleyEMS Scheme Manager management systems Lead Auditor and EMS Scheme Leader. Assessing clients management systems to the requirements of ISO 14001, ISO 9001, ISO 27001, ISO 45001, OHSAS 18001, 2019
- Role of the Planning Department: MNCPPC, MD. (n.d). Retrieved December 11, 2020, From http:/colleggeparkaviationmuseum.com/766/Role-ofthe-Planning-Department
- Zainon, N. (2016). IBCC 2016. The Rise of BIM in Malaysia and Its Impact on QuantitySurveying, 1-2.
- Jessica Woolliams, (2011) Eco-City Planning Company. Planning, Design and Construction strategies For Green Buildings, from <u>https://www.greenbiz.com/sites/default/files/document/O16F22028.pdf</u>

Gerd Waloszek, Introduction to Design Thinking, 2012:

https://experience.sap.com/skillup/introduction-to-design-thinking/

Course: Design Thinking - The Beginner's Guide: <u>https://www.interaction-design.org/courses/design-thinking-the-</u> beginners- guide

http://prkonsultan.blogspot.com/2018/11/range-of-expertise.html



# LAMAN WEB BERCIRIKAN REALITI MAYA SEBAGAI PLATFORM PENYAMPAIAN MAKLUMAT DAN PROMOSI

#### Siti Nur Syakirah Binti Mohamad Azman<sup>1</sup>, Umi Kalthom Binti Ramin<sup>2</sup> and Mazlisa Binti Mohd Isa<sup>3</sup>

<sup>1</sup> nrsykirhazman@gmail.com,<sup>2</sup>umikalthom@pis.edu.my, <sup>3</sup> malisa\_isa@pis.edu.my

#### Abstract

Kelab Alami Tanjung Kupang menawarkan aktiviti penerokaan kerana tarikan ekopelancongan seperti paya bakau, rumput laut dan hutan yang menghijau. Namun begitu, penyampaian maklumat dan promosi menyukarkan pengunjung untuk mengetahui tentang Kelab Alami. Objektif kajian ini adalah untuk membangunkan laman web yang berkesan dengan berkonsepkan kehijauan alam semulajadi dan mendapatkan maklum balas pengguna. Model *User-centered design (UCD)* telah digunakan untuk membangunkan laman web yang melibatkan gabungan kaedah dan alatan penyiasatan seperti tinjauan dan temu bual dan kaedah generatif iaitu *brainstorming* untuk membangunkan pemahaman tentang keperluan pengguna. Kajian ini telah berjaya menghasilkan laman web dengan dilengkapi pandangan 360 dan telah mendapatkan maklum balas daripada 30 orang responden. Hasil analisis diuji dengan soal selidik dari aspek *user interface*, kandungan dan *user experience*. Soal selidik ini telah dijalankan secara kuantitatif dengan menggunakan borang kaji selidik dalam *Google Form*. Kajian ini diharapkan dapat membantu Kelab Alami dalam meningkatkan strategi promosi kelab dan perkhidmatan yang ditawarkan untuk para pelancong terutama pelanconga dalam negara.

Kata kunci: laman web, sistem penyampaian maklumat, pandangan 360°, promosi.

#### 1. Pengenalan

Laman web juga merupakan teknologi yang penting pada masa kini terutama sekali untuk perniagaan, pelancongan dan pemasaran. Hal ini kerana, menurut Khir Khalid laman web adalah platform yang paling efektif dan berpontensi dalam memberi informasi kepada individu untuk mencari sesuatu yang mereka inginkan. Ini kerana laman web boleh diolah dan dikemas kini dari masa ke semasa untuk informasi yang dipaparkan agar sentiasa relevan dengan keperluan semasa (Khir Khalid, 2019). Kelab di Mukim Tanjung Kupang, yang dikenali sebagai Kelab



Alami juga tidak dapat lari daripada kesan dunia digital ini. Kelab Alami menyediakan aktiviti meneroka alam semulajadi. Hal ini kerana, di kawasan tersebut terdapat paya bakau, rumput laut dan hutan yang menghijau.

Namun begitu, segelintir warga tempatan tidak mengetahui lebih lanjut berkaitan dengan kelab ini terutama sekali mengenai persekitaran kelab. Hal ini kerana, menurut Irfan Yazid kebanyakkan pengunjung yang datang adalah pengunjung dari singapura dan hanya segelintir sahaja pengunjung warga tempatan yang datang berkunjung untuk menyertai aktiviti yang disediakan oleh kelab ini.

Oleh itu, sebuah laman web bercirikan realiti maya iaitu realiti maya 360 dijadikan platform penyampaian dan promosi yang dapat memberikan gambaran yang menyeluruh berkaitan dengan maklumat dan pesekitaran aktiviti yang disediakan dan ini juga untuk memberikan pengalaman yang menarik kepada individu yang suka akan aktiviti penerokaan alam semulajadi.

# 2. Kajian Literatur

#### 2.1 Kepentingan Laman Web untuk Promosi

Pengguna internet boleh memperoleh maklumat dengan lebih pantas dari teknologi maklumat. Laman web adalah contoh kemajuan moden dalam teknologi maklumat. Laman web ialah koleksi halaman yang saling berkaitan pada domain di internet yang ditubuhkan untuk tujuan tertentu dan boleh diakses secara amnya melalui halaman utama menggunakan pelayar menggunakan URL tapak web. Laman web berfungsi sebagai kenderaan promosi, antara lain. Telah ditunjukkan bahawa dengan menggunakan pemasaran digital melalui penggunaan laman web, barangan yang dijual menjadi lebih laku (M. Petrova, pp.30-32). Laman web ini berfungsi sebagai satu cara untuk mempromosikan destinasi pelancongan serta perdagangan.

Teknologi maklumat digunakan dalam pelbagai industri, salah satunya adalah sebagai alat untuk mengiklankan produk atau tempat. Menggunakan laman web sebagai alat pemasaran untuk melibatkan pelawat dalam kajian. Dalam kajian ini, melihat bagaimana estetika dan penyampaian maklumat di laman web mempengaruhi keputusan pelancong



untuk melawat Indonesia dan membeli barangan Indonesia. Dapatan kajian ini memberi penerangan tentang bagaimana aspek linguistik dan visual digunakan secara strategik untuk

menyampaikan keaslian Indonesia sebagai destinasi pelancongan yang popular. Penyelidikan ini membantu orang ramai lebih memahami destinasi pelancongan Indonesia, yang dipromosikan melalui wacana unik seperti alam semula jadi asli dan warisan budaya asli. (M.Salim, H. Hassan, dan N. Ibrahim)

Seterusnya, berdasarkan kaedah analisis masa daripada analisis Google, (Awichanirost dan Phumchusri) menyiasat kesan sesi terhadap pelawat unik dan paparan halaman unik tapak web pelancong. Para penyelidik membentangkan cara untuk meneroka. Kajian ini mendapati bahawa semua model sesi mencirikan pelawat unik dan paparan halaman dengan tepat. Penemuan analisis regresi berganda mendedahkan bahawa sesi jenis pelawat yang paling berkesan adalah sesi yang melibatkan pelawat baharu, yang mempunyai pengaruh paling besar terhadap pelawat individu. Pelawat yang kembali, bagaimanapun, mempunyai pengaruh terbesar pada paparan halaman yang unik. Tambahan pula, sesi trafik (saluran) yang paling berpengaruh termasuk rujukan, yang mempunyai pengaruh paling besar pada pelawat unik, manakala trafik langsung mempunyai kesan terbesar pada paparan halaman unik. Tambahan pula, apabila ia datang kepada sesi teknologi (penyemak imbas), Internet Explorer mempunyai pengaruh yang paling besar terhadap pelawat unik, manakala mempunyai pengaruh halaman unik (pelayar).

#### 2.2 Realiti Maya

Realiti maya (VR) ialah teknologi yang berkembang pesat yang kini digunakan secara meluas dalam sektor pelancongan dan berpotensi untuk berguna dalam bidang seperti perancangan, pemasaran, hiburan, pendidikan, dan pemeliharaan warisan (Guttentag 2009).

Terdapat banyak firma dan aplikasi pelancongan VR yang tersedia hari ini. Salah satu aplikasi VR terhebat untuk tahun 2021, menurut Trend Digital, ialah Google Expeditions (Nicol, Revilla 2021) - aplikasi yang membolehkan pengguna meneroka dunia melalui lawatan realiti maya (Google 2021). Walaupun teknologi VR tidak dapat menggantikan



sepenuhnya lawatan sebenar pada masa ini, ia mungkin menarik perhatian pengguna ke lokasi (Akhtar et al. 2021).

Menurut penyelidikan Voronkova (2018), VR amat popular dalam pemasaran produk dalam konteks pelancong kerana ia membolehkan orang ramai "mencuba sebelum mereka membeli." VR diistilahkan oleh Akhtar et al. (2021) sebagai "alat demonstrasi untuk pemasaran destinasi." Pelancongan maya, khususnya, menawarkan banyak potensi untuk mempromosikan destinasi dan produk pelancongan (Voronkova 2018).

Apabila realiti maya (VR) menjadi lebih popular dalam pemasaran, pelbagai kajian telah dijalankan mengenai pengaruhnya terhadap sikap pelanggan dan niat melawat (Tussyadiah et al. 2018; Willems et al. 2019). Video realiti maya, apabila digunakan sebagai alat pemasaran, menyediakan pelanggan dengan jangkaan yang lebih realistik berbanding media perwakilan lain, dengan baik mempengaruhi sikap pengguna tentang lokasi dan pilihan mereka untuk hadir (Rainoldi et al. 2018).

Menurut Willems et al. (2019), menggunakan teknologi yang lebih menarik dan interaktif, seperti realiti maya (VR), mempunyai pengaruh yang lebih kuat pada niat pembelian atau pelawat. Realiti maya, khususnya, mempunyai tahap penglibatan yang lebih tinggi dan mencetuskan emosi yang lebih kuat daripada media tradisional, yang mempunyai kesan yang baik terhadap sikap mengenai lokasi (Yung et al. 2021).

Tussyadiah et al. (2018) menilai hubungan antara keseronokan pengalaman, perubahan sikap, dan niat melawat, dan menyimpulkan bahawa realiti maya boleh menjadi alat yang berguna dalam pemasaran pelancong berdasarkan penemuan.

Sebagai medium untuk belajar dan mengajar, teknologi realiti maya 360 ° mewujudkan persekitaran pembelajaran yang lebih menarik dan berpotensi untuk membentuk pendekatan pembelajaran masa hadapan. Teknologi realiti maya (VR) boleh digambarkan dalam fail animasi 3D, penyuntingan maklumat melalui fail animasi 3D, dan juga melalui tayangan gambar dan video 360 ° dalam pembelajaran dan pengajaran Seni Bina. Teknologi realiti maya boleh digunakan untuk menggambarkan foto 360 darjah dan rakaman video.



# 3. Metodologi

Kajian ini merangkumi 3 fasa iaitu fasa pertama model yang digunakan untuk membangunkan laman web, fasa kedua membangunkan laman web dan yang ketiga adalah kajian soal selidik.

3.1 peringkat 1 Model – Sistem pengurusan kandungan (content management systems)

Untuk peringkat ini model yang digunakan untuk membangunkan laman web adalah sistem pengurusan kandungan atau lebih dikenali sebagai *content management systems* (cms) dan sistem yang digunakan adalah Wordpress, ia merupakan proses penyuntingan yang mudah untuk membina laman web buat kali pertama kerana perisiannya mudah difahami untuk membangunkan laman web yang menarik.



Rajah 1: menunjukkan proses sistem pengurusan kandungan (cms)

3.2 Membangunkan laman web

Bagi peringkat kedua cms Wordpress digunakan untuk membangunkan laman web ini. Platform ini dicipta oleh Matt Mullenweg dan Mike Little pada tahun 2003. Sejarah WordPress berawal dari menutupan software blogging bernama b2/cafeblog, Matt dan Mike sebagai pengguna b2/cafeblog. Di tahun 2004, kedua progammer itu berhasil membangunkan WordPress 1.0 dengan fungsi-fungsi dasar seperti yang dimiliki b2/cafeblog yang digunakan sebelum ini. Sejak saat itulah perjalanan WordPress dimulai hingga saat ini menjadi CMS paling popular di seluruh dunia. Yang menarik dari



WordPress adalah software yang bersifat open source maksudnya WordPress boleh digunakan secara

percuma dan bebas untuk digunakan oleh siapa saja. Selain itu, WordPress menyediakan plugin yang memudahkan pengguna untuk menambahkan ciri-ciri di website hanya dengan sekali klik. Contoh syarikat besar menggunakan WordPress antaranya adalah SONY Music, Microsoft News Center, Bata, The Walt Disney Company, The New York Times Company, Mercedes-Benz, dan masih banyak lagi.

#### 3.3 Kajian soal selidik

kajian soal selidik ini dilakukan untuk mendapatkan maklumbalas seramai 34 orang bagi mendapatkan keberkesanan laman web.Soal selidik ini terbahagi kepada beberapa bahagian dan ia diedarkan secara rawak.

#### 4. Dapatan Kajian

Dapatan kajian ini memperincikan berkenaan soal selidik yang telah diedarkan secara rawak melalui atas talian kepada 34 orang responden.

# 4.1 Demografik

Soal selidik tinjauan telah diedarkan dalam talian di kalangan khalayak sasaran antara jantina,umur dan peranti yang digunakan untuk melayari laman web dalam Jadual 1 yang terdiri daripada 8 Lelaki (23.5%) dan 28 Perempuan (76.5%). Seterusnya, umur responden dikategorikan dalam lingkungan 17 – 40 tahun dan ke atas. Akhir sekali, telefon pintar (82.4%) digunakan lebih kerap daripada komputer riba atau PC (17.6%).



Jantina	Kuantiti	Jumlah %
Lelaki	8	23.5
Perempuan	26	76.5
Umur	Kuantiti	Jumlah %
17-25	17	50
26-30	4	11.8
31-35	7	20.6
36-40	1	2.9
40 dan keatas	5	14.7
Peranti yang digunakan	kuantiti	Jumlah%
Telefon pintar	28	82.4
Laptop/ PC	6	17.6

#### Jadual 12: menunjukkan jantina, umur dan peranti yang digunakan

#### 4.2 User Interface

Elemen reka bentuk UI termasuk kandungan seperti dokumen, teks, imej, video; borang termasuk butang, teg, medan teks, kotak semak, senarai juntai bawah, reka bentuk grafik; dan tingkah laku seperti apa yang akan berlaku apabila pengguna klik/seret/masuk.

soalan	1- sangat tidak setuju	2-tidak setuju	3- sederhana	4-setuju	5-sangat setuju
1. Adakah anda menikmati reka bentuk laman web?	0	0	3 (8.8%)	14 (41.2%)	17 (50%)
2. Adakah anda dapat membezakan antara pautan dengan mudah?	0	0	4 (11.8%)	13 (38.2%)	17 (50%)
3. Adakah imej di laman web membantu anda?	0	0	4 (11.8%)	11 (32.4%)	19 (55.9%)
4. Adakah imej di laman web berguna kepada anda?	0	0	5 (14.7%)	10 (29.4%)	19 (55.9%)
5. Laman web kelihatan menarik bagi saya.	0	0	3 (8.8%)	11 (32.4%)	20 (58.8%)

Jadual 2: Menunjukkan dapatan untuk bahagian *user interface* 



6. Warna yang digunakan memuji laman web.	0	0	4 (11.8%)	10 (29.4%)	20 (58.8%)
7. Teks boleh dibaca dari segi saiz dan huruf	0	0	3 (8.8%)	13 (38.2%)	18 (52.9%)

Berdasarkan jadual diatas *user interface* berada dalam kategori memuaskan kerana setiap soalan responden memberi tahap 5 bagi semua interface. Interface untuk laman web ini menarik dan menggunakan warna yang sesuai kerana sebanyak 20 responden memberi tahap 5.

### 4.3 User Experience

Pengalaman pengguna (UX) ialah tanggapan yang dibuat oleh laman web atau perisian kepada penggunanya untuk menjadikan interaksi mereka menarik dan menyeronokkan.

soalan	1-sangat tidak setuju	2-tidak setuju	3-sederhana	4-setuju	5-sangat setuju
1. Navigasi laman web adalah jelas dan mudah digunakan.	0	0	3 (8.8%)	16 (47.1%)	15 (44.1%)
2 Laman web ini mudah diakses.	0	0	7 (20.6%)	12 (35.3%)	15 (44.1%)
3. Penggunaan istilah di seluruh laman web adalah konsisten	0	1 (2.9%)	5 (14.7%)	12 (35.3%)	16 (47.1%)
4. Kedudukan mesej pada skrin adalah konsisten	0	0	6 (17.6%)	14 (41.2%)	14 (41.2%)
5. laman web mesra pengguna	0	0	5 (14.7%)	11 (32.4%)	18 (52.9%)



Berdasarkan jadual diatas *user experience* berada dikategori memuaskan. Namun begitu, terdapat seorang responden memberi tahap 2 iaitu tidak setuju dengan kenyataan penggunaan istilah di dalam laman web konsisten. Walaupun demikian, kebanyakkan responden setuju dengan kenyataan yang diberikan.

### 4.3 Ciri pandangan 360 dalam laman web

Soalan		
1. Adakah ciri 360 mampu menarik minat anda untuk menggunakan laman web?	kuantiti	Jumlah%
Ya	29	85.3
Tidak	1	2.9
Mungkin	4	11.8
2. Adakah anda mendapati ciri 360 sukar untuk digunakan?	kuantiti	Jumlah%
Ya	5	14.7
Tidak	17	50
Mungkin	12	35.3
3. Adakah anda fikir imej yang digunakan dalam ciri 360 jelas?	kuantiti	Jumlah%
Ya	25	73.5
Tidak	2	5.9
Mungkin	7	20.6

#### Jadual 3: Menunjukkan dapatan untuk bahagian ciri pandangan 360

Berdasarkan jadual diatas responden amat menyukai tambahan maklumat seperti pandangan 360. Hal ini kerana sebanyak 85.3% menyatakan bahawa pandangan 360 ini mampu menarik minat responden untuk melawati laman web ini.

Ringkasnya, majoriti memberi komen dan kenyataan yang baik, namun tardapat juga respon yang negatif. Komen yang negatif juga diperlukan untuk mengenalpasti kesalahan dan kesilapan dari susunan konten,warna,imej dan sebagainya untuk diperbaiki agar kelihatan lebih kemas dan teratur.

#### 5. Kesimpulan

Objektif utama kajian ini adalah untuk membangunkan laman web interaktif dengan ciriciri realiti maya 360 sebagai platfrom penyampaian informasi dan promosi untuk Kelab Alami. Kajian literatur telah dijalankan untuk mencari kaedah membangunkan laman web dan definisi berkaitan dengan pandangan 360 ataupu lebih dikenali dengan realiti maya.



Pengalaman pengguna, antara muka pengguna dan maklumbalas pandangan 360 telah menjadi titik penilaian utama kajian selain memberi tumpuan kepada orang dewasa dan dewasa muda sebagai khalayak sasaran mereka. Laman web yang telah dibuat menerima kesan positif dan negatif terhadap pengguna. Impak positif menunjukkan bahawa bakal tetamu Kelab Alami boleh menggunakan laman web untuk mengumpul maklumat mengenai aktiviti dan perkhidmatan yang mereka tawarkan manakala impak negatif boleh digunakan sebagai cara untuk menambah baik laman web dari semasa ke semasa.

### Penghargaan

Kajian ini diberi penghargaan kepada Kelab Alami kerana menyumbangkan idea dalam menjayakan projek ini.

#### References

M.A. Muhammad Salim, H. Hassan, and N. Ibrahim, "Authenticating the Tourist Destination on the Official Tourism Website of Indonesia: A Multimodal Perspective," Astra Salvensis, 2018.

M. Petrova, "Internet Marketing as a Tool Of Tourism Enterprise," pp. 30–32.

Guttentag, D. A. (2009). Virtual reality: Applications and implications for tourism. – *Tourism Management. Vol. 31, pp. 637-651.* 

Akhtar, N., Khan, N., Mahroof Khan, M., Ashraf, S., Hashmi, M. S., Khan, M. M., Hishan,

S. S. (2021). Post-COVID 19 Tourism: Will Digital Tourism Replace Mass Tourism? – Sustainability. Vol. 13, 5352.

Voronkova L. P. (2018). Virtual Tourism: on the Way to the Digital Economy. – IOP Conf. Ser.: Mater. Sci. Eng. Vol. 463, No. 4.

Tussyadiah, I. P., Wang, D., Jung, T. H., tom Dieck, M. C. (2018) Virtual reality, presence,

and attitude change: Empirical evidence from tourism.

– Tourism Management. Vol. 66, pp.140-154.

Willems, K., Brengman, M., Van Kerrebroeck, H. (2019). The impact of representation media on customer engagement in tourism marketing among millennials.



– European Journal of Marketing. Vol. 53, No. 9, pp. 1988-2017.

mockplus. (2019, March 3). A full guide on the differences between UI and UX design. A Full Guide on the Differences Between UI and UX Design. Retrieved July 3, 2022, from https://www.mockplus.com/blog/post/difference-between-ui-and-ux

EDI SUSILO. (2019, February 25). Pengertian user experience (UX) dan mengapa user experience itu penting? Pengertian User Experience (UX) Dan Mengapa User Experience Itu Penting? Retrieved July 3, 2022, from

https://www.edisusilo.com/pengertian-user-experience/



# A STUDY ON IMPROVEMENT OF ANTI-RUST DIPPING MACHINE (ARDM) : A TRIZ-CDIOBASED APPROACH

Muhammad Safwan Bin Khaad, Norazam Bin Aliman Department of Mechanical Engineering ,Polytechnic Sultan Azlan Shah, 35950 Behrang, Perak safwankhaad@gmail.com azam.820731@gmail.com

#### Abstract

This research is about improvement on Anti-rust dipping machine (ARDM) to reduce the time and man power. The ARDM is use to coating the metal product with chemical namely Nox-rust to prevent from rust. However, the problem of ARDM is product stuck in the dipping tank. It will reduce the quantity of the productthat will be sent to next process which is vibration machine. Currently this problem have been remove by manually. The operator was needed to remove the product from dipping tank manually. Therefore, the purpose of this research is to solve the problem that product stuck in the dipping tank. it can be achieve bydeveloping pneumatic system for removing part out from machine. The combination of two method have been used to design the pneumatic system i.e. Conceiving, Designing, Implementing, Operating (CDIO) and Theory of Inventive Problem Solving (TRIZ). This combination method is called CDIO-TRIZ. As a result, problem of product stuck can be solve by automation system and cycle time also been reduce.

Keywords: ARDM, TRIZ, CDIO.

# **1.0 Introduction**

Anti-Rust Dipping Machine (ARDM) is a machine that usually used to dipping the metal product with chemical Nox-rust. this process is used to prevent the metal from rusty. The process that involve in this machine have 3 process which is loading, dipping and vibration.



First, product will be load in the dipping tank. Then, the product will be removed from tank automatically and rollinginto the vibration machine. The machine will vibrate to reduce the excessive noxt-rust from the metal before being placed in the polybox.



Figure 1: Anti-Rust Dipping Machine (ARDM)

From the observation that have been made at ARDM the problem that occurred at ARDM was the cycle time for the product out from machine is high. This problem was occurred because of the product have been stuck in the dipping tank of the ARDM machine. This will cause an increasing of the time for product out from machine. However, the problem of ARDM is product stuck in the dipping tank. It will reduce the quantity of the product that will be sent to next processwhich is vibration machine. From figure 1, currently this problem have been remove by manually. The operator was needed to remove the product from dipping tank manually. Furthermore, the worker having a difficulty to remove the product from the ARDM. They need to remove the product of the worker.

Therefore, the purpose of this research is to solve the problem that product stuck in the dipping tank. it can be achieve by designing a pneumatic system for removing part out from machine and reduce the cycle time. the combination of two method have been used to deign the pneumatic system i.e. Conceiving, Designing, Implementing, Operating (CDIO) and Theory of Inventive Problem Solving (TRIZ). This combination method is called CDIO-TRIZ.



#### 2.0 Literature Review

### 2.1 Cdio-Triz

Creativity is important in the quality improvement in production assembly line. The methodology of problem solving usually included in different knowledge domains. Traditionally, the solution ideas come intuitively or logically, depending on creativity and experience of process engineers. The tools such as Conceiving, Designing, Implementing,

Operating (CDIO) and TRIZ (Russian acronym for the "Theory of Inventive Problem Solving) can be used to generate the idea of qualityimprovement. Therefore, the paper aims to present a strategy called CDIO-TRIZ which to be used as a tool for improvement on quality defect in production assembly line. Through CDIO-TRIZ approach, an application to improve product quality in production line was used to demonstrate the capability of the proposed methodology. As a result has indicated, CDIO-TRIZ approach is proven can be used to generate solution for quality improvement in manufacturing system [1].

# 2.2 Pneumatic System

System that uses compressed air as its main source of energy is termed pneumatic systems. Pneumatic driven systems are of lower cost than hydraulic and electromechanical systems and perform well in carrying out arduous work. Advantages of pneumatically actuated systems are mainly increased level of safety, cleanliness, variable load carrying capacity, simple configuration, minimum pollution, reliable, storage capability, high strength to weight ratio, ease of maintenance, high speed and fast transmission. The system is better at working in hazardous environment where explosions are likely; industries where it is highly suitable are mining, chemical, petroleum and painting industries. It has been used extensively for many years in robotics and factory automation mostly to execute simple tasks using open loop control. Nonetheless, they are often avoided because they exhibit high nonlinearity and are hence difficult to control. But the advent of sophisticated control systems and algorithm for pneumatic servo system in the recent years shifted the paradigm in pneumatic technologies. It is now possible to control pneumatic servo system just like electro servo system.



### 3.0 Methodology

Methodology is a conceptual structure that is used to analyse and organize data and serves as a guideline for solving the research problem. It comprises of theoretical analysis of the associated principles and the methods with the knowledge [3]. The research methodology of this current research will be explained in this chapter. Generally, the project methodology involves sequence of procedures or methods performed from the beginning until the end of thestudy. The research methodology is also important to ensure that the research runs smoothly and systematically. Therefore, it is vital to know and understand the processes occurring in the structure of research methodology, in detail.

### 3.1 CDIO Method

In this study, the main concept and idea of CDIO will be described. CDIO method educates students to master a deeper working knowledge of technical fundamentals. A CDIO program is predicated on the principle that product and system lifecycle development and deployment are the appropriate context for engineering education [3].



#### Figure 2 : CDIO.

The lifecycle comprises of four concepts which are conceiving, designing, implementing, operating. In addition, these concepts will be defined and described according to their chronological order, which is the basis of this research [3].



### 3.2 Coceive

This process includes processing client's needs, requirements, considering technology and developing abstract, technical and business plan. Conceive is characterized as indicating client'snecessities; in perspective on innovation, corporation methodology and guideline; create ideas, systems and marketable strategies. In this investigation, checking has been completed at the production line to distinguish issues that occur. Some work stations have also been recognized. The prominent issues are considered because the assigned process duration (CT) of the machinethat surpasses Machine Cycle Time (MCT) is infusion forming. Subsequently the operation is conducted through a challenging procedure. This study focuses on the problem which the productwas stuck in the dipping tank.

#### 3.2.1 Data Collection

The process of getting, gathering, and measuring current data that is connected to the target variables is known as data collection. This is to verify that the data is accurate and that the results

are properly analysed. Every piece of scientific research that is undertaken must have a root cause and be backed up by facts. In each form of research endeavour, data collecting is crucial.



Figure 3: Process time

# Table 1: Time collected for dipping process.



PROCESS		TIME					
		TAKEN					
LOADING	28	29	26	28	30		
MACHINE	21	23	21	20	22		
OUT	6	5	7	8	6		

# 3.3 Design

The Design stage focuses on creating the design, which includes the plans, drawings, and algorithms that will be used to create the solution. In this research, it focussed on designing a newpneumatic system which that will used to remove the part out from the dipping tank. This phase will purpose the ideas that can help solve the problems that occur on the dipping tank at Anti-RustDipping Machine (ARDM).



Figure 4: Area for dipping tank

# 3.4 Implementation

Implementation method of this project is considering as less waste, less cost and help company earn profit. This project is implement by collecting the data such as size, and some required measurement to start develop this pneumatic system. Dimension need to be follow during designprocess. The target location to implement pneumatic system which at dipping tank to reduce the cycle time for product out from machine. The transition of the planning into a merchandise blend occurs during this stage, which includes manufacturing, assembly, and testing. To bring the concept to life, specific equipment and machines are chosen. The following are the steps that must be completed prior to fabrication:

#### i. Measuring



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- ii. Cutting
- iii. Assembly
- iv. Testing



#### Figure 5: Target location for pneumatic

This figure show that the location have been identify that suitable to create pneumatic system. The pneumatic actuator will push the product from the back to front for removing part.

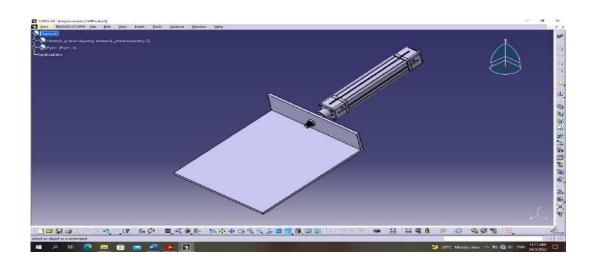


Figure 6: Design for pneumatic system



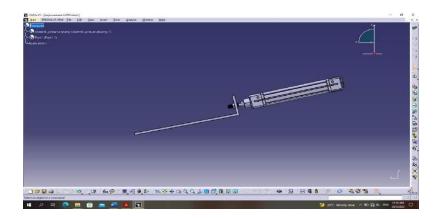


Figure 7: Side view for design

# 3.5 Operate

Maintaining, evolving, and retiring the system, as well as operating the implemented product to perform the specified purpose, are all part of the operation stage. Operation, or work done in linewith a method, is the final step in the CDIO technique. The operation of the product can determineits utility in the process. All of the designs were made to make

the product out from the machine smoothly and reduce the time. The operation of the product can determine its utility in the process.All of the designs were made to make the product out from the machine smoothly and reduce the time



Figure 8 show the operation of pneumatic system at ARDM.



#### 4.0 Results

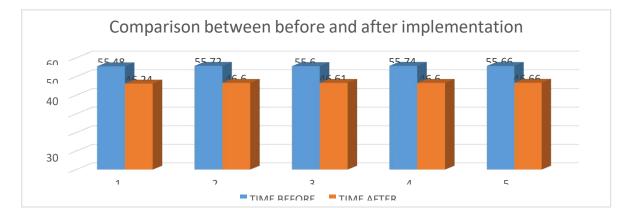


Figure 9 show the comparison of data between before and after implementation.

Figure 9 shows the time of comparison of the graph bar cycle before and after implementation in a bar chart. Because the pneumatic system , the bar chart shows that there is more time savings before and after the adoption of the pneumatic system. The use of a pneumatic system lowered day1 time by 9.24 seconds, day 2 time by 9.11 seconds, day 3 time by 8.99 seconds, day 4 time by

# 4. Conclusions

To conclude, putting the CDIO method of theory and practice into action is simple and unique in the engineering industry. The basic principles of CDIO are fairly simple, have a variety of applications, and may be applied in real-world situations. The CDIO concept is the fundamental concept that has been utilised to aid the project's progress throughout the process, from determining the overview, concept, design, implementation, and operation. It managed to gain the complete purpose of this study and to come up with a solution to the difficulties stated by using the correct approach and appropriate resource of information.

#### References

Noor, N. M., Aliman, N., Rahman, W. M. N. W. A., Abdullah, A., & Ruslan, M. A. I. (2021).



CDIO-TRIZ-Based Approach to Manufacturing Quality Improvement. International Journal of Academic Research in Business and Social Sciences, 11(1), 1005-1014.

Abhinav D. Khasale1" Introduction to Pneumatic Robotic Arm", 2019.

Dr Noreen Kamarudin, "Enhancing TVET Graduates," *21st Century Skills Through An* Integrated Curriculum, 2014.



# IMPROVE SPOT NUT WELD PROCESS FOR AUTOMOTIVE FLOOR BY DESIGN JIG AND FABRICATION

Muhammad Adam Izham Idrus<sup>1</sup>, Khalis Suhaimi<sup>2</sup> Department of Mechanical Engineer, Polytechnic Sultan Azlan Shah, 35950 Behrang, Perak *Izhamadam03@gmail.com khalis@psas.edu.my* 

### Abstract

This project holds main objective for design and fabricate jig for use of production line. As know that problem found on Body Assemble section for nut spot weld machine. It is part from automotive floor by name 'Reinforcement Front Floor Under' where need 2 manpower to produce part and checking quality part. Problem of miss weldnut and high cycle time. By fabricate jig, it helps to counter problem and simplify work of worker. Design are modelled by using Catia V5 and concept PUGH method are use for selected design to determined which design are best to fabricate. Data time taken are taken for 3 parts with constraint method to determine before and after time taken by apply jig on process. Apply jig on process also can increase output quantity for a daily production. In the end, result for install jig on nut spot weld machine can reduce cycle time and manpower.

Keywords: Jig and fabricate, Spot nut weld, Clamp and hold workpiece.

#### 1. Introduction

The useful of spot welds has been applied in the automotive industry for many years. Although the welds in these factories are made by process machine, their inspection is still being done manually and for a limited number of welds. Due to the repetitive and fast cycle-time of the production process, human errors are inevitable.



To relate this problem, company M are one of the automotive manufacturing part for cars in Malaysia that produce sub part and child part for car customer especially Perodua and Toyota

To focused into problem, consumption of spot weld nut are important because it assembly nut with part that are use to be installed at car and this part are use for two model (D93L) & (D42L). For this research, to look into part REINF. FR FLOOR UNDER for process spot weld nut that use two nut for each part.

Nut spot welding is a typical welding technique used in the appliance and automotive industries where nuts are required for the assembly of pieces on an object.

In this study, by doing this process sometimes, was analyzed there were few issues in quality of the product like when at QG(QualityGate) for checking, several part that have missing weldnut spot because there are two model part that common and used two nut for each part. Another problem is, there do not marking the spot before weld and it will cause wrong place nut install and take time to rework.

A proper jig should be proceed to overcome this problem and help to increase productivity of product.

The objective of this study is to develop jig and for prevent mistake happen at nut weld spot, improvement on process have to make to get better result. The purpose objective of project are to design and fabricate jig that can use to holds part with clamping while process scribing with use current method – (Okamochi bolt).

## 2. Literature Review

In purpose of project are to focus on built a jig by designed according to part product. Then, to fabricate the jig as prototype before apply on production line. Reason for because it have issue on the way process of spot nut weld and checking nut. Thus, it is unavoidable



that have to create own jigs according to the specification based on research. Thus, a study on the jig was made by review the example of jig designs and the information on how the jig should be made and from what it should be manufactured.

#### 2.1 Spot Weld

Spot welding is an economical method for joining metals that is commonly used in car manufacturing plants. The method is adaptable to high-speed automation and is under strict cycle times. Typically, a car body contains about 5000 spot welds joining sheets of different thicknesses.

The demand for Quality control is ever increasing due to safety requirements and demand for quality. This leads to the need to check the welds are correct in as many points as possible. The process involves applying pressure and heat to the weld area using shaped alloy copper electrodes which convey an electrical current through the weld pieces.

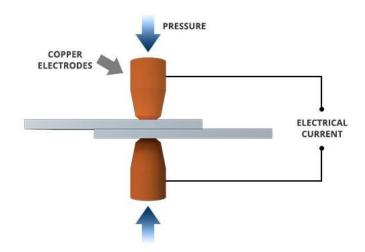


Figure 1: Schematic diagram of resistance spot welding



#### 2.2 Weld Nut

A weld nut is a type of nut that is specially designed to be welded to another workpiece. Different types of weld nuts are used for different purposes. These include round base nuts, slab base nuts, tab base nuts, hex and square nuts, retainer weld nuts, tube end nuts, twin piloted nuts and more.

Weld nuts are classified according to thickness, shape and size. These specialized industrial fasteners can be welded on to other pieces of metal, thereby reducing gaps and seams. These nuts can be used in restricted spaces as well.

Type of weld nut:

- 1. Tab spot weld nuts
- 2. Tab projection weld nut
- 3. Hex 3 projection weld nuts
- 4. Square projection weld nut
- 5. Round weld nut
- 6. Flange weld nuts
- 7. Stamped flange weld nuts

#### 2.3 Spot Nut Weld Basics

Nut spot welding is a process where nuts or fasteners are joined onto metal parts. To practice spot welding, electrodes with pointed tips are used as the welding tool to create opposing forces that allow metal parts to be heated and joined.



Nut spot welding is a common form of welding in the appliance and automotive industry where the nuts are needed for the assembly of parts on an object. The nuts provide assembly points for screws, bolts, and other fastening accessories used in part assembly. Nut spot welding is one of the major welding approaches applied for creating nut weld. In a nut welding process, spot welding, as well as other forms of resistance welding, can be used.

## 2.4 Principal Clamping

Principles of clamping devices are used to hold the workpiece in the correct relative position in the jig or fixture. Clamping devices are designed for minimum operating and handling time. The following design and operational factors should be considered to

achieve best results. (Nov 19, 2020. Principles of Clamping – Mechanical Actuation Clamp).

- (i) The applied clamping pressures against the workpiece must counteract the tool forces.
- (ii) The clamping force should be kept minimum. It must only hold the workpiece and should never be great enough so as to damage the workpiece.
- (iii) The clamping pressure should be exerted on the solid supporting part of the workpiece to prevent distortion.

Type of clamps:

- i. Toggle clamps
- ii. Bench clamps
- iii. Hinge clamps
- iv. Quick action clamps



## 3. Methodology

The procedure for making jig are based from the flow of research of concere concept with it details, locator, clamps and support.

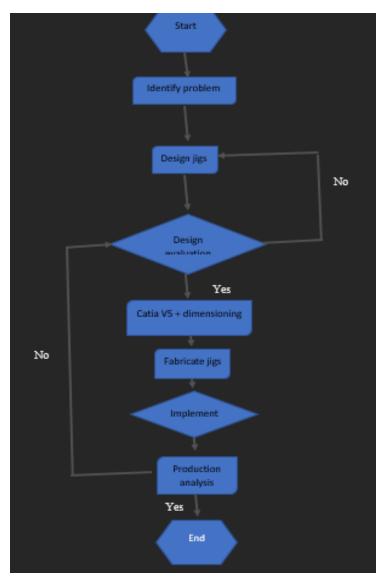


Figure 2: Flow of research



## 3.1 Procedure of jig design

Before proceed to design jig, there are method that can be used for making jig based on specific that are need. The method that are reasonable to use are concrete method because in fill on that it has details, locator, clamps and support which is important thing to have for design jig.

For data and design criteria:

- 1. Jig planning
- 2. Jig layout
- 3. Jig element design
- 4. Jig body design
- 5. Evaluation & approval completion of design
- 3.2 Jig Design

Below show several design that make from Catia V5 can be compare:

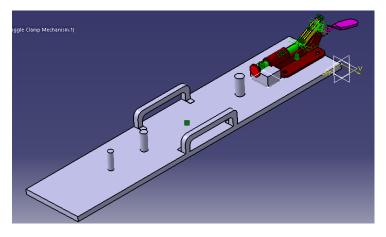


Figure 3: Design A



For design A, by using vertical clamp, it clamp from back side of part while applied three datum hole at center part .

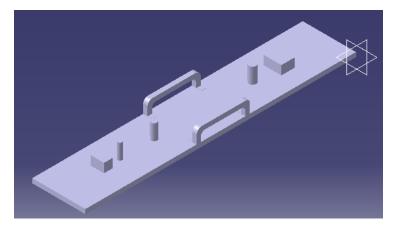


Figure 4: Design B

For design B, it have add two stopper at two sides on front and back part to lock part so that part cannot move while doing scribbing. Three datum are same before will use again to secure part hole on the right place.

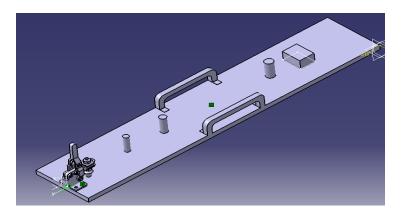


Figure 5: Design C



For the last design C, it has horizontal clamp that use for hold back of the part. Besides that, it also include stopper with help to support the clamp. While three datum in center are required.

## 4. Comparison and Discussion

From the design in above, the best jig that can be selected to use are from design C. The reason because it look suitable to use on production line because of selection on clamping. Better to chose horizontal clamping because based on part shape that more in vertical long body. Besides than same three datum that included, it also have stopper to support clamp to hold part so that part cannot move.



Figure 6: Prototype of jig

4.1 Concept Selection

Stuart Pugh created idea screening in the late 1980s to assist restrict the amount of concepts. The Pugh Concept was another name for this strategy. In the process, Concept



C was chosen as reference concept. Each concept has several criteria which is durability, affordability, simplicity of manufacture, ease of use, space efficiency, and usefulness are all factors to consider. Concept screening are show to provide clear vision which concept been chosen.

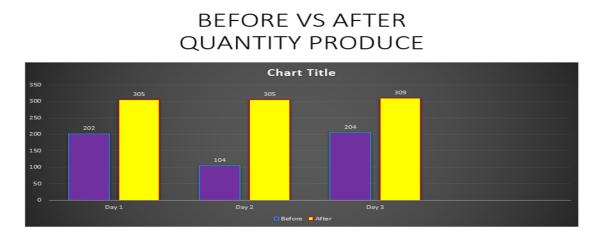
#### 4.2 Selection Design

	_			CONCEPT VARIANTS		
SELECI		ITERIA				
Criteria A	0	(-)	(-)	(+)	0	0
Criteria B	0	(-)	(-)	(+)	(+)	0
Criteria C	0	0	(+)	(+)	0	(+)
		PLUSES	1	2	3	
		SAMES	3	2	3	
		MINUSES	2	2	0	
		NET	-1	0	3	
		RANK	3	2	1	
		CONTINUE	No	No	Continue	

#### **Table 1: Concept Screening**

The relative score for each notion was assigned as "better than" (+), "same as" (0), or "worse than" (based on the criteria) (-). All score are given base on reference concept. After summing total score, concept C shows to be best concept of fabricate jig.





## Figure 7: Before vs After quantity produce part

Quantity of output part daily are increase by apply jig on the nut spot weld. For a daily, production run part about 250 pcs for a rack. After jig add on nut spot weld machine, it helps increase to quantity of part. Quantity for running part are increase by produced part and only need one manpower to handle it.

## 5.0 Conclusion

As a conclusion, the objectives of this project are considered as accomplish. A proper jig that be design and fabricate can help worker to doing job more easily and same time can can increase quantity. The practice of design jig is important to make sure that design have made are good on element and characteristic as the best with suitable selection material. Designs also can be modelled accurately by using software such as CatiaV5. With use of jig at process spot nut weld, it can improve quantity and quality by applied online inspection on work process with add scribing for method checking. Besides this research follow objective, it also the problem statement by increase the quantity of process part. For overall, benefit having jig for par process critical also are good product by it can help worker to doing job comfortless and ease for everybody that use jig.

## References

Wijaya, S., Hariyadi, S., Debora, F., & Supriadi, G. (2020). Design and Implementation of Poka-Yoke System in Stationary Spot-Welding Production Line Utilizing Internet-of-Things Platform. Journal of ICT Research & Applications, 14(1).



Junqueira, D. M., Silveira, M. E., & Ancelotti, A. C. (2018). Analysis of spot weld distribution in a weldment—numerical simulation and topology optimization. The International Journal of Advanced Manufacturing Technology, 95(9), 4071-4079.

Cho, Y., Hu, S. J., & Li, W. (2003). Resistance spot welding of aluminium and steel: a comparative experimental study. Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture, 217(10), 1355-1363.

Tang, H., Hou, W., Hu, S. J., & Zhang, H. (2000). Force characteristics of resistance spot welding of steels. WELDING JOURNAL-NEW YORK-, 79(7), 175-s.

Tolf, E., & Hedegård, J. (2007). Resistance nut welding: Improving the weldability and joint properties of ultra high strength steels. Welding in the World, 51(3), 28-36.

Jurgaitis, V., Česnavičius, R., Kilikevičius, S., & Dundulis, R. (2018). Strength and microstructure analysis of spot welded joints between a sheet and a nut of different steels. Mechanics, 24(3), 305-310.

Chun, E. J., Lim, S. S., Kim, Y. T., Nam, K. S., Kim, Y. M., Park, Y. W., ... & Park, Y. D. (2019). Influence of heat-treated Al–Si coating on the weldability and microstructural inhomogeneity for hot stamped steel resistance nut projection welds. Metals and Materials International, 25(1), 179-192.

Wang, X., & Zhang, Y. (2017). Effects of Welding Procedures on Resistance Projection Welding of Nuts to Sheets. ISIJ International, 57(12), 2194-2200.

Brozek, M. (2015). Resistance spot welding of steel sheets of different thickness. Eng Rural Dev, 14, 72-77.



# DEVELOPMENT OF PATIENT MONITOR USING WIRELESS AND TOUCHSCREEN TECHNOLOGY

Muhd Shaqil Aqim bin Ariffin<sup>1</sup>, Ku Lee Chin<sup>2</sup>

Department of Electrical Engineering, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor, Malaysia. <sup>1</sup>shaqilmuhd1608@gmail.com <sup>2</sup>lohleechin1@gmail.com.my

#### Abstract

The project aims to create a Patient Monitor using wireless and touch screen technology. The idea is to transmit data faster at a high-speed wireless technology. Meanwhile, the current patient monitors in the market provide less convenience in accessing menus, keyboards, or functions because they still rely on button features. The objective of the project is to change the cable technology by replacing it with wireless technology. The project also uses a touch screen display to provide a faster and more efficient selection of menu options. Furthermore, this product also aims to track patient data history via an IoT application. This project uses Wemos D1 Mini and NodeMCU ESP8266 to send the data wirelessly from the device to the smartphone. The project also uses a Thin Film Transistor (TFT) LCD to make the screen touchable. This project used the MAX30102 sensor to find heart rate, temperature, and oxygen concentration parameters. The Wemos D1 Mini provides the internet connection between the device and the database because this microcontroller is already built in the Wi-Fi inside its components. The data will store on a cloud storage system via the internet. IoT apps securely store user data online, which can be accessed via a phone app. The application can monitor patient health and analyze the data to recommend treatments or generate alerts.

**Keywords:** Patient Monitor, wireless, touchscreen, Wemos D1 mini, NodeMCU ESP8266, TFT LCD, MAX30102.



#### **1.0 Introduction**

A patient monitor is a medical instrument that monitors a patient's vital signs. A typical operating room patient monitor includes ECG, Respiration, Non-Invasive Blood Pressure (NIBP), blood oxygen level, temperature, and invasive blood pressure (IBP), which measures carbon dioxide levels from the patient's respiratory system. Patient monitor parameters include ECG, respiration, blood pressure, temperature, and blood saturation. These include electrocardiogram (ECG), respiratory rate and oxygen saturation, temperature, and invasive blood pressure (IBP), which monitors carbon dioxide levels in the patient's respiratory system. This equipment is the most important medical tool in hospitals and clinics, according to several studies. A Patient Monitor is essential in every household, not just hospitals. This study focused on portable patient monitors with touchscreens and wireless cable technology that were connected to an IoT system.

The most common Patient Monitor issue is the cable. On one hand, there are technical issues with the cable, like disconnected cables and bent or damaged plugs. All medical equipment encouraged to have a touch screen interface for dependable and effective data collecting. At the same time the touchscreen application also makes launching data and outcomes easier. The developing of the Patient Monitor with IoT and mobile apps may solve this issue. Today's technology is essential to develop wireless patient monitors that are simple and quick to respond. Touch screen technology is ideal for this purpose.

Several studies have concluded that the most significant medical gadget in hospitals or clinics is the Patient Monitor device. Not just in hospitals, but in every home, a Patient Monitor gadget is required to monitor health. This research focused on portable Patient Monitor devices that had been modified with a touchscreen monitor and wireless cable technology that was integrated with an IoT system.

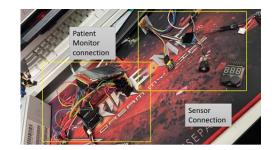
#### 1. Methodology

This chapter describes the process and methods to implement this project successfully. Designing and developing the Patient Monitor using Wesmo D1 mini and NodeMCU, drawing operating system block diagrams, making operating device flow charts, and making the device wireless are all stages of this research. Data collection was collected to analyze the error of the output. This method is used to achieve project objectives that achieve perfect results.



This project combines software (systems) and hardware (device) to develop an IoT system for patient data monitoring. Using MIT App Inventor for Graphic User Interface (GUI) on the smartphone, the Arduino platform's software has been developed. This application controls and monitors the patient's historical data. The application became the output for the data of the overall project.

## **1.1 Developing the hardware and IoT implementation of the Patient Monitor**



**Figure 12 Circuit Connection** 

Figure 1 shows the circuit of the Development Patient Monitor using wireless and touchscreen technology. All hardware installations follow the schematic circuit made in Fritzing software. Wemos D1 mini is the microcontroller used in this project, on which programs may be loaded using the Arduino IDE software. Next, NodeMCU is an open-source firmware and development kit that aids in the prototyping and developing of Internet of Things (IoT) products. In addition, a MAX301022 sensor is used to find the patient's heart rate, blood oxygen concentration, and temperature. This device required the smartphone to turn on the internet data and the personal hotspots to take the data. The polystyrene was used to prevent the component from getting too close due to a short circuit. The casing is made of plastic, so it is strong and not easily broken.



Figure 13 Project's Device



Figure 2 above shows the complete product of the project. The left box represents the sensor the user will put their finger to the MAX30102 sensor. The data will be shown on the OLED display. The left box represents the Patient Monitor device with a TFT touchscreen display. The data shown on the sensor will be transferred to the Patient Monitor device wirelessly through Wi-Fi. The data is also displayed on the smartphone so the user can track the data history after using it.

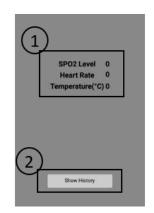


Figure 14 Application on Android smartphone

The interface of IoT implementation using the MIT App Inventor application for collecting the data from the sensor is shown on figure 3 above. The MIT App Inventor application is easy to download for android smartphones. The user can track their health record easily by using the application.

No.	Button	
1	Output data	
2	History button	

Table 13 Function button on the MIT App Inventor application

Table 1 above shows the function of each button of the MIT App Inventor application. No. 1 is will shows the data taken from the sensor. No. 2 is the history button. The user can track their history by pushing the history button.



SP02 Level	94
Heart Rate	32
Temperature(°C)	34.3125

Figure 15 Value appears

The figure 4 above shows the example data when the user touches the MAX30102 sensor. The data that comes out is data from the Patient Monitor device.

	Clear	8	
Date/Time	BPM	SP02	Temp(*C)
(08/06/2022 09:52 pm)	(75)	(82)	(37)
	(75)	(82)	(37)
(08/06/2022 09:53 pm)			
	(76)	(89)	(39)
		(89) (89)	(39) (39)
(08/06/2022 09:53 pm) (09/06/2022 12:29 am)	(76)		

Figure 16 History data

Figure 5 shows the history data when the user puish the history button. The application will record and save information such as date and time, BPM, SP02, and temperature. This record is saved as private and confidential files to keep the privacy of patient information.

## 1.2 Block Diagram of the Operating System

This project's hardware and software will be combined to create the project "Development of Patient Monitor Using Wireless and Touchscreen Technology".



Furthermore, the device will have an application that will allow users to pick the mode, receive alerts in the form of alarms, and receive updates about the health monitoring system through IoT. A 7V rechargeable battery will serve as the circuit's power source. The output from the device will be displayed on the OLED displayand TFT display. Below shows the block diagram of the MAX30102 sensor, TFT display, and collecting data block diagram.

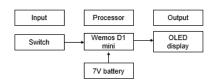


Figure 17 Block diagram (MAX30102 sensor)

Figure 6 shows the block diagram of MAX30102 sensor. The Wemos D1 small will process the MAX30102 sensor's data. A 7V rechargeable battery will serve as the circuit's power source. The output from the MAX30102 sensor will be displayed on the OLED display.

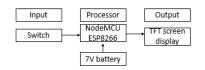


Figure 18 Block diagram (TFT display)

Figure 7 shows the block diagram of TFT display. The NodeMCU ESP8266 will process the data collected from the Wemos D1 Mini and display the data on the TFT screen.

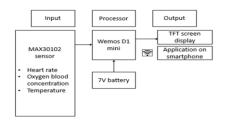


Figure 19 Block diagram (Collecting data)



Figure 8 shows the block diagram of collecting data. The NodeMCU ESP8266 will process the data collected from the Wemos D1 Mini and display the data on the TFT screen.

## **1.3 Making Flow Chart of the Operation Device**

Flowchart in Figure 9 displays a process that begins with users turning on the device and then choosing to change a setting on the device or the user's smartphone. The user has selected the parameters heart rate, oxygen blood concentration, and temperature as his or her preferences. All the device's characteristics can also be customized by the user. After that, the device will begin monitoring and displaying the data collected. The information will be displayed on the touchscreen display of the device or smartphone.

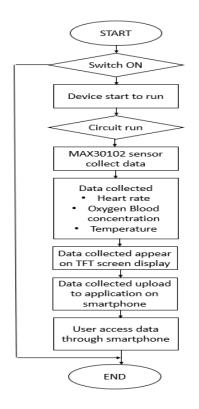


Figure 20 Project's Flow chart

## 1.4 Data Collection Method



## **1.4.1 Experimnt on Transmission Data and Connection Test**



Figure 21 Transmission Data and Connection Test

Figure 10 shows the transmission Data and Connection Test. This experiment aims to determine whether the data displayed on the sensor device and the TFT screen Patient Monitor are the same. The user will put finger on the sensor and wait for several seconds. Make sure the internet connection is stable. The user can determine how much error occurred by using percentage error calculation.

## 1.4.2 Comparison of Product Data and Current Product Data

Oximeter devices were used for comparing heart rate data and oxygen blood concentration data. Using this method, the difference in value between the new and the existing products may be determined. Temperature data also be compared to analyse the temperature data by using infrared thermometer.

## 1.4.3 Percent error

. Percent errors indicate how significant the errors are when measuring something in an analysis process. More minor percent errors indicate that they are close to the accepted or original value. For example, a 1% error indicates that the user got very close to the accepted value, while 48% means they were far from the true value. Measurement errors are often unavoidable due to certain reasons like hands can shake, the material can be imprecise, or instruments might not be able to estimate exactly. The percent error formula will let the user know how seriously these inevitable errors influenced the results.



 $Percentage \ Error = \frac{Measured \ Value - True \ Value}{True \ Value} x \ 100\%$ 

#### 2. Result and Discussion

## 2.1 Transmission Data and Connection Test

Table 2 shows the table of Transmission Data and Connection Test data. Data Transmission and Connection Test find the percentage error between the data displayed on the TFT display and the data displayed on the Application on the smartphone. The data shows that all data transmission and connection errors are 0%.

No.	Heart rate			Oxygen Blood Concentration			Temperature		
	TFT	Apps	Error	TFT	Apps	Error	TFT	Apps	Error
	display		(%)	display		(%)	display		(%)
1	1.16	1.16	0	79%	79%	0	32.44	32.44	0
2	0.53	0.53	0	95%	95%	0	33.69	33.69	0
3	2.13	2.13	0	96%	96%	0	34.12	34.12	0

Table 14 Table of Transmission Data and Connection Test data

## 2.2 Data Analysis of The Product

Table 3 below shows the error analysis of the product. This data analysis finds the percentage error between the product (MAX30102 sensor) and the oximeter. The first data compares the heart rate data between the two products. To conclude the data, most of the error is 99%, so the heart rate product data is inaccurate compared to the oximeter data.

Next, the Oxygen Blood Concentration data will be taken using two devices: the product and the oximeter. Following the table below, the highest value of percentage error is 18.56%, and the lowest value of percentage error is 1.03%. This data shows that the value of the product and oximeter is approximate.

The last data taken is temperature data. Temperature data were taken using the product and infrared thermometer. The highest percentage error value is 10.41%, and the lowest is 8.35%.



No.	Hea	Plus, minus (+ -)	Error (%)		
	MAX30102 Oximeter Sensor				-,
1	1.16	132.11	130.95	99.12	
2	0.53	127.51	126.98	99.58	
3	2.13	2.13 140.70		98.49	
No.	Oxygen Bloo	Plus, minus (+ -)	Error (%)		
	MAX30102 Sensor	Oximeter	_		
1	79%	97%	18	18.56	
2	95%	98%	3	3.06	
3	96%	96% 97&		1.03	
No.	Tem	Plus, minus (+	Error (%)		
	MAX30102 Sensor	Infrared Thermometer	-)		
1	32.44	36.21	3.77	10.41	
2	33.69	33.69 36.76		8.35	
3	34.12 37.63		3.51	9.33	

Table 15 Error analysis of the product

#### 3. Conclusion

The development of the Patient Monitor using wireless technology and a touch screen is a user-friendly device, and it can be used by anyone, especially for hospital needs. Moreover, the Wireless network can be accessed from anywhere, at any time. It will facilitate the work of the hospital in taking patient data. Using the Wemos D1 Mini will act as a web server, allowing any Wi-Fi-connected device to interact with the board and send data wirelessly. MAX30102 sensor is a full pulse oximetry and heart rate sensor module. The sensor is tiny, allowing for data collection without compromising optical or electrical performance. The Arduino 2.4-inch TFT LCD Touch shield makes this project have a touchscreen display. The device will be a low-cost Patient Monitor with wireless and touch screen technology.



#### 4. Acknowledgment

İ would like to thank you to Mrs. Ku Lee Chin, lecturer of Polytechnic Sultan Salahuddin Abdul Aziz Shah for a valuable advice and technical assistance during the development of my final year project.

#### 5. References

- Tscholl, D. W., Handschin, L., Rössler, J., Weiss, M., Spahn, D. R., & Nöthiger, C. B. (2019). It's not you, it's the design - Common problems with patient monitoring reported by anesthesiologists: A mixed qualitative and quantitative study. BMC Anesthesiology, 19(1). <u>https://doi.org/10.1186/s12871-019-0757-z</u>
  - A. (2018, January 16). Introduction to Wireless and Telecommunication ASM Technoogies Ltd. ASM Technologies Ltd. <u>https://www.asmltd.com/introduction-wireless-</u> <u>telecommunication/#:%7E:text=Advantages%20of%20Wireless%20Comm</u> <u>unication,be%20accessed%20from%20anywhere%2C%20anytime</u>.
     B.
- Newman, E. D., Lerch, V., Jones, J. B., & Stewart, W. (2012). Touchscreen questionnaire patient data collection in rheumatology practice: Development of a highly successful system using process redesign. Arthritis Care and Research, 64(4), 589–596. <u>https://doi.org/10.1002/acr.21560</u>
- Mavrogiorgou, A., Kiourtis, A., Perakis, K., Pitsios, S., & Kyriazis, D. (2019). IoT in Healthcare: Achieving Interoperability of High-Quality Data Acquired by IoT Medical Devices. Sensors (Basel, Switzerland), 19(9). <u>https://doi.org/10.3390/s19091978</u>
- Ganesh, K. V. S. S., Jeyanth, S. P. S., & Bevi, A. R. (2022). IOT based portable heart rate and SpO2 pulse oximeter. HardwareX, 11, e00309. https://doi.org/10.1016/j.ohx.2022.e00309
- Ahmed, M. F., Hasan, M. K., Shahjalal, M., Alam, M. M., & Jang, Y. M. (2020). Design and implementation of an OCC-based real-time heart rate and



pulse-oxygen saturation monitoring system. IEEE Access, 8, 198740–198747. https://doi.org/10.1109/ACCESS.2020.3034366

- Kanagond, S. S., Huddar, S. S., Hoolageri, S. H., Kapatakar, V., Itagi, R. L., & Jolad, S. (2020). Smart assistive device for senior citizens. 2020 IEEE International Conference on Distributed Computing, VLSI, Electrical Circuits and Robotics, DISCOVER 2020 - Proceedings, 42–46. https://doi.org/10.1109/DISCOVER50404.2020.9278083
- Fezari, M., & al Dahoud, A. (2018). Integrated Development Environment "IDE" For Arduino Lung Sounds analysis View project Integrated Development Environment "IDE" For Arduino Introduction to Arduino IDE. <u>https://www.researchgate.net/publication/328615543</u>



## STUDY ON THE AWARENESS LEVEL AMONG THE HOSPITAL STAFF TOWARDS CLINICAL WASTE HANDLING DURING PANDEMIC COVID-19

Aqilah Binti Zaid<sup>1</sup>, Sumaini Binti Che Maid<sup>2</sup>

Department of Civil Engineering, Polytechnic Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor qeelaaa88@gmail.com sumaini06@gmail.com

#### Abstract

Due to the high number of infections globally and nationwide the increase in the amount of clinical waste generation was expected. Malaysia has reported a 27% (by weight) increase in the generation of clinical waste which was mostly attributed to COVID-19 related waste.Problems such as lack of awareness about health to the community and also environment. Poor handling practices and improper waste disposal increase health hazards. For example, hazardous and clinical waste can be handled and disposed along with domestic waste, thus posing a health risk to workers, the general public and the environment. Although studies on practices in dealing clinical waste already extensively conducted in previous studies, however, in the aspect of handling that only involves nurses has yet to be implemented. This research used the method in the form of quantitative approach. The instruments used in this study was questionnaire for data collection.

Keywords: Clinical waste, Covid-19, waste handling, waste

#### 1. Introduction

Hospital waste is a potential reservoir of pathogenic microorganisms that needs to be handled properly, safely, and consistently (WHO, 2007). All those who come into contact with hazardous hospital waste, including those who manage it at any point, are at danger (MOH, 2007). According to the Malaysian Department of Environment, mixing general garbage into clinical waste streams and vice versa is widespread in hospitals, posing a cost to the concession business, the owner of the health care facility, and the government (DOE, 2009).



Hospitals, primary care facilities, labs, mortuaries, autopsy centres, laboratories, blood banks, nursing homes, and other medical facilities produce the majority of this waste (Pepin et al., 2014). It is produced during human or animal diagnosis, treatment, immunisation, research, or the development or testing of biologicals. During an infectious disease outbreak, the waste generated by healthcare facilities multiplies enormously; as a result, management must take extra precautions to minimise negative consequences (Ramteke and Sahu, 2020).

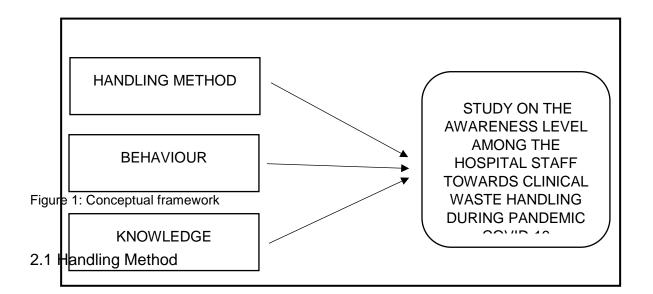
The SARS-CoV-2 virus, which causes an acute respiratory sickness, has caused the coronavirus disease 2019 (COVID-19) outbreak (Mol and Caldas, 2020). Of practically every section of the world, the rise in COVID-19 infections can be linked to an increase in healthcare waste in facilities such as hospitals, clinics, labs, temporary quarantine centres, and research laboratories. From March 18, 2020, the Malaysian government has announced an MCO.

New cases are on the rise, with over 8904 cases and 124 deaths documented as of July 27, 2020. The amount of clinical waste appears to be increasing with the increase in new cases practically every day and the number of tests performed. Following the COVID-19 outbreak, the Ministry of Health in Malaysia recorded a 27 percent increase in clinical waste. The rise is primarily due to medical personnel's increased use of disposable gloves, face masks, and personal protective equipment (PPE) (Astro Awani, 2020).

#### 2. Literature Review

It is critical to create concept definitions for the constructs involved in order to ensure that the constructs can accurately represent the concepts examined based on past research. The following figure (Figure 1) are the four constructs that make up the conceptual framework for this study:





Prior to 1990, clinical waste management was not created in Malaysia, and general hospital garbage was handled using a similar strategy (Siru, D.; Pillay, M.S.; Sinha, K., 2006). Due to the transmission of diseases, MOH and DOE swiftly created a standard operating procedure and guideline for the handling of clinical waste.

By adhering to standard operating procedures and directives outlined in Schedule Waste Regulation 2005, typical management practises are comparable (DOE, 2005). Basic requirements in environmental management practises include clinical waste segregation, labelling and marking, collection and storage, internal transportation to central storage, transportation to approved facility, documentation, treatment, and final disposal form to reduce the risk of public health and environmental contamination. The next section will go into more detail about these steps.

#### 2.2 Behaviour

Because they produce clinical waste as a result of providing healthcare and come into contact with it frequently, health professionals play a vital role in controlling clinical waste. clinical waste management concerns can be dangerous for hospital staff members. The second-highest risk factor for health workers contracting hepatitis B and other blood-borne diseases is occupational hazards like puncturing used, non-sterile needles (KEMENKES RI 2017).



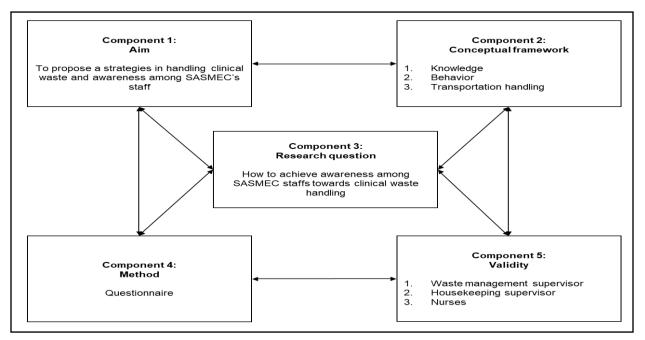
The main problems with managing clinical waste in Malaysia have been attributed to a variety of factors, including a lack of awareness, a lack of education, and the attitude of health workers (Khanehzaei, 2014).

#### 2.3 Knowledge

According to the Department of Environment Malaysia, it is typical for general waste to be mixed with clinical waste stream, and vice versa. This problem results in additional expenses for the government, the concession business, and the owner of the healthcare institution (DOE, 2009).

Due to inadequate employee training and, to a lesser extent, due to inadequate facilities, toxic wastes and normal garbage are mixed together in hospitals (M. Askarian, 2004). Private health care facilities frequently have loose clinical waste in yellow wheeled bins or improperly sealed yellow bags. Despite the extremely little amount of unsecured trash, this will put healthcare personnel at heightened risk for needle sticks and biological hazards (WHO, 2007).

## 3. Research Methodology





The study design, as shown in Figure 2, consists of five components based on Maxwell's theory of 2012. Through his research design, he demonstrates the link between the five components: aims, conceptual frameworks, study design, technique, and validity.

The research question is regarded as a focal point, and all of these elements can, in turn, answer all of the research questions posed in the study. Furthermore, the components of this study are linked to the conceptual framework and research methodologies because the goal of this study is to build a conceptual framework while also determining the best way for gathering research data and answering questions.

The aims, conceptual frameworks, methodologies, and research questions all have a relationship with validity. Both parts must be verified, either through formal expert interviews and authorization, or through the use of system software that most researchers utilise to demonstrate the study's validity and dependability.

#### Conclusion

Clinical wastes are extremely dangerous and put patients at risk for life-threatening illnesses. It's crucial to comprehend clinical waste management and control procedures. The concept of clinical waste, clinical waste management regulatory acts, exposure concerns, and clinical waste management processes and control mechanisms are introduced in this paper.

It is crucial to handle and dispose of hospital and other healthcare facility generated clinical waste in the right manner. Due to the possibility that the clinical waste may contain contaminated and infectious human tissues, blood, bodily fluids, excretions, medicines, needles, and other related items, doing this will prevent any unintended infection as well as negative health and environmental effects. The same principle applies to COVID-19-related waste: any unintended infection or virus propagation can be prevented with adequate management and disposal measures. CWM in Malaysia is governed by the DOE and the Federal Government. Malaysia is actively putting the Environmental Quality Act of 1974 into effect with the most recent modifications.



#### References

Agency, U. E. (2009). A User -Friendly reference Document.

- Akter. (1998). Medical Waste Disposal at BRAC Health Centres. An Environmental Study.
- Allahyari, T. (2011). Development and Evaluation of a New Questionnaire for Rating Cognitive Failures at Work. 6-11.
- Al-Zahrani. (2000). Healthcare Risk waste in Arab Saudi. In Saudi Medical Journal (pp. 245-250).
- Anagnostopoulou. (2007). Medical waste managmnet and toxicity evaluation. A case study, 912-920.
- Bajeva. (2000). Medical Waste Management. 485-486.
- Balakrishan, V. (2012). Treatment of Clinical Solid Waste Using a Steam Autoclave as a Possible Alternative Technology to Incineration. Environmental Research and Public Health, 855-867.

Barasarathi, J. (2020). Clinical Waste Management under Covid-19 scenario in Malaysia.

- Capoor, M. R. (2016). Implementation Challenges in Bio-Medical Waste Mangement rules. Indian J Med Microbiol, 623-5.
- Chartier, Y., Jorge, E., Ute, P., & Annette, P. (2014). Safe Management of Waste from Healthcare. WHO Blue Book.
- DOE. (2005). Enviromental Quality (Schedule Waste) Regulation . Percetakan Nasional Malaysia Berhad.
- Ghafar, A. (2003). Rekabentuk Tinjauan Soal Selidik Penyelidikan. Skudai.
- Kenny, C. (2021). Review of Current Healthcare Waste Management Methods and Their Effect on Global Health. Healthcare.
- Lee, B.-k. (2005). Waste Management. Alternatives for treatment and disposal cost reduction of regulated medical wastes, 143-151.
- Makhura, R. (2016). Implications for training of healthcare professionals. Medical waste disposal at hospital in Mpumalaga, 1096-102.



Manupati, V. K. (2021). Selection of the best healthcare waste disposal techniques during and post COVID-19 pandemic era. Journal of Cleaner Production, 125-175.

Marican, S. (2006). Kaedah Penyelidikan Sains Sosial. Petaling Jaya.

Maxwell, J. A. (2011). A Realist Approach to Qualitative Research.

Mekonnen, B. (2021). Healthcare Waste Status and Handling Practise during Covid-19 Pandemic.

Journal of Enviroment and Public Health, 7.

- MJ, E. (2004). Alternative for treatment and disposal cost reduction of regulated medical waste. Waste Manage, 143-51.
- Noman, E. (2020). Qualitative of Healthcare Waste.

Pasupathi. (2011). Biomedical waste management for healthcare industry. 472-428.



## ANALYSIS OF COWHIDE CUTTING PROCESS, IN COMPARISON BETWEEN MANUAL AND DIE CUTTING, ALONG WITH PRE-MARKING AND PRE-CUTTING.

Muhammad Fikri bin Zulkifli<sup>1</sup>, Zureena Binti Abu Samah<sup>2</sup>

<sup>1</sup>Department of Mechanical Engineering, Polytechnic Sultan Azlan Shah 35950 Behrang, Perak *Muhd.eikeyz@gmail.com* 

<sup>2</sup>Department of Mechanical Engineering, Polytechnic Sultan Azlan Shah, 35950 Behrang Stesen, Perak *zureena*@psas.edu.my

#### Abstract

A comparison of cowhide cutting utilizing a manual cutting procedure and a die-cutting process. Its goal is to determine which method of production has the highest efficiency. Cowhide may now be sliced utilizing die-cutting for a flexible shape as a result of this research. The purpose of the research is to introduce pre-marking and pre-cutting methods for operators to reduce cycle time spent by them. Method collection tools used in this study are a stopwatch, time study, and measure tape. Information was collected from this study in September 2021. With the information data collected, a comparison between manual cutting and die-cutting has been made, saving time and increasing production. The results can be proven by utilizing the die-cutting method because of this study. Side Panel 85 percent, Rear Storage 81 percent, Air Vent 84 percent, Front Bezel 81 percent, Armrest Center 85, and Side Armrest 71 percent are some parts that can save time with various percentages. This process cycle can also reduce the overall process time. In conclusion, the die-cutting process method can speed up production productivity. Furthermore, the benefits of pre-marking and pre-cutting will significantly help simplify the process.

**Keywords:** Die Cutting Process, Manual Cutting, Reduce Cycle Time, Pre-Marking, Pre-Cutting.

#### 1.0 Introduction



Most people prefer genuine leather products because of the shape and model, as well as the durability and long-term ease of care to keep it cool over time. The quality of the leather varies, and the price is determined by the type of animal and parts utilized, as well as how the leather is treated. Leather quality is assessed by its appearance and mechanical and chemical properties (Fantová et al., 2015). The interior of the car is made of leather, which is a great material to use. Side panels, Rear Storage, Armrests, Air Vents, and Front Bezels, for example. Leather is a great material for automotive interiors, as in figure 1.0, which is cowhide. Most luxury cars use cowhide because the skin is smooth and does not hot in the sun. Furthermore, the usage of this leather can make it feel like a premium vehicle.

The leather can be easily cleaned with a soft cloth and a little bit of water once it has been applied. If there is any spilled water or food on the leather, it should be cleaned immediately. Debris can be washed away with a solution of detergent and water. Without having to wait several hours for the leather to dry entirely, the surface will dry immediately. Leather surface by projecting images rendered based on the fine geometric structure of leather surface (Takezawa et al., 2019). An automobile is difficult to construct and comprises several major components, including the exterior, body pieces, engine parts, and interior. Car Door Panels can be found on both the inside and outside of the vehicle. It includes doorknobs, regulators, door locks, armrests, and other components. A seat is a complex part of an automobile and is applied for many materials such as leather, plastic, cloth, and steel (Choi et al., 2017)

The manual cutting process is a cutting that uses human energy without the help of modern equipment. The first process is marking. Without it, the cutting would not be accurate. Marking is a helpful way to indicate cut marks or add visual design. Marking is a functional or aesthetic action that results in temporary or permanent marks on or in materials. Some techniques involve applying color to the surface, such as with pens or markers. Marker pen inks have organic solvents, which can cause many health hazards, including central nervous toxicity, respiratory effects, and eye irritation (Muthonimuchemi et al., 2018). The next process is cutting. Usually, manual cutting can be said to be the tool used as scissors. Scissor is a cutting implement consisting of two blades joined by a swivel pin that allows the cutting edges to be opened and closed. Scissors are hand-operated, and Scissors are used for cutting various thin materials, such as paper, cardboard, and others. Scissors can also be used to cut on leather cowhide. When cutting an object with a pair of scissors, the force that feels between the fingers includes two main components, friction forces of the contact of the blades. Scissors are more efficient for noiseless linear amplification (Winnel et al., 2020). The cut gives the hand free



movement of each finger. Cutting with scissors works on the separation of the two sides of the hand and strengthens the hand muscles.

Die-cutting presses have their origins in letterpress printing, and they evolved to become a more specific manufacturing process. The die-cutting process in pattern design utilizes a die to cut materials into an array of different shapes, designs, and patterns. The tool used for cutting is a steel die-cut blade. It's a specialized tool used to cut and shape product materials using a press. It can think of a die-cut blade as a mold that is shaped in the specific way needed to cut out a custom design. Optimal force conditions are needed to increase the durability of the blade, depending on the angle of sharpening of the cutter, blunting of the edge of the blade, the used undercoat, and the type and kind of steel used in its production (Tarcia et al., 2019). Die-cutting presses are a very valuable

process as it is easier, faster, and more cost-effective to produce a custom design in larger quantities.

Cycle time is the time taken it takes for production to complete. This process will concentrate on the actual rate of work or time spent on a product before it is shipped. A work's production cycle time is the time it takes to turn raw material into a finished product (Lathashankar et al., 2018). The cycle time is the most important factor in this study since it compares the manual and die-cutting processes. Various variables will be developed based on the cycle time in order to understand the items and the production disadvantages. Cycle time studies can be used to determine waste identification.

The problem statement that occurred in this research. Based on observations and surveys conducted at the cutting station, there are issues seen during the cutting process. When operators spend more time producing cowhide cut stocks, difficulties arise due to the problem of low-cut stock productivity caused by manual marking and cutting of cowhide from production. The method of manual marking and cutting is depicted in figure 1.1. This section of the station requires two operators to mark and cut. The process involved marking according to the form's criteria using a kraft paper template. The operator will cut according to the markings made with scissors in the next step.

The purpose of this research is to introduce pre-marking and pre-cutting methods for operators to reduce cycle time spent by them.

## 2.0 Methodology

The current study discusses and covers a detailed explanation of the methods that are being used to make this project complete and work well. A good and right methodology

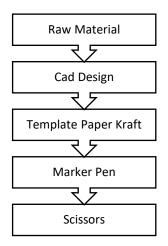


can help the researcher to obtain good data and more findings. Within this, it will guide to finish up the job well. Clearly explained the method of the research is required to ensure that it could be described more about the reasons for choosing the method.

## 2.1 Manual Cutting proses

Figure 2.1 show a flow chart of manual cutting tools. Cowhide cutting is a hand-operated experimental method. At the time, customer demand for purchase orders was minimal. Each cutting workstation has one operator, and each marking workstation has one operator. The purpose of this research area is to focus on collecting information and data in one area in order to create more reliable results. The raw material is the analysis tool utilized in the manual marking procedure, and the material employed in this research is cowhide. It is also the most common material utilized in this process; according to the research, cowhide has been used in the car's interior. The Template paper board is the next tool. The cowhide material is marked according to the desired shape using this paper

board template. For strength and durability, it has excellent elastic qualities and tears resistance. A marker pen is used as a marking tool. The purpose is a first step in the creation of a single piece that will be used in following work operations like cutting. Finally, there is cutting, which is done using scissors. Curves and tiny details are easier to cut with scissors. It is very easy to cut hands free with hand control. These scissors can also be used to cut minor details like lace, trimming, and so on.



## Figure 2.1: Flow Chart Manual Cutting Tools

#### 2.2 Die Cutting process



The die-cutting machine may cut one or more layers of flexible or semi-rigid material. With this machine, the data collected in this research study will be supplemented and merged with earlier procedures to create a chapter methodology approach. This die-cutting operation comprises three operators on the workstation. The figure 2.2 show flow chart die cutting. To begin, go to the pre-marking station. The pre-cutting station is the second, and the process die-cutting station is the third. The focus of this research is to gather data and information at this location in order to compare it to the manual method. The raw material was used as an analysis tool in this study. The beginning of a process that uses cowhide material is raw material. The next analytical tool is a template glass plastic made of acrylic, which is transparent and has excellent strength, rigidity, and optical clarity. It was utilized in this research. The pre-marking step is completed with the help of this template glass plastic. This pre-marking technique is like marking, but the shape of the template is not as complicated; it is simply a square shape. A mini knife cutting machine was used as a pre-cutting tool. This machine is known as a round knife cutting machine because its cutter is circular but slightly octagonal in shape. The machine is small, adaptable, and suited for production, and the cutting method simply follows the premarked shape. Finally, there's the steel die-cut. Cowhide materials are cut into various shapes and sizes using the steel rule die method. It is suited for use with cowhide. The material to be sliced is placed carefully beneath the die press. The cutting edges of the die come into contact with the material to be cut and penetrate through once the press is turned on. The sliced material is visible when the press is reversed. Using this die-cutting machine has the advantage of ensuring that each product is prepared to always bring consistent outcomes.

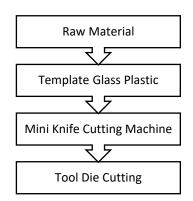


Figure 2.2: Flow Chart Die Cutting

#### 2.3 Data collection tools



The working method for comparing manual cutting and die-cutting, based on the observations, necessitates the use of data-gathering equipment. Stopwatches were utilized as research tools in this study. A stopwatch is used to keep track of the processing speed from beginning to end. Cycle time can be determined using this tool to determine how much can be produced in a single day. The next step is to time study. In this analysis, the purpose of a time study is to determine the work sequence that runs to make a part. It can also calculate the precise average amount of time from the start to the finish of a time cycle. The next tool is a measuring tape, which is a flexible ruler. The objective of this research tool is to figure out the dimensions of a template glass plastic. It is currently in the pre-marking process.

## 3.0 Result and Discussion

Once all the data and information have been obtained, the analysis is performed to see the comparison between the cutting manual as well as the die-cutting. The expected result from the project has been carried out were explained. The finding of the project was shown according to the following objectives.

## 3.1 Different manual & die-cutting processes of cowhide.

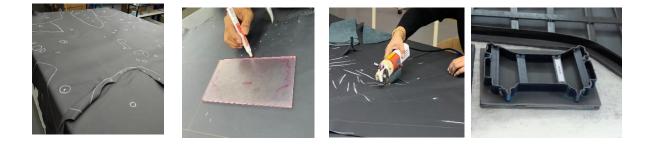
This figure 2.3 the manual marking & cutting process. At the beginning of the operation, the operator will get cowhide leather from the cowhide inspection store. Then the operator will select the proper surface for marking on the cowhide. Finally, when the cowhide is marked with manual marking, the cutting procedure will be carried out according to the marking made by the operator.



Figure 2.3: Manual marking & cutting



Pre-marking and pre-cutting are shown in this figure 2.4 until die-cutting. It will get cowhide leather from the cowhide inspection store at the start of the procedure, same as the manual method. The next step is the pre-marking process, which involves marking the template glass according to its shape. The cutting operation is then carried out in accordance with the pre-marked shape. Finally, the die-cutting procedure is carried out. In order to cut according to the shape, a steel die-cut must be used in this die-cutting operation. Operation is pressed on the steel die-cut to cut according to the shape of 6 types of die-cut parts.



## Figure 2.4: Pre-marking & cutting to die-cutting

3.2 Manual marking & cutting of cycle time vs. Lucid model 1 of 5 working days.

The manual cutting process for each piece created is shown in figure 2.5 below. This research was performed from the first to the fifth day in order to determine the average of each part produced. The side panel, rear storage, air vent, front bezel, and side armrest are Lucid components in the graph. The side panel takes the highest amount of time for

manual marking (132.12 seconds), whereas the side armrest takes the shortest amount of time (70.26 seconds). The next longest pre-cutting time is for the side panel, which takes 584.18 seconds to finish per piece. Then there's the side armrest, which takes 158.7 seconds to pre-cut.



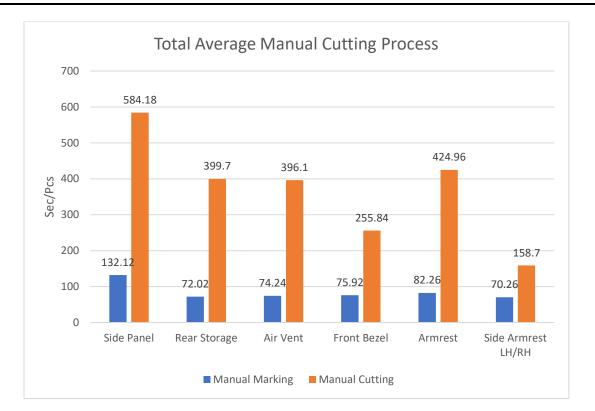


Figure 2.5: Total Average Manual Cutting Process

3.3 Pre-marking & cutting of cycle time vs. Lucid model 1 of 5 working days.

The figure 2.6 of the die-cutting process. This research is also conducted from the first day to the fifth day to get the average part produced. Parts involved in this research include the side panel, rear storage, air vent, front bezel, and side armrest. This procedure contains 3 kinds of processes, namely pre-marking, pre-cutting, and die-cutting. The highest recorded time for the pre-marking process is the side panel which is 12.32 sec. While the lowest is the side armrest which is 6.14 sec. for the pre-cutting process, the time recorded is the greatest among the 6 types of parts, namely the side panel is 72.38 sec, and the lowest in the front bezel 34.16 sec. Next to the die-cutting process, the time recorded for the average of the 6 types of parts is the same, which is 22.44 sec. This is because this die-cutting procedure can be cut simultaneously in at the same time.



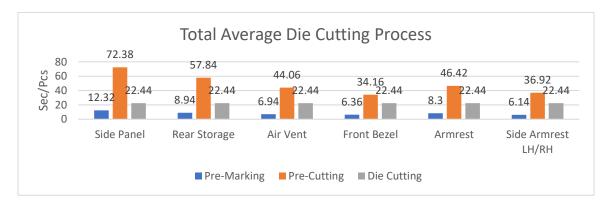


Figure 2.6: Total Average Die Cutting Process

3.4 Total process method vs. die-cutting for Lucid model 1 of 5 working days per piece.

For Lucid model 1 of 5 working days per piece, the figure 2.7 shows the total process manuals vs. die-cutting. The difference between manual cutting and die-cutting may be observed clearly here. The side panel is the longest part produced, with a total time of 716.3 seconds recorded for manual cutting. The die-cutting process, on the other side, takes relatively little time, taking only 107.14 seconds in total. Now compare manual and die-cutting on the side armrest part for the lowest value. Manual cutting takes 228.96 seconds, while die-cutting takes 65.5 seconds. Each part produced has a different percentage rate, and the time span for Side Panel, Rear storage 81 percent, Air vent 84 percent, Front Bezel 81 percent, Armrest 85 percent, and Side Armrest 71 percent can be lowered by up to 85 percent. Overall, the results of die-cutting show that time can be saved significantly when compared to manual cutting.

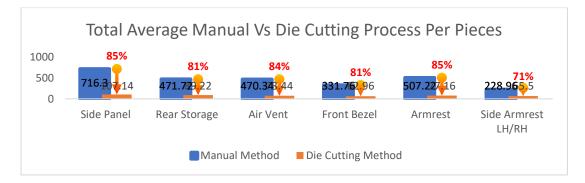


Figure 2.7: Total average manual vs. die-cutting process per piece



#### 4.0 CONCLUSION

Conclusions from this analytical study include the findings for each analysis that has been made in previous chapters. The implementation of both methods analyzed showed a difference in producing a reduction between manual cutting and die-cutting. Data are analyzed and can be inferred among the best methods used. Based on the data, it can be concluded that the die-cutting method can reduce the time in product production up to a decrease of 85 percent Side Panel, 81 percent rear storage, 84 percent air vent, 81 percent front bezel, 85 percent armrest, and side armrest 71 percent. Moreover, the advantage of using pre-marking and pre-cutting methods is that they can produce many of the same shapes quickly at once. Even die cutters will create shapes faster. Next, the operator no longer uses these scissors because it is not ergonomic due to repeated movements using scissors, and clumsy posture. Can also feel numbness and weak pain in the hands and wrists. Finally, with the use of this new method, it can be used more efficiently in productivity generation.

## REFERENCES

- Choi, H., Song, J., Lee, J. K., & Ko, J. (2017). A Squeak Noise Study between Leather and Plastic. SAE Technical Papers, 2017-March(March). https://doi.org/10.4271/2017-01-1741
- Fantová, M., Nohejlová, L., & Stádník, L. (2015). Mechanická kvalita kůže jehňat plemene Texel a jejich kříženců. *Journal of Central European Agriculture*, *16*(2), 54–61. https://doi.org/10.5513/JCEA01/16.2.1588
- Muthonimuchemi, S., Nyaoramoturi, W., & Moraraogendi, G. (2018). *Knowledge*, *attitudes and practices on use of white board marker pen ink among school teachers*. *12*(11), 48–54. https://doi.org/10.9790/2402-1211014854
- Takezawa, T., Iwai, D., Sato, K., Hara, T., Takeda, Y., & Murase, K. (2019). Material surface reproduction and perceptual deformation with projection mapping for car interior design. 26th IEEE Conference on Virtual Reality and 3D User Interfaces, VR 2019 - Proceedings, 251–258. https://doi.org/10.1109/VR.2019.8797923
- Tarcia, O., Wycinaniu, P., & Naturalnych, S. (2019). *friction force of the natural leather cutting process*. 81–85. https://doi.org/10.5604/01.3001.0013.7772
- Winnel, M. S., Hosseinidehaj, N., & Ralph, T. C. (2020). Generalized quantum scissors for noiseless linear amplification. *Physical Review A*, 102(6). https://doi.org/10.1103/PhysRevA.102.063715



## IMPROVEMENT IN AUTOMOTIVE INDUSTRY FOR PRODUCTION ASSEMBLY LINE BALANCING OF MODEL X BY USING YAMAZUMI METHOD

Dr. Supa'at Bin Zakaria @ Jawahir<sup>1</sup>, Nor Anis Amira Binti Mohd Razali<sup>2</sup> supaat@puo.edu.my<sup>,</sup> noranis301@gmail.com

#### Abstract

A system called an assembly line is created by lining up workstations. Using an assembly line to produce a product is a key strategy for increasing productivity and maximising manufacturing efficiency. The productivity of the plant has significantly increased since line balancing was implemented in the automotive sector. Line balancing is a flow-oriented production strategy for improving productivity and cost-efficiency in mass production processes. Three objectives are considered is minimizing the number of workstations, eliminate unnecessary work movement and reduce production costing for overtime and operator salary by study Yamazumi method. Yamazumi Chart is used for line balancing. The results of the proposed measures were compared with the current situation in terms of improve of the production line. This project describes how to use line balance to save production cost. As a result, operator reduction is done from 8 to 7 operators with make the production cost reduce 12.5% for overtime and salary payment.

Keywords: Line Balancing, Operator Reduction, Cost Reduction, Yamazumi method.

#### 1. Introduction

The automotive sector is dealing with difficulties from consumers who demand a greater level of quality and customer care, as well as quicker deliveries and lower prices. Because of this, the producer must ensure that the process is carried out as efficiently as possible in order to overcome these obstacles. Production is a process that transforms raw materials (inputs) into the goods that are needed (output). The company needs to run the



manufacturing line expertly in order to get the optimum output. A methodical strategy or approach ought to be used in this situation.

This project presents optimum efficiency improvement of assembly production line by using line balancing idea in automotive industry. The project is regarding improvement in assembly line balancing with reduce manpower at the same time it can be save the production cost by minimize the workstations and eliminate operator work movement. The

corporation has set a number of focused measures based on the targets that are intended to improve productivity because productivity is one of the factors that determines a firm's performance in the more competitive industrial environment. In order to provide a projected productivity objective and an anticipated cost savings for the production department, the project's objective is to enhance line balance at the assembly line.

Line balancing is the process of setting up a production line such that production moves evenly from one work station to the next. The number of workstations, cycle duration, workload smoothness, and task relatedness were all minimised, increased, and/or maximised using the line balancing technique. The automotive industry's assembly lines frequently employed the line balancing technique. For instance, it has been demonstrated to be a successful method for reducing the number of employees in an automobile industry without lowering output. Line balancing is a method to increase a work cell's or line's throughput while also lowering the necessary cost. Improvement of line balancing at assembly line by using Yamazumi method to improve the track balance and also reduce the production cost for overtime and salary payment. With the Yamazumi it is possible to visualize the state of the project and focus on the process. Yamazumi is a used tool to proceed the Kaizen for line balancing. It is necessary to continuously identify cycle time and layout.

## 2. Research Quetion

The questions that should be answered in this research is what is the minimum number of operator needed to run the production of assembly line and standard method and time of each operator in doing their task at the assembly line in the automotive company by using line balancing technique and Yamazumi method. Later, to response the question of the research, it is conducted to achieve below three objectives:



- 1. To determine the minimum number of operators needed to run production assembly line.
- 2. To eliminate unnecessary work movement at assembly line.
- 3. To reduce production costs at assembly line.

## 3. Method

Line balancing is an adjustment made to the distribution of work tasks from one assembly line to a work station with the goal of reducing the number of workstations and reducing idle time on all stations at a given production level. By decreasing workstations, work cycles,

and working loads, as well as by increasing flexibility across workstations, line balancing could improve process efficiency.

Line balancing is a tool to improve the throughput of a work cell or line which at the same time reducing manpower and cost needed. Its equalizing the workload across all operations in a line to remove bottlenecks and excess capacity. With the aid of line balancing, tasks can be distributed among connected workstations in a way that achieves optimal assignment and reduces the number of workstations and overall idle time for a given output level. If the workload allocated to each workstation is the same, the line is balanced.



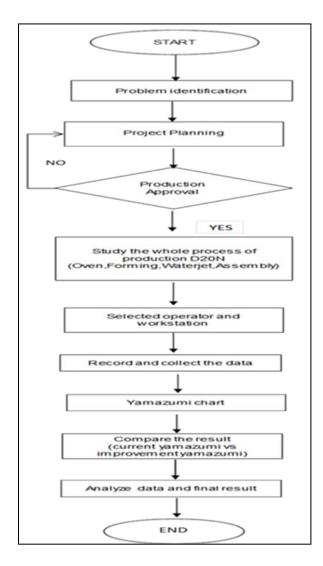


Figure 1: Flowchart



### 3.1 Data Collection Methods

Each workstation's cycle time was calculated from the time the first part was picked up until it was located at the following workstation. Based on the work sequences discovered

through observation, the cycle time was measured and recorded. A video camera was employed to record the data in order to increase the reliability of the results. This is done to obtain correct work-time data. To calculate the cycle time of the process, each work step and its duration were then recorded in a time measurement sheet. From the videos recorded, the cycle time for workstation has been calculated by using time measurement check sheet.

#### 3.2 Time Measurement Check Sheet Table

Time measurement check sheet is a table that needed cycle time to fill in to balancing the work for each manpower. In additional, this check sheet is dividing by manpower and every work they do include walking and waiting. The cycle time for each workstation was measured from the start picking part until it has been located at the next workstation.

#### 3.3 Yamazumi chart

We shall obtain a graph from the time measurement check sheet that was created by each operator to balance their effort with that of the process. In order to balance the workload of each operator, the graph must be below the takt time line. The graph will have a time balance rather than a work and movement balance.

#### 4. Result and Discussion

#### 4.1 Time Measurement Data Before Improvement



NO	OP1 (OVEN + FORMING)	OP2 (OVEN + FORMING + GLUE SPRAY)	OP3 (FORMING + GLUE SPRAY)	OP4 (FORMING + FELT)	OP5 (WATERJ ET)	OP6 (STAPLER + ASSEMBLY)	OP7 (SPRAY FELT & PLATE MATE)	OP8 (CH EC KIN G & FIN AL INS PA CTI ON)
1	2.4	13.7	2.7	6.9	13.8	9.2	15.4	4.6
2	3.2	33.3	2.5	3.4	7.5	15.3	18.4	65.4
3	5.0	9.6	4.4	3.2	3.2	6.4	7.5	5.9
4	1.6	9.2	16.2	20.5	68.4	8.5	14.7	15.5
5	6.4	7.0	14.9	5.2	3.3	61.7	37.3	4.5
6	17.7	11.7	21.1	3.6	11.6	2.9	5.3	6.2
7	32.1	3.1	3.9	4.8	5.8		4.1	30.9
8	7.6	5.6	6.3	14.7				
9	4.3	1.6	4.2	10.4				
10	32.3	5.6	17.0	7.2				
11	18.8	4.4	10.1	8.3				
12	4.1	2.4		5.0				
13	3.0			4.7				
14	4.0			4.0				
15	2.1			3.4				
16				3.4				
17				9.8				
Total	144.8	107.4	103.4	118.6	113.6	104.2	102.7	133. 0

## Table 1: Summarize of task of each operators for before implementation

4.2 Yamazumi Chart Before Improvement



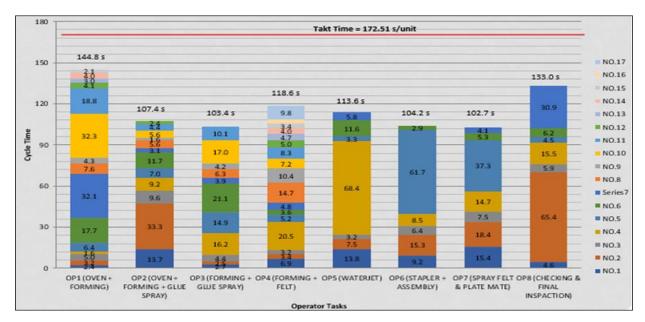


Figure 2: Yamazumi chart before improvement

Takt time = <u>Available production time per day</u>

Customer demand per day

= <u>Total working hours x 3600sec</u>

Total customer order

= (296.76 hours x 3600sec)

6193 pieces

= 172.51 sec/pieces

4.3 Operator task for current condition

Table 2 and Table 3 shows the operator task for forming and waterjet process.



Table 2: For Forming Process
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NO	OP1 (OVEN + FORMING)		OP2 (OVEN + FORMING + GLUE S	PRAY)	OP3 (FORMING + GLUE SPRAY)		OP4 (FORMING + FELT)	
1	Take slab	2.4	Put felt in the spray booth	13.7	Streach the slab before entering the Forming MC	2.7	Arrange felt in the Forming MC	6.9
2	Walking to the Oven	3.2	Spray felt	33.3	Jabbed the slab into the Forming MC	2.5	Streach the slab before entering the Forming MC	3.4
3	Put slab into oven	5.0	Waiting for Forming MC	9.6	Walking to the spray booth	4.4	Jabbed the slab into the Forming MC	3.2
4	Push "ON" button for oven timer	1.6	Take the sprayed felt	9.2	Put felt on spray tray	16.2	Waiting for the Forming MC	20.5
5	Walking to the Slab station	6.4	Walking to the Forming MC	7.0	Spraying the felt	14.9	Walking to the Forming MC	5.2
6	Roll slab	17.7	Put felt into the Forming MC	11.7	Waiting for the Forming MC	21.1	Take out part from Forming MC	3.6
7	Waiting for the Forming MC	32.1	Walking to the Oven	3.1	Walking to the Forming MC	3.9	Flip the part to assembly felt table	4.8
8	Walking for the Forming MC	7.6	Waiting for the Oven	5.6	Take out the slab from Forming MC	6.3	Put sprayed felt on the slab	14.7
9	Pull the previous slab in the Forming Machine	4.3	Push "OFF" oven timer	1.6	Flip the part on the assembly felt table	4.2	Appreance checking & part numbering	10.4
10	Put felt into the Forming MC	32.3	Take slab	5.6	Put the sprayed felt on the slab	17.0	Walking to the WaterJet MC	7.2
11	Waiting for the Oven	18.8	Streaching slab	4.4	Put the part into the Water Jet/WIP rack	10.1	Remove extra slab from Waterjet MC	8.3
12	Take out slab from Oven	4.1	Jabbed the slab into the Forming MC	2.4			Remove jig on the slab	5.0
13	Streaching Slab	3.0					Walking to the Forming MC/WIP rack	4.7
14	Jabbed the slab into Forming MC	4.0					Took slab	4.0
15	Push "ON" button (FM)	2.1					Walking to the WaterJet MC	3.4
16							Put slab into the WaterJet MC	3.4
17							Put jig on the slab before entering the WaterJet MC	9.8
		144.8		107.4		103.4		118.6

OP5 (WATERJET)		OP6 (STAPLER + ASSEMBLY)	SSEMBLY) OP7 (SPRAY FELT & PLATE MA		ATE)	E) OP8 (CHECKING & FINAL INSPACTION)		
Remove extra slab after the waterjet cut	13.8	Staple the extra slab	9.2	Put felt on spray tray	15.4	Take slab from G3	4.6	
Remove the jig	7.5	Marking	15.3	Spraying the felt	18.4	Checking	65.4	
Flip slab on the jig table	3.2	Arrange the extra slab for the next slab	6.4	Assamble spray ed felt on slab	7.5	Stick the QC pass	5.9	
Trimming	68.4	Flip the slab to G2	8.5	Stick a sticker varience AT	14.7	Labeling checksheet	15.5	
Walking	3.3	Trimming	61.7	Assamble sprayed felt on slab	37.3	Walking	4.5	
Put jig on the slab	11.6	Flip the slab to G3	2.9	Attach plate mate on part	5.3	Put slab on the rack	6.2	
Push "START" WaterJet button	5.8			Put plate mate for the next slab	4.1	Clean surface using Air blower	30.9	
	113.6		104.2		102.7		133.0	

Based on the all table above, the number of manpower at assembly line is 8 manpower. From the yamazumi chart, if we can see that allocation work among the operators can be implemented for these studies. So, this project is to balance the work of operator by reducing from 8 operator to 7 operator which means that 1 operator will be reduce for saving



production cost. After conducting research on task distribution, a line has been drawn to ensure equality. To check whether the goal can be met or not, this project should conduct a trial. Then, flow movement must be altered in order to balance each worker's task.

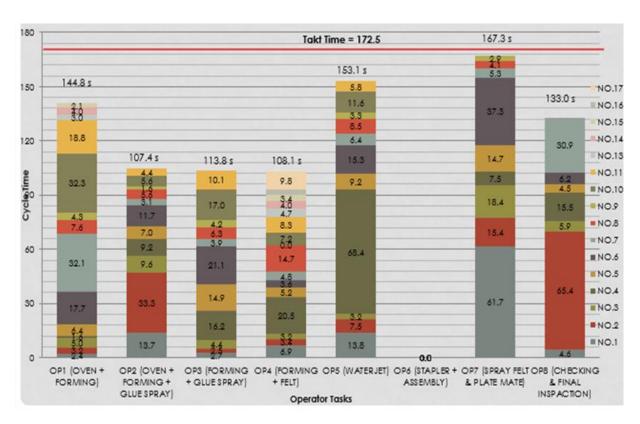
## 4.4 Time Measurement Data After Improvement

Table 4 show summarize of task operator after reallocated their task.

NO	OP1 (OVEN + FORMING)	OP2 (OVEN + FORMIN G + GLUE SPRAY)	OP3 (FORMIN G + GLUE SPRAY)	OP4 (FORMIN G + FELT)	OP5 (WATERJET )	OP6 (STAPLER + ASSEMBLY )	OP7 (SPRAY FELT & PLATE MATE)	OP8 (CHECKING & FINAL INSPACTION)
1	2.4	13.7	2.7	6.9	13.8	0.0	61.7	4.6
2	3.2	33.3	2.5	3.4	7.5	0.0	15.4	65.4
3	5.0	9.6	4.4	3.2	3.2	0.0	18.4	5.9
4	1.6	9.2	16.2	20.5	68.4	0.0	7.5	15.5
5	6.4	7.0	14.9	5.2	9.2	0.0	14.7	4.5
6	17.7	11.7	21.1	3.6	15.3	0.0	37.3	6.2
7	32.1	3.1	3.9	4.8	6.4		5.3	30.9
8	7.6	5.6	6.3	14.7	8.5		4.1	
9	4.3	1.6	4.2	0.0	3.3		2.9	
10	32.3	5.6	17.0	7.2	11.6			
11	18.8	4.4	10.1	8.3	5.8			
12	4.1	2.4	10.4	5.0				
13	3.0			4.7				
14	4.0			4.0				
15	2.1			3.4				
16				3.4				
17				9.8				
Total	144.8	107.4	113.8	108.1	153.1	0.0	167.3	133.0

Table 4: Summarize of task of each operators for after implementation





#### 4.5 Yamazumi Chart After Improvement

Figure 3: Yamazumi chart after improvement

We obtained the graph (Figure 3) that depicts how each operator balances their job with that of the process from the time measurement check sheet. The graph is balanced by time rather than by the quantity of work or movement. This graph was created after a new work flow was implemented, work was spread to other operators to ensure equal distribution of workload, and a WIP table-related workstation was removed. Even if the operator is still in the takt time line, it makes no difference. From (Figure 3), it can be seen that the operator task is still within the range of the cycle time balance, thus work balance and new work sequences have already been completed to obtain the optimal work method.



#### 4.6 Reallocation of operator task

NO	OP1 (OVEN + FORMING)		OP2 (OVEN + FORMING + GLUE SPRAY)		OP3 (FORMING + GLUE SPRAY)		OP4 (FORMING + FELT)	
1	Take slab	2.4	Put felt in the spray booth	13.7	Streach the slab before entering the Forming MC	2.7	Arrange felt in the Forming MC	6.9
2	Walking to the Oven	3.2	Spray felt	33.3	Jabbed the slab into the Forming MC	2.5	Streach the slab before entering the Forming M	3.4
3	Put slab into ov en	5.0	Waiting for Forming MC	9.6	Walking to the spray booth	4.4	Jabbed the slab into the Forming MC	3.2
4	Push "ON" button for oven timer	1.6	Take the sprayed felt	9.2	Put felt on spray tray	16.2	Waiting for the Forming MC	20.5
5	Walking to the Slab station	6.4	Walking to the Forming MC	7.0	Spraying the felt	14.9	Walking to the Forming MC	5.2
6	Roll slab	17.7	Put felt into the Forming MC	11.7	Waiting for the Forming MC	21.1	Take out part from Forming MC	3.6
7	Waiting for the Forming MC	32.1	Walking to the Ov en	3.1	Walking to the Forming MC	3.9	Flip the part to assembly felt table	4.8
8	Walking for the Forming MC	7.6	Waiting for the Ov en	5.6	Take out the slab from Forming MC	6.3	Put sprayed felt on the slab	14.7
9	Pull the previous slab in the Forming Machine	4.3	Push "OFF" oven timer	1.6	Flip the part on the assembly felt table	4.2	Appreance checking & part numbering	0.0
10	Put felt into the Forming MC	32.3	Take slab	5.6	Put the sprayed felt on the slab	17.0	Walking to the WaterJet MC	7.2
11	Waiting for the Oven	18.8	Streaching slab	4.4	Put the part into the Water Jet/WIP rack	10.1	Remove extra slab from Waterjet MC	8.3
12	Take out slab from Oven	4.1	Jabbed the slab into the Forming MC	2.4	Appreance checking & part numbering	10.4	Remove jig on the slab	5.0
13	Streaching Slab	3.0					Walking to the Forming MC/WIP rack	4.7
14	Jabbed the slab into Forming MC	4.0					Took slab	4.0
15	Push "ON" button (FM)	2.1					Walking to the WaterJet MC	3.4
16							Put slab into the WaterJet MC	3.4
17							Put jig on the slab before entering the WaterJet	9.8
		144.8		107.4		113.8		108.1

## Table 5: Forming Process after improvement

Table 6: Waterjet Process	after improvement
---------------------------	-------------------

OP5 (WATERJET)		OP6 (STAPLER + ASSEMBLY)		OP7 (SPRAY FELT & PLATE MATE)		OP8 (CHECKING & FINAL INSPACTION)	
Remove extra slab after the waterjet cut	13.8	Staple the extra slab	0.0	Trimming	61.7	Take slab from G3	4.6
Remove the jig	7.5	Marking	0.0	Put felt on spray tray	15.4	Checking	65.4
Flip slab on the jig table	3.2	Arrange the extra slab for the next slab	0.0	Spraying the felt	18.4	Stick the QC pass	5.9
Trimming	68.4	Flip the slab to G2	0.0	Assamble sprayed felt on slab	7.5	Labeling checksheet	15.5
Staple the extra slab	9.2	Trimming	0.0	Stick a sticker varience AT	14.7	Walking	4.5
Marking	15.3	Flip the slab to G3	0.0	Assamble sprayed felt on slab	37.3	Put slab on the rack	6.2
Arrange the extra slab for the next slab	6.4			Attach plate mate on part	5.3	Clean surface using Air blow er	30.9
Flip the slab to G2	8.5			Put plate mate for the next slab	4.1		
Walking	3.3			Flip the slab to the G3	2.9		
Put jig on the slab	11.6						
Push "START" WaterJet button	5.8						
	153.1		0.0		167.3		133.0

For this improvement, I suggest to reduce the man power from 8 to 7 man power. As the takt time for this line/production is far from the target. Thus, we can reduce one man power to reduce the cost production for this line.



### 4.7 Comparison Before and After Implementation Project

#### Table 7: Comparison before and after implementation

BEFORE IMPLEMENTATION	AFTER IMPLEMENTATION
The cost saving with OT for 8 manpower is RM165.4/shift	The cost saving with OT for 8 manpower is RM144.73/shift.
Basic Salary that company need to pay for 8 manpower is RM10,400.00	The salary for 7 manpower that company to pay is RM9,100.00 After reduced one manpower, company can be
	saved RM1, 300.00 / month.





## Figure 4: The comparison of production cost for overtime and salary payment

Graph figure 4 show the total amount of overtime 8 operator to running model X product at assembly line for 8 manpower is RM 165 per shift. After Implementation the project, the total amount overtime is RM 144.40 per shift for 7 manpower. The total saving cost for overtime after implementation this project is save about RM 20.60. It decreased by 12.5% after the implementation of this project. For one-month company can save RM 785.46 per shift for overtime allowance. Production cost for basic salary for 8 manpower is RM10,400.00. After reduced one manpower, company can be saved RM1, 300.00 / month. It can be seen the trendline decrease about 12.5% of payment for basic salary of operator at production line.



## 5. Conclusions

As a conclusion, this project has presented the result of reducing production cost at assembly line using yamazumi method in automotive industry. The result of reduce production cost at assembly line for model X by using yamazumi method. From the yamazumi chart data generated in this case study by time measurement check sheet, the data was collect for 8 operator base on their tasks. Thus, this project helps to achieve the project's objective to reduce production cost and improve line balancing at automotive industries. For make sure the operator task balanced and no overlap activities, line balancing used to balancing all work so that work becomes more organized and no need operator at the line will eliminated. Company can reduced cost for overtime as much as RM 785.46 per shift and RM1,300 for 1 month. After implementation this project, operator reduction is done from 8 to 7 operators only with the production cost reduce 12.5% for overtime and salary payment. Hence, it can be concluding that the objectives this project is achieves.

#### References

Mohamad Hafizdudin bin Tajul Arifin1,a, Wan Emri Wan Abdul Rahaman1, Process Improvement at Automotive Assembly Line Using Line Balancing and Lean Manufacturing Approach 2020 Applied Mechanics and Materials Submitted: 2019-10-01.ISSN: 1662-7482, Vol. 899, pp 268-274

Adeppa A 2015 A Study on Basics of Assembly Line Balancing. International Journal on Emerging Technologies pp 294-297

S. O. Tasan, & S. Tunali. A review of the current applications of genetic algorithms in assembly line balancing. Journal of Intelligent Manufacturing, 19(1), pp. 49–69, 2008.

Rahani AR and Muhammad Al-Asyraf. 2012. "Production Flow Analysis through Value Steam Mapping: A Lean Manufacturing Process Case Study", International Symposium on Robotic and Intelligent Sensors 2012, Vol. 41, pp. 1727-1734.

Singh, J., & Singh, H. (), "Kaizen philosophy: A review of literature," Journal of Operations Management, vol. 8, p. 51 – 72, 2009

Monden, Y. 1998. Toyota Production System, 3rd Edition, Industrial Engineering and Management Press, Norcross, GA.



## THE DEVELOPMENT OF WRIST JOINT REHABILITATION WITH SERVO MOTOR DRIVE FOR STROKE HANDED

Adibah binti Azmi<sup>1</sup>, Yaakub bin Omar<sup>2</sup>

Department of Electrical Engineering, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor, Malaysia. <sup>1</sup>adibahazmi0@gmail.com <sup>2</sup>yaakub2499@yahoo.com.my

#### Abstract

A stroke begins when the blood flow to the brain is stopped or diminished because of a blockage (ischemic stroke) or a blood vessel rupture (hemorrhagic stroke) that prevents him or her from performing activities that other healthy people can do. Stroke victims typically experience paralysis with one of their arms, lose dexterity and interaction with their affected hand. However, most wrist rehabilitation devices are still manually operated and required a therapist to assist them. Furthermore, the increasing number of stroke patients among the elderly are challenging to find low-cost rehabilitation tools. In order to overcome this problem, a wrist joint rehabilitation device with servo motor drive is developed. This device consists of three MG996R servo motors using predefined Arduino IDE programming so that the device start rotating automatically and the patient can perform their rehabilitation sessions individually. The designing process of this device is done by using an online 3D modeling program, Tinkercad. The MG996R servo motor was physically modeled, and the parameters were identified during the implementation of the device. Testing of the hardware and software was undertaken to analyze the usability of the wrist joint rehabilitation for the stroke patients undergo the rehabilitation exercise according to the basic movement of wrist by comparing the normal ROM of the wrist and achieved ROM of the device can be delivered. As a result, the prototype design has proven to be effective because it can achieve a ROM that close to the normal wrist. It can be concluded that an automatic wrist rehabilitation device can be used to assist poststroke patients in their rehabilitation sessions by performing regular wrist exercises.

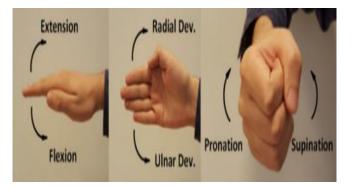


Keywords: Stroke, wrist, rehabilitation device, MG996R servo motor.

#### 1. Introduction

A stroke can occur when the blood flow to the brain is stopped or diminished due to a blockage that called ischemic stroke or a blood vessel rupture, haemorrhagic stroke. Without blood, the brain would be deprived of oxygen, causing cells in various parts of the brain to die. Citing to the Malaysian National Burden of Diseases Study and study on vital registration system in 2000, stroke was the second highest cause of death in Malaysia (National Institute of Health, 2017). Most stroke survivors will experience problems with one of their arms, lose upper-limb motor function, or maybe have limb paralysis (Activities, n.d.). It is well known that effective post-traumatic care and rehabilitation therapy are required for patients to regain their lost abilities and return to their usual daily activities (Bonita & Beaglehole, 1988). After a patient has recovered from a stroke, rehabilitation is usually done through physiotherapy (Ferrarello et al., 2011). Wrist is one of the most critical regions of the body that is damaged by stroke.

This project designs and develop a wrist rehabilitation device powered by a servo motor so that patients can perform the therapy individually. Flexion and extension, radial and ulnar deviation, and pronation and supination in Figure 1 are the three types of movements performed by this device. The rehabilitation session can be performed at the patient's house, which is especially beneficial for those who have transportation issues or live far from the hospital. Wrist training, wrist stretching, and other activities are designed to improve or rehabilitate the patient's wrist range of motion. An article state that although these natural wrist exercises are useful for developing hand strength and preventing future injuries, normal rehabilitation exercises are boring and prolonging full recovery (Hsieh et al., 2016).





#### Figure 1: The movements of the wrist

The effects of a stroke can vary depending on which of these areas of the brain it happens in. When a section of the brain is destroyed by a stroke, it is possible that a section of the body will lose its usual function. If the stroke occurs in the left side of the brain, the right side of the body will be affected and paralysis. Meanwhile, if the stroke occurs in the

right side of the brain, the left side of the body will be affected and paralysis (Foucher & Faure, 2020). The overall goal of post-stroke rehabilitation is to help stroke survivors regain as much physical, psychological, social, and financial independence as possible (Senes, 2006).

According to the Encyclopaedia Britannica 2009, the wrist is made up of a group of tiny bones, muscles, and component joints that connect the five metacarpal bones of the hand to the ulna and radius bones of the forearm, allowing it incredible flexibility and range of motion (Encyclopaedia Britannica 2009). The eight tiny carpal bones of the wrist that connect the metacarpals to the forearm are seen in Figure 2. The eight carpal bones are roughly divided into two rows, referred to as the proximal and distal rows.

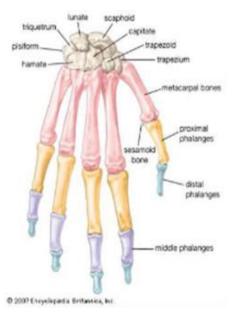


Figure 2: Bones of the Hand, Including The Carpal Bones

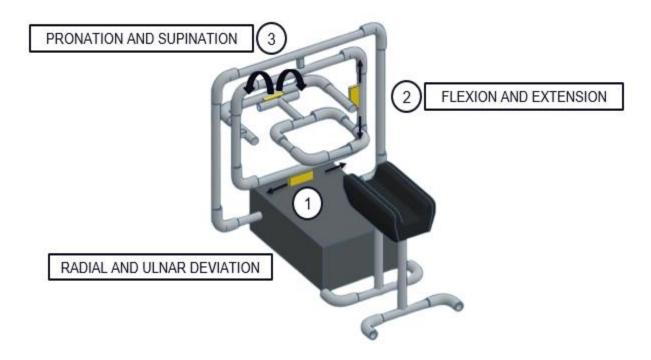


## 2. Methodology

This chapter is descripted and explained about the process and the method to implementing this project with successful. Designing and developing the mechanical part of the wrist joint rehabilitation with servo motor, drawing block diagram of the operating system, making flow chart of the operation device, and making servo motor speed settings are all the stages of this research. The data collection has been done to analyze the usability of the wrist joint rehabilitation. These method are used to achieve the objective of the project that accomplish a perfect result.

# 2. Designing the mechanical part of the Wrist Joint Rehabilitation with Servo Motor Drive

The wrist joint rehabilitation in Figure 3, has three movements where each joint has one servo motor. The components of the device in this project are, one (1) ESP 32 Wi-Fi module, one (1) LM2596 power supply step down, one (1) power supply 5A, one (1) buzzer and three (3) MG996R servo motors. The frame of the device is made from the PVC pipe since this material are easy to design into any shape.



## Figure 3: Mechanical Design of The Wrist Joint Rehabilitation using Tinkercad



## 2. Developing the hardware and IoT implementation of the Wrist Joint Rehabilitation with Servo Motor Drive

Figure 4 illustrates the system of circuit installation of the Wrist Joint Rehabilitation with Servo Motor Drive. ESP32 Wi-Fi module work as device controller which is programs can be loaded onto it from the Arduino IDE programming. The USB cable connection is used to upload the verified coding from the Arduino IDE to the circuit of device.

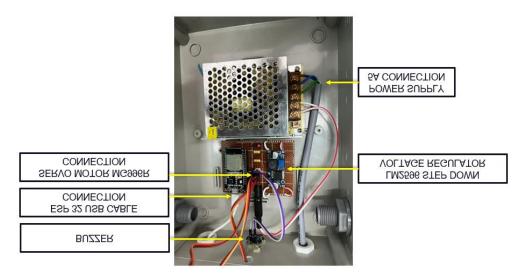
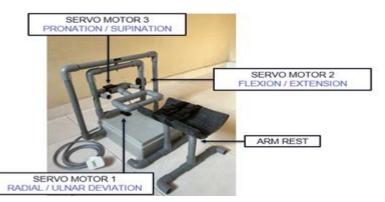


Figure 4: Circuit Installation of The Wrist Joint Rehabilitation

Figure 5 had showed the development of electronic and mechanical part the wrist joint rehabilitation. The hand of the patient is passed through two untied belts before being locked to the arm rest. Tighten the belt at the arm then turn on the device. Through the Blynk application, patients can select the basic wrist movement mode and the desired number of rotations. Since the ESP32 is turned on, the servo motor will begin rotating automatically. This device performs the wrist motions for patients undergoing rehabilitation exercises.





# Figure 5: Development of electronic and mechanical part of The Wrist Joint Rehabilitation

Referring to Figure 6, the interface of IoT implementation using Blynk application for controlling the movement of servo motor. The Blynk application is easy to download for the IOS and android system user's that can make them easy to control the movement of basic exercises of wrist without forgetting a step, even if the therapist is not around and display the angle of device can deliver. Based on Table 1, shows the function of each button of Blynk application during using the device.



Figure 6: Interface of IoT implementation using Blynk application for controlling the movement of servo motor

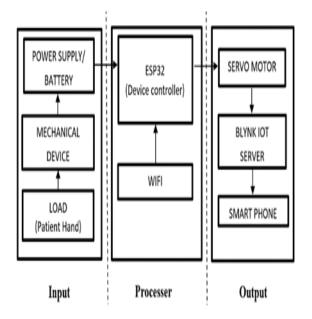


## Table 1: Function of the button of Blynk application

NO	Button
1	Controlling servo motor for the wrist movement one by one
2	Adjusting the number of rotation of the wrist movement that the patient required
3	Display the number of rotation of the movement
4	Display the angle of each movement
5	Stop and start button rotation of the wrist movement

## 2. Block Diagram of the Operating System

Each block has a specific purpose, and the block diagram in Figure 7 presents how each process is connected. This operating system's block diagram has three sections: input, processer, and output. The input section when the device is connected by the power supply and the patient's forearm is placed through an adhesive belt. During processing section, turning on the plug and make sure Wi-Fi connection is on and in stable condition. After that, the ESP32 is ready to start in real-time through a mobile application. Lastly, in output section is where the servo motor begins to rotate automatically, which can be controlled using the training programme at the mobile phone through Blynk Application.





## Figure 7: Block Diagram of The Wrist Joint Rehabilitation

## 2. Making Flow Chart of the Operation Device

Flow Chart in Figure 8 had shown the operation of the wrist joint rehabilitation. The patient's hand is placed through two loose belts then tighten the belt. Switch on the device and at the same time connect the device to the Blynk Application using smartphone. Patients can choose the mode of the wrist movement and select how many turns they want to do. The servo motor will start rotating automatically since the ESP32 is turned on. The wrist motions such as flexion and extension, radial and ulnar deviation, and pronation and supination are recognized by this device for the post stroke survivors undergo the rehabilitation exercise. The session will be finished according to the programmed that have been done. The degree of the angle of wrist movement will be display in Blynk Application.

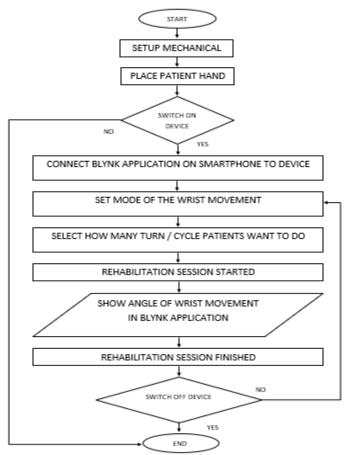


Figure 8: Flow Chart of The Wrist Joint Rehabilitation



## 2. Making Servo Motor Speed Settings

(1)

To manage the servo motor's speed, first determine how far the turning angle will be turned. The turning angle is calculated using the formula below.

(3) where,
[Equation]: angle difference
[Equation] : angle at the end of movement / final angle
[Equation] : angle at the beginning

(2)

[Equation] then

[Equation]

[Equation] then

[Equation]

where,

[Equation]: angle difference (pulse) [Equation]: duration each pulse (mS/pulse) [Equation]: total time to reach the final angle (1000 mS)

## 2. Data Collection Method

After the final hardware prototype is completed, the results are collected from testing the performance of the device. Testing of the hardware and software was undertaken to analyze the usability of the wrist joint rehabilitation for the stroke patients undergo the rehabilitation exercise according to the basic movement of wrist. As shown in Figure 9, the device has been tested by a subject. The evaluated data are important in determining the usability of the wrist joint rehabilitation for the stroke patients undergo the rehabilitation and gathering feedback from professionals and the public.



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## Figure 9: Testing of the hardware and software of the device 3. Result and Discussion

This device must be able to accommodate the range of motion wrist movement. By comparing the achieved ROM of the device and normal ROM for the wrist, it can figure out the usability of the wrist joint rehabilitation for the stroke patients undergo the rehabilitation exercise according to the basic movement of wrist. Figure 10 shows how to measure the ROM of the device using goniometer.



Figure 10: Measure the ROM of the device using goniometer Table 2: Comparison ROM of device between normal ROM of the wrist



Movement	Range of Motion				
	Normal	Achieved	Comparison		
Radial deviation	[Equation]	[Equation]	[Equation]		
Ulnar deviation	[Equation]	[Equation]	[Equation]		
Flexion	[Equation]	[Equation]	[Equation]		
Extension	[Equation]	[Equation]	[Equation]		
Pronation	[Equation]	[Equation]	[Equation]		
Supination	[Equation]	[Equation]	[Equation]		

As shown Table 2, the range of motion of the device comfortably exceeds the normal ROM required to perform activities of daily living and accommodates the entire normal range of wrist and forearm motion except for flexion/extension, which is slightly 6° comparison between normal and achieved ROM. Nevertheless, for the device to accommodate all the ranges of motion at any rotational position of the forearm, required to adjust the programming for additional degree of flexion/extension movement. These modifications represent the movement of servo motor. Due to its ability to generate a ROM that closely matches the normal wrist, the prototype design has proven to be successful. Referring to Figure 11 shows the comparison of device's ROM and normal ROM of the wrist.

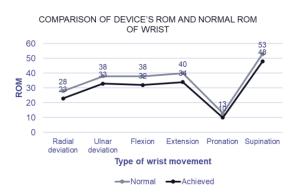


Figure 11: Comparison of device's ROM and normal ROM of wrist

#### 4. Conclusion

The wrist joint rehabilitation device was designed and developed to be 38cm length, 25cm width, and 38cm height according to the specifications. To drive the



servo motor for the wrist movements flexion and extension, radial and ulnar deviation, and pronation and supination, the Arduino IDE program (UNO Program) can be adjusted according patients' needs. IoT is successfully implemented to the device using Blynk application so that the patient can undergoing wrist therapy without forgetting a step, even if the therapist is not around. Next, this project helps the stroke survivors to get physiotherapy sessions at home without supervision from the physiotherapist. The proposed system for biomechanics movements, uses real-time measurements of wrist joint angles enable users to get physiotherapy sessions at home without supervision from the physiotherapist.

#### 5. Acknowledgment

The author would like to express the gratitude to all researchers for all the technical papers, supports and guidance. Also thanks to Encik Yaakub as supervisor for their guidance and encouragement in carrying out this project work.

#### 6. References

- Activities, E. (n.d.). Chapter 6: Effects of Stroke Effects of Stroke: Physical Changes. 69–82.
- Bonita, R., & Beaglehole, R. (1988). Recovery of motor function after stroke. *Stroke*, *19*(12), 1497–1500. https://doi.org/10.1161/01.STR.19.12.1497
- Ferrarello, F., Baccini, M., Rinaldi, L. A., Cavallini, M. C., Mossello, E., Masotti, G., Marchionni, N., & Di Bari, M. (2011). Efficacy of physiotherapy interventions late after stroke: A meta-analysis. *Journal of Neurology, Neurosurgery and Psychiatry*, 82(2), 136–143. https://doi.org/10.1136/jnnp.2009.196428
- Foucher, G., & Faure, S. (2020). What is a stroke? *Actualites Pharmaceutiques*, *59*(600), 57–60. https://doi.org/10.1016/j.actpha.2020.09.020
- Hsieh, W. M., Hwang, Y. S., Chen, S. C., Tan, S. Y., Chen, C. C., & Chen, Y. L. (2016). Application of the blobo bluetooth ball in wrist rehabilitation training.



Journal of Physical Therapy Science, 28(1), 27–32. https://doi.org/10.1589/jpts.28.27

National Institute of Health. (2017). *Malaysian Burden of Disease and Injury Study* 2009-2014. http://iku.moh.gov.my/images/IKU/Document/REPORT/BOD/BOD2009-2014.pdf

Senes, S. (2006). How we manage stroke in Australia. *Australian Institute of Health* and Welfare, 1–50.



## DEVELOPMENT ON PORTABLE LUMBAR SUPPORTER WITH ELECTRONIC MOTOR MASSAGER FOR LOW-BACK PAIN RELIEVER

N.B.R. BASO<sup>1</sup>, W.R.W. Omar<sup>2</sup>,

Electronic Engineering Technology (Medical Electronic), Department of Electrical Engineering, Politeknik Sultan Salahuddin Abdul Aziz Shah, Malaysia. balqisraihana.baso@gmail.com<sup>1</sup>, rosemehah@psa.edu.my<sup>2</sup>

#### ABSTRACT

L1 through L5 are lumbar vertebrae between the chest and sacrum. Large lower back muscles move the trunk. Overworked or spasming muscles might cause lower back pain. According to observations and research, prolonged sitting in an unergonomic workstation causes low-back pain. This project's objectives are as follows. Develop a portable lumbar supporter with an electronic motor massager to relieve lumbar pain from non-ergonomic seating. The 'Blynk' app on a smartphone able to manage the massager's speed and usage time. The produced product is validated by following the standard operating procedure of the product's operation conducted on a subject. Future enhancements to the product's usability have been recommended based on the findings of this study.

**Keywords:** - Low-Back Pain, non-ergonomic workstation, lumbar supporter, electronic motor massager

#### **1.INTRODUCTION**

Lumbar discomfort, also referred to as low back pain, is a significant and ongoing problem in today's culture due to its impact on people's health. The condition is considered an epidemic because it has a high prevalence and spreads quickly across the world, particularly during the pandemic era when professional individuals were forced to perform their task at home without any preparation of setting up a proper working environment(Kamaludin et al., 2020). The most prevalent causes of lumbar discomfort in the home include restricted movement, lengthy periods of sitting, and workplace conditions that are not ergonomically appropriate(Jung et al., 2021). Accordingly, studies have shown that with the appropriate application of non-invasive joint lumbar support massage treatment, it is possible to reduce the intensity of lumbar pain(Mohammad Yusof et al., 2021).



A lumbar supporter, also known as a lumbar orthosis, is a device that, according to the suggestions made by medical professionals, is intended to alleviate some of the pressure that is exerted on the spinal structures by unloading some of the weight that is typically carried by the lower back(Grondin et al., 2013) .This piece of equipment helps to keep the lower back in the best possible posture while working in a sitting position, which is especially helpful in a workplace that is not designed to be ergonomically friendly. As a result, the amount of strain that can be caused by working in this position is reduced(Schott et al., 2018).

A back that is in discomfort can benefit tremendously from using an electric back massager that does not involve any sort of invasive procedure(Gasibat & Suwehli, 2017). The greatest level of pain relief can be attained by using a massager that is adapted to the user's way of life and has motions that are targeted especially at the painful places. The device achieves its purpose by stimulating an increase in blood flow to the skin and muscles via a massaging action that is generated by a motor that is coupled to a device that performs the massaging action(Zheng et al., 2012). This assists in relieving discomfort and stiffness in the area of the low back.

Therefore, the research on product development was put to good use there, serving its own aims. In the first place, the development of a portable hybrid gadget that relieves low back pain by combining a lumbar supporter and a lumbar massager into one product. The second objective is to design and build an electronic motor lumbar massager that can be controlled by the user's smartphone through an internet of things application called blynk. Last but not least, for the purpose of analysis, to analyze variations in motor speed by simulating Pulse Width Modulation (PWM), and to evaluate the device's efficiency in speed rate based on the amount of time spent utilizing the newly developed device

#### 2. METHODOLOGY

This chapter expressed in details the development of a product based on first and second objectives that is aimed at providing a spinal support system as well as reducing the load of spinal pain through the use of a non-invasive massage that can be controlled



remotely using user's smartphone. Then, the developed device is tested via simulation test and evaluation method on the speed's pace.

Figure 1 displays the initial design of a Lumbar Supporter with an Integrated Massager that is intended for professionals and students who are forced to sit for extended periods of time due to the nature of their employment, which might result in low back pain (LBP). Even if the user is sat in a non-ergonomic place, each component of this device will contribute to their enjoyment and comfort while executing their task. The device has the ability to perform two distinct functions when in operation. The first function is that of a Lumbar Supporter, which entails maintaining a straight spine in order to rectify body posture. The second objective is to reduce lumbar pain by decreasing pressure on the lumbar region. During this process, the lumbar region is massaged in an effort to ease lower back discomfort (LBP) that can be controlled using user's smartphone via blynk application.

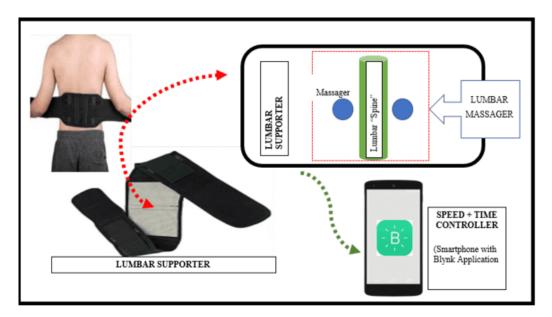


Figure 22 Initial Design of the Portable Lumbar Supporter with Massager

A 3D design of the product was drawn by using tinkercad based on different angle to enhance and realizing the idea of this project from different angle. Figure 2 is the top view of the product which consist of two motor massager and implemented in the lumbar



belt/orthoses. Meanwhile, Figure 3 shows the back view of the product that is attached together with the control system of the massager with power supply.

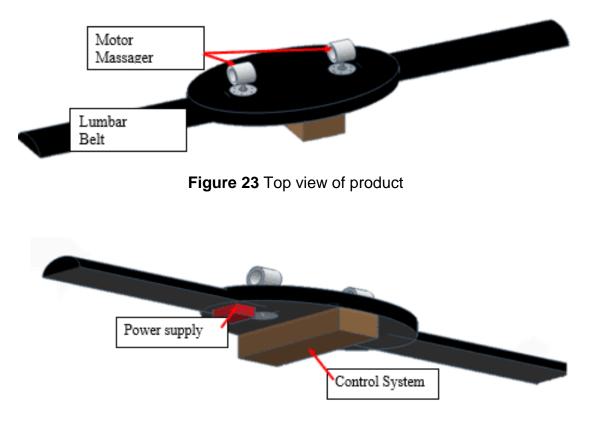


Figure 24 Back View of product

## 3. RESULT AND DISCUSSION

In this section, the results of developed product Portable Lumbar Supporter with Electronic motor massager are explained in details on based on the hardware implementation, interface of the blynk application and standard operating procedure in using the product.

Developed Portable Lumbar Supporter with Electronic Motor Massager



Products from this project have been successfully developed as shown in Figure 4 and Figure 5. The lumbar belt-style massager is worn around the lower back and provides a comfy massaging sense.



Figure 25: Developed product at top view angle



Figure 26: Developed product at back view angle

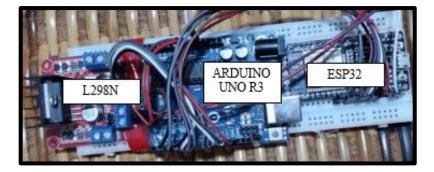


Figure 6: Control system for messaging device



As been shown in the Figure 6 below, massager electronic components (control system), the Arduino Uno R3 microcontroller and the Motor Driver (L298), which controls two DC motors, are powered by a 7.3-volt power source (installed together in control system). Activating the sequence rollers on each DC motor causes a shiatsu-like movement in the motor. The device itself can be controlled from user's smartphone via blynk application Figure 7 by creating communication from ESP 32.

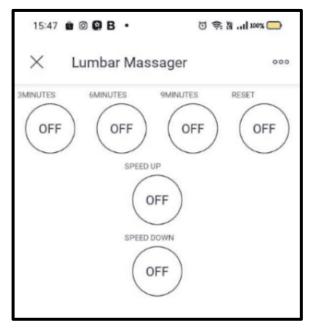


Figure 7: Blynk's Interface Control Panel for Massaging Device

The purpose of each button displayed in the Blynk application's interface for the massaging device is outlined in Table 1.

Table 1: Blynk application's buttor	functions for massaging device
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Button	Function
3MINUTES	Massaging device switch ON and operates for 3 minutes straight
6MINUTES	Massaging device switch ON and operates for 6 minutes straight



9MINUTES	Massaging device switch ON and operates for 9 minutes straight
RESET	Switch OFF massaging device
SPEED UP	Increase level of massaging speed till maximum (Option: 250Hz and 255Hz)
SPEED DOWN	Decrease level massaging till minimum (Option: 250Hz and 200Hz)



**3.1.** Evaluation of the product's usability by adhering to the product's standard operating procedure

This section fully described the standard operating procedures (SOP) (Figure 12) for sequentially employing the Portable Lumbar Supporter and the Lumbar Massager. When the user has been sat for a lengthy amount of time in a non-ergonomic setting (Figure 10) and begins to experience lumbar discomfort, which can be a precursor to lower back pain (LBP), the user should begin utilizing the device (Figure 11). Consequently, it is advised that the user wear the lumbar supporter to offer support for the low back region. In addition, the supporter can assist the user in altering their body posture, which can help relieve pain, especially in the back. As soon as the user noticed lumbar discomfort, they were urged to instantly turn on the lumbar massager. The discomfort in the targeted area will be reduced by the massager, which uses DC motors to provide a shiatsu motion. The massager focuses on the guadratus lumborum muscle, a lumbar area muscle. While utilizing the massager, the user has complete control over the strength of the massaging. The user of the 'blynk' program on a smartphone can adjust the speed rate to 200Hz (the lowest), 250Hz (the moderate), or 255Hz (the highest), as well as the time duration to 3, 6, or 9 minutes. These settings rely on the preferences of the user. When the user's discomfort has been reduced, the device may be withdrawn from the body, or the user may continue to use it as a posture supporter, especially for the lumbar region



Figure 10: Subject (1) before wearing Lumbar Supporter and Massager



Figure 11: Subject (1) while wearing Lumbar Supporter and Massager



<sup>2nd</sup>National Conference on TVET Undergraduate Students (NCTS) Politeknik Tuanku Syed Sirajuddin 19-20 July 2022

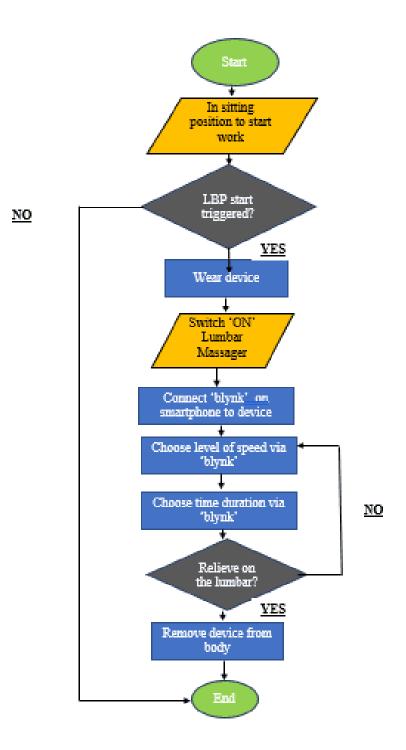




Figure 12 SOP's Portable Lumbar Supporter with

Electronic Motor Massager with Blynk Usage

#### 4. CONCLUSION

These studies had two distinct purposes that were successfully achieved. First, the development of portable lumbar supporter with electronic motor massager is achieved with a control system that can be controlled remotely by using user's smartphone via blynk application. It was shown that frequencies of 200Hz, 250Hz, and 255Hz provide the most pleasant massage based on given duration. Despite the fact that the product was successfully built, there were a few suggestions to improve its usability that were made. Increase the size of the lumbar belt so that it can be utilized by a wider range of people.

#### 5. ACKNOWLEGMENT

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#### 6. RREFERENCES

- Gasibat, Q., & Suwehli, W. (2017). Determining the Benefits of Massage Mechanisms: A Review of Literature. *Article in Journal of Rehabilitation Sciences*, *2*(3), 58–67. https://doi.org/10.11648/j.rs.20170203.12
- Grondin, D. E., Triano, J. J., Tran, S., & Soave, D. (2013). The effect of a lumbar support pillow on lumbar posture and comfort during a prolonged seated task. *Chiropractic and Manual Therapies*, *21*(1), 1–9. https://doi.org/10.1186/2045-709X-21-21

Jung, K. S., Jung, J. H., In, T. S., & Cho, H. Y. (2021). Effects of prolonged sitting with



slumped posture on trunk muscular fatigue in adolescents with and without chronic lower back pain. *Medicina (Lithuania)*, *57*(1), 1–8. https://doi.org/10.3390/medicina57010003

- Kamaludin, K., Chinna, K., Sundarasen, S., Khoshaim, H. B., Nurunnabi, M., Baloch, G. M., Sukayt, A., & Hossain, S. F. A. (2020). Coping with COVID-19 and movement control order (MCO): experiences of university students in Malaysia. *Heliyon*, *6*(11), e05339. https://doi.org/10.1016/j.heliyon.2020.e05339
- Mohammad Yusof, N. A. D., Karupiah, K., Tamrin, S. B. M., Rasdi, I., How, V., Sambasivam, S., Jamil, P. A. S. M., Mani, K. K. C., Naeini, H. S., & Nata, D. H. M. S. (2021). Effectiveness of lumbar support with built-in massager system on spinal angle profiles among high-powered traffic police motorcycle riders: A randomised controlled trial. *PLoS ONE*, *16*(10 October), 1–15. https://doi.org/10.1371/journal.pone.0258796
- Schott, C., Zirke, S., Schmelzle, J. M., Kaiser, C., & Fernández, L. A. I. (2018). Effectiveness of lumbar orthoses in low back pain: Review of the literature and our results. *Orthopedic Reviews*, 10(4). https://doi.org/10.4081/or.2018.7791
- Zheng, Z., Wang, J., Gao, Q., Hou, J., Ma, L., Jiang, C., & Chen, G. (2012). Therapeutic evaluation of lumbar tender point deep massage for chronic non-specific low back pain. *Journal of Traditional Chinese Medicine*, 32(4), 534–537. https://doi.org/10.1016/s0254-6272(13)60066-7



# IMPLEMENTATION OF SPARE PARTS INVENTORY AND ORDERING METHOD

Muhammad Hafizzudin Bin Md Teni<sup>1</sup> Muhamad Harith Bin Abdul Hamid<sup>2</sup> and Hamidah Bt Khalil<sup>3</sup>

Mhafizzudin @gmail.com harith.1014@gmail.com <sup>3</sup> Company XYZ Lot 9414 Persiaran Jasmine 1, Seksyen BB10, 48300 Rawang, Selangor Darul Ehsan

#### Abstract

Spare parts inventory are needed for maintenance and repair of final products, vehicles, industrial machines and equipments, frequently requiring high investments and significantly affecting customer satisfaction. Inventory management is complex due to the large number of different items and low demands. This purpose of this project is to implement spare parts inventory and ordering method. It involve daily monitoring stock for spare parts, downtime-hours vs cost of injection moulding machine that produce various of automotive parts. The system is created using Microsoft Excel with details and formula that available on software. Overall, the project implementation will give the benefit to XYZ Sdn Bhd. Maintenance team in order to sustain the key performance index and produce positive output on downtime-hours efficiency vs cost of machine.

#### Keywords: Spare parts inventory, key performance index, downtime-hours, cost.

#### 1. Introduction

The series of operations performed to keep a system in a state where it can fulfil its purpose is referred to as maintenance. These systems are frequently production systems with products and/or services as outputs. Some maintenance can be performed during



production, while others can be performed during scheduled production interruptions in the nights, weekends, and holidays. However, in many circumstances, manufacturing equipment must be shut down for maintenance. This may cause conflict between a company's production and maintenance departments.

Spare parts inventory is required for the maintenance and repair of final products, vehicles, industrial machines, and equipment, which frequently necessitates large investments and has a significant impact on customer satisfaction. Inventory management is challenging because of the enormous number of different items and the low demand.

#### 1.1 **Problem Statement**

There were many current issues and problem that require timely action to improve the situation by maintenance department. Firstly, uncontrol stock of spare parts inventory by xyz Maintenance department. This because there is no proper system in handling the inventory resulting not achieving company monthly KPI. Secondly is no proper system and method ordering for the spare parts. The spare parts were took in and out without proper monitor causing shortage. Thirdly, frequent downtime during machine breakdown due to no spare parts.

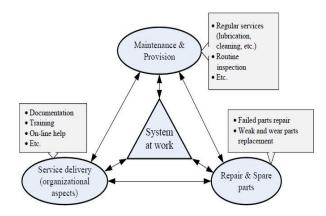


Figure 1.1: Three main factors influencing the system at work



#### 1.2 Objective

- To study department KPI by control stocks of spare parts inventory (min max control)
- To design new ordering system/method for spare parts purchased by using excel.
- To improve efficiency of downtime hours vs cost for spare parts by 50%

#### 1.3 Scope

The scope for this research are focus on:

- Maintenance department
- Person in charged for maintenance

#### 2.0 LITERATURE REVIEW

Intelligent inventory management solution that aided in closing the gap between inventory management theory and reality. To validate the model, an automated demand and lead time detection is used. They found the lead time pattern using numerical tests for demand identification. The probability distribution model for constant and probalistic demand, as well as linear and seasonal demand, were explored. The empirical evaluation of this system with real data of manufacturing industries showed that system could lead to considerable saving of inventory cost. (Driessen,2010)

Continual rapid pace of technological development in the twenty-first century, the industry and industrial systems have gotten more sophisticated, creating their availability more crucial. The product support and its concerns with spare parts were crucial. Shortage of timely and full assistance, such as a lack of spare parts when needed, often resulted in unanticipated downtimes, which led to



losses. As a result, forecasting the proper support to keep the system running has become critical. The proportional hazard model was used in the research to assess the system's dependability and the operational environment, which were the two characteristics to be addressed. The proportional hazard approach was used in the research to assess the system's reliability and the operational environment, which were the two character to assess the system's reliability and the operational environment, which were the two components to be addressed. (Ghodrati, B.; Kumar,2005)

A proposed of methodology for planning and regulating an organization's spare parts supply chain that maintains and uses high investment assets [3]. The framework was utilised to improve the efficiency, consistency, and sustainability of decisions on how to manage and regulate the spare parts supply chain. The framework's applicability in various situations has been further investigated. (Driessen, M.; Houtum, J.; Van, 2004)

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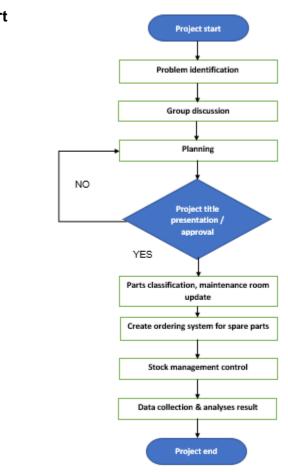
Examining the need for spare parts inventory for product, vehicle, industrial machinery, and equipment repair and maintenance. needing a significant investment and having a significant influence on customer satisfaction Inventory management was tough due to a large number of commodities and the unpredictable demand. Opportunities on inventory management were discovered, including whether to stock an item or not, how much to order in the first and final batch, demand forecasting and inventory control model integration, and case studies on real-world applications. (Rego, J.; Mesquita, M, 2011)

investigation on product support enhancement of spare parts by taking the operating system environment into account. The goal of this study was to examine the impact of time-dependent elements in an industrial system on product support when replacement parts were required. variety of elements such as the operating environment system, dependability, and maintainability have an impact on product support. that the system operating environment should be addressed while estimating spare components. The spare management software was used to examine the results after examining the numerous aspects that impacted product support. (Ghodrati, B.; Benjevic, D,2012)



#### 3.0 Methodology

The methodology and structure of this project will be discussed in this chapter. The study of research methodologies as a step or flow project, known as methodology, would be effective. It may also be thought of as a technique and talent that includes a process that includes the project's procedure and planning. There are various sources that present the technique as a framework having a guideline that permits the process of conducting analyses to resolve difficulties that arise. This chapter will discuss the method and step uses and consider completing and finish of the project. Every method and step will be done and should be explained and elaborated which will help to understand about this project.



#### 3.1 Flow Chart

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Figure 3.1: Gantt Chart

### 3.2 Project Requirement

Microsoft Excel is a software program produced by Microsoft that allows users to organize, format and calculate data with formulas using a spreadsheet system. Majority staff in xyz SDN. BHD. use Microsoft Excel. By choosing this software, it will save time and cost saving. Microsoft Excel shall be used to create and design the spare parts data, new ordering spare parts and new spare parts request form. The requirement information shall be on the new format are:

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#### i. Spare parts name

Each of the spare parts have its own name. Serial number or product details will be included in the part.Categories

Spare parts will be label to its designated category. As an example machine, electrical, facilities or common spare parts

ii. Supplier

Supplier section will be included their details such as addresses, phone number and website as references.

- Price per unit
   This column will fill up with price per unit of the spare parts.
- iv. Minimum stock quantity
   This column will indicate the level below which actual spare parts inventory items should not normally be allowed to fall.



- Maximum stock quantity stock level is a not to exceed the amount used for spare parts inventory planning. Stock level is based on a calculation of the cost of storage, standard order quantities and risk of inventory.
- vi. Control stock

Stock control, otherwise known as inventory control, is used to show how much stock you have at any one time, and how you keep track of it.

vii. Purchase requisition/ Purchase order

A purchase requisition is an internal document created by your employee to request the purchasing of goods or services from an outside vendor. Once the document is approved by the department manager, finance department, and is three-way matched, the actual purchasing of goods or services can now happen with the use of a purchase order. Once a requisition is approved, it is assigned a purchase order number and sent to the vendor. This external document initiates the sales transaction and is a binding contract for all parties involved. The purchase order system is designed for organized recordkeeping. The PO number that is assigned generally matches the requisition number, and they are filed together.

viii. Remarks

Column that will be key in the PR/PO numbers. This will be as indicator that the desired parts already have been request for or already been purchase.

#### 3.3 Data Collection

#### 3.3.1 Maintenance department monthly KPI



	BEFORE IMPLEMENT							
MONTH	NOVEMBER	DECEMBER	JANUARY					
WORKING DAY	22	23	17					
ACHIEVED SAFE STOCK	28	35	67					
NOT ACHIEVE SAFE STOCK	122	115	83					
ACHIEVED SAFE STOCK %	19%	23%	44%					
NOT ACHIEVED SAFE STOCK %	81%	77%	56%					
STATUS	×	×	×					

#### Table3.1: KPI for maintenance department before project implementation

The table shows the overall KPI for spare parts inventory at xyz from November 2021 until Jan 2022. Before minimum and maximum policy were implement, the KPI show a bad result for spare parts safe stock in November. This is because lacks monitoring in and out of spare parts without record. Solely update on the stock card cause the quantity did not match with the actual quantity and sometimes, the parts may out of stock.

#### 3.3.2 Downtime

Downtime and excessive cost are more focus on machine which related to the spare parts usage. At company xyz, there were 14 injection moulding machines with various of capacity. Each of the machine have machine rate per hours with average cost RM 120 per hours. The excessive cost come from the longer downtime of machine will cause loss to the company. Data collection of this section is made based on how many cases occur in a month and how long the down time for each case.

Table 3.2: downtime vs cost summary for 3 month before implementing

MONTH	Nov-21	Dec-21	Jan-22	TOTAL
CASES	17	19	17	53
DOWNTIME-HRS	162	142	140	444
RM	19440	17040	16800	53280



The Table 3.2 shown that the total downtime hours for 3 months from nov-21 until jan-22 up to 444 hours which cost about RM 53,280 loss. This happens because of no spare parts for replacement. Having no choice, the company need to do ad hoc buying for the desire parts which will add more cost of purchasing.

#### 4.0 Result

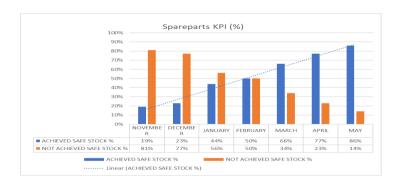
The inventory is currently managed by adopting the monitoring system for all types of spare parts, regardless of their consumption value or their rotation. That is, the company, based on past data and history, predicts and establish a minimum level of stock that must be kept in the inventory.

			SPARE P	ARTS INVE	NTORY KPI				
	BEFO	RE IMPLE	VENT	IN PRO	OGRESS	COMPLETED			
молтн	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY		
WORKING DAY	22	23	17	17	23	21	18		
ACHIEVED SAFE STOCK	28	35	67	75	100	112	135		
NOT ACHIEVE SAFE STOCK	<sup>122</sup> F	igùre -	4.1 <sup>8³</sup> spa	arep <sup>7</sup> årts i	inventory	KPI(%)	15		
ACHIEVED SAFE STOCK %	19%	23%	44%	50%	66%	77%	86%		
NOT ACHIEVED SAFE STOCK %	81%	77%	56%	50%	34%	23%	14%		
STATUS	x	x	x	x	Δ	Δ	o		

#### Table 4.1: Spare Parts Inventory KPI

The Table 4.1 and figure 4.1 graph shows the overall KPI for spare parts inventory at company xyz from November 2021 until May 2022. Before minimum and maximum policy were implement, the KPI show a bad result for spare parts safe stock in Nov-21 until Jan-22. This is because lacks monitoring in and out of spare parts without record. In term of spare parts, most of it were build up stock month by month. During in progress phase, the KPI showed improvement of safe stock percentage with 50% on Feb-22 and 66% on Mar-22. Even thought KPI achievement on Apr-22 was 77% it still showed increasing on safe stock achieve. On





May-22, percentage on KPI was 86% which is exceed the requirement set by the company, 80%.

	ZENIG SPARE PARTS INVENTORY MONITORING LAST UPDATED 31/5/2022																	
			LAS	ST U	PDAT	ED		31	/5/	20	22							
:	SUPPLIER	NAME PART	UNIT PRICE	UM	STAD / BOX	FREQ	LEAD TIME	MIN 8 TOC K	MAX	CON TRO	O PENI NG	оит	IN	STOCK IN HAND	STATUS	SYMBOL	PR/PO NO	REMARK
1	CSM Hardware	Ballast	RM58.95	705	1	WEBKLY	1 WIEK	z	- 4	2	3		1	4	STOCK OK	•		IN CONTROL
z	AKF Electrical & Automation	Barrel Heater (195 X 80)	RM(72.63	705	1	WEBKLY	1 W 12 K	а	8	z	3	1		6	STOCK OK			IN CONTROL
3	AKF Electrical & Automation	Barrel Heater (285 X 200)	RM89.21	75	1	WEBKLY	1 1 10 12 15	з	В	z	3		3	6	STOCK OK			IN CONTROL
•	AKF Electrical & Automation	Barrel Heater (118 X 35)	RMG3.72	205	1	WEBKLY	1 WIEK	3	8	2	3		3	6	STOCK OK			IN CONTROL
5	AKF Electrical & Automation	Barrel Heater (120 X42)	RMGS.44	705	1	WEBKLY	1 WIER	3	8	2	3		3	6	STOCK OK			IN CONTROL
5	AKF Electrical & Automation	Barrel Heater (132 X 80)	RMISG.80	75	1	WEBKLY	1 WIER	з	8	2	3		3	6	STOCK OK			IN CONTROL
7	AKF Electrical & Automation	Barrel Heater (135 X70)	RM69.51	705	1	WEBKLY	1 WIEK	з	8	2	3		3	6	STOCK OK			IN CONTROL
8	AKF Electrical & Automation	Barrel Heater (135 X 80)	RM67.21	705	1	WEBKLY	1 WEEK	з	B	2	3		3	6	STOCK OK			IN CONTROL
2	AKF Electrical & Automation	Barrel Heater (180 X 30)	RM69.51	705	-	WEBKLY	1 WIER	з	8	2	3		3	6	STOCK OK			IN CONTROL
10	AKF Electrical & Automation	Barrel Heater (190 X185)	RM72.35	705	1	WEBKLY	1 WIEK	з	8	2	1		5	6	STOCK OK			IN CONTROL
11	AKF Electrical & Automation	Barrel Heater (195 X 120)	RM69.51	705	1	WEBKLY	1 WIEK	3	B	2	3		3	6	STOCK OK			IN CONTROL
12	AKF Electrical & Automation	Barrel Heater (195 X 160)	RMI70.35	705	1	WEBKLY	1 WIER	з	8	2	3		3	6	STOCK OK			IN CONTROL
13	AKF Electrical & Automation	Barrel Heater (195 X175)	RM73.32	705	1	WEBKLY	1 WIEK	з	8	2	1		5	6	STOCK OK			IN CONTROL
14	AKF Electrical & Automation	Barrel Heater (195 X 195)	RM75.29	705	1	WEBKLY	1 WIER	з	8	2	3		3	6	STOCK OK			IN CONTROL
15	AKF Electrical & Automation	Barrel heater (195 X 195) 240V 2650	RM75.29	705	1	WEBKLY	1 WIER	з	8	2	2		5	1	STOCK OK			IN CONTROL
	AKF Electrical & Automation		RM79.90	205	1	WEBKLY	1 WIEK	з	8	2	3		3	6	STOCK OK			IN CONTROL
17	AKF Electrical & Automation	Barrel Heater (200 X 5)	RM79.08	705	1	WEBKLY	1 WIEK	з	B	2	3		3	6	STOCK OK			IN CONTROL
18	AKF Electrical & Automation	Barrel Heater (210 X 160)	RM85.24	705	1	WEBKLY	1 WIER	3	В	2	1		5	6	STOCK OK			IN CONTROL
19	AKF Electrical & Automation	Barrel Heater (210 X 62)	RM83.11	205	1	WEBKLY	1 WIER	3	8	2	1		5	6	STOCK OK			IN CONTROL
20	AKF Electrical & Automation	Barrel Heater (230 X 201)	RM86.67	705	1	WEBKLY	1 WIEK	з	B	2	3		4	7	STOCK OK			IN CONTROL
21	AKF Electrical & Automation	Barrel Heater (235 X 200 X) 240V 40	RM87.60	705	1	WEBKLY	1 WIER	3	В	2	4		4	8	STOCK OK			IN CONTROL
		Barrel Heater (290 X 50) 240 V 1800		205	1	WEBKLY	1 WIEK	з	8	2	1		5	6	STOCK OK			IN CONTROL
	AKF Electrical & Automation		RM92.82	705	1	WEBKLY	1 WIER	3	8	2	3		5	8	STOCK OK			IN CONTROL
24	AKF Electrical & Automation	Barrel Heater (30 X 45) 240V 300 W	RM30.85	705	1	WEBKLY	1 WILLS	з	В	2	2		5	7	STOCK OK			IN CONTROL

Figure 4.2: Spare Part Inventory monitoring system

The figure 4.2 show after implemented the spare parts inventory monitoring system, all the parts can be easily monitor. All the details on parts will be supervise through the system. Before implement the new system, a master data of spare sparts list was created using Microsoft excel. The old spare part list was made for monthly physical check-up. Compare to the new system also create by using Microsoft excel, the old spare part list does not have details on suppliers, control stock quantity, and no programme formula was created to make it easier to update.



Previous data collection shown how un effectiveness spare parts inventory took in and out from maintenance room by updating using stock card. Unethical manner from some technician who did not follow the right work instruction for spare parts took in and out resulting different in quantity. Spare parts requisition form is made in conjunction with the spare parts inventory monitoring system shows in Figure 4.3. By having this requisition form, the person in charged will easily trace and monitoring the spare parts that in and out from maintenance room. From this implementation, new work instruction is needed as a guide for maintenance department as well technician from injection moulding department.



Figure 4.3: spare parts requisition form

Benefits of new work instructions:

- i. Easily to trace and track the in and out of spare parts
- ii. Less wasting time on searching the spare parts at maintenance room



iii. More proper on managing the spare parts inventory since all the parts are being monitoring through system.

MONTH	Nov-21	Dec-21	Jan-22	Feb-22	Mar-22	Apr-22	May-22	TOTAL
CASES	17	19	17	14	14	14	13	108
DOWNTIME-HRS	162	142	140	100	90.5	80	70	784.5
RM	19440	17040	16800	12000	10860	9600	8400	94140

Table 4.2: Downtime Vs cost

Based on the Table 4.2 above, it shows gradually decrease of down time. On May-22, total downtime is 70 hours and total loss cost is RM 8400. Compare to the first month data collected on Nov-21, total downtime is 162 hours and total loss cost is RM 19440. Company xyz save about 80 hours downtime and RM 11040 for loss cost of machine. This happened because of the availability of spare parts that already been build up and monitor by using new system of spare parts inventory monitoring. All the replacement job can be done quickly. Thus, result increasing the efficiency of downtime and decreasing the excessive cost of injection moulding. This will give benefits to the company in terms of daily productivity on producing product output.

#### 5.0 Conclusion

In the conclusion of the project, it is possible to conclude that this implementation was exceeds the objective of this project. The respondents agreed that all the issues that arise in the logistic department had an impact on their work. The Implementation Spare Parts Inventory And Ordering is proposed for use at XYZ Sdn Bhd in the Maintenance department. Maintenance department are pleased with the positive improvement achieve within the end of this project. The researcher has achieved the objective of this project. The specifications objectives of this study are to achieve department KPI by control stocks of spare parts inventory by using minimum and maximum. Next is to create new ordering



system and method for spare parts purchase using Microsoft Excel. Microsoft Excel is one of common software that have been use at XYZ Sdn Bhd. The last objective of this project is to improve efficiency of downtime hours vs cost for spare parts by 50%.

#### REFERENCES

Driessen, M. A.; Arts, J.; Van, H. G.; Rustenburg, W. D.; Huisman, B. (2010). Maintenance spare parts planning and control: A framework for control and agenda for future research. *Beta Research School for Operations Management and Logistics*.325: 31.

Ghodrati, B.; Kumar, U. (2005) Reliability and operating environment based spare parts estimation approach. *Journal of Quality in Maintenance Engineering*, 11(2): 169 – 184

Driessen, M.; Houtum, J.; Van, G. (2004) <u>Maintenance spare parts planning and</u> control a framework for control and agenda for future research

Rego, J.; Mesquita, M. (2011) Spare parts inventory control -A literature review. 21(4): 656 – 666

Ghodrati, B.; Benjevic, D.; Jardine, A. (2012) Product support improvement by considering system operating environment. *International Journal of Quality & Reliability Management*, 29(4): 436 - 450.



# DEVELOPMENT OF AN AUTOMATED ASSISTIVE DEVICE FOR BEHAVIOURAL TREATMENT OF AUTISM CHILDREN

Nur Zulaikha binti Zubir<sup>1</sup>,Suryani binti Ilias<sup>2</sup> Department of Electrical Engineering, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Malaysia nurzulaikhazubir@gmail.com<sup>1</sup>, suryani@psa.edu.my<sup>2</sup>

#### Abstract

Autism is a subset of pervasive developmental disorders characterised by abnormal behaviour. The growing role of technology has provided different hopes for improving the lives of different individuals with Autism Spectrum Disorder (ASD). Existence use of audio-visual support, a cognitive tool to enable behaviour adjustment, is one of the interventions required to support autistic kids. Although audio-visual support is successful in assisting in reducing many of the difficulties associated with autism, its creation, distribution, and use are challenging and time-consuming. Furthermore, most interventions are still handled manually and require parents to constantly monitor them. To solve this problem, prototype devices were created with the use of audio-visual prompts and IoT, including a control module consisting of a processor panel with a series of inputs and outputs. According to the findings of the study, the device can accurately deliver instructions as it guided the autistic youngster through the stages and collected the data in real time using mobile apps. In order to improve the existing device, the system can be upgraded by providing more prompts, such as inserting video in terms of the visual aspect.

**Keywords:** Autism Spectrum Disorder (ASD), Intervention, Behaviour, Self-care Skills, Assistive Device.

#### 1. Introduction



Autism is a complex neurodevelopment disorder that affects communication and social skills and behavioural and intellectual abilities. Symptoms and severity of autism vary widely(Lord et al., 2018). Children with autism spectrum disorder (ASD), as well as the parents and caregivers who support them, may find it extremely difficult to learn how to take care of themselves. Self-care skills are harder for people with ASD to learn than they are for people without it, and in more severe cases, they might never be able to carry out self-care tasks without help(Hirano et al., 2010).

Incorporating assistive device into daily activity can provide autism children with an opportunity to take control of their behaviours and self-care skills. Increase, maintain, or improve the functional capabilities of kids with autism is the aim of this assistive technology(Mechling et al., 2009). Tactile, auditory/vocal, gestural, textual, pictorial, and video prompts are among the prompt types that have been shown to be successful(Mechling et al., 2009).

The Internet, robots, virtual reality, assistive and prompting devices, and voice output communication devices are some of the technologies that have been used to this aim. Children with ASD and their caregivers can utilise the assistive gadget described in this study to independently assist with self-care activities. The system follows a child with ASD through an activity using Internet of Things vision and provides auditory and visual cues as necessary. Utilizing technology to develop novel interventions is one method to satisfy the needs of people with ASD while lessening the burden on caregivers(Bennett et al., 2013).

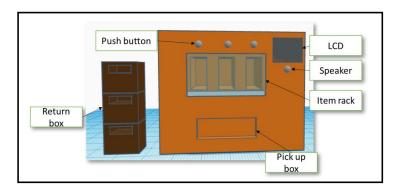
#### 2. Methodology

The An Automated Assistive Device For Behavioural Treatment Of Autism Children device creation, pilot testing, and evaluation are discussed in this study. This ASD device was created to assist children with ASD in doing routine self-care tasks. Through pilot testing of a functioning prototype as the kids worked on the activity, this study aimed to find out how well the gadget worked and how easy it was for kids and their parents to use.

## 2.1. Project Designing Process



This assistive device for ASD consisted of a flat-screen LCD mounted over the device, a voice module, push button and ultrasonic sensor as shown in Figure 1. This ASD assistive technology employs specially created audio-visual prompts for the child via speakers and an LCD. Recorded verbal prompts and display prompts that may be used at any step of the activity were both different sorts of prompts. Components for hardware are utilized in this section.





Thinkercad is used to design this project. This assistive device is design to fit on top of a desk and not be too tall. Recycle wood will be used as the casing of this device and sturdy plastic are used for the front panel. This device also consists of item rack to store the items, IR sensor to detect item collection and return, LCD to display the option, push button to select the item, and MP3 module with speaker to give instruction to the autistic child.

#### 2.2. Project Development Process

This project will undergo the designing development process. One of the most important steps in creating this assistive equipment is the designing process. As listed in Table 1, the project's hardware components include the push button, LCD, MP3 module and speaker, IR sensor, servo motor, and server (Wi-Fi module; ESP32). Each components have their crucial function in order to ensure that this device can be operated according to its function.



Components	Picture	Function
Push button		A push button switch regulates a machine's or other process's action. In this project, user can choose the product by pressing the related button.
LCD	eeecceFcH1JKLM NdPARSTULIAVZ 3.5.1 Stanceerstuu xgz(1).2.5 Stancerstuu xgz(1).2.5 Stancerstuu	LCDs are a commonly used to display data in devices. LCD is to show the information such as the items and when making a selection.
MP3 module & speaker		It is a speaker-dependent module with speaker and reproduces sounds stored on a memory card. Any sound could be trained as command to give instruction to the user.
IR sensor		An IR sensor can detect motion of object or if there is any object present in its's surrounding. In this device it's use to detect if the item has been collect.
Servo motor		Precision rotating and pushing pieces of a machine are accomplished by electronic devices and rotary or linear actuators. It is used to control the rotation of the coil and dropping of the product
Server (Wi-fi module; ESP32)		It is mainly utilized for IoT-based embedded applications development. It is capable of handling various functions of the Wi-Fi network from another application processor. The ESP32 then will send the data to apps, Blynk.

# Table 16: List of hardware components



#### 2.3. Project Block Diagram

The operating system of the project is depicting in Figure 2 with block diagram showing the mechanism and flow of the process of this work which consist of three parts; input, process and output. The mechanical system representing the physical prototype which have push button, LCD monitor, MP3 module, IR sensor, servo motor, and Wi-fi module (ESP32), are group together as they are the main components used to build the device. All components will be controlled by ESP32 microcontroller. The ESP32 then will send the data to apps (Blynk). Servo motors move to rotate the coild and dispense the item.

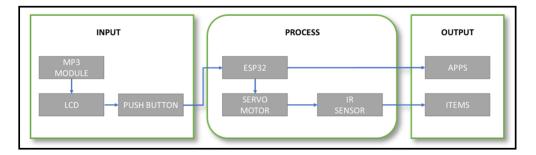
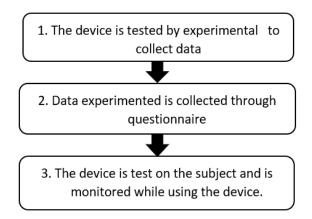


Figure 28: Project block diagram

2.4. Data analysis method

Data analysis has been carried out following the conclusion of the designing and developing phase. The approaches for data analysis include examining each circuit component and how it affects the outcome. The development of a control module with a processing panel and a range of input and output is one of the primary objectives of this project. The results of component testing indicate that all the elements and aspects of this device can perform in accordance with its aims. Several project parameters have been reviewed. In addition, subject testing and data collecting from the survey have been completed. According to the survey data, parents and other caregivers were in agreement that this gadget may be utilised as an aid for children with autism. Additionally, subject testing data demonstrated that this tool can accomplish its goals of guiding autistic youngsters with voice and visual prompts used in this project.





#### 3. Result and Discussion

The hardware for the assistive device has been constructed, as shown in Figure 3. The board's coding is programmed using the Arduino IDE. The goal of this is to improve the project's production. Also utilised in this project is Blynk. It can be used by caregivers to support autistic children throughout the process as well as to monitor the activity of the autistic child. There were three buttons, one for each component of the gadget, as seen in Figure 3. Additionally, a speaker and LCD are available to assist in instructing and guiding the youngster throughout the procedure. The corresponding step progress on applications would display the progress status for each step when a child completed a step of the task.

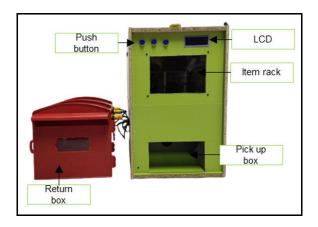


Figure 29: Actual device prototype



#### 3.1. Application interface

The application interface that we can see from user's phone is shown in Figure 4. As we can see, by using this application (Blynk), parents can easily check the stock left for every item. The LCD on this application will display the same information as the LCD on the device, so that the parents can know which item their kids are choosing. When the work is complete, a percentage rate will be shown at the bottom of the programme. The application also shows progress for each step that the child has completed. Parents also can help their child to choose an item using the application by selecting the selection button for each item on the application display.

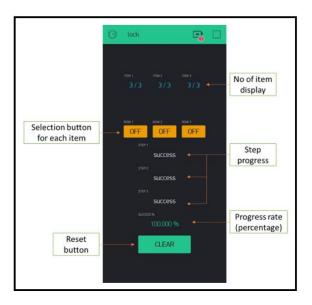


Figure 30: Application interface

#### 3.2. Project Flowchart

The five states that make up this device's state cycle are: system asking the user to choose an item, user choosing, product delivery, product return, and progress data update on apps. The MP3 module will first provide instructions when the switch on button is pressed, and then the machine will be ready for consumers to choose the product. The design is in its initial state at this point. The user will then choose the product to be dispensed after this. This condition may fall under one of items 1, 2, or 3. Let's assume that the user chooses input item 1. The machine will initially determine whether or not the products are in stock. The item will then be delivered to the pickup box by the machine



when it travels to the item state. The user must put the item in the return box when returning it. The applications will update each step's progress and progress rate at the end of the steps simultaneously.

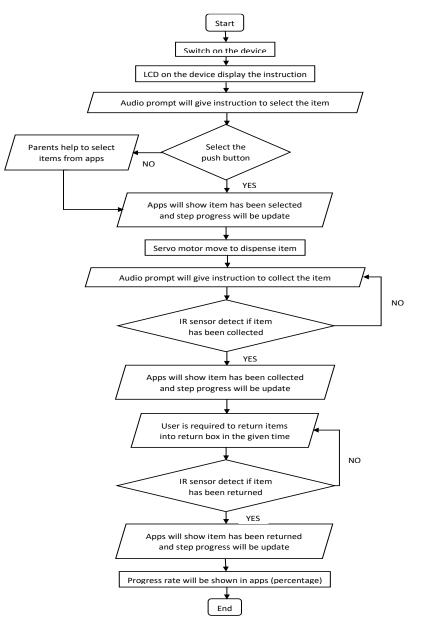


Figure 31: Project flowchart



3.3. Standard Operation Procedure (SOP) for An Automated Assistive Device for Behavioural Treatment of Autism Children

The method developed to carry out an experiment is shown in Figure 6. Before utilising the assistance equipment and after using the assistive device, the procedure will be recorded.

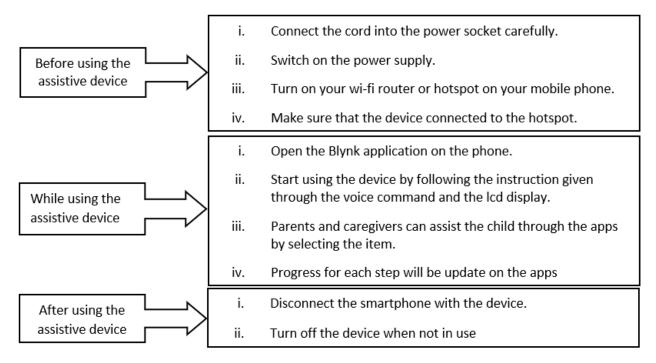


Figure 32: SOP for Automated Assistive Device for Behavioural Treatment of Autism Children



## 3.4. Subject experiment data

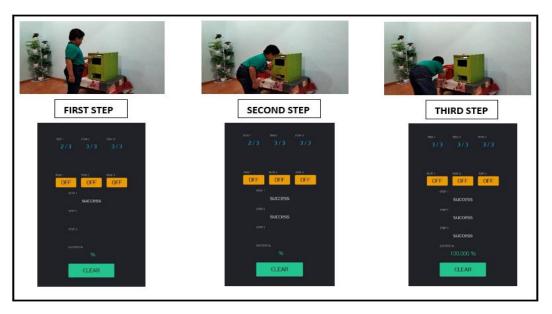


Figure 33: Subject can follow instruction successfully without parents' assistance

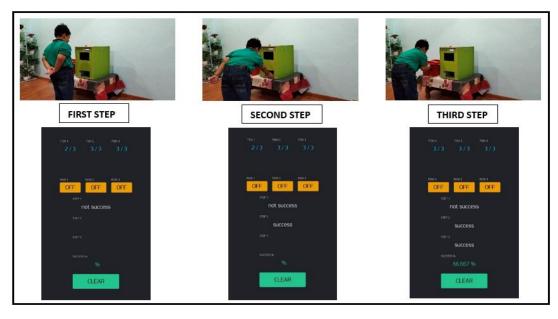


Figure 34: Subject need parents assistance through apps



This experiment sought to determine whether the ASD device was a suitable intervention and could carry out its intended functions. The study was done to determine how ASD youngsters responded to this gadget, as illustrated in Figure 7 and Figure 8. Other than that, the purpose of this experiment is to analyse the real time response by the parents through apps in assisting behavioural treatment for autism children.

Figure 9's result shows that 83% of the trial was successfully completed by the child without the help of parents or other caregivers. Only child 1 got a total of 66.67% successful rate during the second trial, but for the third trial he managed to follow through the steps successfully. From this we conclude that this device success in giving 2 mode of prompt which is audio and visual to meet the needs of the autism children's behaviour in completing through the task.

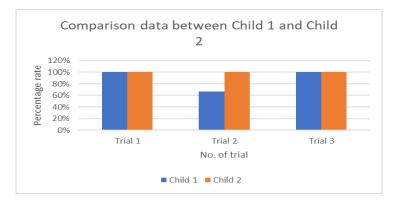


Figure 35: Subject data analysis graph

#### 4. Conclusion

An assistive device has been designed to assist parents and caregivers to monitor progress of self-care activity and behaviour of autism children using ESP32 and Blynk. This device's innovation consist with 2 mode options which is the visual and audio aspect has been successfully developed test for autism children. Behavioural autism activity has been successfully test and can be used as an assistive device for behavioural treatment for autism children. This automated assistive device for behavioural treatment of autism

children is a low cost intervention that pursued to develop a device that resulting audiovisual prompts to serve as an effective self-prompting device to assist children with ASD. This device allows the autistic children in improving behaviour while perform multi-step



tasks. The impact of giving children with autism numerous instructions for two different setup options—an audio prompt and a visual prompt—will be evaluated across the activity. Data will also be recorded using programmes for additional analysis.

5. Acknowledgment

I would like to express my sincere appreciation to my supervisor, Madam Suryani binti Ilias, for giving me the chance to complete this wonderful project on the subject of An Automated Assistive Device For Behavioural Treatment Of Autism Children. She also encouraged me to conduct extensive research and complete the project within the allotted time. I learned a tonne of new information as well, and I appreciate my supervisor so much for that.

- 6. References
- Bennett, K. D., Ramasamy, R., & Honsberger, T. (2013). The effects of covert audio coaching on teaching clerical skills to adolescents with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 43(3), 585–593. https://doi.org/10.1007/s10803-012-1597-6
- Grigorenko, E. L., Torres, S., Lebedeva, E. I., & Bondar, Y. A. (2018). Evidence-based interventions for ASD: A focus on applied behavior analysis (ABA) interventions. *Psychology, Journal of the Higher School of Economics*, 15(4), 711–727. https://doi.org/10.17323/1813-8918-2018-4-711-727
- Hirano, S. H., Yeganyan, M. T., Marcu, G., Nguyen, D. H., Boyd, L. A., & Hayes, G. R. (2010). vSked: Evaluation of a system to support classroom activities for children with autism. *Conference on Human Factors in Computing Systems - Proceedings*, 3, 1633–1642. https://doi.org/10.1145/1753326.1753569
- Lord, C., Elsabbagh, M., Baird, G., & Veenstra-Vanderweele, J. (2018). Autism spectrum disorder. *The Lancet*, *392*(10146), 508–520. https://doi.org/10.1016/S0140-6736(18)31129-2
- Mechling, L. C., Gast, D. L., & Seid, N. H. (2009). Using a personal digital assistant to increase independent task completion by students with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 39(10), 1420–1434. https://doi.org/10.1007/s10803-009-0761-0



# DEVELOPMENT AND DATA ANALYSIS ON IOT-BASED SAFETY MONITORING AIR DETECTOR (SMAD) DEVICE

MOHAMMAD FIKRI ANUAR, DR SABARIAH BOHANUDIN

Department of Electrical Engineering, Politeknik Sultan Salahuddin Abdul Aziz Shah, Malaysia. madfikrie@gmail.Com; bsabar@gamail.com

## ABSTRACT

Monitoring temperature, humidity, and gas are very important to ensure that the environment is safe and prevent the degradation process, especially in the medical area. The existing technology device is limited to analysing the data of humidity, temperature, and gas content in the air integrated. The aim of this study is to develop, and analyse the temperature, humidity, and gas for the medical area that can provide monitoring data via IoT. The device uses the DHT22 sensor which can monitor the environment's temperature and humidity. The MQ-5 Sensor is used to detect the level of gas as the input for the ESP32 that acts as the main processor of the device. When the large change exceeds the standard level in all input sensors, the alarm buzzer and LED will be automatically turned on to give a warning. The result will be shown on the LCD display only when the device is connected to the wi-fi. The integrated data from this device can be transmitted to the server by using an IP address via wi-fi and shown on the SMAD website. Based on error analysis of data collected, the device can monitor the level of safety and health of the air environment for a medical place with an accuracy of 87%. It can be concluded that the SMAD device can be used to monitor the level of safety condition of the air environment in the medical area.

Keyword: Degradation process, safety air detector, safety medicine, IoT technology

#### INTRODUCTION

Monitoring of temperature, humidity, and gas is very important especially in the storage of medicines. This monitoring is to ensure that the medicines are safe to use and



prevent the degradation process. The appropriate temperature and humidity range are at 15°c - 30°c and humidity does not exceed 75% (Hashim et al., 2020). This is to ensure that the medicines are safe. Monitoring of gases in the air is also very important to prevent fires or the release of toxic gases. the existing technology device is unable to determine humidity, temperature, and type of gas content in the air integrated. Then The data that be recorded and kept manually after the device transmitted data wirelessly through IoT. After that, the system is unable to analyses the data after the device transmitted the data for monitoring continuously. The objective in this technical paper is to develop dan analysis the device that can determine the humidity, temperature, and gas content in the air integrally.

#### METHODOLOGY

#### Block diagram

Figure 1 shows the block diagram of the project that also shows the input and output of the component of the project. This device is call SMAD device and place in the medicine store, also can monitoring through wi-fi (IP address).

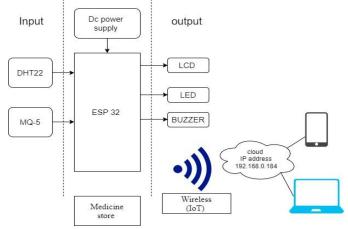


Figure 1. Block Diagram

Based on Figure 1, the input sensor of the device is DHT22 that can detect temperature and humidity in environment of room, and MQ-5 can detect gas in the air. The output of the SMAD device is use LCD display, Buzzer, and LED. This device can be use in the medicine store and able to use as monitoring data through wi-fi using IP address.



The design of the SMAD device

Figure 2 shows the devices SMAD there are many types of components. This sketch design shows the position of components like DHT22, MQ-5, Buzzer, red and green LED, LCD, and push-button. As we know, the SMAD device is placed in the Medicine store and the data send to server by using the wi-fi (IP address).

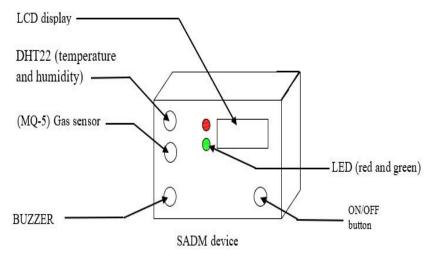


Figure 2. The Design of The SMAD Device

Based on Figure 2, the input of the device DHT22 and MQ-5. The DHT11 function as detector for temperature and humidity whereas the MQ-5 act as a gas detector. The level of temperature and humidity as well as gas of the room will be displayed on LCD display. Buzzer will be activated when the level of temperature and humidity as well as gas exceed the threshold value that is fixed. Data from the sensor will be proses and send to server by using IP address that have be set in the program device.

#### The scenario of SMAD device

Figure 3 shows the scenario of the position SMAD device that will use and the area the of sensor that can detect such as humidity, temperature, and gas. Only one SMAD device that shows in figure 4 in one recommendation area



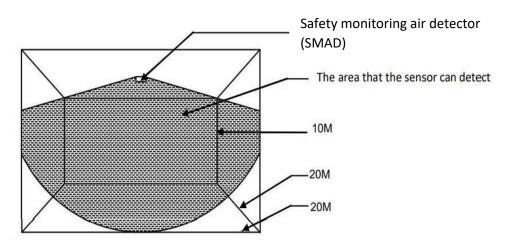


Figure 3. The Scenario of The Project

The SMAD device in figure 3 is placed in the middle of the lower surface of the building ceiling. Radius estimates for sensor SMAD device can detect is 10m. Also, this figure 4 shows the recommended room area. The height, width, and length of the room are 10 m, 20 m, and 20 m.

#### Flow of operation

Figure 4 shows the process of the SMAD device from start to end. This SMAD device flow gives some concise description about the operation of idea.



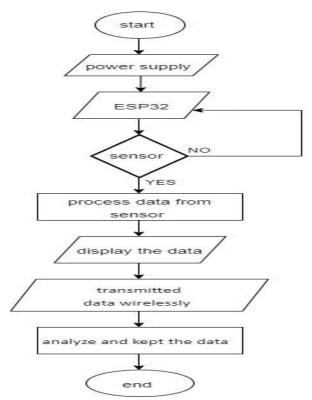


Figure 4. Flow of Operation

Based on figure 4, the power supply comes into ESP32 and the ESP32 sends the information to every sensor such as DHT22 and Mq-5 that detect the among of temperature, humidity, and gas. If not, the information from the sensor will is sent back to ESP32. Each yes or the sensor can read the information, the data from the sensor will proses and show in LCD display and send to sever by using IP address wi-fi.

#### **RESULT AND FINDING**

#### Hardware

A black plastic shell, DHT22, red and green LED, push button, MQ-5, buzzer, jumper wire, PCB strip board, and 7.4v battery are also used to make the SMAD gadget. On the outside of the SAMD device, the dimensions are 9 cm in height, 5 cm in width, and 15 cm in length. Figure 5 shows the final form of the SMAD device, which can be viewed in 3D.





Figure 5. SMAD device hardware

Figure 6 shows the front view of the SMAD device, which includes a DHT22, LCD i2c, red and green LEDs, a push-button, and an MQ-5. The push-button is the primary component that functions to switch on and off SMAD devices. The DHT22 sensor, detects temperature and humidity within a 10m radius. Furthermore, the MQ-5 sensor component detects the level of gas in the surroundings within a radius of 10 m. The placement of the DHT22 and MQ-5 in the front view is intended to give a greater number of opportunities for improved detection. The i2c LCD serves as an information display, displaying the air's overall temperature, humidity, and gas conditions. The green LED functions as an ON-device symbol and signals that the air conditioner is safe, in addition to transmitting a warning notice on the red LED. LEDs and LCDs are used to improve visibility on the front display.



Figure 6. Front view of the SMAD device



Figure 7 shows a side view of the SMAD device, which includes a buzzer and a ventilation part. On the DHT22 and MQ-5, this buzzer works as a warning when there is a large change that exceeds the standard level. Furthermore, the ventilation area is important for keeping the ESP32 microprocessor safe from overheating.

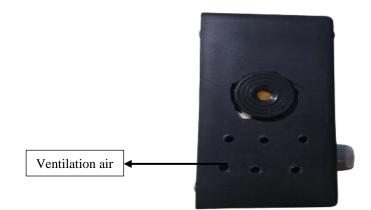


Figure 7. side view of the SMAD device

Figure 8 shows the inside of SMAD device, which is made up of components, a PCB board, and a battery. the PCB board used is a stripboard Because there aren't many jumper wires. A lithium-ion 18650 battery with a total voltage of 7.4 V is used(Xu et al., 2016). This battery produces 5 volts, which is directly connected to the ESP32 microcontroller. This battery may also be charged by attaching it to a micro-USB cable.

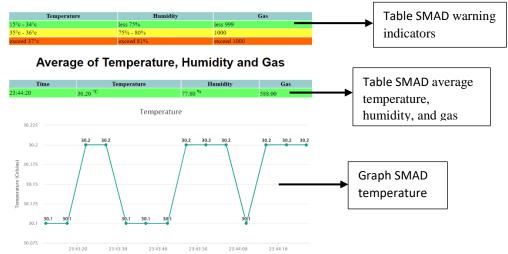


Figure 8. the inside of SMAD device



#### Software

This software is generated by creating webpages with HTML programs. The generated webpage takes advantage of a Wi-Fi IP address specified in the ESP32 code. The IP address used for this project is 192.168.0.186. When successfully linked to this IP address, this program can be activated. With several graphs, this program reveals the actual amount of temperature, humidity, and gas.

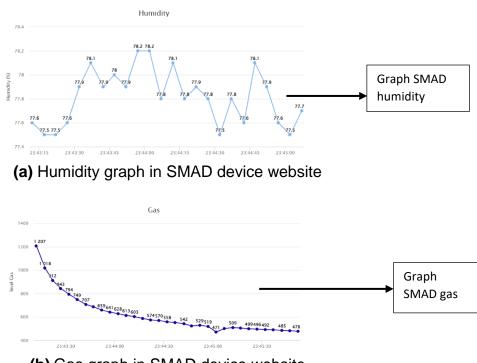


#### **SMAD Weather Station**

Figure 9. Temperature graph in SMAD device website

After turning on the SMAD device and successfully connecting it to this website, the display form shown in Figure 9 will be shown. There are two tables in this image. The first is a table of warning indicators broken down by level. The first level is green, which is the safe level; the second level is yellow, which is the alert level; and the third level is red, which is the danger level. The second table provides the average temperature, humidity, and gas for the next 30 seconds. The current time is also shown on the left side of this table. The first graph displayed is the temperature and time graph. This graph displays the entire temperature for 5 seconds, with the time at the bottom indicating when the temperature can be detected.





(b) Gas graph in SMAD device website

Figure 10: (a) Humidity graph in SMAD device website (b) Gas graph in SMAD device website

The graph for humidity and time is shown in figure 10(a). The overall humidity is displayed in 5 seconds each reading. While figure 10(b) shows a graph of gas level and time, every reading takes 5 seconds. Anyone may modify the time on this graph by changing the time in the HTML code. Furthermore, the colour of the table or tables may be changed using code.

## Analysis project

The goal of this analysis research is to evaluate the safe storage conditions of medicines in accordance with pharmacy management recommendations. There are three analyses performed: the type of area, the type of environment, and the rate of gas evaporation. Each analysis is given in combination with parameters to determine the current amount of error present. The present of error is to see the level of accuracy of the SMAD device with the parameters used.



The type of area

This analysis was carried out in two situations, mostly in the day and at night, for three different types of areas. Rooms, baths, and public areas with different area sizes are all used. Parameters SLATTIS, which can display total temperature and humidity, was used for this analysis. This analysis is performed to determine whether improved ventilation can offer a suitable level of temperature and humidity for the storage of medicines. This analysis can generate two types of data, temperature, and humidity data.

Table1: The type of area (temperature)					
TYPE OF AREA	SLATTIS	SMAD	PRESENT OF		
			ERROR, %		
ROOM	28.8	31.00	10.42		
BATHROOM	29.00	31.10	7.24		
PUBLIC AREA	27.80	29.40	2.08		
ROOM	29.60	32.00	8.11		
BATHROOM	29.80	33.20	5.39		
PUBLIC AREA	27.60	29.30	6.16		
	TYPE OF AREAROOMBATHROOMPUBLIC AREAROOMBATHROOM	TYPE OF AREASLATTISROOM28.8BATHROOM29.00PUBLIC AREA27.80ROOM29.60BATHROOM29.80	TYPE OF AREASLATTISSMADROOM28.831.00BATHROOM29.0031.10PUBLIC AREA27.8029.40ROOM29.6032.00BATHROOM29.8033.20		

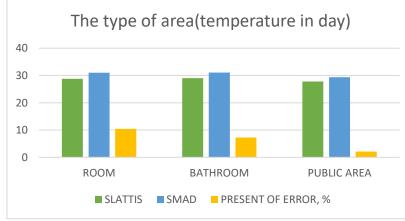


Figure 11(a): the type of area (temperature in day)

According to table 1, this is the temperature data that can be collected during the day and night, from three different locations. This information is derived from the parameters (SLATTIS) and the SMAD device. Figure 11(a) is a bar graph created in day using Table



1 data. This graph is divided into three sections, SLATTIS parameter data (green), SMAD device data (blue), and present error (yellow). The collected data by the SLATTIS parameter differs from that obtained by the SMAD device in the room. The bathroom has the highest temperature, which is 31.10 ° C for the SMAD device and 29 ° C for parameters SLATTIS with an accuracy level of 7.24 %. At a medium room temperature of 31 ° C for the SMAD device and 28.8 ° C for the SLATTIS, with an accuracy of 10.42 %. The public area has the lowest temperature, with the overall temperature for SMAD devices being 29.40 °C and SLATTIS being 27.8 °C. In public places, the temperature accuracy is 2.08 %.

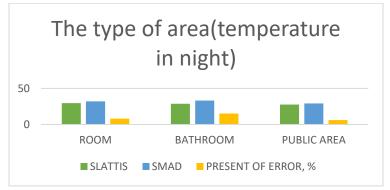


Figure 11(b): The type of area (temperature in day)

Based on figure 11(b), this is a graph for the type of area temperature at night based on table 1. The bathroom has the maximum temperature at night, which is 28.80 ° C for SLATTIS parameters and 33.20 ° C for SMAD devices with an accuracy of 5.39 %. Room is a middle level for temperature detection, with SLATTIS detecting 29.60 °C and SMAD detecting 33.20 °C with an accuracy of 5.39 %. The low temperature is in the public area, with SLATTIS devices measuring 27.60 °C and SMAD devices detecting 29.30 ° C, with an accuracy of 6.16 %.

Table 5. the type of area (number)					
TIME	TYPE OF AREA	PARAMETERS	SMAD	PRESENT OF ERROR, %	
DAY	ROOM	74.00	73.40	0.81	
	BATHROOM	75.00	74.80	0.13	
	PUBLIC AREA	71.00	74.50	4.93	
NIGHT	ROOM	72.00	69.00	2.92	
	BATHROOM	75.00	78.30	4.40	
	PUBLIC AREA	71.00	72.60	1.87	

Table 3: the type of area (humidity)



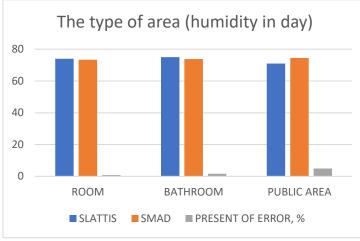


Figure 12(a): the type of area (humidity in day)

This is the humidity data that may be collected during the day and night, according to table 2. This information is derived from three different categories with rooms, bathrooms, and public areas. Figure 12(a) shows a bar graph with a different types of area types, including room, bathroom, and public area. This graph is divided into three sections with the SLATTIS (blue) parameter, the SMAD device (orange), and the presence of error (Gray). Figure 12(a) shows that the high humidity during the day is in the bathroom, with 75 % for SLATTIS and 74.80 % for the SMAD device at 0.13 %. At 0.81 % accuracy, the second-highest room has a 74 % SLATTIS and a 73.40 % SMAD device. The lowest humidity level is seen in public areas, where SLATTIS may reach % and the SMAD device can reach 74.50 %. In public areas, accuracy can reach 1.87 %.

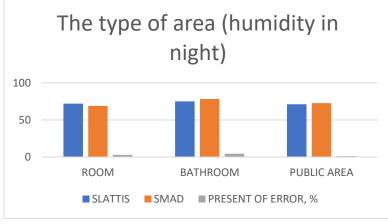


Figure 12(b): the type of area (humidity in night)



Figure 12(b) shows a bar graph of humidity at night in the room, bathroom, and public areas. The bathroom has high humidity, which is 75 % for the SLATTIS and 78.30 % for the SMAD device. The second is a % room for SLATTIS devices and a % room for SMAD devices. The public area has low humidity, which is 71% for the SLATTIS and 72.6 % for the SMAD device. In this analysis, the hypothesis that can be made is that the better the ventilation air, the lower the level of temperature and humidity(Fang, 1998). This is because a large area has better ventilation than a small area. The type of environment

This analysis measures the level of temperature and humidity in five different situations that are "ON THE LAMP," "ON THE FAN," "ON THE AIRCON," "OFF ALL SITUATION," and "ON ALL THE SITUATION". This analysis is SLATTIS. This analysis was performed in the morning in the room. The information gathered for this analysis was put into tables and graphs.

Table 3: the type of environment (temperature)					
SITUATION	ON THE LAMP	ON THE FAN	ON THE AIRCON	OFF ALL SITUATION	ON ALL THE SITUATION
PRAMETERS	29.70	28.70	27.50	30.50	27.00
SMAD	31.70	31.20	30.60	32.00	29.80

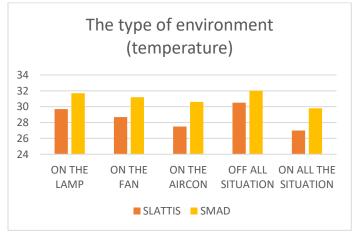


Figure 13: the type of environment (temperature)



Based on figure 13, this graph is derived from the data in table 3 and obtained from temperatures in five different situations. This data displays the temperature of the SLATTIS parameters (orange) and SMAD device (yellow). The highest temperature was obtained in the "off all situation" situation, with SLATTIS reaching 30.50 °C and the SMAD device reaching 32 °C. next highest in the situation "on the lamp" with 29.70 ° C for the SLATTIS parameter and 31.70 ° C for the SMAD device. For "on the fan," the temperature obtained is 28.70 °C for SLATTIS and 31.20 °C for the SMAD device. In the "on the aircon" situation, the temperature that can be recorded is 27.50 °C for SLATTIS and 30.60 °C for SMAD. The lowest temperature is in the situation "on all", with the temperature of SLATTIS being 27 °C and SMAD being as much as 29.80 °C.

Table 4: the type of environment (humidity)					
SITUATION	ON THE LAMP	ON THE FAN	ON THE AIRCON	OFF ALL SITUATION	ON ALL THE SITUATION
PRAMETERS	74.00	75.00	63.00	75.00	58.00
SMAD	71.50	71.20	57.20	75.80	55.00

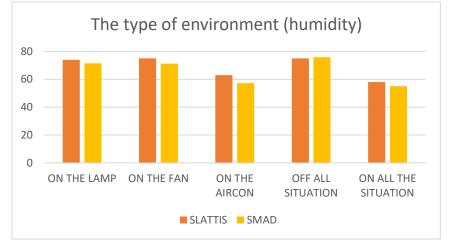


Figure 14: the type of environment (humidity)

According to figure 14, this is a graph of humidity data in table 4. in five different situations consisting of SLATTIS (orange) and SMAD device (yellow) parameters. The highest humidity can be detected in the "off all situation" situation with 75% for SLATTIS and 75.80% for SMAD device. The second highest is in the "on the fan" situation which



is 75% for SLATTIS and 71.20% for SMAD devices. In the "on the lamp" situation, the SLATTIS gets a reading of 74%, while the SMAD device gets a reading of 71.50%. in the "on the aircon" situation, the amount of humidity that can be recorded is 63% for SLATTIS and 57.20% for SMAD devices. The lowest humidity that was successfully recorded was in the "on the all situation" situation with 58% for SLATTIS and 55% for SMAD device. With all these temperature and humidity readings, the hypothesis that can be made is the lower heat, the lower amount of temperature and humidity(Hass et al., 2016). This is because in cold and low humidity situations it can give a good reading compared to hot and high humidity situations.

### The rate of gas evaporation

This analysis is performed to determine the rate of gas evaporation in the air in three different areas that are the room, the restroom, and the public space. Alcohol wipes containing 75% alcohol were used as the parameters in this analysis. To detect gas evaporation, the SMAD device with alcohol wipes is put 1 metre away.

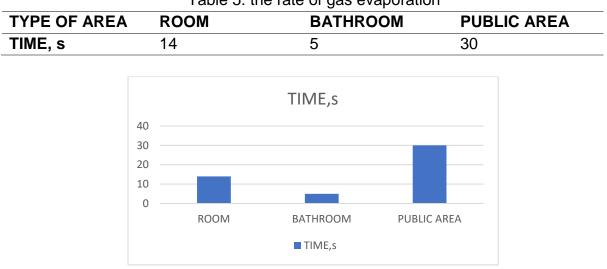


Table 5: the rate of gas evaporation

Figure 15: the rate of gas evaporation

Based on Figure 15, this is a graph of the time taken by a gas detector to detect the evaporation of alcohol gas in the air. The highest rate of gas evaporation that can be detected is in the bathroom area, which takes 5 s, while moderate levels in room areas take 14 s, and low evaporation is in public areas that take 30 s. As a result of this analysis, a hypothesis can be built that the better ventilation air, the lower amount of gas



evaporation in the air(1994\_vantKlooster\_airflow&natvent&ventrate&CO2balance.Pdf, n.d.). This is because good air ventilation can reduce gas evaporation.

#### CONCLUSION

In conclusion, temperature, humidity, and gas monitoring are important, especially in the storage of medicines. Monitoring of gases is also important for preventing fires or the discharge of dangerous gases. There are several problem statements that can be detected, including the existing technology device is limited to analysing the data of humidity, temperature, and gas content in the air integrated. So, the revenue objectives of this product are to develop, and analyse the temperature, humidity, and gas for the medical area that can provide monitoring data via IoT. This method is intended to show some of the methods used in the production of this SMAD device. Don't forget, in this method there is a description of the analysis method on the SMAD device that will be run. After that, the results of the form of hardware and software are also described, as is some analysis carried out. Based on data analysis errors, the device can monitor the level of safety and health of the air environment in a medical facility with an accuracy of 87%. It may be concluded that the SMAD device can be used to monitor the level of safety in the medical area's air environment. The project was able to provide a later design overview of a new product that can determine the humidity, temperature, and gas in the air integrally. In addition, this product is also able to provide a little variation in the development process where it uses the IP address and the area that the sensor can detect.

#### REFERENCE

1994\_vantKlooster\_airflow&natvent&ventrate&CO2balance.pdf. (n.d.).

Adiono, T., Fathany, M. Y., Fuada, S., Purwanda, I. G., & Anindya, S. F. (2018). A portable node of humidity and temperature sensor for indoor environment monitoring. *IGBSG* 2018 - 2018 International Conference on Intelligent Green Building and Smart Grid, 1–5.

Fang, L. (1998). Impact of temperature and humidity on perception of indoor air quality during immediate and longer whole-body exposures. *Indoor Air*, *8*(4), 276–284.

Hashim, A. B., Samad, W. U. S. B. W. A., Zain, M. B. M., & Hamdi, N. B. A. (2020). Garis



Panduan Pengurusan Farmasi Logistik Kementerian Kesihatan Malaysia Edisis 1. 20, 230.

- Hass, A. L., Ellis, K. N., Mason, L. R., Hathaway, J. M., & Howe, D. A. (2016). Heat and humidity in the city: Neighborhood heat index variability in a mid-sized city in the Southeastern United States. *International Journal of Environmental Research and Public*
- Pranav Darji, C. (2021). IoT Based Sensor for Humidity and Temperature Measurement in Smart HVAC Systems. *International Journal of Recent Technology and Engineering*, 9(5), 42–44.
- Shamang, K. J., Chukwuma-Uchegbu, M. I., & Sa'id El-nafaty, A. (2020). Indoor Temperature and Humidity Monitoring System. *Journal of Science Engineering Technology and Management*, 02(05), 50–58.
- Xu, J., Liu, B., Wang, X., & Hu, D. (2016). Computational model of 18650 lithium-ion battery with coupled strain rate and SOC dependencies. *Applied Energy*, *172*, 180–189.



# IMMEDIATE REDUCTION OF BONE AEROSOL DURING AUTOPSIES USING AUTOPSY SAW WITH AUTOMATIC VACUUM

Muhammad Abdul Aziz Che Mat, Dr Siti Anizah Muhamed Faculty of Electrical Department,

Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor. azizcm99@gmail.com

## ABSTRACT

Particulate matter (PM) emitted during autopsies can serve as a vector for numerous viruses or bacteria and can lead to infections. Reducing the exposure of those particles in indoor working environments is, therefore, an important issue. Even shortterm exposures with high concentrations have a harmful potential and can lead to an increase in cardiovascular and respiratory mortality. The aerosol of PM needs to be cleaned by vacuuming during and after the autopsies process. An autopsy machine is a single-user machine. The most common practice in Malaysia, such as observed in Hospital Besar Ipoh, Perak is to use an autopsy saw and vacuum machine separately with two staff members simultaneously cutting and vacuuming. There are autopsy saws that came with a vacuum attachment, but the vacuum still needs to be operated manually. This project's purpose is to develop and implement modern autopsy saw prototypes that meet the needs of forensic pathologists and other medical examiners. This autopsy saw is equipped with an automatic vacuuming function that can be singlehandedly operated. The design is ergonomic and specially crafted for easier cleaning of the machine's tanks after the autopsy procedure. Tested in the simulation of the autopsy process, the machine instantly reduces the number of particulate matter PM2.5 during the cutting process.

Keywords: Autopsy saw machine, 3D printing, DC Motor, Small Fan and Blade Saw



#### **1. INTRODUCTION**

An autopsy is a process that takes place in the forensic unit of every major hospital. An autopsy involves an external and internal examination to determine the cause of death and its characteristics. Whether it was caused by a disease, chemistry, radiation, accident or other injuries. The autopsy is divided into two, the first being a medicolegal autopsy. A medicated autopsy is a case of death to be dissected and directed by the police. While, a clinical autopsy, is an autopsy in which the attending doctor needs to obtain the permission of the next of kin. The next of kin has the right not to allow the autopsy of the body to be performed or allow an autopsy to be performed on a specific part only. In any case, an autopsy is crucial in identifying the cause of death.

The main part of an autopsy is dissection. One of the important procedures is dissecting the cranial using a chainsaw swing. The swinging saws used to open cranial vaults are potentially dangerous for three reasons. First, the electrical equipment is used in wet environments. An improperly maintained swinging saw poses an electrocution risk. Secondly, the dissection process produces aerosols of bone dust and bodily fluids. Therefore, they must be used with an exhaust system that collects these aerosols into closed containers. Third, it has been suggested that prolonged use of the device may be the cause of white finger vibrations (a long-term condition that causes numbness or tingling in the fingers, which is often accompanied by whitening (or blanching) of the fingertips) in anatomical pathological technologists. While these chainsaws are very effective at cutting bones, they pose little danger of cutting the handler.

This paper is suggesting a solution for the danger of bone aerosol produced during the use of an autopsy saw. We recommend the use of a modified swinging saw machine for user optimization. The swinging saw machine was modified to a smaller size compared to a regular autopsy saw commonly in use but has approximately the same cutting power. It was specially designed to be used for cutting cranial or bones that have the same hardness as cranial. The machine was also designed to have a small tank for a shorter cleaning cycle. Therefore, this machine will reduce the bad smell and bacteria on the machine and the user will be able to use it safely. More importantly, this machine only requires one user to operate.



### 2. LITERATURE REVIEW

#### 2.1 HUMAN SKULL

During the surgery of a human body, various parts need to be dissected, among which are the skull, brain, heart, liver, and other parts found throughout the body. The focused part is the skull. The skull is the bone structure that forms the head in the vertebrae. It supports the structure of the face and provides a protective cavity for the brain. The skull forms an anterior-most skeletal part and is a product of brain cephalization, housing some sensory structures such as the eyes, ears, nose, and mouth. So, let's find out that the skull part is a little complicated to dissect.

In addition, the skull has a front bone and consists of two main parts. This is the squamous part and the orbital part. The squamous part marks the vertical, flat part, as well as the largest part and the main region of the forehead. The orbital part is the horizontal region between the second and third largest front bones. It enters the formation of the roof of the orbital cavity and the nose. Sometimes the third part is inserted as the nasal part of the frontal bone, and sometimes this is accompanied by a squamous part. The nasal part is between the eyebrow ridge and ends up in a serrated nasal notch articulated with the low nasal bones and with the lacrimal and maxilla bones laterally.

In short, the skull has a large structure to be dissected carefully as well with a higher risk in the surgical process. A lot of strength is needed to cut off the skull. Thus, the force of the chainsaw causes the skull to crack, which can cause the saw blade to break. Blades also tend to rupture or crush the skull, causing pieces of bone to fly in and around the operating area.

#### 2.2 BONE AEROSOL

Aerosols typically appear in specific climates or as a result of pollution from sources like automobile exhaust, garbage incinerator fumes, industry emissions, and so forth. As a result of the unstable air quality, individuals may have health effects. Although aerosols in the open are detrimental to people. There are measures to prevent them, including wearing a mask, staying inside, and limiting the use of motor vehicles. Blood and bone aerosols, however, are produced in an operating theatre or autopsy room. Blood and bone aerosols together may form harmful microorganisms that can infect anyone in the vicinity.



Concerns over exposure to blood and other human fluids prompted an investigation into the potential production of blood-containing aerosols during orthopaedic surgical procedures. To imitate the aerosols normally produced during routine orthopaedic operations, standard surgical power equipment was used in the lab. Blood trickled over the surgical surface while a bone saw, a Hall drill, a Shea drill, and electrocautery were employed on bone or tendon [4]. A low-pressure cascade impactor was used to measure the particle size distribution, and a midget impinger was used to measure the amount of haemoglobin in inhalable particles. Depending on the type of power tool utilised, the particle size distribution varied, but the majority of the particles were in the respirable range. In every sample, haemoglobin was found.

In cervical spine surgery, high-speed cutters are employed. Such quick machines can create an aerosol cloud. A patient can act as a reservoir for infections that can spread through aerosols, therefore every aerosol used during surgery must be considered a possible source of infection for both the patients and the medical staff present.

#### 2.3 OPERATION OF AUTOPSY SAW COMMONLY USED IN MALAYSIA HOSPITAL

When sawing during autopsies on human remains, fine dust is produced, which consists of particles of sizes that may fall within the human respirable range, and can act as vectors for pathogens. To eliminate the hazard, vacuuming is needed during and after the cutting process. There are several models of autopsy saw that came with vacuum attachments, that need to be operated separately by an assistant during autopsies. Furthermore, the equipment is massive and heavy, as well as expensive. The machine usually has a large suction tank and a long cleaning cycle. As a study case, the autopsy saw currently used at the Hospital Besar Ipoh in Perak needs two staff for cutting and vacuuming at the same time. The equipment is enormous and heavy, and it comes at a hefty price. It also has a big vacuum tank and requires a lengthy cleaning cycle, hence making the machine stink, and infecting it with harmful microorganisms. This results in an unpleaseant smell as part of the machine which is very uncomfortable for the operating staff. As a solution, a small, low-cost autopsy saw that cuts and vacuums at the same time are needed. With an easier and shorter cleaning cycle, the machine will be more hygienic.



# 3. METHODOLOGY

## 3.1 BLOCK DIAGRAM

Figure 3 shows the block diagram our autopsy saw. The input is the power supply that will function to channel power to the entire machine. Then the output is the saw blade and vacuum. Saw blade to cut to the bone. Vacuum to suck the particle of bone simultaneously during the cutting of the bone.

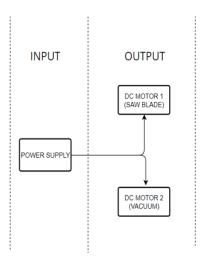


Figure 3: Block Diagram

# **3.2 OPERATION PROCEDURE**

Figure 4 shows the flow chart of the standard operation procedure of this machine, it ch was designed with easy-to-use features without compromising safety for the user. The ON switch will turn on the motor of the saw and the vacuum at the same time.



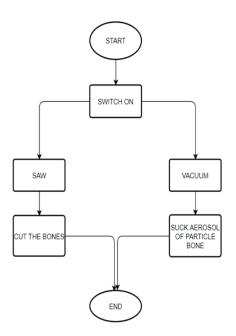


Figure 4: Flow Chart

# 3.3 PROJECT DESIGN

Figure 5, Figure 6 and Figure 7 show the housing design of the machine. The Solid Work was used in the design process. The design takes into account the ergonomics of hand-held power tools while at the same time making sure it will be able to execute the two main functions of cutting and vacuuming. The small tank is part of the strategy to reduce the cleaning cycle; this tank only can hold residue for one autopsy at a time. The machine body that the user needs to hold during the cutting is wrapped with a durable but easy-to-grip material made out of synthetic polymer; the same type used for a tennis racket handle tape.



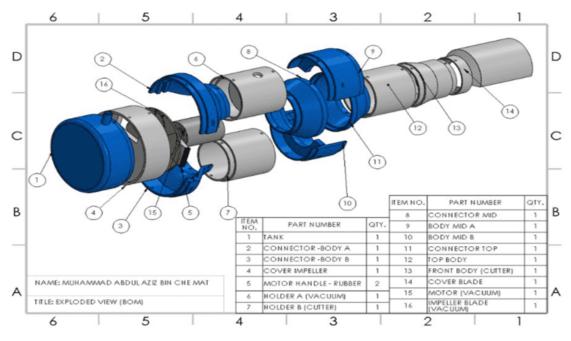


Figure 5: Exploded View

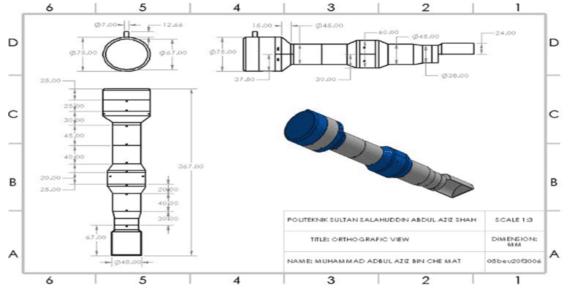


Figure 6: Orthographic View



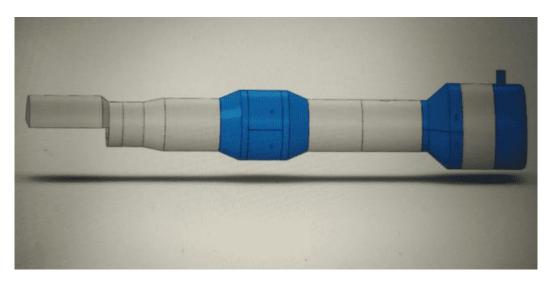


Figure 7: Full Design

## 4. RESULT AND ANALYSIS

## 4.1 DEVELOPMENT OF PROJECT

Figure 8 depicts the whole design of this project. To get this machine going an adaptor is needed. It is possible to alter the voltage strength of the adapter when it is plugged in. It has high- and low-speed adjustments. One metre of adapter wire is split into two equals 0.5 metres. If the adapter is operating, a blue light will be emitted from it to indicate that it is doing so. The project's length is 31 cm, and its various diameters make up that length. The tank and DC motor chamber are located at the bottom, each measuring 7 cm in diameter. Between 3.5 cm and 6 cm in diameter for the mid section of the machine. Then there's the apex, which has a 4 cm and 3.5 cm diameter.



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Figure 8: Result Full Design

## 4.2 RESULT ANALYSIS

An air quality sensor is used to check the air quality during the bone cutting process by detecting particles (PM2.5). A light indicates three levels of air quality – green (good), yellow (okay), and red (not good). Bovine bones were used in the experiment. The table below compares an autopsy without a vacuum versus an autopsy with a vacuum. The table adds to the analysis for this project.



AUTOPSY SAW WITHOUT VACUUM	AUTOPSY SAW WITH VACUUM
Figure 9: Red colour	Figure 10: Orange colour
Figure 9 demonstrates that if you do not apply a vacuum, the release of aerosols throughout the whole room area will result in poor air quality. The colour then shifts from green to orange, then to red. This will jeopardise the user since bone aerosols, nasty germs, and a terrible odour from the bones will be present.	This change from red to orange is shown in figure 10. This is because the vacuum is working to keep the aerosol from getting into the room air. It will lower the chance that aerosols will hurt people who use them or are near them.

## 5. CONCLUSION

In conclusion, the portability of an autopsy machine, from big to little, is essential in the modern-day to ease moving it without the assistance of others. Since it is light in weight and simple to transport and store in a compact space, it is not exposed to harmful microorganisms and may avoid damage from falls and other accidents. The smaller tank reduced the cleaning cycle which is the problem in old-style autopsy saw. Most important, the bone-cutter needs to have a vacuum that turns on and off automatically along with the blade motor so that bone aerosols are immediately reduced in the air around the room. All these features are present in the prototype of the autopsy saw that we design. This is a good base for the actual design that will need to take into account the actual power tools force needed.



#### References

- Moreira-Gonzalez A, Calvarial thickness and its relation to cranial bone harvest. Plast Reconstr Surg. 2006
- Albert AM, Ricanek K, Patterson E. A review of the literature on the aging adult skull and face: implications for forensic science research and applications. Forensic Sci Int. 2007 Alonso, S. (2013). SSRN Electronic Journal
- Wenner,(2017). Aerosol Generation During Bone-Sawing Procedures in Veterinary Autopsies. https://doi.org/10.1177/0300985816688744
- American Society of Heating 2017. Method of testing general ventilation air-cleaning devices for removal efficiency by particle size. , Refrigerating, and Air-Conditioning Engineers (ASHRAE).



# REAL-TIME LOCALIZATION OF HEALTH CENTER ASSETS BY USING WI-FI-BASED TRACKING APPLICATION

Ahmad Rafiqie Mohd Sazali, Dr Siti Anizah Muhamed

Faculty of Electrical Department, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor. *ahmadrafiqie16@gmail.com* 

## ABSTRACT

Hospitals and healthcare facilities all over the world are facing disastrous challenges related to the COVID-19 pandemic. Hence, managing infrastructure, equipment, and technology resources are now more challenging than before the pandemic era. The appropriate placement and supply of commodities in hospitals not only improves the quality of patient treatment but also influences the outcomes of treatment in emergencies. Asset flows have historically been a challenge in the health care industry. Misplaced and missing medical equipment is inherent in traditional methods of resource management in healthcare centers. During these challenging times, there is a need for hospitals to turn into high-technology asset tracking systems. This system is utilizing an IoT environment to apply a Real-Time Location System (RTLS) solution for tracking mobile medical equipment in healthcare centers. We use an ESP32 as a processor and Wi-Fi stations to connect with the network. Received Signal Strength Indicator (RSSI) is used to locate the misplaced medical equipment. The system can function with 100% accuracy even operating on poor Wi-Fi signals of around -8 dBm. Regardless of the distance of the equipment location to the tracker, response time maintained below 5 seconds in excellent Wi-Fi signal strength.

**Keywords:** Real-time localization system, Assest tracking system, Received Signal Strength Indicator.



#### **1. INTRODUCTION**

The appropriate placement and supply of commodities in hospitals not only improves the quality of patient treatment but also influences the outcomes of treatment in emergency situations(*How Bluetooth Low Energy Benefits a RTLS | Blog | Link Labs*, n.d.). The development of information communication and technology (ICT) has made the automatization of human-assisted task in a wide range of applications such as asset tracking for management. In digitalized world, precise indoor location tracking using Wi-Fi and indoor localization using Wi-Fi are becoming increasingly common. The wireless indoor positioning system works by determining coordinates with Wi-Fi access points capable of transmitting specific data. Using the multilateration approach and the RSSI (received signal strength indicator) and MAC-address, the system can pinpoint the exact location of the user's device(*WiFi Trilateration With Three or More Points*, n.d.).

## 2. LITERATURE REVIEW

#### 2.1 Wi-Fi TECHNOLOGY

Tags are Wi-Fi transmitters that send basic packets to a number of Wi-Fi access points throughout a facility in a Wi-Fi positioning system. These access points send the time and strength of the reading to a backend, which then utilizes algorithms to calculate the location of the reader. After then, the location information is sent to the cloud(*Wi-Fi Location System* | *Wi-Fi Positioning System* (*WPS*), n.d.).

Because they use time difference of arrival (TDOA) measurements with a large bandwidth, Wi-Fi indoor positioning systems have a relatively high level of accuracy from three to five meters. However, in order to reach this level of accuracy, each tag broadcast must be "heard" by at least three different access points. If do not yet have the Wi-Fi access points necessary to support it, this might be a very expensive solution for your organization. Wi-Fi tags are also very pricey, and they are typically less energy-efficient than their counterparts in comparison(*Wi-Fi Location System | Wi-Fi Positioning System (WPS)*, n.d.).





Figure 1: Wi-Fi location tracker(*Wi-Fi Location System | Wi-Fi Positioning System (WPS)*, n.d.)

# 2.2 Wi-Fi RECEIVED SIGNAL STRENGTH INDICATION (RSSI)

RSSI, or "Received Signal Strength Indicator," is a measurement of how well a signal from an access point or router can be heard by your device. It's a useful value for determining whether you have enough signal to establish a good wireless connection. Because an RSSI value is obtained from a client device's Wi-Fi card (hence "received" signal strength), it is not the same as transmitting power from a router or access point(*What Is WiFi Strength and RSSI? – SimpliSafe*, n.d.).



Signal Strength	TL;DR		Required for
-30 dBm	Amazing	Max achievable signal strength. The client can only be a few feet from the AP to achieve this. Not typical or desirable in the real world.	N/A
-67 dBm	Very Good	Minimum signal strength for applications that require very reliable, timely delivery of data packets.	VoIP/VoWi-Fi, streaming video
-70 dBm	Okay	Minimum signal strength for reliable packet delivery.	Email, web
-80 dBm	Not Good	Minimum signal strength for basic connectivity. Packet delivery may be unreliable.	N/A
-90 dBm	Unusable	Approaching or drowning in the noise floor. Any functionality is highly unlikely.	N/A

Table 1: Acceptable Signal Strength(Understanding RSSI Levels | MetaGeek, n.d.)

Wi-Fi Strength (RSSI) is measured in dBm, an indication of how strong the Wi-Fi's radio waves are when received. This measure goes from -100 to 0, with -100 being the worst. Some causes of weak signal strength are(*Understanding RSSI Levels* | *MetaGeek*, n.d.):

- Obstructions between the router and the device (trying to talk through doors and walls)
- Interference from other electronic devices which generate electronic signals (trying to talk in a room where others are also talking)
- Distance between the router and the device (trying to talk while far away)
- Multiple devices streaming to your router (trying to listen to multiple people at once)
- An outdated router (not understanding the latest lingo)

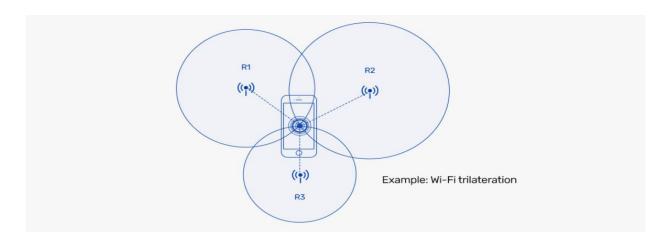


#### 2.3 Wi-Fi TRILATERAL

Indoor positioning system that uses trilateration to estimate the position of a mobile device using Received Signal Strength (RSS) data from Wi-Fi access points. It divided into two major stages, the first of which is distance estimation. In this stage, the distance between APs and mobile devices is calculated using RSS values from four access points and a signal propagation model. The position of the mobile phone is calculated in the second stage using four distances and the trilateration algorithm(*WiFi Trilateration With Three or More Points*, n.d.).

The main concept behind Trilateration is calculating the distance between the user and the Access-Point. Distance can be measured in a variety of ways, including TOA, TDOA, and RSS. In this section, RSS Ranging is used instead of TOA or TDOA because it does not require synchronization between transmitters or between transmitters and receivers, instead measuring the distance between the user and the Access-Point by attenuating the signal strength. Using propagation models, a database containing the path loss exponent, shadowing parameter, and solving all the equations using linear and iterative approaches with varying the number of APs beginning with three APs at least to achieve the best performance with a suitable accuracy in the sense of HDOP (Horizontal Dilution of precision)(*WiFi Trilateration With Three or More Points*, n.d.).

The RSS in these points decreases exponentially as the user's distance from the Access Point increases. As a result, this dependency can be thought of as a function of distance. The line of constant distance is a circle centered on the AP. As shown in Figure





2, the intersection of three Access-Point radiuses yields a point or area of the receiver(*WiFi Trilateration With Three or More Points*, n.d.).

Figure 2: Wi-fi trilateral concept(*WiFi Trilateration With Three or More Points*, n.d.)

## 3. METHODOLOGY

### 3.1 BLOCK DIAGRAM

Based on figure 3, from Wi-Fi station, it will connect to the Wi-Fi access point and by using the received signal strength (RSS) to locate the medical equipment. User will search the identification of the equipment by using IP address of the Wi-Fi station from the application. The RSS then will locate the location, send the information to the application to inform the user about the location.

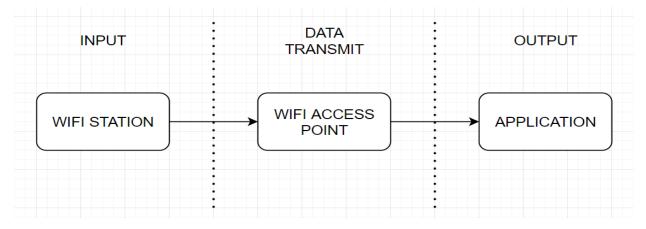


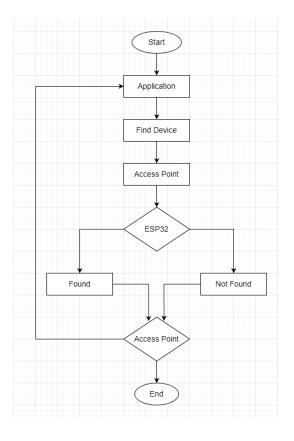
Figure 3: Functional block diagram

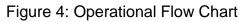
## 3.2 OPERATIONAL FLOW CHART

Based on figure 6, this flowchart shows the operational of the project from hardware to app. Wi-Fi beacons power by battery and it will always scanning the signal



from Wi-Fi access point. Wi-fi station will receive the signal and calculate the signal strength to pinpoint the location. The information will send to the server and received by the user.





## 3.3 APPLICATION FLOW DIAGRAM

This flowchart shows the operational of the application. First it will show the home page and press the "FINDER" button to proceed to the next page. Then, after the button had been pressed, second page will be appeared and, in the page, it shows "Select Device". Select the device that want to find by pressing the button. Third page appear after the button in second page had been pressed. It will ask to write down the ID of the device in the text and then press "Find" button to find the device. After the device that had been located, the result will show in the final page.



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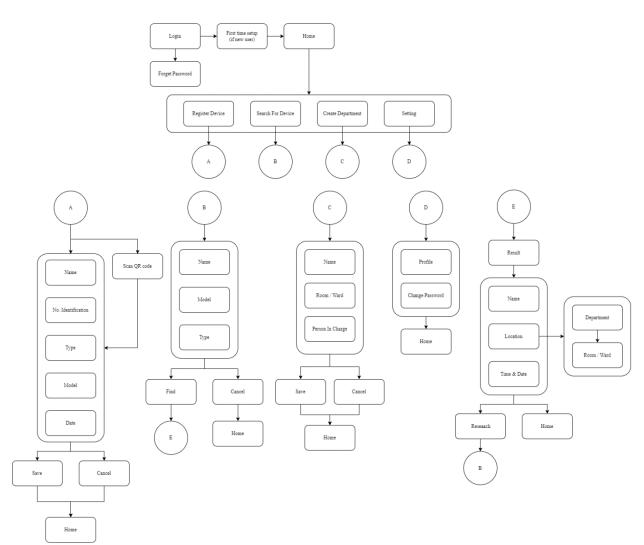


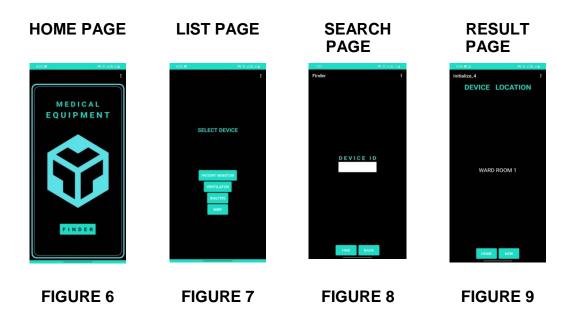
Figure 5: Application Flow Diagram

# **3.4 PROJECT DESIGN**

Figure 6 until figure 9, these is the design application that had been developed from first page of the app until the result page of the app.



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## 4. RESULT AND ANALYSIS

## 4.1 DEVELOPMENT OF PROJECT

The figures below show the actual shape of the real-time localization of health center by using Wi-Fi based tracking applications. The prototype consists of ESP32 and rechargeable battery for the hardware and Medical Equipment Finder applications.

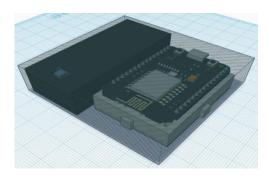


Figure 10



Figure 11



### 4.2 RESULT ANALYSIS

These are analytical data that have been recorded based on experiments that have been conducted several times. There are two data analysis that have been recorded. The first is Wi-Fi signal strength data based on varying distances until the signal is disconnected. The second is the data where the speed of time taken to detect equipment based on different places and signal strength is best to detect equipment

Distances	Wi-Fi Signal Strength				
Distances	Trial 1	Trial 2	Trial 3	Average	
1m	-53	-62	-63	-59	
5m	-86	-78	-88	-84	
10m	-91	-89	-83	-88	
15m	-87	-68	-61	-72	
20m	-80	-79	-75	-78	
25m	-90	-93	-87	-90	
30m	-88	-88	-88	-88	
35m	-96	-95	-94	-98	
40m	Disconnect	Disconnect	Disconnect	Disconnect	

Table 2: Wi-Fi signal strength based on distance

Places	Distance	Signal	Time Taken	Accuracy
		Strength		
Master	3.5m	-53 dBm	0.76s	88%
Bedroom				
Bathroom	4.3m	-67 dBm	1.27s	49%
Kitchen	4.0m	-56 dBm	0.63s	78%
Bedroom	3.7m	-55 dBm	1.54s	81%

Table 4: Time taken for application to locate equipment with accuracy based on distance and Wi-Fi signal strength

## 5. CONCLUSION

In clonclusion, the problems that frequently occur among hospitalized technicians, as well as medical equipment that is frequently lost or dislocated, can be easily and quickly located with this project, Real-Time Localization Of Health Center by Using Wi-Fi



Based Tracking Application. The application can determine the location of equipment more accurately and efficiently by using the existing Wi-Fi signal strength and trilateral method of Wi-Fi access point in real-time localization of health center. With the efficiency of this project, technicians can reduce search time and work efficiency can be improved on occasion. With today's rapidly developing Wi-Fi technology, this project can be completed successfully while also preserving green technology.

#### References

- How Bluetooth Low Energy Benefits a RTLS | Blog | Link Labs. (n.d.). Retrieved January 18, 2022, from https://www.link-labs.com/blog/how-bluetooth-low-energy-benefits-rtls
- Understanding RSSI Levels | MetaGeek. (n.d.). Retrieved June 11, 2022, from https://www.metageek.com/training/resources/understanding-rssi/
- What is WiFi Strength and RSSI? SimpliSafe. (n.d.). Retrieved June 11, 2022, from https://support.simplisafe.com/hc/en-us/articles/360035742191-What-is-WiFi-Strength-and-RSSI-
- *Wi-Fi location system | Wi-Fi Positioning System (WPS).* (n.d.). Retrieved June 11, 2022, from https://navigine.com/blog/wifi-for-indoor-positioning-and-navigation/
- *WiFi Trilateration With Three or More Points.* (n.d.). Retrieved June 26, 2022, from https://www.appelsiini.net/2017/trilateration-with-n-points/



# KAJIAN KEPUASAN PEKERJA TERHADAP PENGURUSAN RUANG KERJA DI BANGUNAN PEJABAT

Madaline MawasTinggom<sup>1</sup> and Nur Hafidzah Muhamadan<sup>2</sup>

<sup>5</sup> Civil Engineering, Politeknik Sultan, Salahuddin Abdul Aziz Shah Shah Alam, Selangor madalinemawas@gmail.com nurhafidzah@psa.edu.my

### Abstrak

Kepuasan pekerja adalah salah satu pendekatan untuk melahirkan pekerja yang produktif dan berkualiti. Akan tetapi, terdapat organisasi mengabaikan kepentingan pengurusan ruang tempat kerja kerana beranggapan bahawa ianya tidak memberikan keuntungan kepada organisasi. Objektif kajian ini adalah menganalisis tahap kepuasan pekerja terhadap pengurusan ruang kerja di banguan pejabat. Kajian ini dijalankan menggunakan kaedah kuantitatif dengan menggunakan-borang soal selidik bagi mengumpul data. Dapatan kajian ini menunjukkan kebanyakkan pekerja bersetuju dengan penyediaan ruang kerja berada pada tahap yang kondusif. Adalah diharapkan kajian ini memberi garis panduan kepada pengurus dalam memastikan pengurusan ruang kerja yang efisien kepada pekerja bagi meningkatkan prestasi pada masa hadapan.

Kata Kunci: Pengurusan ruang, Kepuasan pekerja, Produktif, Kondusif

#### 1. Pengenalan

Pengurusan ruang meliputi aspek persekitaran ruang seperti fizikal ruang, kebersihan, kualiti ruang, dan sebagainya untuk menjamin keselamatan dan kesihatan pengguna ruang tersebut.



Tujuan ruang di bangunan adalah untuk menyokong setiap aktiviti dan tugas organisasi. Pengurusan ruang merupakan tugas pengurus dalam menyediakan ruang bekerja, menjaga keselamatan, membenarkan peredaran dan menerima pelawat dan pelanggan atau menyebarkan sesuatu maklumat. Ruang kerja yang kondusif serta akan serta memenuhi keperluan penggunaan semasa mampu menyumbang kepada peningkatan pembangunan produktiviti pekerja dalam organisasi. Oleh itu, pengurusan ruang kerja yang berkesan penting untuk dilaksanakan oleh sesebuah organisasi.

Pengurusan ruang yang lemah menjadi punca kepada kemorosotan prestasi pekerja (Vip Paramarta, 2005). Selain itu, fizikal ruang yang tidak memuaskan pekerja telah menjejaskan kesihatan pekerja serta penurunan tahap kepuasan pekerja (Nurul Izzah binti Matnor, 2020). Pengurusan ruang tidak efisien punca penurunan produktiviti pekerja di mana perlaksanaan sesuatu kerja kurang berkesan (Shukor, 2015).

Kesimpulannya, tujuan kajian ini dijalankan adalah untuk meningkatkan tahap efisien pengurusan ruang kerja agar produktiviti dan kualiti pekerja dapat ditingkatkan. Tujuan kajian dapat dicapai dengan objektif kajian iaitu i) mengenal pasti faktor yang mempengaruhi pengurusan ruang kerja di bangunan pejabat, ii) menganalisis tahap kepuasan pekerja terhadap pengurusan ruang kerja di bagunan pejabat dan iii) mencadangkan penambahbaikan pengurusan ruang kerja di bangunan pejabat.

## 2. Kajian Literatur

Ruang merupakan sumber fizikal utama serta melibatkan perbelanjaan kos. Oleh itu, pengurusan ruang yang efisien penting bagi membantu sesebuah organisasi dalam pengurusan perbelanjaan kos yang optimum serta efektif. Sekiranya pengurusan ruang tidak efisien akan menyumbang bebanan organisasi itu sendiri, seterusnya memberi impak negatif kepada organisasi tersebut.

## 1 Faktor-Faktor Yang Mempengaruhi Penyediaan Ruang Kerja

Penyediaan ruang kerja sangat penting kepada pekerja kerana, ruang mampu menjadi penyumbang kepada produktiviti dan kualiti pekerja dalam menghasilkan keluaran sesuatu tugas yang berkualiti. Oleh itu, organisasi perlu memastikan produktiviti pekerja ditingkatkan dengan mengambilkira faktor-faktor pengurusan ruang yang mampu mempengaruhi kepuasan pekerja agar produktiviti mereka dapat ditingkatkan. Menurut



kajian lepas, kepuasan melaksanakan kerja adalah bila mana seseorang pekerja mempunyai perasaan gembira dan selesa terhadap persekitaran pekerjaan mereka (Vip Paramarta, 2005).

Kepuasan pekerja terhadap pengurusan ruang perlulah dinilai oleh sesebuah organisasi berdasarkan beberapa faktor-faktor yang patut dipertimbangkan dalam pengurusan ruang iaitu faktor persekitaran ruang kerja, keluasan ruang kerja dan struktur susun atur ruang di tempat kerja. Ketiga-tiga faktor ini haruslah memenuhi jangkaan dan keperluan individu dalam mencapai kepuasan terhadap pengurusan ruang tempat kerja.

## 2.1.1 Persekitaran Ruang Kerja

#### 2.1.2

Persekitaran tempat kerja boleh didefinisikan sebagai keadaan di sekeliling kawasan tempat kerja. Manakala, persekitaran ruang kerja merupakan kawasan meliputi ruang sekeliling yang mempunyai fizikal ruang dalaman yang terdiri daripada suhu persekitaran, pencahayaan matahari dan lampu, kualiti udara dalaman, bunyi, bau, dan sebagainya. Kepuasan persekitaran ruang kerja merupakan faktor yang mampu mempengaruhi produktiviti tenaga kerja dalam sesebuah organisasi. Kajian lepas menerangkan, faktor persekitaran ruang kerja yang kondusif serta memenuhi keperluan dan kehendak pekerja adalah penting untuk diambilkira oleh pihak pengurusan (Vip Paramarta, 2005). Hal ini kerana, pihak pengurusan perlu mengambil tindakan untuk memastikan pekerja berpuas hati akan persekitaran ruang kerjanya. Tambahan pula, pekerja yang mempunyai tahap kepuasan kerja yang tinggi secara tidak langsung akan mendorong kepada kecemerlangan dirinya sendiri, organisasi dan juga negara (Samsudin, 2018). Keselesaan ialah suatu penilaian subjektif yang berbeza-beza mengikut persepsi seseorang dimana persepsi keselesaan akan wujud apabilanya keseimbangan berlaku antara faktor psikologi, biologi, fizikal dan fisiologi seperti suhu, pendengaran, pencahayaan dan kualiti udara berada pada tahap yang selesa (Samsudin, 2018). Oleh itu, persekitaran ruang bukan sahaja mampu memberikan kepuasan malah secara langsung akan membenarkan tingkah laku yang cergas serta proaktif pada diri pekerja.

## 2.1.2 Keluasan Ruang Tempat Kerja

Definisi keluasan atau luas ialah kuantiti fizikal yang menyatakan saiz untuk sebahagian permukaan, manakala luas permukaan ialah penjumlahan keluasan sisi-sisi objek yang terdedah (Vip Paramarta, 2005). Keluasan ruang yang memenuhi piawaian yang ditetapkan dapat mengurangkan tahap risiko semasa bekerja. Hal ini kerana, keluasan ruang telah menepatifungsi dan kegunaan telah ditentukan oleh pihak atasan dalam



piawaian pengurusan ruang. Keluasan ruang mampu menghasilkan pekerja yang produktif dan berkualiti, sesuai dengan perubahan zaman, kemajuan teknologi dan taraf pendidikan di kalangan pekerja pada masa kini. Perlaksanaan tugas semasa bekerja memerlukan kapasiti ruang yang bersesuaian. Untuk mengekalkan keselesaan pekerja sepanjang masa. Keadaan susun atur yang terancang dalam ruang pejabat hendaklah telah mengambil kira laluan pergerakkan pekerja adalah cukup mengikut Garis Panduan yang telah ditetapkan agar memeudahkan pergerakkan semasa kecemasan berlaku. Oleh itu, pekerja sentiasa merasa selamat ketika bekerja. Konsep pejabat pelan terbuka mengoptimumkan penggunaan ruang kerana a dapat mengurangkan pembinaan dinding-dinding kekal. Ruang yang tidak digunakan tersebut boleh dijadikan sebagai ruang untuk rehat/stor/sebgainya yang mamapu memberi manfaat kepada pekerja organisasi. Pernyataan ini bermaksud, kapasiti sesuatu keluasan ruang hendaklah mengikut pengiraan yang sebetulnya kerana ia mampu mempengrauhi individu. Penyataan ini disokong oleh (Abdul Aziz, 2020), perlaksanaan tugas semasa bekerja memerlukan kapasiti ruang yang bersesuaian untuk mengekalkan keselesaan pekerja sepanjang masa (Arzizul Bin Antin, 2020). Keluasan ruang yang memenuhi piawaian yang ditetapkan dapat mengurangkan tahap risiko semasa bekerja (Aziz, 2017). Keluasan yang mengikut piawai, mampu mengurangkan risiko kemalangan di tempat kerja. Hal ini kerana, keluasan ruang mengikut fungsi dan kegunaan telah ditentukan oleh pihak

atasan dalam piawaian pengurusan ruang (Hairulliza Mohhamad Judi, 2010). Keluasan ruang mampu menghasilkan pekerja yang produktif dan berkualiti, sesuai dengan perubahan zaman, kemajuan teknologi dan taraf pendidikan di kalangan pekerja pada masa kini.

## 2.1.3 Faktor Susun Atur Ruang Tempat Kerja

Susun atur bermaksud penempatan dan penentuan lokasi peralatan serta bahan sesuai dengan keluasan ruang (Nizam, 2012). Selain itu, susun atur ruang melibatkan pengaturan ruang yang cekap dan terbaik akan meningkatkan kepantasan pelaksanaan tugas, penggunaan ruang kerja dengan berkesan dan penggunaan ruang tanpa melakukan pembaziran (Danial, 2018). Menurut Teori Definisi yang lebih luas diberi oleh (Terry, 1953) Beliau mendefinisikan pengurusan sebagai satu proses sistematik yang merangkumi perancangan,pengorganisasian, kawalan dan pendorongan. Menurut kajian lepas, susun atur ruang yang berkesan mampu melicinkan lagi aliran kerja di dalam pejabat, memperbaiki pengawasan kerja dan kakitangan serta menjimatkan ruang pejabat dan kos pembinaan (Klang, 2020). Menurut konsep EKSA, susun atur ruang membantu organisasi untuk memantapkan lagi produktiviti serta penyampaian maklumat pengurusan. Selain itu, kajian lepas menyatakan bahawa susun atur ruang yang



bersistematik akan menggalakkan interaksi, mengurangkan jurang antara pekerja secara berkesan (Arzizul Bin Antin, 2020). Motivasi untuk meningkatkan produktiviti pekerja adalah memerlukan susun atur yang membenarkan aktiviti bersosial agar setiap pekerja berinteraksi, di mana pekerja akan dikumpul dalam unit kerja tertentu untuk berinteraksi bagi mewujudkan kerjasama untuk mencapai matlamat organisasi (Nizam, 2012). Seperti yang dinyatakan dalam kajian lepas, tahap kesejahteraan mental mempengaruhi cara seseorang itu membuat keputusan dan pilihan dalam hidup, menyelesaikan masalah serta berinteraksi dengan orang lain dan apabila seseorang mempunyai tahap kesihatan mental yang memuaskan, tekanan hidup seharian yang dilalui akan ditangani dengan berfikir secara positif, tenang dan tidak membahayakan diri (Abdul Aziz, 2020). Dapat disimpulkan bahawa, pengaruh kegagalan dalam pengurusan ruang bagi faktor susun atur mampu memberikan kesan teruk sehingga meragut nyawa sekiranya pihak bertanggungjawab tidak memberi penekan secara mendalam pekara ini. Pereka bentuk dan pengurus fasiliti membuktikan bahawa persekitaran fizikal mempengaruhi hasil organisasi seperti pekerjaan kepuasan, hasil kerja, ketidakhadiran, pusing ganti, dan, akhirnya, produktiviti organisasi (Veitch, 2007). Oleh itu, sebagai pengurus hendaklah lebih peka akan kepentingan ruang kerja yang sihat kepada kaki tangan organisasi.

### 3. Metodologi

## 3.1 Kawasan Kajian

Kajian ini dijalankan di Pejabat Penyelenggaraan Bangunan Kerajaan (Pejabat FM), Putrajaya iaitu bertempat di Bangunan Kementerian Perumahan dan Kerajaan Tempatan (KPKT), Menara Usahawan dan Kementerian Pengajian Tinggi(KPT). Ketiga-tiga bangunan ini terdiri dari pelbagai Jawatan tertinggi iaitu Pengurus Fasiliti (FM), Pegawai Kualiti(QO), Pegawai Tenaga, Pegawai Keselamatan, Jurutera awam, Jurutera Mekanikal dan Jurutera Elektik dan Pekerja Teknikal. Bilangan responden bagi ketiga lokasi kajian adalah 77 responden. Ketiga lokasi ini merupakan Kontraktor Penyelenggaraan Fasiliti di Bangunan Kerajaan, Putrajaya.

## 3.2 Soal selidik dan Persampelan

Instrumen utama yang digunakan dalam kajian ialah borang soal selidik menggunakan persampelan jenis rawak mudah. Rawak jenis ini memberikan peluang yang sama kepada kepada setiap individu untuk mewakili populasi. Satu set soalan telah direka



dengan menggunakan skala likert 1 hingga 5 mewakili (Sangat Setuju, Setuju, Tidak Pasti, Tidak Setuju, Sangat Tidak Setuju).

### 3.1 Kaedah Analisis Data

Data kajian yang diperoleh telah dianalisis menggunakan perisisan SPSS versi 6.0. Analisis dilakukan bagi mendapatkan nilai peratus dan nilai skor min bagi kajian ini.

## 4. Dapatan dan Perbincangan

4.1 Dapatan Tahap Kepuasan Terhadap Persekitaran Ruang Tempat Kerja

4.2

Jadual dibawah menunjukkan data responden berdasarkan pengalaman serta keadaan sebenar ketika berada di ruang tempat kerja. Skala pilihan tersebut akan menjadi pengukur kepada pengkaji untuk menilai tahap kepuasan responden terhadap persekitaran ruang di tempat kerja. **Jadual 4.1** berikut diperolehi dan dianalisis menggunakan sistem perisian SPSS versi 6.0.

Pekara/Lokasi	KPKT (MEAN)	KPT (MEAN)	MU (MEAN)
Tahap pencahayaan	4.76	4.62	4.68
Peredaran udara	4.72	4.76	4.90
Suhu ruang kerja	4.75	4.79	4.73
Kemudahan ruang sokongan	4.75	4.62	4.68
Kerja penyelenggaraan berkala dan berjadual	4.72	4.65	4.78
Keadaan bersih dan terjaga	4.87	4.7	4.78
Keselamatan ruang kerja	4.6	4.6	4.94

Jadual 1 : Tahap Kepuasan Pekerja Terhadap Persekitaran Ruang Kerja

Sumber: Sistem Perisian SPSS Versi 6.0

Daripada jadual Jadual 4.1 di atas, Tahap kepuasan keselamatan di ruang tempat kerja menunjukkan tahap skor min tertinggi iaitu 4.94 di Menara Usahawan. Ini menunjukan pekerja sangat berpuas hati terhadap tahap keselamatan ruang kerja. Seterusnya adalah min skor untuk tahap kepuasan peredaran udara di ruang tempat kerja menunjukkan



tahap skor min tertinggi iaitu 4.90 di Menara Usahawan. Bagi tahap kepuasan suhu di ruang tempat kerja pula menunjukkan skor min tertinggi iaitu 4.79 di KPT. Selain itu, tahap kepuasan pencahayaan di ruang tempat kerja menunjukkan tahap skor min tertinggi iaitu 4.76 di lokasi KPKT. Ini menunjukan pekerja sangat berpuas hati terhadap tahap pengcahayaan di ruang kerja diikuti oleh skor min penyediaan ruang sokong iaitu 4.75 juga di lokasi KPKT. Dapat disimpulkan bahawa, item paling mencapai min skor tertinggi adalah 4.94 iaitu responden kajian sangat berpuas hati akan keselamatan ruang di tempat kerja.

# 4.2 Dapatan Tahap Kepuasan Terhadap Keluasan Ruang Tempat Kerja

Jadual dibawah menunjukkan data responden berdasarkan pengalaman serta keadaan sebenar ketika berada di ruang tempat kerja. Skala pilihan tersebut akan menjadi pengukur kepada pengkaji untuk menilai tahap kepuasan responden terhadap keluasan ruang di tempat kerja. **Jadual 4.2** berikut diperolehi dan dianalisis menggunakan sistem perisian SPSS versi 6.0.

Pekara/Lokasi	KPKT (MEAN)	KPT (MEAN)	MU (MEAN)
Laluan kecemasan yang mudah dilalui	4.31	4.6	4.68
Keluasan ruang kerja bersesuaian	4.52	4.4	4.78
Kapasiti ruang kerja bersesuaian	4.7	4.48	4.52

Jadual 2: Tahap Kepuasan Pekerja Terhadap Keluasan Ruang Kerja

## Sumber: Sistem Perisian SPSS Versi 6.0

Daripada jadual Jadual 4.2 di atas, Tahap kepuasan terhadap keselesaan keluasan ruang kepada responden mencapai tahap skor min tertinggi iaitu 4.78 di Menara Usahawan. ini bermaksud responden berpuashati karena keluasan ruang memberi keselesaan kepada mereka.

Kepuasan terhadap kapasiti keluasan ruang mencapai skor min 4.70 di KPKT manakala min skor keluasan laluan kecemasan pulak mencapai 4.68 di bangunan Menara Usahawan. Ini menunjukkan responden lebih berpuas hati dengan kesesuaian keluasan ruang kerja bagi aktiviti kerja berbanding keluasan laluan kecemasan ruang di tempat kerja. Dapat disimpulkan bahawa, item paling mencapai min skor tertinggi adalah 4.78 di



Menara Usahawan iaitu responden sangat berpuashati terhadap keluasan ruang yang bersesuaian dengan aktiviti syarikat.

# 4.3 Dapatan Tahap Kepuasan Terhadap Susun Atur Ruang Tempat Kerja

Jadual dibawah menunjukkan data responden berdasarkan pengalaman serta keadaan sebenar ketika berada di ruang tempat kerja. Skala pilihan tersebut akan menjadi pengukur kepada pengkaji untuk menilai tahap kepuasan responden terhadap susun atur ruang di tempat kerja. Jadual 4.3 berikut diperolehi dan dianalisis menggunakan sistem perisian SPSS versi 6.0.

Pekara/Lokasi	KPKT (MEAN)	KPT (MEAN)	MU (MEAN)
Susun atur bersistematik	3.6	4.27	4.31
Pergerakkan tidak terhalang	4.48	4.55	4.33
Memberi keselesaan	4.24	4.58	4.21

Jadual 3: Tahap Kepuasan Pekerja Terhadap Susun Atur Ruang Kerja

# Sumber: Sistem Perisian SPSS 6.0

Daripada jadual Jadual 4.3 di atas, Tahap kepuasan terhadap struktur susun atur bersistematik ruang tempat kerja menunjukkan tahap skor min tertinggi iaitu 4.31 di Menara Usahawan. Ini menunjukan pekerja sangat berpuas hati terhadap tahap struktur susun atur bersistematik di ruang kerja. Manakala tahap kepuasan susun atur yang memberi kebebasan untuk melakukan pergerakkan di ruang tempat kerja menunjukkan tahap skor min tertinggi iaitu 4.55 di KPT. Ini menunjukan pekerja sangat berpuas hati terhadap tahap susun atur ruang yang bebas untuk melakukan pergerakkan di ruang kerja dan tahap kepuasan kesesuaian susun atur dengan keselesaan di ruang tempat kerja menunjukkan tahap skor min tertinggi iaitu 4.58 di KPT. Ini menunjukan pekerja sangat berpuas hati terhadap tahap kesesuaian susun atur. Dapat disimpulkan bahawa, item paling min skor tertinggi adalah 4.48 di KPKT iaitu susun atur yang membenarkan pergerakkan di ruang kerja.

## 5. Kesimpulan

Kesimpulannya, tahap kepuasan pekerja terhadap pengurusan ruang kerja adalah memenuhi keperluan pekerja secara amnya. Skor min untuk keseluruhan soalan



Pengurusan Ruang yang signifikan mempengaruhi Kepuasan Pekerja adalah aspek keselesaan namun begitu masih ianya masih pada tahap yang memuaskan. Seperti yang di nyatakan dalam kajian literatur, *Keselesaan ialah suatu penilaian subjektif yang berbeza-beza mengikut persepsi seseorang dimana persepsi keselesaan akan wujud apabilanya keseimbangan berlaku antara faktor psikologi,biologi, fizikal dan fisiologi seperti suhu, pendengaran, pencahayaan dan kualiti udara berada pada tahap yang selesa (Samsudin, 2018).* ini bermaksud pekara yang melibatkan keselesaan seseroang individu agak sukar di ukur atau dinilai kerana setiap individu mempunyai persepsi kepuasan yang berbeza akan tetapi sebagai pengurus hendaklah terus berusaha untuk merancang strategi yang lain agar isu-isu yang melibatkan kepuasan pekerja tidak berlaku lagi. Menurut *teori Dole dan Schroeder (2001), pekerja yang berpuas hati dengan persekitaran lebih cenderung untuk menghasilkan hasil kerja yang lebih baik.* 

### References

Abdul Aziz, A. R. (2020). Wabak Covid-19: Pengurusan Aspek Kesihatan Mental Semasa Norma Baharu.

Arzizul Bin Antin, D. N. (2020). Pengaruh Motivasi Kerja Intrinsik Dan Ekstrinsik Terhadap Keefisienan Kerja. Malaysian Journal Of Social Sciences And Humanities (Mjssh).

Aziz, Z. B. (2017). Kualiti Persekitaran Dalam Reka Bentur. Retrieved From Sekolah Pulau Pinang: Http://Eprints.Usm.My/45507/1/Zalena%20abdul%20aziz.Pdf

Baharin, S. R. (2021). Ruang Kerja Dan Penggunaan Teknologi Nerubahpekerjaan Masa Kini. Case Study.

Che Ahmad, C. N. (2016). Persekitaran Pembelajaran Fizikal Dan Psikososial Makmal Sains Dan Hubungannya Dengan Tahap Kepuasan Pelajar. Retrieved From Research Gap:

Https://Www.Researchgate.Net/Publication/311807718\_Persekitaran\_Pembelajaran\_ Fizikal\_Dan\_Psikososial\_Makmal\_Sains\_Dan\_Hubungannya\_Dengan\_Tahap\_Kepua san\_Pelajar/Citation/Download



Danial, J. B. (2018). Strategi Dalam Mengoptimumkan Kos Pengurusan Penghantaran Bahan Ke Tapak Bina Di Kawasan Bandar. Retrieved From Utm: Https://Bic.Utm.My/Files/2018/08/Julius-Danil.Pdf

Hairulliza Mohhamad Judi, N. R. (2010). Cadangan Penambahbaikan Susun Atur Ruang Perniagaan. Layout Improvement Suggestion For Ground Floor Business Spaces At.

Nizam. (2012, Jun). Fungsi Pengurusan Ruang. Retrieved From Slide Share: Https://Www.Slideshare.Net/Smklbting6/Bab-2fungsi-Pengurusan

Rahman, P. M. (2020, Okt 15). Majikan Perlu Peka Isu Kesihatan Mental Pekerja. Retrieved From Berita Harian: Https://Www.Bharian.Com.My/Rencana/Lain-Lain/2020/10/742090/Majikan-Perlu-Peka-Tangani-Isu-Kesihatan-Mental-Pekerja

Samsudin, N. H. (2018). Kepuasan Kerja Dalam Kalangan Pekerja. Human Capital Development, 1.

Shafii, A. A. (2018). Satu Kajian Teoritikal. Retrieved From Keselesaan Termal:: Https://1library.Net/Document/Qo3l9omq-Keselesaan-Termal-Satu-Kajian-Teoritikal.Html

Shukor, Z. A. (2015). Faktor Yang Mempengaruhi Prestasi Kerja Dalam Kalangan Staf Sokongan Kolej Universiti Antarabangsa Selnagor. Proceeding Of The 2nd International Conference On Management And Muamalah 2015 (2ndicomm)16th – 17th November 2015, E-Isbn: 978-967-0850-25-2, (P. 3). Selangor.

Vip Paramarta, T. H. (2005). Kepuasan Kerja: Konsep, Teori, Pendekatan Dan Skala Pengukurannya. Fakultas Bisnis & Manajemen Universitas Widyatama.



# PENGURUSAN RISIKO DARI SEGI KESELAMATAN DAN KESIHATAN PEKERJAAN BAGI INDUSTRI PENGURUSAN FASILITI

Sajidah Rambran<sup>1</sup>, dan Sr Norezan Asmangi<sup>2</sup>

<sup>6</sup> Jabatan Kejuruteraan Awam, Politeknik Sultan, Salahuddin Abdul Aziz Shah Shah Alam, Selangor sajidahrambran0220@gmail.com norezan@psa.edu.my

#### Abstrak

Pengurusan risiko dalam aspek keselamatan dan kesihatan pekerjaan merupakan salah satu perkara penting dalam memastikan prestasi keselamatan dan boleh mendorong kesedaran pekerja untuk mementingkan persekitaran tempat kerja yang selamat. Kajian ini dijalankan adalah untuk mengenalpasti hubungan antara dasar dan prosedur serta peranan pekerja terhadap tahap kesedaran pekerjaan syarikat pengurusan fasiliti. Pendekatan yang digunakan adalah kuantitatif melalui kaedah soal selidik yang dijalankan dalam kalangan pekerja serta orang yang terlibat dan berpengalaman dalam pengurusan keselamatan dan kesihatan bahagian pengurusan fasiliti di bangunan Kementerian Perumahan dan Kajian Tempatan. Analisis diskriptif bagi nilai statistik kebolehpercayaan sebanyak 0.806 yang diuji dengan menggunakan perisian Statistic Package for Social Science (SPSS) Versi 26.0. Kajian ini dapat membantu industri pengurusan fasiliti dalam memastikan kelemahan pengurusan risiko KKP. Selain itu, kajian ini juga dapat dimanfaatkan serta dijadikan panduan untuk meningkatkan tahap pengurusan KKP. Tambahan pula, kajian ini boleh dijadikan bahan rujukan serta membantu penyelidik akan datang untuk mengkaji kekurangan dalam aspek keselamatan dan kesihatan yang belum dikaji. Pengkaji mencadangkan, kajian akan datang perlu menitikberatkan persekitaran dan keadaan semasa bagi pengurusan risiko keselamatan dan kesihatan pekerjaan.

Kata Kunci: Pengurusan risiko, Kesedaran Pekerja, Keselamatan dan Kesihatan



### 1. Pengenalan

Akta keselamatan dan kesihatan pekerjaan 1994 yang telah digubal di dalam undangundang Malaysia pada 25 Februari 1994 merupakan suatu Akta untuk memastikan keselamatan, kesihatan dan kebajikan orang yang sedang bekerja, bagi melindungi orang lain terhadap risiko kepada keselamatan atau kesihatan berkaitan dengan aktiviti orang yang sedang bekerja, untuk menubuhkan Majlis Negara bagi Keselamatan dan Kesihatan Pekerjaan, dan bagi perkara yang berkaitan dengannya (Akta Keselamatan Dan Kesihatan Pekerjaan 1994, 1994). Hal ini telah pun dijelaskan dalam kajian (Ramli, 2017), bahawa kerajaan telah mengambil inisiatif dengan menubuhkan Jabatan Keselamatan dan Kesihatan Pekerjaan (JKKP) dan Akta Keselamatan dan Kesihatan Pekerjaan 1994 adalah untuk memastikan setiap organisasi mematuhi undang-undang dalam menyediakan persekitaran pekerjaan yang selamat untuk para pekerja.

Pengurusan keselamatan dan kesihatan pekerjaan adalah sangat penting dan merupakan elemen yang perlu diberi keutamaan oleh semua yang terlibat, terutamanya mereka yang terlibat dalam aktiviti-aktiviti yang melibatkan kerja-kerja yang berisiko (Tuan Mat, 2020). Penyataan tersebut turut disokong oleh (Mohd Kefri & Selamat, 2021) yang berpendapat bahawa keselamatan di tempat kerja merupakan aspek terpenting dalam sesebuah organisasi bagi mewujudkan suasana persekitaran yang selamat dan bebas dari risiko berlakunya sebarang kemalangan. Manakala (Bakar et al., 2018a) pula menjelaskan bahawa keselamatan dan kesihatan pekerja di tempat kerja merupakan aspek yang penting kepada sesebuah organisasi yang bertujuan untuk melindungi keselamatan, kesihatan dan kebajikan pekerja. Dan bagi mengukuhkan lagi penyataan tersebut (Tengah & Yahya, 2019) di dalam kajian mereka turut menyatakan keselamatan dan kesihatan pekerjaan (KKP) semakin penting bagi meningkatkan budaya kerja selamat di tempat kerja dan meningkatkan kesedaran kepada para pekerja.

Kajian (Mohd Noor, 2020) ada menyatakan bahawa kemalangan yang seringkali dilaporkan berlaku adalah berpunca daripada organisasi yang tidak mempraktikan kesedaran piawaian prosedur keselamatan di tempat kerja dan menyebabkan organisasi tersebut terpaksa menampung kos pembiayaan rawatan terhadap kakitangan yang terlibat dalam kemalangan. Menurut (Amran & Selamat, 2019), kesedaran terhadap isu keselamatan dan kesihatan pekerjaan masih berada pada tahap yang minima.

Oleh itu, pekerja seharusnya mempunyai kesedaran terhadap kepentingan untuk menjaga keselamatan dan kesihatan di tempat kerja. Hal ini kerana, dengan mempunyai kesedaran terhadap aspek ini organisasi atau syarikat dapat

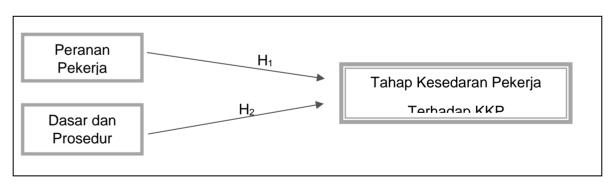


mengurangkan segala risiko yang boleh meningkatkan kebarangkalian berlakunya kemalangan semasa berada di tempat kerja. Lantaran itu, setiap individu yang bekerja haruslah memainkan peranan dalam memupuk kesedaran dalam pengurusan risiko keselamatan dan kesihatan di tempat kerja.

## 2. Kajian Literatur

## 2.1 Kerangka Konseptual Kajian

Dalam kajian ini, pemilihan pembolehubah-pembolehubah dibuat berdasarkan teori dan kajian lepas yang berkaitan dengan tajuk serta objektif kajian. Berdasarkan kerangka kajian dalam Rajah 1, terdapat dua jenis pembolehubah yang digunakan dalam kajian ini iaitu pembolehubah tidak bersandar dan pembolehubah bersandar. Pembolehubah tidak bersandar terdiri daripada (i) amalan pengurusan risiko kkp dan (ii) tahap kesedaran pekerja terhadap aspek kkp. Manakala pembolehubah bersandar adalah memastikan setiap pekerja mempunyai kesedaran kkp dengan mencadangkan penambahbaikan terhadap amalan pengurusan risiko KKP.



## Rajah 1 Kerangka Konseptual

## Tahap Kesedaran Pekerja

Kesedaran pekerja terhadap kepentingan dalam menjaga keselamatan dan kesihatan di tempat kerja dapat membantu mengurangkan kebarangkalian berlakunya kemalangan semasa di tempat kerja (Bakar et al., 2018b). Di samping itu, dalam kajian (Arifin et al., 2021) mereka merumuskan kesedaran keselamatan merupakan satu elemen penting yang perlu dipupuk dalam diri setiap pekerja bagi mencegah berlakunya kemalangan di tempat kerja. (Abidin et al., 2017) berpendapat untuk meningkatkan tahap kesedaran dalam kalangan pekerja dan majikan, Akta



Keselamatan dan Kesihatan Pekerjaan 1994 (Akta 514) telah digubal bagi mewujudkan langkah-langkah keselamatan dan kesihatan di tempat kerja. Justeru itu dalam hal ini, bagi mengurangkan risiko berlakunya kemalangan di tempat kerja semua pihak yang terlibat dalam sektor pekerjaan perlulah memainkan peranan dan mempratikkan amalan keselamatan sewaktu tempoh mereka bekerja.

## 3. Metodologi Kajian

Semua maklumat yang telah dikumpulkan adalah bertujuan untuk memenuhi objektif dan persoalan bagi kajian. Metodologi penyelidikan melibatkan teknik khusus yang digunakan dalam proses penyelidikan adalah untuk mengumpulkan, mengorganisasi dan menilai data. Metodologi adalah merujuk kepada alat-alat yang digunakan untuk mengumpulkan maklumat yang relevan dalam kajian penyelidikan tertentu (Norhisham, 2019).

## 3.1 Reka Bentuk Kajian

Reka bentuk bagi kajian ini adalah kajian yang menggunakan data kuantitatif dalam pengumpulan data yang sesuai untuk memenuhi objektif kajian dan meliputi kajian literatur. Reka bentuk kajian ini di mulakan dengan menentukan matlamat dan objektif untuk menjawap persoalan kajian yang memainkan peranan dalam melaksanakan kajian literatur. Setelah itu, pada fasa kedua pengumpulan data sekunder dapat dijalankan hasil daripada kajian literatur. Maklumat daripada data sekunder digunakan untuk menjalankan pendekatan kuantitatif. Fasa ketiga pula, untuk menentukan persempelan kuantitatif iaitu tinjauan soal selidik yang dibangunkan untuk menjalankan pendekatan kuantitatif. Seterusnya borang soal selidik diedarkan kepada pekerja bahagian Pengurusan Fasiliti. Fasa keempat merupakan analisis terhadap pendekatan kuantitatif. Akhir sekali, hasil daripada dapatan kajian diperolehi setelah semua fasa telah dijalankan bagi reka bentuk kajian ini.

## Pendekatan Kuantitatif

(Adibah, 2019) Menjelaskan, pengumpulan data kuantitatif boleh dilakukan dalam pelbagai sumber dan cara. Apabila dilihat daripada data tetapan boleh dikumpulkan dalam tetapan semula jadi, dalam makmal dengan eksperimen, di rumah dengan pelbagai responden, dan lain-lain. Penyataan tersebut telah disokong oleh (Hua, 2016) dalam kajiannya iaitu kajian penyelidikan yang menggunakan kaedah kuantitatif dilakukan melalui kajian eksperimental dan data numerical yang dipungut dianalisis dengan ujian statistik.



### Tinjauan Soal Selidik

(Adibah, 2019) Menjelaskan bahawa soal selidik adalah teknik pengumpulan data yang dilakukan dengan memberikan pertanyaan secara terus atau pertanyaan bertulis kepada responden untuk mendapatkan jawapan. Selain itu (Adibah, 2019) juga menyatakan soal selidik merupakan teknik pengumpulan data yang sangat cekap jika penyelidik mengenal pasti pemboleh ubah diukur dan mengetahui apa yang diharapkan oleh responden.

### 3.2 Instrumen Kajian

Dalam kajian ini, pendekatan kuantitatif yang digunakan untuk pengumpulan data ialah melalui soal selidik.

Soal selidik yang disediakan mempunyai dua bahasa (Bahasa Malaysia dan Bahasa Inggeris). Untuk mencapai objektif kajian, terdapat tiga bahagian yang disediakan dalam soalan selidik ini. Bahagian A, memerlukan responden untuk mengisi maklumat latar belakang demografi responden antaranya ialah jantina, taraf pendidikan tertinggi, pengalaman bekerja, jawatan terkini.

Soal selidik pada bahagian B dan C yang disediakan adalah berlandaskan pada objektif kajian. Bahagian B untuk mengenal pasti amalan pengurusan risiko kkp. Manakala Bahagian C untuk mengukur tahap kesedaran pekerja terhadap aspek keselamatan dan kesihatan di tempat kerja.

### 3.3 Kajian Rintis

Didalam modul(*Modul Bahagian C (Penulisan Bab)*, n.d.), menjelaskan bahawa kajian rintis yang juga dikenali sebagai *pilot test* merupakan kajian yang dilakukan ke atas sample kecil untuk tujuan menguji instrumen yang digunakan adalah benar-benar mengikut objektif kajian. Kajian rintis ini dapat memastikan bahawa kaedah yang direka bentuk mempunyai nilai kesahan dan kebolehpercayaan yang tinggi dalam mengumpul data tepat dan cukup mengikut yang diperlukan (*Bab 3 Metodologi Kajian*, n.d.).

Oleh itu, pengkaji telah melakukan kajian rintis (*pilot test*) soal selidik seramai 15 orang responden dan mendapat nilai kebolehpercayaan sebanyak 0.806. Kajian ini dilakukan adalah untuk mengetahui reaksi responden, memperbaiki soalan dan mengenal pasti jangka masa yang perlu diambil untuk mengisi sesuatu soal selidik.



Selain itu, tujuan kajian rintis ini dilaksanakan adalah untuk mengenal pasti item-item yang bermutu dan signifikan secara statistik.

	Cronbach's	
	Alpha Based	
	on	
Cronbach's	Standardized	N of
Alpha	Items	Items
.806	.813	31

## Jadual 1 Nilai Kebolehpercayaan Kajian

### 3.4 Persempelan dan Populasi

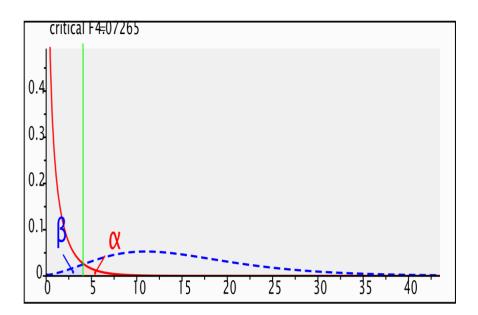
Merujuk pada Rajah 2 dibawah pengkaji telah menentukan sampel kajian dengan mengira dan memilih jenis ujian statistik yang bersesuaian dengan menggunakan perisian program G\*Power versi 3.1.9.4. Manakala Rajah 3 dibawah menggambarkan graf parameter plot yang terhasil daripada pengiraan G\*Power.

### Rajah 2 Pengiraan Sampel

F tests - M	ANOVA: Repeated measures, betwee	en fa	actors
Options:	Pillai V, O'Brien-Shieh Algorithm		
Analysis:	A priori: Compute required sampl	e si	ze
Input:	Effect size f	=	0.25
	α err prob	=	0.05
	Power (1-β err prob)	=	0.95
	Number of groups	=	2
	Number of measurements	=	5
	Corr among rep measures	=	0
Output:	Noncentrality parameter λ	=	13.7500000
	Critical F	=	4.0726538
	Numerator df	=	1.0000000
	Denominator df	=	42.0000000
	Total sample size	=	44

Rajah 3 Graf Parameter Plot





## 4. Dapatan dan Perbincangan

### 4.1 Data Sosial Demografi Responden

Jadual 2 menunjukkan data social demografi responden. Jadual telah menunjukkan majoriti responden adalah pekerja lelaki (68.8 %), tahap pendidikan tertinggi yang dikumpul ialah pada peringkat Diploma (43.8 %), manakala ketegori jabatan yang banyak membantu bagi menjawap boring soal selidik ini ialah jabatan bahagian teknikal (62.5 %) dan rata-rata pekerja tersebut mempunyai pengalaman diantara 0-5 tahun (58.3 %).



			Kekerap	Peratus
			an	an
а	Jantina	Lelaki	33	68.8
		Perempuan	15	31,3
		Jumlah	48	100.0
a	Tahap Pendidikan Tertinggi	Sijil	15	31.3
		Diploma	21	43.8
		Sarjana Muda	12	25.0
		Jumlah	48	100.0
a	Kategori Jabatan	Bahagian Pengurusan	7	14.6
		Bahagian Kejuruteraan	5	10.4
		Bahagian Pentadbiran	4	8.3
		Bahagian Teknikal	30	62.5
		Lain-lain	2	4.2
		Jumlah	48	100.0
a	Pengalaman Bekerja	0-5 Tahun	28	58.3
		6-10 Tahun	9	18.8
		11-15 Tahun	1	2.1
		Lebih 15 Tahun	5	10.4
		Praktikal	5	10.4
		Jumlah	48	100.0

### Jadual 2 Taburan Data Sosial Demografi

#### 4.2 Ujian Normaliti

Kolmogorov-Smirnov & Shapiro-Wilk

Ujian normaliti perlu dijalankan untuk memastikan data pengkaji ialah normal atau tidak. Oleh itu, pengkaji dapat menyimpulkan bahawa data yang telah diuji ialah



normal. Taburan normal dapat dilihat melalui nilai Signifikan (Sig.) pada Ujian Kolmogorov-Smirnov dan Shapiro-Wilk. Kedua-dua ujian ini hendaklah menunjukkan tidak signifikan dimana nilainya mesti melebihi 0.05. Oleh itu, merujuk kepada Jadual 3 di bawah data kajian ini tertabur secara normal memandangkan kedua-dua nilai signifikan melebihi 0.05 iaitu .200 dan .582.

### Jadual 3 Kolmogorov-Smirnov & Shapiro-Wilk

	Kolmogorov-Smirnov <sup>a</sup>			S	hapiro-Wilk	
	Statistic	df	Sig.	Statisti c	df	Sig.
DEMOGRAFI + DASAR + PERANAN + KESEDARAN	.078	48	<mark>.200</mark> *	.980	48	<mark>.582</mark>

\*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

### Skewness & kurtosis

Bagi hasil ujian menggunakan skewness & kurtosis pula, pengkaji perlu memastikan kedua-dua nilai terletak diantara nilai skewness = +1.96 nilai dan kurtosis = -1.96. Merujuk pada Jadual 4 dibawah, pengkaji menyimpulkan bahawa data kajian ini mempunyai taburan yang normal kerana berada diantara nilai  $\pm$  1.96 iaitu nilai skewness = 0.121 dan nilai kurtosis = -0.433.

			Statistic	Std. Error
DEMOGRAFI + DASAR + PERANAN +	Mean		3.7837	.03797
KESEDARAN	95% Confidence Interval for Mean	Lower Bound	3.7073	
		Upper Bound	3.8601	
	5% Trimmed Mean		3.7788	
	Median		3.8056	
	Variance		.069	
	Std. Deviation		.26305	



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Minimum	3.30	
Maximum	4.36	
Range	1.06	
Interquartile Range	.42	
Skewness	.121	.343
Kurtosis	<mark>433</mark>	.674

Jadual 4 Diskriptif Skewness & Kurtosis

## Objektif Kajian Pertama

Objektif pertama bagi kajian ini ialah, pengkaji ingin mengenal pasti hubungan antara peranan pekerja dengan tahap kesedaran keselamatan dan kesihatan pekerjaan (KKP) bagi pekerja-pekerja yang bekerja dalam bidang pengurusan fasiliti di sebuah bangunan kerajaan iaitu Bangunan Kementerian Perumahan dan Kerajaan Tempatan (KPKT). Pengkaji menggunakan kaedah korelasi memandangkan data yang digunakan adalah bertaburan normal. Pekali korelasi merupakan satu indeks yang menunjukkan darjah hubungan antara pembolehubah. Nilai-nilai *r* adalah seperti dalam Jadual 5 di bawah.

Jadual 5 Penilaian Skor Kore	Jadual 5 Penilaian Skor Korelasi di Antara Hubungan				
Korelasi	Hubungan				
<i>r</i> = .1029	Lemah				
<i>r</i> = .3049	Sederhana				
<i>r</i> = .50 - 1.00	Kuat				

Dalam kajian ini, pengkaji menggunakan Ujian Multivariate untuk mengukur kekuatan antara pembolehubah-pembolehubah tidak bersandar dengan pembolehubah bersandar. Jadual 6 di bawah menunjukkan nilai korelasi bagi setiap pembolehubah tidak bersandar (i. dasar dan prosedur dan ii. peranan pekerja) terhadap pembolehubah bersandar (tahap kesedaran keselamatan dan kesihatan pekerjaan).

Dapatan kajian untuk objektif kajian pertama menunjukkan bahawa terdapat hubungan linear yang lemah antara peranan pekerja dengan tahap kesedaran keselamatan dan kesihatan pekerjaan bagi pekerja-pekerja industri pengurusan fasiliti di Bangunan KPKT kerana nilai korelasi terbesar ialah (r = 0.225,  $\rho = 0.507$ ). Oleh itu,



hasil kajian ini mendapat hipotesis pertama (H<sub>1</sub>) iaitu terdapat hubungan signifikan yang lemah di antara peranan pekerja dengan tahap kesedaran keselamatan dan kesihatan pekerjaan.

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	Peranan Pekerja	1.276ª	11	.116	.950	.507	.225
	Dasar dan Prosedur	5.795 <sup>b</sup>	11	.527	1.790	.093	.354
Intercept	Peranan Pekerja	593.115	1	593.115	4856.610	.000	.993
	Dasar dan Prosedur	439.345	1	439.345	1492.945	.000	.976
KESEDARAN	Peranan Pekerja	1.276	11	.116	.950	<mark>.507</mark>	<mark>.225</mark>
	Dasar dan Prosedur	5.795	11	.527	1.790	<mark>.093</mark>	<mark>.354</mark>
Error	Peranan Pekerja	4.397	36	.122			
	Dasar dan Prosedur	10.594	36	.294			
Total	Peranan Pekerja	988.704	48				
	Dasar dan Prosedur	758.827	48				
Corrected Total	Peranan Pekerja	5.673	47				
	Dasar dan Prosedur	16.389	47				

# Jadual 6 Ujian di Antara Kesan Subjek

a. R Squared = .225 (Adjusted R Squared = -.012)

b. R Squared = .354 (Adjusted R Squared = .156)

### Objektif Kajian Kedua

Objektif kajian kedua ialah untuk mengenal pasti hubungan antara dasar dan prosedur dengan tahap kesedaran keselamatan dan kesihatan (KKP) bagi pekerja-pekerja yang bekerja dalam bidang pengurusan fasiliti di Bangunan Kementerian Perumahan dan



Kerajaan Tempatan (KPKT). Dengan merujuk Jadual 6 di atas, dapatan kajian ini menunjukkan bahawa terdapat hubungan linear yang signifikan dan sederhana antara dasar dan prosedur dengan tahap kesedaran keselamatan dan kesihatan pekerjaan bagi pekerja-pekerja industri pengurusan fasiliti di Bangunan KPKT kerana nilai korelasi terbesar ialah (r = 0.354,  $\rho = 0.093$ ). Oleh itu, hasil kajian ini menerima hipotesis kedua (H<sub>2</sub>) iaitu terdapat hubungan signifikan yang sederhana di antara dasar dan prosedur dengan tahap kesedaran keselamatan dan kesihatan pekerjaan.

### Jadual 7 Keputusan Hipotesis Kajian

	Hipotesis	Keputusan
H₁	Terdapat hubungan signifikan yang lemah di antara peranan pekerja dengan tahap kesedaran keselamatan dan kesihatan pekerjaan.	Diterima
H <sub>2</sub>	Terdapat hubungan signifikan yang sederhana di antara peranan pekerja dengan tahap kesedaran keselamatan dan kesihatan pekerjaan.	Diterima

## 5. Kesimpulan

Kesimpulannya, kedua-dua pembolehubah tidak bersandar yang telah dikaji, iaitu (i) peranan pekerja dan (ii) dasar dan prosedur mempunyai hubungan yang positif dengan tahap kesedaran keselamatan dan kesihatan pekerjaan dalam kalangan pekerja-pekerja industri pengurusan fasiliti yang bekerja di Bangunan Kementerian Perumahan dan Kerajaan Tempatan (KPKT). Namun begitu faktor dasar dan prosedur mempunyai hubungan yang lebih tinggi terhadap tahap kesedaran keselamatan dan kesihatan pekerjaan, berbanding faktor peranan pekerja. Oleh itu, pihak atasan pengurusan fasiliti perlu memberikan fokus yang lebih terhadap faktor peranan pekerja sekiranya pihak mereka ingin meningkatkan tahap kesedaran keselamatan dan kesihatan pekerja. Faktor peranan pekerja lemah berkemungkinan berpunca daripada kurangnya sikap bertanggunjawab dalam diri pekerja untuk menjalankan tugas dan amanah yang telah ditetapkan oleh industri. Selain itu, peranan pekerja juga boleh terganggu disebabkan kerja atau tugas yang diberikan tidak mempunyai prosedur yang tetap dan menyebabkan pekerja kurang faham dengan peranan mereka. Lantaran itu, pengkaji mencadangkan agar pihak pengurusan menjalankan penilaian dan analisis tentang peranan pekerja yang boleh membantu industri untuk melahirkan pekerja yang mampu untuk memainkan peranan setanding dengan matlamat yang ditetapkan. Selain itu, pengkaji juga bercadang agar pihak industri membangunkan satu program pembangunan kemahiran yang mewajibkan setiap pekerja yang layak untuk menyertai program-program berkenaan secara berterusan bagi memastikan



mereka mendapat kemahiran yang betul dan kompeten sebelum menjalankan sebarang aktiviti pekerjaan, yang mana ia boleh mengurangkan risiko berlaku kemalangan ditempat kerja. Kajian ini dapat membantu industri pengurusan fasiliti dalam memastikan kelemahan pengurusan risiko KKP. Selain itu, kajian ini juga dapat dimanfaatkan serta dijadikan panduan untuk meningkatkan tahap pengurusan KKP. Tambahan pula, kajian ini boleh dijadikan bahan rujukan serta membantu penyelidik akan datang untuk mengkaji kekurangan dalam aspek keselamatan dan kesihatan yang belum dikaji. Pengkaji mencadangkan, kajian akan datang perlu menitikberatkan persekitaran dan keadaan semasa bagi pengurusan risiko keselamatan dan kesihatan pekerjaan.Untuk kajian di masa hadapan. Pengkaji lain juga boleh mempelbagaikan lagi kaedah pengumpulan data seperti membuat permerhatian dan temu bual bagi mendapat keputusan kajian yang lebih tepat dan kajian ini boleh dipanjangkan kepada responden dalam industri-industri lain.

### Rujukan

- Abidin, Nawi, S. R., & Rahimi. (2017). Kesedaran Terhadap Amalan Keselamatan Dalam Kalangan Pekerja Di Tapak Pembinaan. School of Technology Management & Logistics, Universiti Utara Malaysia.
- Adibah, U. (2019). *Teknik Pengumpulan Data*. Pascasiswazah. https://www.pascasiswazah.com/teknik-pengumpulan-data/
- Akta Keselamatan dan Kesihatan Pekerjaan 1994, Pub. L. No. Akta 514 (1994).
- Amran, A. A., & Selamat, M. N. (2019). Hubungan Antara Sistem Kerja Ergonomik dan Prestasi Keselamatan dan Kesihatan Pekerjaan. 3(2), 1–12. https://spaj.ukm.my/jws/index.php/jws/article/view/233
- Arifin, K., Mohamad Zaidi Wan Isa, W., Haji Zaini, Z.-A., & Shazli Sahimi, A. (2021). Persepsi Terhadap Perlaksanaan Pengurusan Keselamatan Dan Kesihatan Pekerjaan Oleh Kakitangan Awam Di Putrajaya, Malaysia. *Journal of Social Sciences and Humanities*, *18*(2), 198–212.
- Bab 3 Metodologi Kajian. (n.d.). Studentsrepo.Um.Edu.My. Retrieved February 13, 2022, http://studentsrepo.um.edu.my/5205/4/Bab\_3\_Metodologi\_kajian.pdf
- Bakar, N. S., Muhamad Yusri, U. N., Baharudin, N. A., Bahari, N. F., & Jaafar, S. (2018a). Kajian Kesedaran Terhadap Faktor Keselamatan dan Kesihatan Dalam Kalangan Pekerja Sektor Pembuatan. *Journal of Management & Muamalah*, 8(2), 2180–1681. https://www.jmm.kuisjournal.com/index.php/jurnal/article/view/51



- Bakar, N. S., Muhamad Yusri, U. N., Baharudin, N. A., Bahari, N. F., & Jaafar, S. (2018b). Kajian Kesedaran Terhadap Faktor Keselamatan dan Kesihatan Dalam Kalangan Pekerja Sektor Pembuatan. *Journal of Management & Muamalah*, 8(2), 2180–1681. https://www.jmm.kuisjournal.com/index.php/jurnal/article/view/51
- Hua, A. K. (2016). Pengenalan Rangka Kerja Metodologi Dalam Kajian Penyelidikan: Satu Kajian Kes. *Malaysian Journal of Social Sciences and Humanities (MJSSH)*, 1(1), 17–23.
- Modul Bahagian C (Penulisan Bab). (n.d.). Pps.Kuis.Edu.My. Retrieved February 13, 2022, from http://pps.kuis.edu.my/images/penerbitan/modul-guided-research-writing/modul-c-penulisan-bab.pdf
- Mohd Kefri, S. N., & Selamat, M. N. (2021). Hubungan Antara Sistem Kerja Ergonomik dan Prestasi Keselamatan dan Kesihatan Pekerjaan (KKP) di Industri Pembuatan. 5(1), 1–11. https://spaj.ukm.my/jws/index.php/jws/article/view/363
- Mohd Noor, M. M. (2020). Faktor yang mempengaruhi kesedaran keselamatan dan kesihatan pekerjaan dalam Unit Penyeliaan Penolong Pegawai Perubatan, Pejabat Kesihatan Daerah Batu Pahat. https://spaj.ukm.my/jws/index.php/jws/article/view/363
- Norhisham, S. (2019, December 12). *Apakah Metodologi Kajian?* https://www.pascasiswazah.com/apakah-metodologi-kajian/
- Ramli, M. N. (2017, March). Pengurusan Keselamatan dan Kesihatan Pekerjaan dalam Industri Pembinaan dan Pembuatan. https://www.researchgate.net/publication/315456801\_PENGURUSAN\_KESE LAMATAN\_KESIHATAN\_PEKERJAAN\_INDUSTRI
- Tengah, A., & Yahya, M. F. (2019). Amalan Pengurusan dan Pematuhan Keselamatan dan Kesihatan Pekerjaan: Kajian di Balai Bomba dan Penyelamat di Bangi, Selangor dan Nilai, Negeri Sembilan. http://conference.kuis.edu.my/icomm/6th/images/eproceedings/ICD13.pdf
- Tuan Mat, T. M. K. (2020). Hubungan Antara Latihan Keselamatan, Komunikasi dan Polisi Organisasi Dengan Pengurusan Kemalangan Di Pasukan Latihan Pegawai Simpanan Universiti Awam Malaysia. https://etd.uum.edu.my/9299/2/s824409\_02.pdf



# DEVELOPMENT OF FINGER THERAPY DEVICE BY USING FLEX SENSOR WITH VIBRATION MOTOR

Ahmad Syafiq Shaari<sup>1</sup>, Dr Sabariah Bohanudin <sup>2</sup> Electrical Engineering Department (Medical Electronic), Politeknik Sultan Salahuddin Abdul Aziz Shah, 40150 Shah Alam, Malaysia <sup>2</sup> bsabariah@psa.edu.my <sup>1</sup> ariff0302@gmail.com

### ABSTRACT

Exercise and massage are two of the best activities for recovering from and improving a healthy lifestyle to avoid various health issues, especially stroke. When there is no direction on recovery training, exercise will be boring, as will the stress of manually recording training data and the lack of multitasking devices on the market, which can lead to increased stroke rates. In order to overcome the problem, a massage and rehabilitation device that can analyse the ability of fingers was designed and constructed. It is able to improve exercise motivation by automatically saving data activities for better diagnosis. The device uses a flex sensor, vibration motor, and elastic material that is attached to a Bluetooth module for recording exercise data remotely. The analysis is done by calculating the perfect grip angle through a flex sensor when completing the grip, which is automatically recorded by the application after receiving data via Bluetooth. The device also uses a flat vibration motor and elastic material as vibration and pressure in the glove to include the process of recovery. When directed at the gloves, the pressure and vibration can promote finger strength and blood flow in the fingers more effectively. The combination of recording data of finger grip capability with vibration and pressure has the potential to be a necessary medical or rehabilitation requirement in order to deal with the rising rate of strokes and maintain a healthy lifestyle.

Keywords: Finger recovery, flex sensor, rehabilitation.

### 1. INTRODUCTION



According to the Centers for Disease Control and Prevention (CDC), someone in the United States has a stroke every 40 seconds, and every year, more than 795,000 people in the United States have a stroke and approximately two-thirds of these individuals survive and require rehabilitation (*Stroke Facts | Cdc.Gov*, 2021). Therefore, the goal of rehabilitation is to help patients with physical or cognitive disabilities regain as much functional ability as possible. There is a strong consensus among rehabilitation experts that the most important element in any rehabilitation programme is carefully directed, and repetitive practice (Bütefisch et al., 1995). Overall, repetition and regularity are the best ways to ensure the success of any treatment programme because they are able to promote neuroplasticity, which is the capability for the mind to form or repair connections that grow out of consistency.

A study in the Journal of Strength and Conditioning Research concluded that grip strength is a predictor of muscular endurance and overall strength (Prasitsiriphon & Pothisiri,

2018). Other studies have found that a stronger grip correlates with a lower risk of heart attack and stroke (Prasitsiriphon & Pothisiri, 2018). Without missing the fact, changes in lifestyle and the rising cost of living are now able to contribute to stress factors that are known to cause the heart to work harder, increase blood pressure, blood sugar and fat levels (Galimanis et al., 2009). These factors can raise the chance of blood clotting and spreading to the heart or brain, resulting in a heart attack or stroke (Galimanis et al., 2009). This shows that it is important to maintain health, such as through exercise, because treating the effects of stroke is as important as preventing the cause of stroke.

Now, the development of technological advances in treatment and training is able to provide an injection of motivation. Motivation in the context of work can be defined as the level of readiness of an individual to perform and sustain efforts toward achieving a goal (Colombo et al., 2007). Work motivation is an internal process by which an individual receives certain stimuli from the environment. In the process of rehabilitation and exercise, motivation is recognised as an important factor and is often used as a determinant of recovery outcomes (Colombo et al., 2007). As a result, efforts to make better use of available technological facilities must be done through focusing and combining on treatment, training, and cost reductions in order to bring about change and better preparation for the rising number of stroke victims.

## 2. METHODOLOGY

In this section, a description and explanation of the methods used in developing this project are provided. In addition, the project design, block diagram, and flow chart of



operation are provided to ensure an explanation of the development process and an overview of this project.

# 2.1. BLOCK DIAGRAM

The block diagram is an overview of this project's use and arrangement of components.

Based on Figure 1, the block diagram is very important to reduce errors in the development process. So, below is the block diagram for this project.

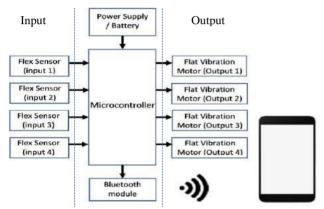


Figure 1, show the functional block diagram of hardware circuit

Based on figure 1, a total of four bending sensors are used as sensor inputs in identifying the grip angle before being processed by the microcontroller. After receiving the input, the microcontroller will give a pre -programmed command to the output, which is a flat vibration motor that works to enhance the finger recovery process. Each activity that occurs will be sent by a Bluetooth sensor to the device to increase motivation and facilitate the storage of data as well as details for diagnosis. This data is stored directly on the storage device in order to see the difference in grip angle change for each finger and enable for additional therapy if necessary.

## 2.2. PRODUCT DESIGN

To ensure that the project succeeds in achieving its objectives, project design needs to be developed to ensure the selection of components and the way the function runs smoothly. Based on Figure 2, the design of the project is shown with labels to



facilitate understanding of the position of the component and facilitate the development of the project.

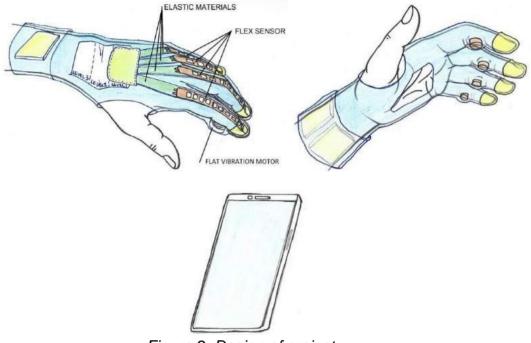


Figure 2. Design of project

This project works by using four flex sensors that shows on Figure 2, where to monitor the angle of grip for each of the four fingers that it supports. The setting of the programmed angle plays a role in analysing the ability of each finger, which will further facilitate the monitoring of the physiotherapist to know the level of each finger. Physiotherapy will decide if another treatment is needed. The data from each finger will be saved automatically on another device. The data is stored using a Bluetooth module that connects to a monitoring device (smartphone). This digital data storage can help to decrease the risk of manipulated data from patients who are losing interest in rehabilitation.

When getting an angle less than required, a flat vibration motor is used to give vibration as therapy to the fingers. The given vibration function only occurs when the set angle is not reached because it can be counted as having no strength or suffering from lack of oxygen in the muscle. This vibration was inspired by the use of muscle therapy (muscle gun), in that it will increase blood flow while suitable for treating tight muscles, adhesions, and minimising muscle soreness and tension (Imtiyaz et al., 2014).



Last but not least, elastic material is used to provide the training necessary to improve the grip strength and also as a measure of stiffness when performing the therapy (Daher, 2013) (Jaber et al., 2012). This material's elastic is manually adjusted according to the user's preferences. Training with this elastic material allows for a stronger development in grip strength, which is highly recommended when a study shows that grip strength is linked to health and correlates with a lower risk of heart attack and stroke (Prasitsiriphon & Pothisiri, 2018)

# 2.3. FLOW CHART OF OPERATION

This flow chart will describe about the expected operations that will be performed in this project. Based on Figure 3, this explanation can give a better picture of the use and simplify the setup process.

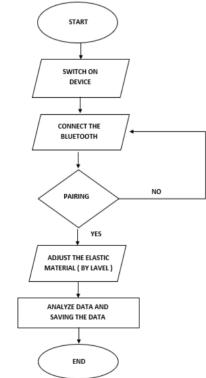


Figure 3. Show the Flow Chart of Operation

Based on the figure 3, the operation of the project begins with the wearing of gloves and is followed by the process of connecting gloves and data storage devices. The connection between these devices is made using Bluetooth. After that, it requires the user to adjust the force level built into the glove to differentiate between the recovery and training process by changing the force level. Every movement in completing one



grip requires effort and strength. More and more efforts are made to further increase the strength and recovery process required.

# 3. RESULT AND FINDING

In this chapter, the final results of the project are shown along with the analysis of this project, which is clarified. In ensuring that the final result of this project achieves the objective, two analyses of the project are done and clarified to support the achievement of the objective of this final project. In addition, to ensure the effectiveness of the project, analyses for bending sensors and forces for elasticity have been developed to ensure that their functions are achieved and impacted.

# 3.1. ANALYSIS PROJECT

To ensure the effectiveness of the project in achieving the objective, analysis of the functions of the project must be done as proof that the end result of the project can be used in improving treatment and diagnosis for stroke patients. The analysis is done on two main functions of this project, namely the force of elastic material and the angle of the flex sensor, to give a picture of the success of this project. Therefore, the analysis proves that the function in this project works well.

# **3.2.** ANALYSIS OF ELASTIC MATERIAL FORCES

In this section, the analysis was done by applying Hooke's law equation to determine the force, which is related to the use of elastic material for this project. The use of the elastic potential energy formula is also explained to support the calculation of force for the production of force from elastic material. In this analysis, elastic force is measured to support the function of weight training in order to strengthen muscles. This elastic material is placed on the finger and pulled to attach at the back of the hand, which will affect the force on the finger. Based on Figure 4, the length of elastic material must be taken to complete the requirement of formula Hooke's law, which is a constant length.



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Figure 4, shows the process of measure the original length

Based on Figure 5, Hooke's law requires a new length to be multiplied by a constant value to obtain the value of elastic force. After calculating the original reading, the reading after fully gripping is also taken into account to see the change in the elastic material. The elastic nature of the material provides the appropriate traction placed on the finger to increase the strength of the finger at a pressure value that is not too high. The use of elastic material also allows full grip to be done without any interruption.



Figure 5, shows the process of measure the new length

Based on Figure 6, Hooke's law, which is used in this analysis, is to measure the force exerted by the elastic material on the object attached to it with the help of the following equation: F = kx. Where "k" is the elastic constant and measures how stiff and strong the elastic is, and "x" is the distance the elastic is stretched or compressed away from its equilibrium or rest position.



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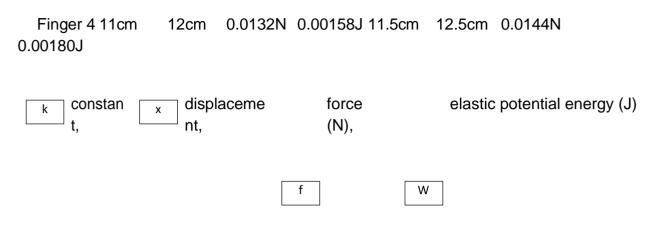


Figure 6, Hooke's law equation for flexible object

Based on Table 1, this analysis takes the initial value of the length of the elastic material and its new value during stretching to obtain the resultant force values. There are two levels provided in this project to allow the change of force according to the user's ability. The value readings for levels one and two show an increase as the stretching increases by 1 cm, which gives a rate of increase to the force value. The increase in the value of the force on this finger proves that the energy to complete the grip requires an excess of energy when there is a value of force produced by the elastic material. In Table 1, the value of potential energy is also stated to support the change in the use of elastic material from level 1 to 2 with increasing values.

Table 1, shows a change in length of the elastic material								
	LEVEL 1				LEVEL 2			
k	х	f	W	k	х	f	W	
Finger 1 12cm 0.00284J	13cm	0.0156N	0.00203J	13.5cm	14.5cm	0.0196N		
Finger 2 14cm 0.00422J	15cm	0.0210N	0.00315J	15.5cm	16.5cm	0.0256N		
Finger 3 13cm 0.00348J	14cm	0.0182N	0.00254J	14.5cm	15.5cm	0.0225N		





Based on Table 1, each finger has a different original length value, causing the force value for each finger to have a different reading. This original length difference occurs according to the strength capacity of each of those fingers. For example, the value of the force for the little finger is 0.0132N, while the value of the force for the index finger is 0.0156N, for which the difference in original length and strength between the fingers is different.

In addition, the calculation of elastic potential energy is also done to support the proof of the use of elastic material to provide force on the grip. The elastic potential energy is the stored energy of an elastic or stretchable object like a spring or rubber band to move or stretch. The formula for the elastic potential energy is W = Fx, which is W = elastic potential energy (J), F = force (N), and x = displacement (m). With the known value of F, connect the formula of force (F

= kx) with the elastic potential energy (W = Fx). Then, the elastic potential energy can be calculated with the equation (W =  $kx^2$ ).

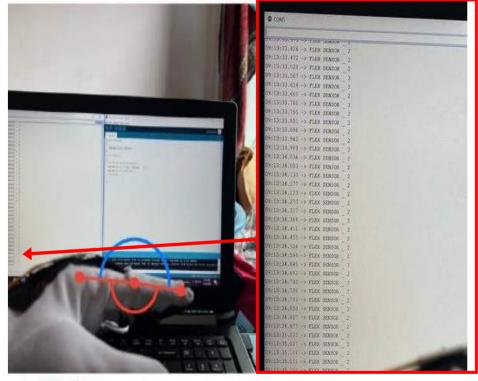
Therefore, the force value resulting from this elastic material provides additional pressure to complete the grip, which indirectly allows the encouragement of increased muscle strength in a faster period. The stated elastic potential energy also brings the same evidence as the value of force, which is, the greater the value of force or potential energy, the greater the amount of energy required to complete the grip. So, the use of force or excess load on exercise allows the muscles involved to work harder and is able to promote increased strength and better blood flow.

The methods and ideas of force used in this project exercise have been taken and refer to existing studies on strengthening programmes in an effort to reduce the amount of knee flexion while walking for children with cerebral palsy, which is weaker in the quadriceps and hamstring muscle groups than controls (Damiano et al., 1995). As a result of this reference studies, quadriceps strength increased significantly and it was recommended to do resistance exercise, which can be a useful adjunct in the treatment of cerebral palsy (Damiano et al., 1995).



## 3.3. ANALYSIS ANGLE OF FLEX SENSOR

In this section, the second analysis is performed for the flex sensor used in this project. The flex sensor that is used in this project to identify the angle of the finger when it has a reflex on the resulting resistance input if the sensor is bent. In this analysis, the Arduino IDE platform and Angulus apps are used in determining the value for the finger angle with the resistance value read that show on Figure 7. Each angle is measured to obtain data readings of each finger for a better diagnosis. By that, the greater the angle of the curve, the greater the resistance value.



a:177.5° b:182.5°

Figure 7, shows the straight condition



Based on Figure 7, the Arduino IDE is used to display the input results on a serial monitor for the resulting resistance value. The resulting resistance value in the straight finger condition indicates a value of less than 10 due to the low resistance rate. After getting the resistance reading, the angle on the finger is calculated using Angulus apps to ensure that the angle of the finger is in a straight state. Angular readings using Angulus are performed by setting the angle point on the finger joint and ensuring the value reaches 180°. Therefore, if the input value is at an average of 30 and below, the finger state is in the straight state.

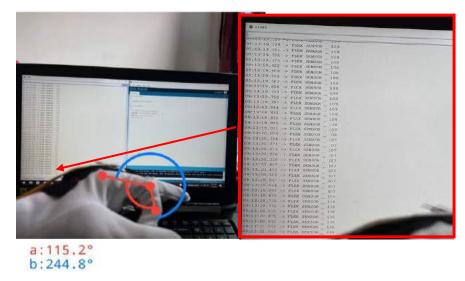


Figure 8, shows the curve condition

Based on Figure 8, the finger is bent more than 90  $^{\circ}$  as a sign that the grip has reached the desired angle. At this angle, the value readings recorded on the Arduino IDE show a sharp increase to 100–170 when the finger angle exceeds 90  $^{\circ}$  and above. Finger angle recording using Angulus apps displays 115  $^{\circ}$  with a resistance value of 108. With the increase in the resistance value along with the increase in the finger angle value, analysis can be performed to identify the finger angle using a flex sensor.



Table 2, Data of flex sensor reflections when bent

Finger Angle	Flex Sensor (Bend)
Straight	0-29
Half Bend	30-99
Full Bend	100-170

Based on Table 2, the change in the resistance value of the flex sensor in this project is influenced by the angle of the finger during the grip, which allows identifying the ability of the finger to complete the grip. In order to get the flex sensor value of resistance, it is necessary to connect the sensor with a fixed value of resistance to create a voltage divider. Therefore, in Table 2, three angles are determined in this project to determine the abilities of each finger. If the full bend condition is achieved, the score for the finger will increase as a sign of complete grip. This increased resistance value occurs when the conductive layer is stretched when the sensor is bent, resulting in a smaller cross section and effecting the higher resistance.

### 4. CONCLUSION

In conclusion, exercise and massage are important aspects of improving a stroke patient's healthy lifestyle and recovery process. The need to improve rehabilitation efforts



for stroke patients needs to be enhanced as the rate of increase in stroke patients increases and the problem of diagnosis and motivation in patients who are able to affect the treatment process needs to be addressed. Therefore, a combination of massage devices and rehabilitation gloves is used in this project to bring the function of massage and diagnosis devices together to better monitor and treat the treatment process. The use of components in this project allows for the recommended treatment of stage 4 stroke patients by referring to the Brunnstrom approach. Methods of improving existing products on the market allow the use of components, can be combined into one device that allows more effective treatment. The three main components, flex sensor, flat vibration motor, and elastic material, in this project are able to provide encouragement to treatment by helping blood flow and participation in load treatment methods to make the process of building muscle strength more comprehensive and faster. Thus, the combination of finger grip ability recording data with vibration and stress has the potential to be a medical or rehabilitative necessity needed to address increased stroke rates and maintain a healthy lifestyle.

## REFERENCE

- Bütefisch, C., Hummelsheim, H., Denzler, P., & Mauritz, K. H. (1995). Repetitive training of isolated movements improves the outcome of motor rehabilitation of the centrally paretic hand. *Journal of the Neurological Sciences*, *130*(1), 59–68. https://doi.org/10.1016/0022-510X(95)00003-K
- Colombo, R., Pisano, F., Mazzone, A., Delconte, C., Micera, S., Carrozza, M. C., Dario, P., & Minuco, G. (2007). Design strategies to improve patient motivation during robotaided rehabilitation. *Journal of NeuroEngineering and Rehabilitation*, 4, 1–12. https://doi.org/10.1186/1743-0003-4-3
- Daher, N. (2013). Effects of elastic band orthosis (aider) on balance and gait in chronic stroke patients. https://www.jptrs.org/journal/view.html?doi=10.14474/ptrs.2013.2.2.81
- Damiano, D. L., Vaughan, C. L., & Abel, M. E. (1995). Muscle Respon Se T O Heavy Resistan Ce Exercise in Chi1 Dren With Spastic. *Developmental Medicine & Child Neurology*, *37*(3), 731–739.
- Galimanis, A., Mono, M. L., Arnold, M., Nedeltchev, K., & Mattle, H. P. (2009). Lifestyle and stroke risk: A review. *Current Opinion in Neurology*, 22(1), 60–68. https://doi.org/10.1097/WCO.0b013e32831fda0e



- Imtiyaz, S., Veqar, Z., & Shareef, M. Y. (2014). To Compare the Effect of Vibration Therapy and Massage in Prevention of Delayed Onset Muscle Soreness (DOMS). *Journal of Clinical and Diagnostic Research*, 8(1), 133–136. https://doi.org/10.7860/jcdr/2014/7294.3971
- Jaber, R., Hewson, D. J., & Duchêne, J. (2012). Design and validation of the Grip-ball for measurement of hand grip strength. *Medical Engineering and Physics*, 34(9), 1356– 1361. https://doi.org/10.1016/j.medengphy.2012.07.001
- Prasitsiriphon, O., & Pothisiri, W. (2018). Associations of Grip Strength and Change in Grip Strength With All-Cause and Cardiovascular Mortality in a European Older Population. *Clinical Medicine Insights: Cardiology*, *12*, 117954681877189. https://doi.org/10.1177/1179546818771894

Stroke Facts | cdc.gov. (2021). https://www.cdc.gov/stroke/facts.htm



# DEVELOPMENT OF SAFETY SECURITY DOOR USING FACE RECOGNITION

Nik Hariz Muhaimin Bin Nik Maharis, Dr Sabariah Binti Hj Bohanudin Electronic Engineering Technology (Medical Electronic). Department of Electrical Engineering, Politeknik Sultan Salahuddin Abdul Aziz Shah,Malaysia. nkhrz99@gmail.com, bsabar@gmail.com

## ABSTRACT

In public places, sanitary conditions are always of concern, particularly on surfaces that are touched by a multitude of people, such as door handles in restrooms. Similar issues arise in medical facilities where doctors and staff enter the security door with their dirty hands. The present security system has weaknesses and is difficult to handle. The existing technology devices mostly use the traditional security system that needs an individual to use a key, identification (ID) card, or password to access an area such as the workplace. In this study, thedevelopment of a security door system using facial recognition is presented. The aim of this study is to assist users in the improvement of the security door by using face detection and recognition. The device uses ESP32 as the main processor and an OVA 2640 camera as the input for face recognition. The device also uses a keypad number as a backup password to enter the door if the device does not recognize the user's face. Face Recognition supported openCV is brought up because it uses Eigen's faces and reduces the scale of face images without losing vital features, facial images for many persons can be stored in the database.

Based on data analysis, it can be concluded that the device is able to monitor people using IP addresses through Wifi, which is able to prevent unregistered people from opening the door aswell as for health purposes.

Keywords: Security Door, Artificial Intelligence, ESP32 Camera, Touchless, Arduino Uno



## 1. INTRODUCTION

The Safety Security Door Using Face Recognition allows users to open a garage door using only our face without physically touching anything. It is like a keypad lock that replaces pressing buttons with touch-less gestures. This is especially important now during the COVID-19 Coronavirus pandemic when touching objects is discouraged. In addition to being a touch-less alternative to keypad locks, it has other of applications. For example, it works well in situations where the user locks themselves out without a key or phone, needs to let many people in, and, ingeneral, is a reliable and simple way to get into a home. It is also extremely easy to install. The

user just needs to stick it behind a window near the garage and plug it in. Since the device is completely indoors, the user also does not have to worry about the device being tampered with or failing due to the weather, such as extreme heat, cold, or humidity. This is made possible with the ESP-32 Camera ability that can recognize our face to unlock the door. The system will use face recognition to identify the owner of the face, which will be compared to the faces of people who want to enter. If the faces do not match, the person will not be allowed to enter.

## 2. METHODOLOGY

#### 2.1 Flow of Operation

Figure 2.1 shows the process of the device from start to end. This device flow gives some concise description about the operation of idea.



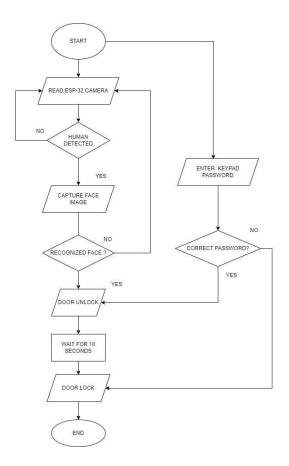


Figure 2.1: Flow of Operation

According to the flowchart as shown in figure 2.1, It show the process of the device from start toend. This flow gives some concise description about the operation of project. First the ESP-32 camera will detect if any human infront the device. If "Yes", the ESP-32 camera will capture the face image of person. If it recognized the face that save in the database, the door will open.



After 10 seconds, the will close back for safety purposes. The second option to open the door iskeypad password. If the user enter the correct password, then the door will open.

#### 2.2 Block Diagram

Figure 2.2 shows the block diagram of the project that also shows the input and output of the component of the project.

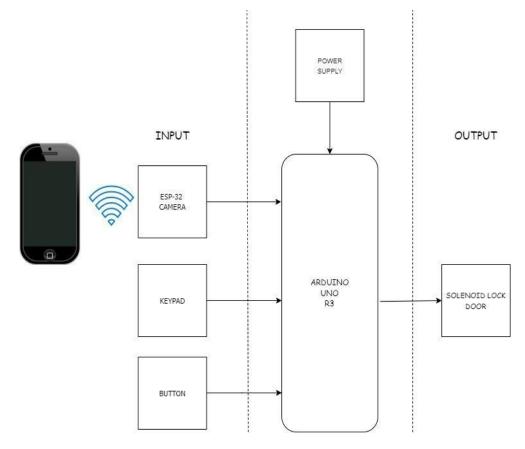


Figure 2.2 : Block Diagram

According to figure 2.2, the input sensor of the device is ESP-32 camera that can detect the face recognition and keypad number as a backup to open the door. Also a button, for emergency to enter the door. The output of the device is solenoid door lock as the door open. This device able to monitoring through Wi-fi using IP address.



# 2.3 Scene Scenario

Figure 2.3 shows the scenario of the device that will use a sensor such as ESP- 32 camera.

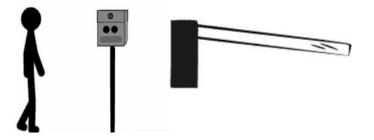


Figure 2.3 : Scene Scenario

According to figure 2,3 or the scene scenario. The user needs to go in front of the device, then the device checks if anyone infront the device. If there is a person in front of the device, the device will scan the face using ESP-32 Camera. The device will recognize the face, If the face ison the database, then the door or gate will open. After 10 seconds, the door will close back for safety purpose.

#### 2.4 Product Design

Figure 2.4 shows the sketch design of the project idea. This project use ESP-32 Camera to detect face recognition.

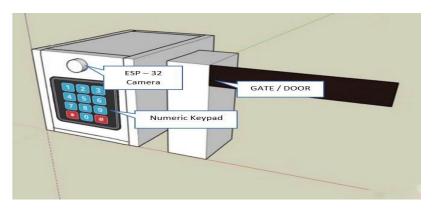


Figure 2.4 : Product Design



Based on Figure 2.4, There are two main components that use in this device that is ESP-32 Camera and Numeric Keypad. The ESP – 32 Camera fuction as a main key to open the door by using a facial recognition. While, the numeric keypad function as a traditional password that userneed to enter the number & alphabet to unlock the door. The user can make a face recognition and monitor the people by using IP address that have be set in the program device.

#### 3. RESULT AND ANALYSIS

#### 3.1 Hardware Result

This project has been successfully developed based on the problem statement and objectives that have been made. The figure below shows the exterior of this device.

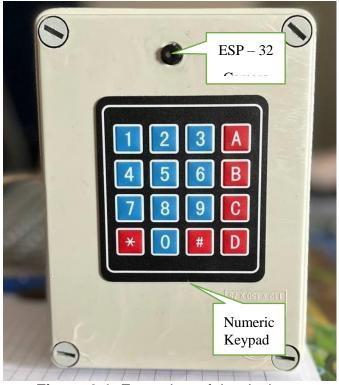


Figure 3.1: Front view of the device

Based on the figure 3.1, This device has used a waterproof plastic casing as a place to place components. We can see that the face imaging sensor that is ESP - 32 camera is placed on thefront along with the numeric keypad. The camera used by the ESP -32 sensor is the OVA 2640.





Figure 3.2: Back view of device

Based on the figure 3.2, The rear view of this device has a button placed as an exit switch. Meanwhile, output for this device is the solenoid door lock that used as an exit and entry signdoor. This door lock solenoid needs to be supplied with 12 volts of energy to turn on

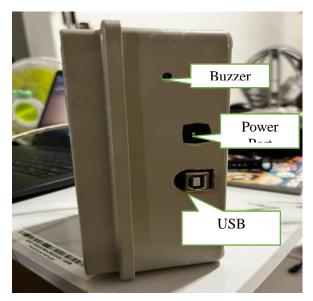


Figure 3.3: Side view of the device



Based on the figure 3.3, There is a 12 Volt charger hole that will be supplied to this device. Another hole is where to upload the coding to the arduino uno. It can also turn on the device byconnecting it with an arudino usb wire to the laptop. The Arduino Uno board have to be powered through USB or by an additional power source. The power source is automatically chosen. External power may be supplied by either an AC-to-DC adaptor or a battery. While thebuzzer will sound if the face recognition system is successful which indicates the door can be opened.

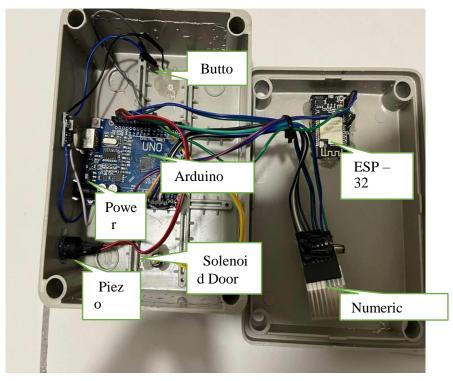


Figure 3.4: Inside view of the device

Based on the figure 3.4, Shows the internal view of the device. Inside the device there is an arduino uno which is used as the main processor. In addition, the arduino uno is connected withan ESP -32 camera. All face recognition will be stored in esp 32 because ESP32 has about 4MB of internal flash memory. If esp 32 can identify the face, it will send the information to the arduino uno to open the door. Meanwhile, for the numeric keypad, it will be connected directly to the arduino uno. The keypad password will continue to be set into the arduino uno using Arduino Software. Piezo buzzer is essentially a little speaker that can be directly connected to an Arduino. It need to programme it to emit a tone at a certain frequency. The buzzer generatessound by reversing the piezoelectric action. Piezo buzzer will give sound when the door is opened.



#### 3.2 Software Result

Based on the figure below, shows how to set the face recognition system on the ESP - 32 camerausing a webserver via IP address. In addition, it also shows how this face recognition system works to open doors.

ESP32 OV2460	x +	∨ – <b>⊡</b> X
	Λ T Δ Not secure   17220.10.11	
- 88 (S. 197) - 186 (S.		🔋 👗 😻 🛓 📴 Ξ
∃ Toggle OV2640 sett	tings IP	
Resolution	QVGA(320x240) 🗸	
Quality	10 🛑 — 63	
Brightness	-2	
Contrast	-2	
Saturation	-2	
Special Effect	No Effect 🗸	
AWB		
AWB Gain		
WB Mode		
AEC SENSOR	ESP 32	
AEC DSP	SETTIN	
AE Level	-2	
AGC		
Gain Ceiling	2x 🔴 128x	
BPC		
WPC		
Raw GMA		
Lens Correction		

Figure 3.5: ESP – 32 Web Server

Based on figure 3.5, shows the ESP -32 web server. On this web server, the place where the facerecognition system with the device. The first step to connect to the device is that there must be aWi-fi connection. After that, enter the IP Address that has been set on the device, which is 172.20.10.11 on a web browser such as google chrome, microsoft edge or safari.



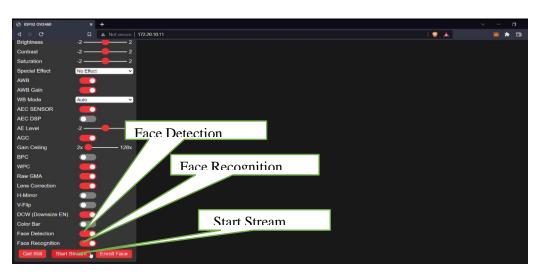


Figure 3.6: ESP – 32 Web Server

Based on figure 3.6, in the ESP -32 Web Server settings. We must turn on two buttons, the first is Face Detection, which is a frictionless biometric that recognizes and identifies human faces based on biometric characteristics present inside the face that are unique to each person. Next, turn on Face Recognition Button. Face Detection is simply detecting a face in a digital picture orvideo. It simply implies that although the face detection system can detect the presence of a human face in a picture or video, it cannot identify the individual. Lastly, turn on the start stream button. Its function is to display the video on a web server. The video is from the ESP -32 camerasensor on the device.

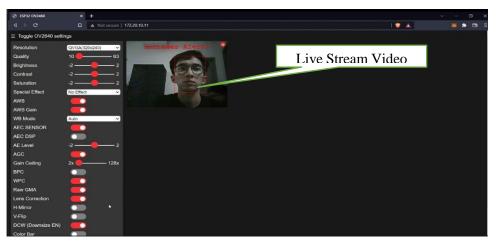


Figure 3.7 : ESP - 32 Web Server



Based on figure 3.7, when the start stream button is on. It will display a live stream of video. We can also see in the video, the user's face is labeled "Intruder Alert" which means the door is not open. This is because the user has no facial recognition on the system stored in the ESP -32 database.



Based on figure 3.8, in the ESP -32 web server settings, press the enroll face button to scan theface so that the scanned face will be stored in the ESP -32 database.

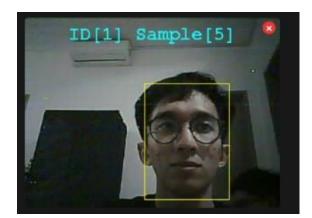


Figure 3.9 : ESP - 32 Taking Face Samples

Based on figure 3.9, when pressing the enroll face button. The ESP - 32 camera took five samples for the face recognition system to identify the user 's face to be stored in the ESP - 32 database.





Figure 3.10 : ESP - 32 Camera recognize face

Based on figure 3.10, ESP -32 camera can recognize user faces that have been stored in the database. This is evidenced based on figure 4.10 where it detects the user's face known by displaying "Hello Friend 0". this means, if the ESP - 32 can recognize the user's face then indirectly the door will continue to open.

3.3 Analysis On Wearing Facemask

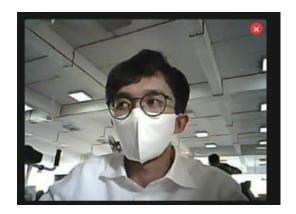


Figure 3.11 : ESP - 32 Video Stream



Based on Figure 3.11, Making an analysis of the facemask is important because this device will be installed in the healthcare entrance like Operation Theathre. This analysis will show if ESP - 32 can create a face recognition system on the user even if the face is covered by wearing a facemask.



Figure 3.12 : ESP - 32 taking sample

Based on Figure 3.12, ESP - 32 camera successfully took a sample of the user's face by wearing facemask. This is because it can detect the shape of a human face.



Figure 3.13 : ESP - 32 recognize user face

Based on Figure 3.13, after taking a sample to recognize the face. ESP -32 camera can recognize the user's face by wearing a facemask.



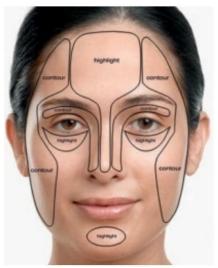


Figure 3.14 : Face Diagram

This is happen because There are two techniques to face recognition algorithms. The first, geometric, utilises the placement, form, and spatial connections between facial characteristics such as eyes, brows, nose, lips, and chin as shown in figure 3.14. The second photometric approach considers the whole face picture as a weighted combination of a number of canonical faces. That's why the ESP – 32 camera can detect user while wearing a facemask.

## **3.4** Analysis On Testing ESP – 32 & Solenoid Door

It is vital to test the system after it has been built. Esp32 will be able to detect face images takenfrom the internet. If the face matches the one recorded, the solenoid that locks the door will be engaged; otherwise, the door will open automatically. If the face does not match what has been recorded or if it is the face of someone else, the solenoid will switch off or the door will not open. This analysis was performed 10 times in total.



TEST	ESP -32 CAMERA		SOLENOID DOOR		FACE DETECTION
	Suitable	Not Suitable	Open	Not Open	
1					Appropriate Face
2					Appropriate Face
3					Inappropriate Face
4					Inappropriate Face
5					Appropriate Face
6					Appropriate Face
7					Inappropriate Face
8					Appropriate Face
9					Appropriate Face
10					Appropriate Face

Table 3.1 : Testing Tool

According to table 3.1, the instrument employs facial recognition to unlock the door. The Esp32 camera detects faces recorded on the internet. If the face matches one already on the list, the door will immediately open. If the face does not match the one recorded, the door will not open.

## 3.5 Analysis On Face Recognition Using Picture

Based on figure below shows the analysis on face recognition using picture. This analysis isimportant because it wants to identify the level of security of this safety security door.



Figure 3.15 : ESP -32 taking sample



Based on figure 3.15, we can see that the ESP - 32 camera managed to take a face sample tobe stored in the ESP - 32 database even using pictures.



Figure 3.16 : ESP -32 detect the photo

Based on figure 3.16, The ESP -32 camera can detect faces using pictures. This proves that this device can also scan faces in 2 dimensions (2D).

# 2 DIMENSION (2D)

A flat, two-dimensional picture is produced via 2D technology. Facial recognition software scansthe face characteristics and generates photos with the bare minimum of physical and mathematical features. Advantages and disadvantages of 2D is because of their efficiency and low cost, 2D algorithms are the most prevalent on the market. High demand drives technology developers to continually enhance their products. Currently, one of the flaws is the high mistakerate:

- > False pass rate is 0.1 percent
- false refusal rate is 2.5 percent.

## 3 DIMENSION (3D)

3D generates a three-dimensional picture and provides a superior image quality. There are various methods for swiping faces:

- > Scanners with lighting and digital image bend processing
- > work scanners with photogrammetric technology
- lasers



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Advantages and disadvantages of 3D technology is distinguished by its excellent reading accuracy. The false-pass rate is 0.0005 percent, whereas the true-pass rate is 0.1 percent. However, more precision in work necessitates more advanced equipment and developmentmethodologies. As a result, the disadvantages are is :

- > need to acquire pricey cameras in order to keep the 3D feature
- the lack of gathered databases of recognised persons, which considerably affects real-timeanalysis
- > For personality identification, the percentage difference between twins is almost nil.

## 4. CONCLUSION

In conclusion, Face recognition technology is used in a variety of ways to make our lives easier. From unlocking our phones to providing security, facial recognition is revolutionizing the way we interact with technology. One of the most common uses of facial recognition is security. In this development, we are going to build a door that can be opened by using face recognition. Hopefully, this will allow people without hands to open doors without the use of their feet or otherassistive devices. The core of this project is a ESP-32 Camera, which we will use to detect when someone using face recognition, and then trigger an electric motor to open the door using solenoiddoor lock. We use the security doors using face recognition software. This software will scan the face of a person, and only the person whose face is scanned will be able to open the door. This is a great security feature, and it will keep our employees and customers safe. It can also keep certain people out if we don't want them to come in, such as trespassers. Based on data analysis, it can be concluded that the device is able to monitor people using IP addresses through Wifi, which is able to prevent unregistered people from opening the door as well as for health purposes



#### References

- Chihaoui, M. (n.d.). A Survey of 2D Face Recognition Techniques. MDPI.https://www.mdpi.com/2073-431X/5/4/21
- G. (2022, May 31). Face Detection vs Facial Recognition what's the difference? NEC. https://www.nec.co.nz/market-leadership/publicationsmedia/face-detection-vs-facial- recognition-whats-thedifference/#:%7E:text=lt%20simply%20means%20that%20the,face%20in %20the%20firs t%20place.

COVID-19 rarely spreads through surfaces. So why are we still deep cleaning? (2021, January29). Nature. https://www.nature.com/articles/d41586-021-00251-4?error=cookies\_not\_supported&code=a12250d1-7478-4c44-b2b8-55ea92f4c2e1

Hrustic, A. (2016, July 15). STUDY: 78% Of Health-Care Workers Don't Properly Wash Their

Hands.Men'sHealth.https://www.menshealth.com/health/a19524980/healthcare-workers-dont-wash-their-hands/Health.

- Hackster.io. (2021, March 20). *Touchless Hand Gesture Door Opener*. https://www.hackster.io/316847/touchless-hand-gesture-dooropener-474c2a
- Whitby, M., McLaws, M.-L., & Ross, M. W. (2006). Why Healthcare Workers Don't Wash TheirHands: A Behavioral Explanation. *Infection Control & Hospital Epidemiology*, 27(5), 484–492. https://doi.org/10.1086/503335



# DEVELOPMENT OF IOT-BASED SELF-USED MONITORING PORTABLE NEBULIZER

M.A.H. Azam<sup>1</sup>, S. Bohanudin<sup>2</sup>,

Electronic Engineering Technology (Medical Electronic), Department of Electrical Engineering, Politeknik Sultan Salahuddin Abdul Aziz Shah, Malaysia. liphh77@gmail.com<sup>1</sup>, bsabariah@psa.edu.my<sup>2</sup>

#### Abstract

Asthma is a disease associated with the airways to the lungs that causes a person to have difficulty breathing and can make some physical activities impossible to perform, especially when it is a chronic condition. The existing support devices are unable to determine the temperature, respiratory rate, and percentage of carbon dioxide to monitor the status of patients. In order to overcome these problems, a self-monitoring portable nebulizer was developed. The purpose of this project is to design, construct, and analyse the Self-Monitoring Portable Nebulizer device which is able to measure the temperature, respiratory rate, and percentage of carbon dioxide of people who suffer from asthma. The device uses multi-sensors such as DS18B20 sensor, CO2 sensor, ESP8266, and software programming that can record data automatically and transmit it remotely by smartphone. The results and output of this device can be seen and monitored on the app used on the smartphone. The percentage of carbon dioxide inhaled by the patient in the form of a line graph and the patient's temperature while using this device will be displayed and analyzed automatically. Based on the error analysis done, the device was able to measure the status level of health of asthma patients with an accuracy of 85%. It can be recommended that by using this device, people who suffer from asthma can get self-treatment and be monitored remotely before reaching the chronic level for the next stage of treatment from the hospital.

Keywords: - Portable nebulizer, difficulty breathing, IoT-based monitoring.

# **1 INTRODUCTION**

Asthma and Chronic Obstructive Pulmonary Disease (COPD) are the chronic conditions that are presently incurable but their symptoms can be controlled through quality health care, appropriate medications, and good self-management skills(Do et al., 2016). Asthma

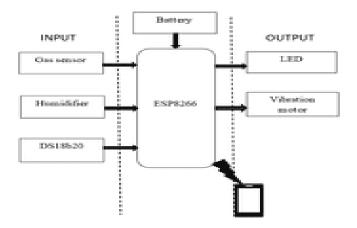


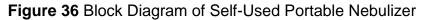
is a disease associated with the airways to the lungs. It causes a person to have difficulty breathing and can cause some physical activities to be difficult or may be impossible to perform. Asthma has different stage which is normal and chronic. The normal patient required inhaler to make the respiration easier and the chronic patient need nebulizer which only available in nearest clinic or hospital. If the chronic patient does not receive the proper treatment, it can cause dead. Over the previous decade, the incidence of asthma, as well as related fatality rates and outpatient visits for asthma, have increased by about 50% in the United States, according to the Centers for Disease Control and Prevention(Quirt et al., 2018). There are various small airways in the lungs to facilitate the delivery of oxygen from the air into the blood. Asthma symptoms occur when the lining of the airways swells and the muscles around it become attracted. This production is called bronchospasm. During an attack, the lining of the airways becomes swollen or inflamed and the cells lining the airways produce more mucus and are thicker than normal.

#### 2 METHODOLOGY

This chapter will cover the details explanation of methodology that is being used to complete this project and make sure it works well. There is several methodology and findings on this field were used to achieve the objective of this project.

Figure 4 shows the block diagram of the project that also include the input and output of the component project







Based on Figure 1, as start in the block diagram, a rechargeable battery is used as a supply to power up the portable nebulizer device. The input of this device are CO2 sensor, humidifier, and DS18b20 temperature sensor. The output of this device are LED, Bluetooth receiver and vibration motor. This device use Bluetooth receiver for transmitted data from receiver to an application used in smartphone.

Figure 2 shows the flowchart of working process from start to the end of Self-Used Portable Nebulizer.

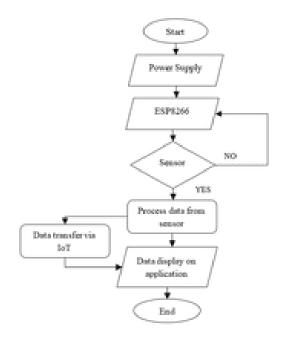
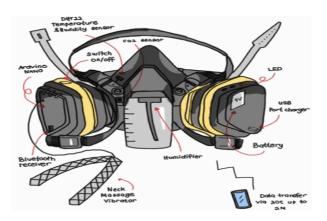


Figure 2 The Flowchart Working of Self Used Portable Nebulizer

Based on Figure 2, shows the flowchart about the process with product working from start to end. Firstly, ESP8266 wifi gives the instruction to every sensor (humidifier, DS18B20 CO2). If the instruction is not allowed by ESP8266, the data will not sent via Bluetooth. If yes, the data will be process and display it via IoT on the application in smartphone.

Figure 3 shows the design of Self-Used Portable Nebulizer. Using hand sketching and Tinker Cad application, the design of product successfully produced.





# Figure 3 Design of Product

Based on figure 5, the design of this project is applied from 3M Half Pieces Respirator that commonly used in industrial. This sketch design shows the position of the components used in this device. With the existing design, I have made modifications by adding some features that are suitable for my project for example CO2 sensor, DHT11 sensor, humidifier, liquid tank, rechargeable battery, and so on.

# **3 RESULT AND DISCUSSION**

In this section, the results of developed product Self-Used Portable Nebulizer are explained in details on based on the hardware implementation, interface of the blynk application and standard operating procedure in using the product.

# 6.1. Hardware Result of Self-Used Portable Nebulizer

This project has been successfully developed based on the problem statement and objectives that have been made. The project has been adapted from a 3M respirator mask that has been modified to form a nebulizer that has an additional sensor capable of measuring the health status of an asthma patient. To activate this product, a 7.4V Li-po battery with a capacity of 1200mAh was used. Based on the calculation of the current required by each sensor, this battery is able to accommodate the load required by each sensor to function. Figure 4 shows the results from the front view of a successfully developed product according to the design specifications that have been made in the methodology part.



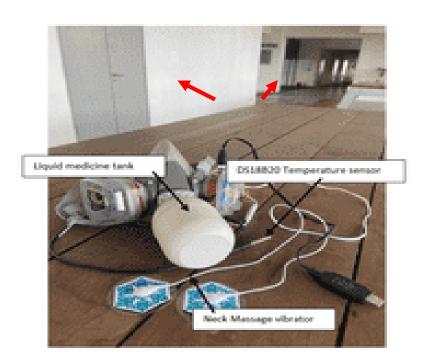


Figure 37: Result of front view of development Self-Used Portable Nebulizer

Based on Figure 4, the front view of Self-Used Portable Nebulizer was successfully developed according to the design that has been made. Special features were also successfully installed on this nebulizer, namely the neck massage vibrator. From the front view, the position of the part can be seen which are liquid medicine tank to fill up the asthma medicine, DS18B20 Temperature sensor for measure patient temperature body and neck massage vibrator.

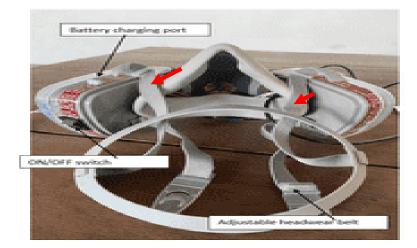


Figure 38: Back view of Self-Used Portable Nebulizer

Figure 5 shows the back view of Self-Used Portbale Nebulizer. Part that can be seen from this view is the ON/OFF switch that activates and turns off the device,



battery charging port to charge the battery and adjustable headwear belt to be worn and tightened on the patient's head according to their comfort.

3.2 Software result of Self-Used Portable Nebulizer

For software results, this product uses IoT as a medium for data transmission from device to smartphone. Blynk is an IoT platform that allows users to remotely manage their Arduino, Raspberry Pi, and NodeMCU devices from their iOS or Android smartphone. This program is used to build a graphical user interface (GUI) or human-machine interface (HMI) by compiling and supplying the correct address on the available widgets. Figure 13 shows a Blynk application that use in smartphone.

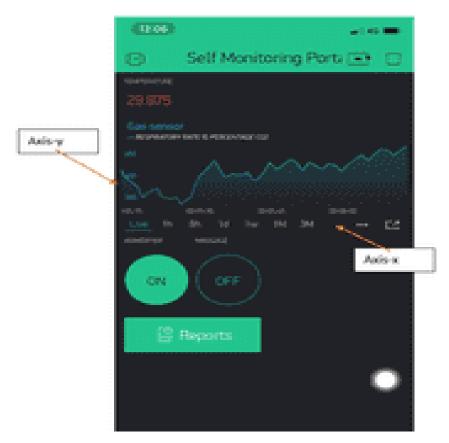


Figure 6: Blynk Application in IOS Smartphone



Based on Figure 6, it shows the IoT application that is Blynk used in this project as a medium for data transmission and output produced by the sensors in the device that is MQ-135 gas sensor and DS18B20 Temperature sensor. The ESP 8266 wifi module is also a data transaction center from the device to the Blynk application. Among the outputs displayed through the blynk screenshot are temperature, respiratory rate, carbon dioxide percentage with labelled axis-y, time duration of using the device with labelled axis-x and the ON/OFF button of the mist maker and massage vibrator that can be controlled via a smartphone.

3.3 Analysis of asthma patient and normal people using MQ-135 gas sensor

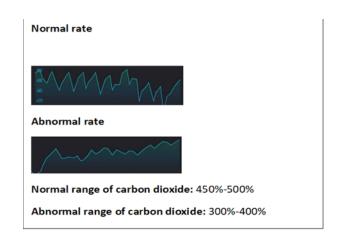
In this product, the component selected for analysis are MQ-135 gas sensor DS18B20 Temperature sensor where it is the parameter measured against the patient. This analysis was made to compare the differences in graph pattern, percentage of carbon dioxide and temperature between people who suffer from asthma and normal people. Table 1 shows the comparison made between asthma patients and normal people.



Type Patient	Respiratory rate	Percenta	Temperature(°
		ge CO2 (%)	c)
Normal Name: Fikri Age: 23 Weight: 60kg Height: 168cm BMI: 21.3 (Normal)	Normal graph represented: TEMPERATURE 31.125 Gas sensor A RESPIRATORY RATE & PERCENTAGE CO2 40 40 20.41:45 20:42:00 20:42:15 20:42:30	490-500	31.125
Asthma Name: Rafiqi Age: 23 Weight: 70kg Height: 170cm BMI: 24.2 (Normal)	Abnormal graph represented: TEMPERATURE 32.562 Gas sensor A RESPIRATORY RATE & PERCENTAGE CO2 430 420 21.05.30 21.05.45 21.06.00 21.06.15	400-420	32.562

# Table 5: Comparison between asthma patient and normal people

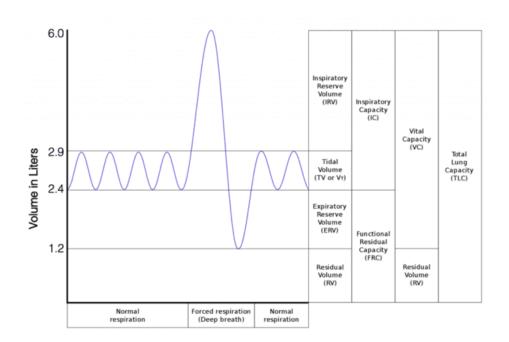




Based on table 1, a comparison between asthma patients and normal people has been made. The purpose of this comparison made was to analyze in terms of respiratory rate, respiratory graph, percentage of carbon dioxide and temperature in people with asthma and normal people. In the table, an asthma patient named Rafiqi has produced an abnormal breathing graph. The percentage of carbon dioxide emitted when exhaled ranges from 400-420 percent. For a normal person named Fikri, he produces a normal graph and the percentage of carbon dioxide emitted is 490-500 percent. This can refer to the legend that has been made under the table. The purpose of each button displayed in the Blynk application's interface for the massaging device is outlined in Table 1.

This analysis is made through a comparison between the research made with the output produced by the sensor used in this device based on figure 14. This shows the pattern of the graph produced by Fikri that is the normal graph resembles the normal graph found in figure 14.





**Figure 7**: Graph of spirometry data for a normal male subject and corresponding lung volumes and capacities

Based on Figure 7, the graph shows the pattern of normal breathing graphs produced by normal people. Diffusion between the air and the blood facilitates the exchange of oxygen and carbon dioxide through the respiratory membrane of the lungs. Parameters of respiration may shift in response to even a little change in diffusion rate. The rate of diffusion is affected by a number of factors, one of which is the pulmonary surface area, which might shift as a result of injury or body posture.

3.4 Analysis of DS18B20 Temperature sensor using digital clinical thermometer

Table 6 shows the analysis or comparison between the DS18B20 Temperature sensor and the digital clinical thermometer purchased at the pharmacy. The purpose of this comparison made is to find out the accuracy and error produced by the sensors used in this product with the thermometers that are already available in the market now. The DS18B20 from maxim integrated is a programmable temperature sensor that only requires a single wire to operate. It is often used to take temperatures under harsh conditions, such as those found in chemical solutions, underground, or on the surface of the earth. Human body temperatures are often measured using digital clinical thermometers in medical settings or at home. The



temperature readings on a digital clinical thermometer are very accurate and simple to interpret.

Type of temperature device	Patient 1	Patient 2
DS18B20 temperature sensor	temperature 31.125	TEMPERATURE 32.562
Digital clinical thermometer	The second secon	MedACCU
Accuracy	<u>36.5-31.125</u> x 100 36.5	<u>35.0-32.562</u> x 100 35.0
Percent Error = <u>Accepted Value - Experimental Value</u> x 100 Accepted Value	=14.72%	=6.86%

Table 2: Analysis of DS18B20 Temperature sensor to digital clinical thermometer

Based on table 2, the table shows a comparison of the two thermometers which are DS18B20 Temperature sensor and digital clinical thermometer. The temperature values measured by the two thermometers were taken and recorded in table 6. The first patient, Fikri, showed a temperature reading of 31.125 degrees Celsius and the second patient, Rafiqi showed a reading of 32.562 degrees Celsius using the DS18B20 Temperature sensor. For digital clinical thermometers have shown readings of 36.5 and 36.5 degrees Celsius, respectively. The table also shows the calculation percentage error or accuracy that has been made for both readings. The first measure on Fikri has 14.72% and the second measure on Rafiqi has a percentage error of 6.86%.



#### 4 CONCLUSION

In conclusion, after making various methods such as methodology, research and product analysis. Finally, the problem statement stated in chapter 1 can be solved based on the objectives to be achieved. With the research done to find the shortcomings found in the existing product, the shortcomings were successfully adapted by adding sensors and designs that are suitable to be used as a nebulizer. Based on the first objective of product design, the design was successfully inspired from the design of 3M Mask Half Respirator by modifying the existing design by adding suitable sensors to be used as parameters for analysis. The second objective was also successfully achieved by making this product as portable and can be controlled by a smartphone. To make it a portable nebulizer, the use of IoT, namely the Blynk application has been used as the control center of this device. This Blynk application is successfully used by entering the correct coding to connect the device with the smartphone and activate each sensor so that it can work properly. The final objective is an analysis made of the results and outputs produced by each sensor. Analysis to measure the level of health is unsatisfactory because of the low efficiency produced by each sensor for example the DS18B20 Temperature sensor which produces a relatively significant value with a real thermometer. With the analysis made, the comparison shows the disadvantages of the used sensor by calculating the accuracy and efficiency of the output produced with the actual value.

# **5 ACKNOWLEGMENT**

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# 6.RREFERENCES

- Do, Q., Tran, S., & Robinson, K. (2016). Big data and mHealth drive asthma selfmanagement. Proceedings - 2015 International Conference on Computational Science and Computational Intelligence, CSCI 2015, 806–809. https://doi.org/10.1109/CSCI.2015.129
- Quirt, J., Hildebrand, K. J., Mazza, J., Noya, F., & Kim, H. (2018). Asthma. *Allergy, Asthma and Clinical Immunology*, *14*(Suppl 2). https://doi.org/10.1186/s13223-018-0279-0



# QAD WORK ORDER PLANNING FOR NON-RUBBER PRODUCTION

Ain Nazira IIIyani Binti Nazri<sup>1</sup>, Mohd Rizan Bin Abdul<sup>2</sup> <sup>1,2</sup>Ungku Omar Polytechnic

Ipoh, Perak ainnainn98@gmail.com mrizan@puo.edu.my

# Abstract

QAD Enterprise Platform is a software is a cloud-based manufacturing software that combines ERP, supply chain, finance, and customer support functions into a single platform. This allows companies to use all these applications in a cloud-based environment rather than on-premises. QAD is designed to help manufacturers stay flexible while focusing on strategic efforts, with bespoke workflows, customising choices, and user preferences (QAD Inc, 2019). QAD Supply Chain solutions offer real-time decision support and improved planning and forecasting, allowing manufacturers to effectively manage supply chain data. It also enables manufacturers to monitor and plan for potential disruptions while maintaining an effective supply chain management process. The project is focus on the explaining the new planning template for non-rubber production of ABC Company (M) Sdn. Bhd., basing on the Work Order Planning on the QAD software. The focus is on the non-rubber department of ABC Company.

**Keywords:** QAD, Material Requirement Planning, Production Planning, Inventory Planning

# 1. Introduction

Material Requirement Planning or MRP is a computer-based production planning and inventory control system (Groover, 2010). It involves the planning for production scheduling and inventory control which aims to keep inventory level at adequate amount as to assure that the required materials or items are available when needed. MRP is most suitable to be used in planning or keeping track of inventory of multiple items with complex bills of materials.



The MRP system is used as to ensure the availability of materials, components, and products for planned production as to assure the materials or items planned can be met at the given estimated time for customer's delivery. Aside from that, MRP is also used to

keep eye for inventory and maintaining the lowest possible level of inventory. Planners also utilize MRP system to plan for manufacturing activities, expecting delivery schedules and foreseeing purchasing activities.

Material Requirement Planning suits the manufacturing settings where the demand of many of the components and subassemblies depend on the demands of items that face external demands. The inventory items are classified into independent demands and dependent demand. Independent demand stands for ends item which are independent and do not require other items to assembly them. Dependent demand on the other are depending on the items which required subassembly, for example childpart which used for assembly purpose to make a complete finished good.

# **1.1 Problem Statement**

Previously, the non-rubber production department of ABD Company make use of Microsoft Excel fully to plan or foresee what item to be run on the press blow machines in their production. The production side will depend fully on the planning template prepared by the planner to decide what to run on specific date and specific machine.

Typically, the flow in a manufacturing process will start with the scheduling of production line based on the forecast generated or the firm sales from customers. Production line would need to run according to the schedule generated by customer, which typically based on the estimated delivery date as requested by customers. Planners usually generated schedule with the available resource as in raw materials and the other sub-assembly item in for a process. It will be easier for planner to foresee what, when and how much raw materials or items to be ordered to complete demand from customers.

The Planning Department aims to make use or implement the function QAD software as a main demand planning platform for non-rubber department, without relying on Excel template as daily production schedule (DPS).



# 1.2 Objective

This project aims to solve the problem stated in the problem statement:

- i. To implement QAD Work Order Planning as planning template for nonrubber production department of ABC Company
- ii. To analyze the Strength, Weakness, Opportunities and Threat (SWOT) of the implementation of QAD Work Order Planning at non-rubber production department
- iii. To reduce Work-In-Process (WIP) inventory by running parts according to estimated time delivery from ABC Company

# 1.3 Scope

The scope of this study is at the non-rubber production Department of ABC Company. This study focuses on determining what parts to run at the press blow machines at the mentioned production department. The plan to be developed aimed to produce parts and finished goods accordingly based on the estimated time delivery (ETD) as per required by customers and available resources using QAD Work Order Planning option.

This study will make use of QAD, a cloud ERP software used in ABC Company. From the QAD system, information such as Sales Order, Outstanding Order, Inventories and Estimated Time Delivery will be retrieved and updated as to identify the orders from customers for the non-rubber items. Another important tab to be used is the Work Order tab for non-rubber production, which is newly used for Planning purposes. From the QAD software, MRP system will be implemented to help non-rubber department scheduling for production.

# 2.0 Literature Review

# 2.1 Material Requirements Planning (MRP)

Generally, Material requirements planning (MRP) can be explained as a system for calculating the materials and components needed to manufacture a product. It consists of three primary steps which are (Groover, 2010):



- i. taking inventory of the materials and components on hand
- ii. identifying which additional ones are needed
- iii. scheduling their production or purchase.

MRP software helps to improve the efficiency, flexibility and profitability of manufacturing operations. It can make factory workers more productive, improve product quality and minimize material and labor costs. MRP also helps manufacturers respond more quickly to increased demand for their products and avoid production delays and inventory stockouts that can result in lost customers, which in turn contributes to revenue growth and stability (Plossl, 2018).

MRP can also make the later stages of production, such as assembly and packaging, proceed more smoothly and predictably by removing most of the uncertainty over inventory and minimizing the time needed to manage it.

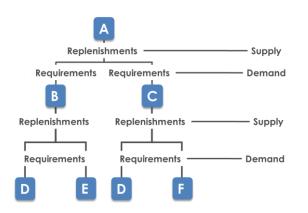
# 2.3 VARIABLES OR INPUT IN MRP

Basically, MRP uses information from the bill of materials (BOM), inventory data and the master production schedule to calculate the required materials and when they will be needed during the manufacturing process (loannou, 2012).

# 2.3.1 Bill of Material

The Bill of Material or BOM is a hierarchical list of all the materials, subassemblies and other components needed to make a product, along with their quantities, each usually shown in a parent-child relationship. The finished good is the parent at the top of the hierarchy.





# Figure 1: Typical Structure of Bill of Materials

The inventory items in the BOM are classified as either independent demand or dependent demand. An independent demand item is the finished good at the top of the hierarchy. Manufacturers determine its amount by considering confirmed orders and examining market conditions, past sales and other indicators to create a forecast, then decide how many to make to meet the expected demand.

Dependent demand items, in contrast, are the raw materials and components needed to make the finished product. For each of these items, demand depends on how many are needed to make the next-highest component in the BOM hierarchy.

# 2.3.2 Master Production Schedule

The **Master Production Schedule (MPS)** on the other hand plans for individual products to be produced. The MPS generally specifies the time a specific product is produced and the inventory needs to produce the specific parts. Raw materials, time and other resources is also quantified in MPS to optimize production.



1			Simple I	nventory N	1PS Templa	ate		
2			ADDED END	NG INVENTORY FO	ORMULA			
3				Product B				·
4		Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7
5 Starting inventor	+							
6 Sales forecast	-							
7 Qty to produce	+							
8 Ending inventory	=	-			-	-	-	-
9								
10				Product C				
1		Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7
2 Starting inventor	+							
3 Sales forecast	-							
4 Qty to produce	+							
5 Ending inventory	=			-	-	-	-	-
.6								
.7				Product D				
.8		Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7

Figure 2: Example of Master Production Schedule

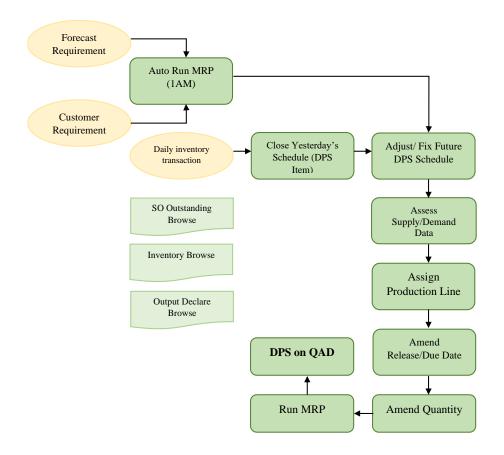
MPS are designed to anticipate needs and identify possible bottlenecks in the supply chain production process. For example, the possibility of shortage of materials or machine capacity can be observed from MPS (Arnold, 2008). Master schedules are typically made using advanced planning and scheduling software. The key elements in MPS are such production costs, forecast demand, inventory levels and costs, 4M capacity and parts/ raw materials supply.

Typically, a Master Production Production Schedule (MPS) for production is in the form of spreadsheet that consisted of list of sales orders, from purchase orders and sales forecasts, and specific time periods that they will be produced within a 3 to 12-month time horizon. Data to create the master production plan is pulled from the enterprise resource planning (ERP), manufacturing execution systems (MES), and material resource planning systems (MRP) and includes:

- bill of materials specifying what parts and raw materials are needed to produce the finished goods
- workforce availability
- machinery capacity and availability



# **3.0 METHODOLOGY**



# Figure 3: QAD Work Order Planning On Non-Rubber Production

#### 3.5 TOOLS USED

Table 1: Tools used for QAD Work Order Planning
---

TOOLS	DESCRIPTION
QAD	Information retrieved from the QAD system are such as sales orders, due dates of orders, forecasts, material or parts inventory and bill of material (BOM)
MICROSOFT EXCEL	Microsoft Excel is used to structure the planning template.

#### 4.0 RESULT



# 4.1 To implement QAD Work Order Planning as planning template for nonrubber

Previously, non-rubber production used a template on Microsoft Excel to plan and schedule for non-rubber production department. The template consisted of main variable such as goods name produced by non-rubber production department, quantity can be produced in a day, material name for each part, opening stock quantities, and daily planning.

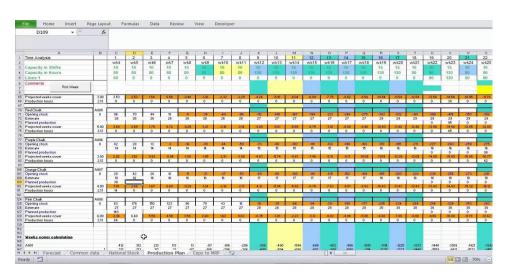


Figure 4: Example of Daily Planning Schedule On Excel

	🝷 🖨 Print 🚮 Preview 🖉 Attach 👻	
		- Attachments
Work Order: 405714	ID: 2084304	Work Order:405714
Item Number:	Q	
Type:		
Site:	Q	
Production Line:		- Item Number:
Quantity Ordered:	Order Date:	
Quantity Completed:	Release Date:	Site:
Qty Rejected:	Due Date:	
Sequence:		
Shift:		
Work Order Status:	Site:	
Sales/Job:	Routing Code:	
Supplier:	BOM/Formula Code:	
Yield Percent:		
Remarks:		
Comments:	Post variances at SFC:	
	Back	Next

Figure 5: Creating Work Order ID on QAD Work Order planning



From the DPS planning, each item that is planned for non-rubber production department has their own Work Order ID created for daily basis use. non-rubber production department does not need to use the Excel template anymore. It can be said the first objective has been achieved.

# ii) To analyse the Strength, weakness, opportunities and threat (SWOT) of the implementation of QAD Work Order Planning at non-rubber production department

The objective is done by analysing and observing the response and outcomes from both planner and production side while implementing the QAD Work Order Planning.

STRENGTH	i.	Provides real time inventory status level as updated by production side
	ii.	Auto calculate the requirements of materials and parts before adding it on the queue to produce or order list
	iii.	Balance stock in inventory list in system with physical stock level
	iv.	Easier to forecast material requirement with the Work Order Plan
WEAKNESS	i.	Lacks of Location to separate goods and no goods production aside from QA
	ii.	Declaration of outputs includes both reject and pass, making the actual quantity available to deliver to customer vary from actual
OPPORTUNITIES	i.	Easier to detect any possible problems with the detailed production lot and ID number
	ii.	The readiness of goods can be trusted if each parts is assigned accurately
THREATS	i.	The changes or inconsistent of variables may cause bigger problem. Example: fluctuation of forecast might affect planning of materials

Table 2: SWOT Analysis for QAD Work Order Planning

4.4 To reduce work-in-process (WIP) inventory by running parts according to estimated time delivery (ETD)



This objective is done by comparing the on-hand quantity versus the quantity of firm order for TVK parts during April 2022. Only produce when according to sales order, releasing work order only when necessary.

Part Number	Total Order	QOH (Beginning) (A)	Total Production (B)	Total Supply (A+B)
TVK/01	5440	3830	4692	8522
TVK/02	13940	6728	9520	16248
TVK/03	20400	10297	12740	23037
TVK/04	11250	8715	5510	14225

 Table 3: Order versus Inventory Quantity for TVK in April



Figure 7: Graph of Demand against Supply for TVK in April

As seen on the line graph above, we can see that the goods are supplied in directly proportional trend as the demand trend. The supply of goods are kept in a safe quantity as reserved as a buffer stock for the next upcoming order, considering that delivery trend is twice per week.

# 5.0 CONCLUSION AND RECOMMENDATION

### 5.1 DISCUSSION

During the implementation of QAD Work Order Planning, there is some inconvenience for reported by both Planner and Production side. The problems were however solved after going through discussions with both sides to ensure a proper implementation of



the plan without disruption of delivery process to customers. The inconveniences face is such as:

- i. Redundant work for planners
- ii. Confirmation of firm sales
- iii. Inventories of goods or location to transfer work in process
- iv. Not enough quantities on work orders

# 5.2 CONCLUSION

To conclude the project, it can be said that QAD Work Order Planning can be implemented well on the non-rubber production production planning. Since the Work Order Planning is still newly used, many issues would arise as the users might not be familiar with the planning structure. However, the problems can be tackled with immediate communication between Planner, Production and the QAD Software developer. As QAD are based on real-time information as per issued or reported by users, it can guess or forecast the potential bottleneck in future when there are some issues on the whole supply chain loop of ABC Company. Implementing QAD Work Order Planning is one of the early steps to reach the Demand Driven Material Requirements Planning that are now being implemented by the other industries players.

### 5.4 RECOMMENDATION

*i.* To prioritize plan or delivery based on the customers' ordering behavior/trend

Typically, customers would provide their forecasts to ABC Company to help or assisted the Supply Chain unit of ABC Company to arrange their order. Some customers tend to place order without providing any forecasts and demanding the order to be completed as soon as possible. This caused the back order to increase since non-rubber production consistently facing the 4M problems that make them unable to adapt with sudden change.

*ii.* Provide location in the QAD system to segregate the goods and no goods part to improve accuracy of inventory

From the Work Order Planning, production will declare the total output with the total parts produced by a machine for both morning and night shift. The total parts declared as output are including the goods and no goods part and being located under the non-rubber production location in QAD. From this situation, QAD will counts and declare the outpu



t as goods and ready-to-pack parts, therefore the exact quantities are unknown until the intervention by Quality Assurance Department.

Therefore, it is suggested that for the QAD developer to adds another location into the system for production to use to declare the no goods output from the machine.

With the continuous communication between planners and production regarding the effectiveness of the work order planning, hopefully the implementation of QAD in the supply chain management for ABC Company can leads to further growth of the company.

# REFERENCES

- Everything you need to know about material requirements planning (MRP). (n.d.). Smartsheet. Retrieved January 22, 2022, from https://www.smartsheet.com/guideto-material-requirements-planning
- J. R. Tony Arnold Master Production Schedule (MPS). Published at: "Introduction to Materials Management (SIXTH EDITION) ", 2008
- Groover, M.P Source of Information used in MRP System. Published at: "Automation, Production Systems, and Computer-Integrated Manufacturing, 2nd Ed., Pearson Education: Singapore"
- Joseph Orlicky, George Plossl Benefits of MRP As a Manufacturing Inventory Management Tool. Published at: "Orlicky's Material Requirements Planning", 2018
- George Ioannou, Stavrianna Dimitriou Lead time estimation in MRP/ERP For Make-To-Order Manufacturing Systems. Published at: "Int. J. Production Economics 139 (2012)"

QAD Cloud Adaptive ERP, QAD Inc, 2019



### STUDY ON THE EFFECTIVENESS OF PLAN PREVENTIVE MAINTENANCE IN HVAC BY FACILITIES MANAGEMENT

Macdayu Angong<sup>1</sup> and Zuriati Abdul Majid<sup>2</sup> <sup>1</sup>Civil Engineering, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor macdayu.m@gmail.com, <sup>2</sup>zuriati @psa.edu.my

# ABSTRACT

Effective maintenance can help to minimize the effects of failure and extend the system's life. Preventative maintenance (PM) was developed in the 1950s and is an alternative to corrective maintenance (CM). Facilities management (FM) an essential strategy to operating, maintaining, improving, and adapting an organization's buildings. Maintenance activities can predict the amount of damage to facilities and infrastructure. Poor heating ventilation air conditioning (HVAC) system operation or failure can result in insufficient ventilation, which can contribute to Sick Building Syndrome (SBS). The main objective of this study is to identify the factors requisite for the implementation of plan preventive maintenance(PPM) in HVAC. This research study will be use the abductive (mixed method) in the form of qualitative approach and supported with qualitative approach. The instruments also will use in this study questionnaire and semi-structured interviews for data collection. Thus, the findings have found that the factors that affecting the effectiveness of PPM in HVAC by FM depends on skilled labour, spare part and material, maintenance and failure downtime, maintenance performance and predetermined intervals maintenance.

Keywords: Preventive maintenance, HVAC, Facilities Management

### **1. INTRODUCTION**

In general, maintenance entails sustaining, keeping, maintaining, or preserving a building or structure to an acceptable standard. Preventative maintenance is costeffective because it can decrease or eliminate necessity, and scope of major repair operations. Effective maintenance can help to minimize the effects of failure and



extend the system's life. Preventative maintenance (PM) was developed in the 1950s and is an alternative to corrective maintenance (CM). Predictive maintenance (PdM), on the other hand, involves condition-monitoring systems. Tasks are scheduled during machine stoppages or shutdowns to replace components before they fail.

Preventive maintenance refers to a compilation of frequent inspections, regular service, and part replacements for all systems. The goal of preventative maintenance is to keep a facility in the maximum possible operating and functioning condition. Preventive maintenance is performed at predetermined intervals or in accordance with specific standards. A building's heating, ventilation, and air conditioning (HVAC) system ensures optimum ventilation and air circulation. In large buildings, such as office buildings, commercial buildings, and shopping malls, a central HVAC system is commonly used. This is owing to the system's advantages. Major components can be divided in a mechanical room according to the central HVAC system. Facilities management is an integrated strategy to operating, maintaining, improving, and adapting an organization's structures and facilities. Managers are involved in maintenance planning, implementation, monitoring, and evaluation. Facilities managers typically have a wide range of responsibilities, ranging from administrative to technical.

Plan Preventive Maintenance enables to significantly reduce reactive maintenance while maintaining the quality of company buildings and assets. Condition monitored maintenance refers to assets that can communicate their current status in real time to a maintenance system (IWMS, CAFM, CMMS). Just-in-time maintenance is enabled by this monitoring, which lowers costs and eliminates asset failure and the reactive maintenance that occurs with it. A maintenance measure will be effective when technicians have the proper skills, expertise, and training to properly implement it. Planning the work that has to be done to keep the building in great condition needs a high level of expertise. Maintenance feedback should be a continuous process for improving the design and maintenance stages. The HVAC system is of limited utility regardless of the preventive maintenance if it is not regularly and adequately maintained (Hassan et al., 2017). Facilities management (FM) an essential strategy to operating, maintaining, improving, and adapting an organization's buildings. As a result, assessing the level of management service delivery is guite important. Previous studies have indicated that Malaysians are concerned about service quality, which has been noted both in the perspective of shifting customer expectations and the problems associated with globalization. The effectiveness of plan preventive maintenance would be questioned if the assessment was completed and the facilities' performance



remained poor. As a result, the purpose of this study is to show the effectiveness of plan preventive maintenance in HVAC by facilities management. This is crucial for the facilities management to make operational recommendations.

Plan preventive maintenance will ensure that all necessary assets are available on time, in the right amount and quality, and at a reasonable cost. Maintenance activities can predict the amount of damage to facilities and infrastructure. In addition, maintenance planning benefits health, safety, and the environment. Poor HVAC system operation or failure can result in insufficient ventilation, which can contribute to Sick Building Syndrome (SBS). Preventive maintenance is a crucial aspect of any asset management strategy, since it leads to longer facility lifespans, less unscheduled downtime, and, eventually, lower long-term maintenance costs. Preventive maintenance entails inspecting an object on a regular basis and servicing or replacing it when a specific condition is discovered. Eye, nose, and throat irritation; skin allergies; mental fatigue; headache; and difficulty concentrating are all symptoms of SBS. (Mentese et al., 2020).

The primary goal of this study is to achieve the research purpose, and the objective of the research is to identify the factors requisite for the implementation, current condition the implementation and appropriate improvements of plan preventive maintenance in HVAC. This study can be used as a guide to the facilities management company for plan preventative maintenance in HVAC. So that the life cycle of HVAC asset will be last longer and the cost repair for the machinery will not expensive. In addition, it is hoped that the findings of this research can be used as a reference to employers and employees.

### 2. LITERATURE REVIEW

A literature search was conducted to identify the studies that related to plan preventive maintenance in HVAC by Facilities management. The review process involved searching for published studies from google scholar, scienceDirect, and Emerald using the keywords plan preventive maintenance, HVAC and facilities management. The study focused on studies on maintenance, HVAC and facilities management that was published between 2014 and 2022.

The goal of maintenance is to provide the most efficient and cost-effective means of keeping the facility and its services fully operational. Building maintenance in Malaysia

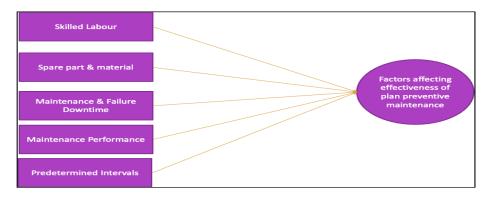


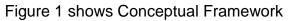
is conditionally driven, and it is often carried out only when funds are available in the budget. Maintenance managers are still implementing ineffective methods in the field of maintenance management, with little regard for the satisfaction of customers and users, as well as the overall performance of the building.

Plan Preventive Maintenance (PPM) is referred to instances in which repair or replacement is performed without the presence of a specific defect. The goal of scheduled maintenance is to create and maintain the most optimal equipment and process conditions possible. It is critical to the survival of any structure, whether historic or not, to perform regular maintenance on it. A preventive maintenance (PM) is a set of plans and recommendations for carrying out additional operations required by a system or a particular system, such as repair and repainting workstations, that are carried out by an organisation's own staff over a period of time.

A central HVAC system may be used to cool or heat one or more areas of a building. It enables significant components to be isolated in a mechanical room for maintenance and repair. The isolation also contributes to the reduction of noise and the enhancement of the aesthetic value. Improper operation and maintenance of the HVAC system can result in energy waste, customer complaints, poor indoor air quality, and even environmental harm. Maintenance should concentrate on these critical components in order to improve system performance and cost effectiveness. (Srinivasan et al., 2017).

Facilities management is an essential strategy to operating, maintaining, improving, and adapting an organization's buildings. With little or no knowledge or skills linked to building maintenance, clients and organisations rely heavily on the facilities manager to maintain their buildings. The importance of facilities managers cannot be overstated.







#### 2.1 Skilled Labour

The quality of the maintenance team's work has a significant impact on the project's overall success. Maintenance workers who do not perform above the acceptable level of maintenance on HVAC systems might have an adverse effect on the everyday activities of building occupants and visitors. It is generally accepted that an individual's salary is directly proportional to his or her level of skill and knowledge. The basis for prioritisation should be a balance between the finalisation of maintenance jobs and the needs of the client (Chua et al., 2018). It is critical that the resident committee or client agree with and support the maintenance priority that has been determined by the maintenance staff or experts. Maintenance management performance in buildings is influenced by a number of factors, including a lack of skilled labor to maintain works in facilities built and designed by expatriates, and the lack of willingness of some establishments to support innovation. As a result, it is critical that the resident committee or client committee or client agree with and support the maintenance staff or experts. Maintenance priority that has been determined by the maintenance by expatriates, and the lack of willingness of some establishments to support innovation. As a result, it is critical that the resident committee or client agree with and support the maintenance priority that has been determined by the maintenance staff or experts.

#### 2.2 Spare Part and Material

The satisfaction of tenants is inversely proportional to the quality of spare parts and materials used in their construction. The use of high-quality spare parts ensures that building systems run efficiently and without interfering with occupants' activities. Poor quality spare parts, on the other hand, will result in more flaws and a rise in the frequency of breakdowns and failures. (Au-Yong et al., 2014a). The availability of spare parts has an impact on the official release of assembly plants.

Spare parts supply is an activity that increases inventory costs, and decision makers seek to keep total cost to a bare minimum. The result is that technicians are idle when they should be working, and the ability of an organization in order to meet customer demands is reduced. Most of the time, the importance is put on management and employee problems rather than equipment-related constraints. Advance demand information (ADI) is info on demand, whether perfect or imperfect, that is made available prior to the occurrence of the actual demand situation. Forecasting spare parts demand is critical for maintaining control over spare parts stocks and avoiding shortages of critical spare parts. This concept was widely adopted in a variety of other



industrial settings, such as demand forecasting in e-commerce, customised products, and the construction industry.

#### 2.3 Maintenance & Failure Downtime

The downtime and cost allocation for maintenance and failure should be taken into account when planning the maintenance method, because scheduled maintenance is unable to eliminate the possibility of failure. Failure of a system can sometimes result in collateral harm to other systems in the surrounding area (Franky & Joseph, 2019). Because the failures happened prior to the specified maintenance time, there would be additional downtime and costs paid as a result. Failure and downtime have an impact on the system's overall quality, including its impact on human health, safety, and the environment. Maintenance downtime must be meticulously managed in order to avoid wasting money on unneeded expenses.

In order to effectively manage maintenance and downtime, maintenance work must be incorporated into an organization's overall maintenance strategy. Lack of maintenance management has resulted in significant financial losses for several organisations as a result of production interruptions and injury to humans, the environment, and physical assets. In order to minimise the problem, we must develop an effective maintenance management system. It is necessary to evaluate the old method that was previously employed in order to improve the maintenance performance.

#### 2.4 Maintenance Performance

Monitoring and evaluating maintenance performance is a process that assists in identifying the advantages and disadvantages of various maintenance procedures and activities. As a result, management is in a better position to plan for and make appropriate decisions regarding future maintenance strategies. The level of success or failure in terms of schedule, cost, and functionality can be used to determine the level of performance achieved or achieved by a project. Main problem with building maintenance management is that it has been applied in an unprofessional manner by the facilities managers. Poor performance of building services and facilities has the potential to cause harm to building users in the areas of health, safety, and comfortability, among other things.



Success of maintenance performance is dependent on the skill and knowledge of maintenance personnel. Organizations can use maintenance performance measurement to understand the value created by maintenance, to re-evaluate and reconsider their maintenance policies and techniques, and to modify resource allocations. It is necessary to measure maintenance performance in order to evaluate the effectiveness and efficiency of the preventive maintenance. Effective maintenance minimises the negative impact of declining equipment performance, while efficient maintenance reduces the amount of money spent on maintenance.

#### 2.5 Predetermined Intervals

The interval between maintenance activities has a significant impact on the outcome of the maintenance. If a maintenance task is not completed on time or is delayed, it may result in further damage to the components of the system. As a result, it is necessary to determine and implement an appropriate maintenance interval. Maintenance schedule works are done at fixed intervals, regardless of whether or not other information is available, in order to ensure the proper functioning of building systems. Preventive maintenance (PM) was first implemented in the 1950s, following the realisation of the importance of preventing failure.

PM systems are based on the principle that they involve predetermined scheduled maintenance that are inferred from machine capabilities and component lifetimes. PM planning is also a component of the managerial point of view, and it necessitates consideration of objectives, planning, and methods prior to the execution of PM on a system. A balance must be struck to avoid the problems associated with under- or over-maintaining of systems. Maintenance intervals must be determined in order to achieve the desired performance level. For maintenance to be beneficial, the equipment must exhibit relatively predictable pattern of failure. Because of the complexity of equipment and specialized equipment, it has become more difficult to identify sequential patterns of breakdown.

### 3. RESEARCH METHODOLOGY

This study is considered to be the central point, and in other words, the five components of the objective, the conceptual framework, and the research questions



for the research are considered to be the central points. As previously stated, this component has a relationship with both the conceptual framework and study method because the goal of this study will result in the creation of a conceptual framework, while at the same time determining the appropriate method selection for the study information and the answering of the study's questions. The validity of a study is determined by the relationship between the goals, the conceptual framework, the methods, and the study's question.

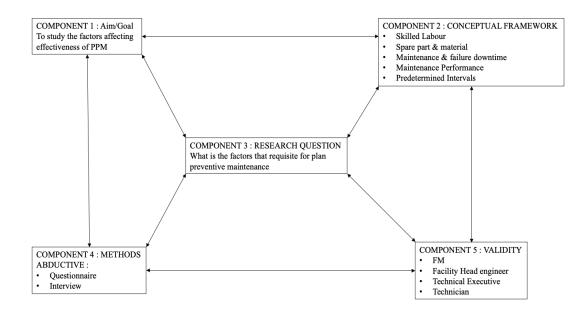


Figure 2 shows Research Design

The research design of the study is a combination of the purpose, objectives and the whole of the subjects being studied in the above chapter. The aim of this study is to study the factors affecting effectiveness of plan preventive maintenance in heating ventilation air conditioning system (HVAC) by facilities management. The conceptual framework has five contracts, which represent the factors that influence the effectiveness of plan preventive maintenance in heating ventilation air conditioning system. When it comes to conducting a study, the research question is one of the most important aspects to consider because it is one of the most important factors in developing research objectives, developing conceptual frameworks, selecting appropriate methods for gathering information, and validating the study's findings. According to (Kothari, 2004) The validity of a study is a criterion that indicates how sound the research was conducted. More specifically, validity can be applied to both the research design and the research methods. Validity in data



collection refers to the extent to which the findings accurately represent the phenomenon that is claimed to exist. In this study, the researcher uses the abductive approach to analyse data for aspects that can further improve of the effectiveness of plan preventive maintenance in heating ventilation air conditioning system by facilities management. Depending on the questions, both quantitative and qualitative methods on questionnaires can be classified as follows as a side from that, answers obtained through closed-ended questions with multiple choice answer options are analyse using quantitative methods, which may include pie charts, bar charts, and percentages, among other things. The interviews use in this study were semi-structured types of interviews in which only the main questions were provided and then the follow-up questions based on respondents' responses were questioned, as in the case of this study. This is due to the fact that the researcher believes that the face-to-face method is more appropriate because researchers are more likely to interact with respondents in order to obtain research information

#### 4. CONCLUSIONS

The literature review identified the important aspects that affecting the effectiveness of plan preventive maintenance in HVAC. Plan preventive maintenance is important for the operation of a building mostly in HVAC system because HVAC is one of the systems that make working environment comfortable. In all of building asset, HVAC asset is the most expensive machinery when it related to repair work because sometime the spare parts are from oversea. Furthermore, the implementation of plan preventive maintenance in HVAC is important for a facility manager. Besides, the problem statement that was stated by the past researcher mention that the occupant satisfaction, maintenance planning and comfortable of working environment is related to HVAC system. After that, from the problem statement the research objective was created to fulfil this research and the scope of this research will involve the facilities management company in Malaysia only. Lastly, was explained that the significant of the research as a guidelines and reference to employer and employee.

Specifically, the effectiveness of planned preventive maintenance in HVAC systems by facilities management was the focus of this study. The factors that influence the effectiveness of plan preventive maintenance in HVAC by facilities management are skilled labour factor, spare part and material factor, maintenance and failure downtime factor, maintenance performance and predetermined intervals. In accordance with the findings of the previous research, these elements can be defined as the primary factors that contributed to the efficiency of planned preventive maintenance in HVAC by facility management. Therefore without a proper plan preventive maintenance



ascpects the facilies management cannot provide or unable to support the intended function and retain the value of HVAC system machinery or asset. Thus, the findings of this research reflected the concerns of the aspects that will affecting the effectiveness of plan preventive maintenance which can ensure the machinery of HVAC can work in optimum demand and also can ensure the customer or client will

satisfying the service that have been delivered by facilites management team. Based on the findings, a future research to study the benefits of plan preventive maintenance to facilites management.

# 4. REFERENCES

- Au-Yong, C. P., Ali, A. S., & Ahmad, F. (2014). Improving occupants' satisfaction with effective maintenance management of HVAC system in office buildings. *Automation in Construction*, 43, 31–37. https://doi.org/10.1016/j.autcon.2014.03.013
- Authors, F. (2017). Journal of Quality in Maintenance Engineering Volume 23 issue 2 2017 [doi 10.1108\_JQME-04-2016-0014] Basri, Ernnie Illyani; Abdul Razak, Izatul Hamimi; Ab-Samat, Has -- Preventive Maintenance (PM) p.pdf.
- Franky, E., & Joseph, M. (2019). *Investigation of Maintenance and Cost Control for High Rise Building*. 1968–1979.
- Hassan, M., Noureldin, S., Kahwaji, G. Y., & Amrin, A. (2017). *Factors Affecting HVAC System Maintenance - Abu Dhabi - UAE. 5*(4), 1–34.
- Jandali, D., & Sweis, R. (2019). Factors affecting maintenance management in hospital buildings: Perceptions from the public and private sector. *International Journal of Building Pathology and Adaptation*, 37(1), 6–21. https://doi.org/10.1108/IJBPA-12-2017-0064
- Kasim, R., Umar, M. A., & Martin, D. (2018). Social Factor as an Indicator for Service Excellence in Facilities Management Services. *Jour of Adv Research in Dynamical & Control Systems*, *10*(6), 294–303.
- Mentese, S., Mirici, N. A., Elbir, T., Palaz, E., Mumcuoğlu, D. T., Cotuker, O., Bakar, C., Oymak, S., & Otkun, M. T. (2020). A long-term multi-parametric monitoring study: Indoor air quality (IAQ) and the sources of the pollutants, prevalence of sick building syndrome (SBS) symptoms, and respiratory health indicators. *Atmospheric Pollution Research*, *11*(12), 2270–2281. https://doi.org/10.1016/j.apr.2020.07.016

Milind M Akarte, P. P. P. (2016). Journal of Quality in Maintenance Engineering Article



information : Maintenance Performance Measurement - A Case of Sugar Industry.

- Putri, H. M., Yunita, K. R., Padmapuspita, L., & Astria, N. (2021). Implementation of maintenance management in educational institutions in Indonesia. *Proceedings* of the International Conference on Industrial Engineering and Operations Management, 1, 1122–1133.
- Wei, C. X., & Radzuan, I. S. M. (2021). Building condition assessment and preventive maintenance of the old shophouses in Raub, Pahang. *Research in Management* of *Technology and Business*, 1(1), 1280–1293.
- Amos, D., Au-Yong, C. P., & Musa, Z. N. (2021b). The mediating effects of finance on the performance of hospital facilities management services. *Journal of Building Engineering*, 34(May), 101899. https://doi.org/10.1016/j.jobe.2020.101899
- Amos, D., Musa, Z. N., & Au-Yong, C. P. (2020). Performance measurement of facilities management services in Ghana's public hospitals. *Building Research and Information*, 48(2), 218–238. https://doi.org/10.1080/09613218.2019.1660607
- Au-Yong, C. P., Ali, A. S., & Ahmad, F. (2014c). Optimising maintenance cost performance with skilled technicians. *Structural Survey*, 32(3), 238–245. https://doi.org/10.1108/SS-01-2014-0005
- Au-Yong, C. P., Ali, A. S., & Ahmad, F. (2017). Competency and commitment of facilities managers: Keys to safeguard maintenance performance. *Malaysian Construction Research Journal*, 22(2), 35–46. https://doi.org/10.6084/m9.figshare.5328379
- Au-Yong, C. P., Ali, A. S., & Chua, S. J. L. (2019). Maintenance priority in high-rise housings: Practitioners' perspective versus actual practice. *Journal of Engineering Research (Kuwait)*, 7(2), 167–177. https://doi.org/10.6084/m9.figshare.10566191.v1
- Au-Yong, C. P., Shah Ali, A., & Ahmad, F. (2016). Relationship between Predetermined Maintenance Interval and Maintenance Performance. *Applied Mechanics* and *Materials*, 845, 305–310. https://doi.org/10.4028/www.scientific.net/amm.845.305
- Chua, S. J. L., Zubbir, N. B., Ali, A. S., & Au-Yong, C. P. (2018). Maintenance of highrise residential buildings. *International Journal of Building Pathology and Adaptation*, *36*(2), 137–151. https://doi.org/10.1108/IJBPA-09-2017-0038
- Fatoni, Z. Z. Z., & Nurcahyo, R. (2018). Impact of training on maintenance performance effectiveness. *Proceedings of the International Conference on*



Industrial Engineering and Operations Management, 2018(JUL), 619–628.

- Franky, E., & Joseph, M. (2019). *Investigation of Maintenance and Cost Control for High Rise Building*. 1968–1979.
- Hassan, M., Noureldin, S., Kahwaji, G. Y., & Amrin, A. (2017). *Factors Affecting HVAC* System Maintenance - Abu Dhabi - UAE. 5(4), 1–34.
- Ighravwe, D. E., Oke, S. A., & Adebiyi, K. A. (2017). Preventive maintenance task balancing with spare parts optimisation via big-bang big-crunch algorithm. *International Journal of Systems Assurance Engineering and Management, 8*, 811–822. https://doi.org/10.1007/s13198-016-0529-9
- Jandali, D., & Sweis, R. (2019). Factors affecting maintenance management in hospital buildings: Perceptions from the public and private sector. *International Journal of Building Pathology and Adaptation*, 37(1), 6–21. https://doi.org/10.1108/IJBPA-12-2017-0064
- Jimenez, V. J., Bouhmala, N., & Gausdal, A. H. (2020). Developing a predictive maintenance model for vessel machinery. *Journal of Ocean Engineering and Science*, *5*(4), 358–386. https://doi.org/10.1016/j.joes.2020.03.003
- Kamaruddin, E. I. B. I. H. A. R. H. A.-S. S. (2017). Journal of Quality in Maintenance Engineering Volume 23 issue 2 2017 [doi 10.1108\_JQME-04-2016-0014] Basri, Ernnie Illyani; Abdul Razak, Izatul Hamimi; Ab-Samat, Has -- Preventive Maintenance (PM) p.pdf.
- Priyantha, J. (2021). Literature Review: The Role of Organizational Factors in Maintenance Organizations Affecting Their Manufacturing Performance, From Sri Lankan Cultural Perspective. April.

Shohet, I. M., & Nobili, L. (2017). Application of key performance indicators for maintenance management of clinics facilities. *International Journal of Strategic Property Management*, 21(1), 58–71. https://doi.org/10.3846/1648715X.2016.1245684



# THE REAL TIME GAIT PHASE DETECTION FOR LOWER LIMBS USING IOT TECHNOLOGY

Nurul Aini Syazlin Binti Mohamad<sup>1</sup>, Suryani Binti Ilias<sup>2</sup> `1Electric Engineering Department, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor, syazlinmohamad99@gmail.com 2suryani@psa.edu.my

# ABSTRACT

Stroke has been recognized as a major public health concern, being the third most common cause of mortality and topping the nation's disability rate. Stroke patients have difficulty walking and moving to the point of endangering areas of the brain that control movement coordination when brain impulses become chaotic, and muscles may find it difficult to communicate effectively. The gait sensor function can measure various characteristics of the human gait with the movement signal recorded and used to perform the gait analysis. The goal of this product is to obtain real-time run phase performance using wearable sensors and IoT technology by tracking the number of steps generated by the patient. The movement signals recorded by these sensors are used to perform gait analysis and can be used as analytical data such as number of steps, cadence, and length of steps to obtain information about the level of progress achieved by stroke patients. Combining with a motorized walker will aid stroke patients' movement during treatment and can encourage them to walk at an appropriate speed. Based on the effectiveness of the tools that have been measured throughout, the patient can produce and display progress in graph form. From this study, several improvements can be made to improve the usability of the device in the future.

Keyword: Stroke patients, brain, gait sensor, walker, treatment.

### I. INTRODUCTION

The Real time gait phase detection for lower limb using IOT technology is the project development for stroke patient that have difficulty walking and getting around. Strokes can harm the areas of your brain that control movement coordination(Alrabghi et al., 2018). Brain impulses get scrambled, and your brain and muscles may struggle



to communicate effectively. Gait is an important human function that allows us to move freely in our surroundings. Gait is a demonstrated key metric of quality of life because of its consequences and being regarded the sixth vital sign, it is even a mortality risk(Alrabghi et al., 2018). One of the most common causes of acquired disability is stroke. It is believed that 80% of stroke survivors have difficulty walking(Nandy, 2019). Given this, enhancing a stroke patient's walking velocity and efficiency is a critical goal for improving overall functionality and quality of life. Other than that, a walker is a tool for disabled people, who need additional support to maintain balance or stability while walking(Brian et al., 2020). So, it can help and support the stroke patient in the treatment they receive. As we know, the gait sensor can stimulate the progress of a stroke patient, and it shows with graph results to present the progress. The goal of this product is to obtain real-time walking phase performance using wearable sensors and IoT technology.

Cerebrovascular accidents (stroke) is brain injury caused by disruption the supply of blood to a brain region, which could result in permanent neurological deficits or death(Yoshioka et al., 2022). Strokes, also known as cerebrovascular accidents, or CVAs, are one of the main causes of morbidity and mortality and have a large negative impact on society. The World Health Organization (WHO) describes strokes as an acute, localized, or diffuse malfunction of the brain that originates from arteries and lasts for more than a day (Nonnekes et al., 2019). Thus, ischemic strokes, subarachnoid hemorrhages, intracranial hemorrhages, and cerebral venous sinus thrombosis are all included in this description. Joint mobility and stability, muscular strength, tone, reflexes, muscle endurance, movement control, and gait pattern functions may all be affected by post-stroke impairment (Li et al., 2019). Transferring, maintaining body position, movement, balance, and walking become difficult due to these deficits. Nearly all patients recover functionally at least somewhat predictably within the first six months after a stroke (Wu & Li, 2020). Even though most stroke patients can walk on their own by six months following their stroke, gait and balance issues continue throughout the chronic stage of the disorder and significantly lower patients' quality of life.

When a person still can walk but needs assistance, they can use a walker instead of a wheelchair. It is a four-legged structure that enables a person to rest, balance, and rely on it (Morone et al., 2016). While more sophisticated measurement techniques can be used to determine kinematic (e.g., joint angles, angular velocity) and kinetic (e.g., ground reaction force, joint moments, and joint power) variables, basic spatiotemporal gait parameters (e.g., step and stride length, step and stride time, cadence, and speed) can be computed with little to no equipment (Zhang et al., 2020).



This not only restricts access to these cutting-edge gait analysis tools to a small number of clinical and research facilities, but gait assessments performed in this way may not accurately reflect how a person walks or runs in a real-world environment (Yeo & Park, 2020). In order to expand the prospective uses, gadget portability should actually be a part of future developments for patient treatment. Preliminary findings have shown that robot-assisted therapy now complements traditional therapy rather than replacing it (Cabanas-Valdés et al., 2020). Therapies and rehabilitation techniques want to be more efficient in terms of both cost and effectiveness.

Therefore, the research on product development was put to good use there, serving its own aims. In the first place, to design the portable device using gait walking phase for stroke patient by using the motorize walker and gait sensor. The second objective is to develop real-time software mechanization for walking treatment using IOT technology application called blynk. Finally, for the purpose of analysis, to analyze the gait phases using wearable sensor for show the patient progress along the treatment they do.

## II. METHODOLOGY

This paragraph of the study discusses the development of a product based on first and second objectives that is aimed at providing the real time gait phase detection for lower limbs that can be controlled remotely using user's smartphone.

### a. Design Process of the real time gait phase detection for lower limb

A 3D design of the product was drawn by using tinker cad based on different angle to enhance and realizing the idea of this project from different angle. Figure 1 is the back and front view of the product which consist of two-wheel motor, gait sensor on shoe and include push button controller.



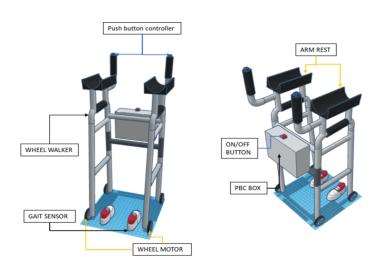


Figure 1: back and front view

# b. Developed the real time gait phase detection of lower limb

Products from this project have been successfully developed (Figure 2). The real time gait phase detection for lower limb is provided a comfy arm rest that focus for upper limbs comfortable and support when use. Apart from that, there is also a motor system that can help the patient in pushing them to walk which is accompanied by a speed that can be adjusted according to the suitability and ability of the patient to help to walk. Finally, with a combination of force sensors that function as detecting the number of step counts can calculate how many steps can be achieved by the patient during rehabilitation is carried out.

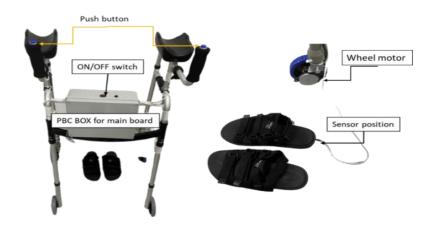


Figure 2: Developed product of the real time gait phase detection for lower limb



As been shown in the block diagram in figure 3 for the real time gait phase detection using gait sensor which includes three parts which is input, process, and output. And the diagram block has two main parts which the wheel walker part and the gait sensor part. For wheel walker part consists of input (switch and battery) works for on/off device system and battery as a power supplier while in the process part includes ESP32 (IOT connection), 30A DC motor, wheel motor he which in this part is the controlling part movement (ESP32) and the component that drives the moving device. and on the gait sensor uses a force sensor where the function of the sensor is to calculate the patient's step when stepping on it and it is connected to ESP 32 (IOT connection) for transmission between wheel walker part and gait sensor part to send a signal to the application that is 'blink' application on the output side of the system and output the gait phase result.

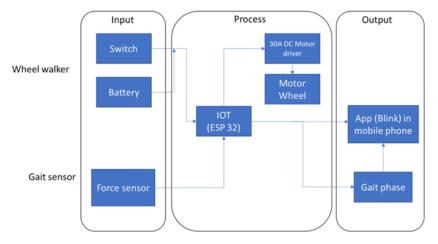


Figure 3: Block diagram of project development

#### c. Standard operation procedure

In figure 4 below demonstrate the usage of the real time gait phase detection for lower limb using IOT technology. The real time gait phase detection for lower limb supports the lower part of stroke patient. The wheel walker can adjust the speed of motor base on suitable of patient situation and also for the shoes that provide the adjustable strap for suitable on patient's size. By using the 'blynk' application software on smartphones, user can control the level of speed, mode of treatment and on off device when they want to do the treatment.



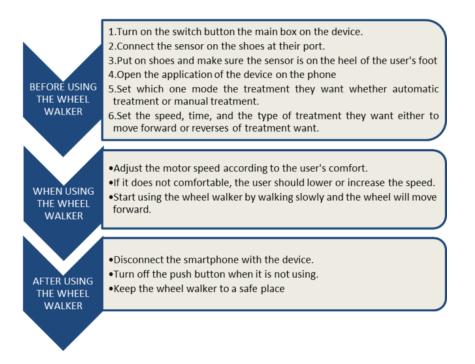
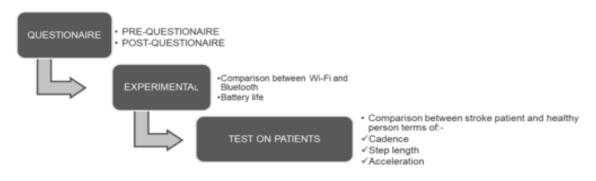
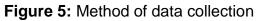


Figure 4: standard operation procedure of the real time gait phase detection for lower limb

### d. Data analysis

Figure 5 below is the method of the data collection of the real time gait phase detection for lower limb. That provide of 3 method which is based on the questionnaire, experimental of design and test on patient.







For questionnaire we provide 2 types of questionnaires, namely pre- and postquestionnaire. For the pre-questionnaire we focus on the introduction device to get approval to develop this device. for the post-questionnaire, the focus is on the effectiveness of the device for stroke patients. After that, In the experimental part of the design, we tested several components such as the difference stimulation between Wi-Fi and Bluetooth (using thinker cad) in figure 6 and the durability of the battery in figure 7 for use during the treatment. And finally, about the test on patient method in figure 8, where in this method we have done testimonials on 2 categories, which are stroke patient and healthy person. In this method, 4-meter track and 10m/s speed are used and tested in terms of increasing the value of cadence produced, the value of step length and the value of acceleration that can be produced by the subject to see the differences produced by these 2 subjects and 4 trial tested is taken of see the progress.

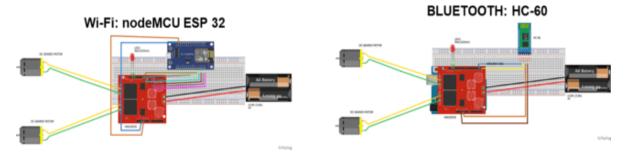


Figure 6: Network connection testing

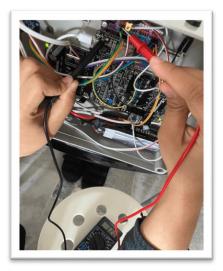


Figure 7: Voltage drop testing





Status: healthy person Age : 25-year-old Weight : 49 kg Medical history: normal Status: minor stroke Age : 39-year-old Weight: 63 kg Medical history : hypertension in the past 3 year ago



Figure 8: Testing on subject

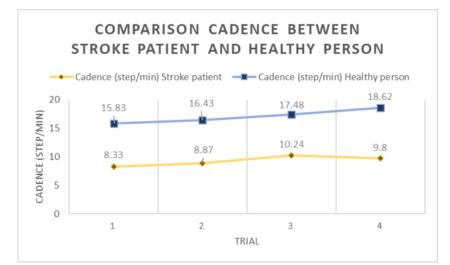
# III. RESULT AND FINDING

In this section, the result of an analysis based on testing on subject using the application which involves several parameters such as the number of step count and time taken. Where with the presence of both parameters can measure progress based on cadence, step length and acceleration.

# A. Analysis on cadence

Figure 9 and table 1 displays comparison of cadence between stroke patient and healthy patient. The graph shows that, the cadence for stroke patient and healthy person is different. The cadence for healthy person is higher than the stroke person for all trials. Then, from Trial no. 1 to Trial no. 4, the cadence is increasing for healthy person. And for stroke patient, from trial 1 to trial no.3 is increased. However, at Trial no 4, the cadence for stroke patient is slightly decreased with the number from 10.24 step/min to 9.8 step/min. This may be due to the step length of stroke patients being slightly longer than the previous one and resulting in a reduced number of steps. With the conclusion that can be seen through the result graph, the frequent of the experiment value produces the cadence value produced, while the increase in step value produced along the 4 meter track the less time it takes, doing 4 attempts to get progress in cadence where the objective for experiment this is to analyze the cadence in stroke patients for a certain speed in the application.







Stroke patient	Trial	No. of steps (step)	Time treatment (sec)	Cadence (step/min)
0	1	10	85	8.33
× I	2	11	87	8.87
Ĕ	3	13	84	10.24
S	4	12	80	9.88
So		No. of	Time	Cadence
ber	Trial	steps (step)	treatment (sec)	(step/min)
y per	Trial			
thy per		steps (step)	(sec)	(step/min)
Healthy person	1	steps (step) 22	<b>(sec)</b> 103	(step/min) 15.83

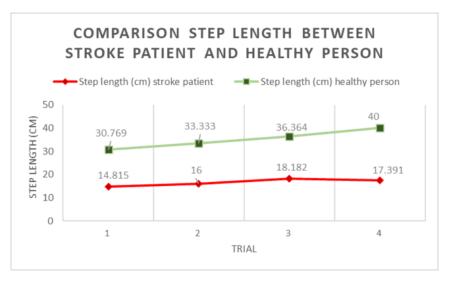
 Table 1: Data collection of cadences

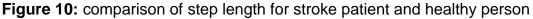
### B. Analysis on step length

Figure 10 and table 2 displays the comparison of step length for stroke patient and healthy person. The graph shows that, the step length of stroke patient and healthy person are different caused by their condition. The step length of healthy person is higher than stroke patient for all trial. Then, from trial no. 1 to trial no.4 the step length is increased for healthy person. And for stroke patient, from trial no.1 to trial no.3 is increased. However, stroke patient at the trial no.4 the step length is slightly decreased with the number from 18.18 cm to 17.39 cm. That is dependent of the cadence value for stroke patient at figure 9 decreased that can affect the step length value. The finding that we can see



based on the objective which is to analyze the step length on stroke patients for given through the graph of results, the higher the trial value the higher the step length value produced, whereas the increasing the value of the cadence produced along the 4m track the increasing the step length taken.





Trial	Stroke patient		Healthy person	
	Cadence (step/min)	Step length (cm)	Cadence (step/min)	Step length (cm)
1	8.33	14.815	15.83	30.769
2	8.87	16	16.43	33.333
3	10.24	18.182	17.48	36.364
4	9.88	17.391	18.62	40

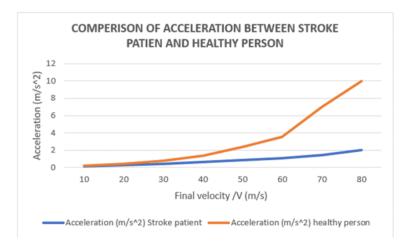
<b>Table 2:</b> Data collection of step length
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### C. Analysis on acceleration

Figure 11 and table 3 shows the comparison of acceleration between stroke patient and healthy person. The graph shows that, graph of acceleration (m/s^2) against final velocity (m/s). Where from graph shows acceleration for stoke patient and healthy person is different. The acceleration for healthy



person is higher than stroke patient for all the specified final velocity which are 10 m/s, 20 m/s, 30 m/s, 40 m/s, 50 m/s, 60 m/s, 70 m/s, 80 m/s. then, from trial no.1 to trial no.4, the acceleration is increased for both stroke patient and healthy person. However, at the final velocity 60 m/s to 80 m/s for healthy person sharply increased from 3.53 m/s^2 to 10 m/s^2. That is because the time taken by healthy person is so short with that speed and produces high acceleration. For the conclusion that can see through the graph of results, the higher the final velocity value the higher the acceleration value produced, whereas the decreasing the value of the times produced along the 4m track the increasing the final velocity taken. With this, through the experiment the objective is achieved that is from this experiment can measure the acceleration on stroke patients for given speed in application.



# Figure 11: comparison of acceleration between stroke patient and healthy person

Final velocity /V (m/s)	Stroke patient		Healthy person	
	Acceleratio	Times	Acceleratio	Times
	n (m/ <i>s</i> ²)	taken (s)	n (m/ <i>s</i> ²)	taken (s)
10	0.137	73	0.2	50
20	0.282	71	0.435	46
30	0.441	68	0.811	37
40	0.635	63	1.379	29
50	0.877	57	2.381	21
60	1.091	55	3.529	17
70	1.458	48	7	10
80	2	40	10	8

Table 3: Data collection of acceleration



## IV. CONCLUSION

These studies had three distinct purposes. First, to design the portable device using gait walking phase for stroke patient. Where we have developed a device that combines the wheel walker and the gait sensor by using IoT technology. And the realtime gait phase-detection for lower limbs using IOT technology has been designed and developed for effective therapy devices. Second, to develop real-time software mechanization for walking treatment using IOT technology. Where an application that has, various functions is created to collect patient data throughout the treatment to find out the progress they have achieved. And from this objective we get the effectiveness of this device has been analyzed through 3 testing on subjects which is a healthy people and stroke patients: cadence, step length, and acceleration. IoT is successfully implemented in the project using the Blynk application. Lastly, to analyze the gait phases using wearable sensor. On the objective we use a force sensor where the sensor can detect the number of step counts and with that value, we can measure readings such as cadence and step length. with the availability of such data, it helps users in getting data easily and can help in treating patients in walking when using this walker. then the last object is reached. Some improvements will be done in the future in terms of the design of the wheel walker which in this section does not have an adjustment function to suit the user's height. other than that improvement in terms of IOT system.

### REFERENCE

- Alrabghi, L., Alnemari, R., Aloteebi, R., Alshammari, H., Ayyad, M., Al Ibrahim, M., Alotayfi, M., Bugshan, T., Alfaifi, A., & Aljuwayd, H. (2018). Stroke types and management. *International Journal Of Community Medicine And Public Health*, 5(9), 3715. https://doi.org/10.18203/2394-6040.ijcmph20183439
- Brian, B., Updated, C., & Hall, M. (2020). The Features of Different Walkers. 1–9.
- Cabanas-Valdés, R., Calvo-Sanz, J., Urrùtia, G., Serra-Llobet, P., Pérez-Bellmunt, A., & Germán-Romero, A. (2020). The effectiveness of extracorporeal shock wave therapy to reduce lower limb spasticity in stroke patients: a systematic review and meta-analysis. *Topics in Stroke Rehabilitation*, *27*(2), 137–157. https://doi.org/10.1080/10749357.2019.1654242
- Li, N., Weng, X., Sun, C., Wu, X., Lu, M., Si, Y., Ye, X., Wang, T., Yu, X., Zhao, X., Wei, N., & Wang, X. (2019). Change of intestinal microbiota in cerebral ischemic



stroke patients. *BMC Microbiology*, *19*(1), 1–8. https://doi.org/10.1186/s12866-019-1552-1

- Morone, G., Annicchiarico, R., Iosa, M., Federici, A., Paolucci, S., Cortés, U., & Caltagirone, C. (2016). Overground walking training with the i-Walker, a robotic servo-assistive device, enhances balance in patients with subacute stroke: A randomized controlled trial. *Journal of NeuroEngineering and Rehabilitation*, *13*(1), 1–10. https://doi.org/10.1186/s12984-016-0155-4
- Nandy, A. (2019). Statistical methods for analysis of Parkinson's disease gait pattern and classification. *Multimedia Tools and Applications*, *78*(14), 19697–19734. https://doi.org/10.1007/s11042-019-7310-4
- Nonnekes, J., Růžička, E., Nieuwboer, A., Hallett, M., Fasano, A., & Bloem, B. R. (2019). Compensation strategies for gait impairments in parkinson disease: A review. *JAMA Neurology*, *76*(6), 718–725. https://doi.org/10.1001/jamaneurol.2019.0033
- Wu, L. F., & Li, T. H. S. (2020). Fuzzy dynamic gait pattern generation for real-time push recovery control of a teen-sized humanoid robot. *IEEE Access*, *8*, 36441– 36453. https://doi.org/10.1109/ACCESS.2020.2975041

Yeo, S. S., & Park, G. Y. (2020). Accuracy Verification of Spatio-Temporal and.

- Yoshioka, K., Watanabe, T., Maruyama, N., Yoshioka, M., & Iino, K. (2022). *Two-Month Individually Supervised Exercise Therapy Improves Walking Speed , Step Length , and Temporal Gait Symmetry in Chronic Stroke Patients : A before – after Trial.*
- Zhang, M., Sun, J., Wang, Q., & Liu, D. (2020). Walking Rehabilitation Evaluation Based on Gait Analysis. *Journal of Biosciences and Medicines*, 08(06), 215– 223. https://doi.org/10.4236/jbm.2020.86021



# **DEVELOPMENT OF 3 IN 1 LIGHT THERAPY WITH IOT**

Muhammad Haikal Bin Abdul Rasid, Ku Lee Chin

Department of Electrical Engineering, Polytechnic Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor, Malaysia haikalm806@gmail.com, lohleechin1@gmail.com

# Abstract

The development of 3 in 1 light therapy with IoT seeks to give various therapy treatments using various wavelengths of visible light, ultraviolet light, and infrared light. This product also has been designed to keep track of data from IoT applications on mobile phones. The existing product in the market is unable to record activity and schedules after using it. This project is allowed to choose among the several types of number of illumination parameters for UV and infrared wavelength and power density in the spectral range from 300 to 1300 nm [1]. The objectives for this product are to develop a 3 in 1 therapy light treatment within UV light, visible light, and Infrared wavelength using UV sensor and Infrared sensor. This product is to improve the safety of the light treatment, by adding safety features for emergency cases. Furthermore, the IoT Arduino application is used to record and schedule this product. This product is used an infrared sensor module, NodeMCU esp8226, and UV light sensor ML8511 as input material. This project uses UV, Infrared bulbs as its light and application mobile for IoT. This project uses an infrared sensor module that detects infrared radiation with the digital signal as output. Additionally, the output result also will come out with an analog signal of UV light treatment with the related range of wavelengths spectral around 280-390 nm.

Keywords: infrared, ultraviolet, wavelength, treatment, Internet of Things

# 1. INTRODUCTION

As people live in a COVID-19 pandemic that continues to wreak havoc around the world with no end in sight, people always need to go to work or study at home during the pandemic. During those times, people may encounter many unexpected things



that cause suffering from pain and/or injury. People may also encounter skin diseases and infections during our everyday lives.

New technologies like UV therapy help to destroy infectious organisms or harmful cells, and Infrared therapy treats pain and inflammation in various parts of the body [2]. The development of 3 in 1 light therapy with IoT aims to provide different therapy treatments with different wavelengths such as visible light, ultraviolet, and infrared light in spectral range from 300 to 1300 nm. This product is designed to record data history using IoT applications. The current product in the market does not have adjustable wavelength treatment, so the use of the development 3 in 1 Light Therapy treatment is combined for inconvenient use.

This product is to improve the safety of the light treatment, by adding safety features for emergency cases. This development of light therapy also adds IoT to help users record their data every time the current product is used. It can manage to see the data history of using this development product for how many times keep using it. The IoT that been using is Arduino UNO which can connect to the products. Esp8266-01 is a Wi-Fi module that allows microcontrollers access to a WiFi network.

This project uses an infrared sensor module that detects infrared radiation with the digital signal as output. Next, the output result also will come out with an analog signal of UV light treatment with the related range of wavelengths spectral around 280-390 nm.

#### 2. LITERATURE REVIEW

#### 2.1 Ultraviolet light therapy

Ultraviolet light Therapy is to destroy infectious organisms or harmful cells that cause disease of the body, especially superficial lesions and skin infection [2]. The sun emits ultraviolet light naturally, but it can also be channeled for treatment using specifically constructed instruments. Light has different wavelengths. The wavelengths most commonly used in therapeutic ultraviolet light treatments are longer wavelength UVA light and shorter wavelength UVB light [3].



#### 2.2 Visible Light

The wavelengths of light that are most visible to human vision are referred to as visible light. Different wavelengths and frequencies of electromagnetic radiation are conveyed as waves or particles. The electromagnetic is the name given to this large spectrum of wavelengths. spectrum. Usually, that spectrum is separated into seven areas in decreasing wavelength order and rising frequency and energy. The typical Radio waves, microwaves, and infrared are examples of names. ultraviolet (UV), infrared (IR), visible light, X-rays, and gamma-rays. Within the range of the visible light EM spectrum between ultraviolet (UV) and infrared (IR) (UV). It has wavelengths between 380 nanometers (nm) and 740 nm, or 2.9 105 inches to 1.5 105 inches, and frequencies between 4 1014 and 8 1014 cycles per second, or hertz (Hz) [7]. Although all electromagnetic radiation is light, the human eye can only detect a limited amount of this radiation, which it refers to as visible light [8].

#### 2.3 Infrared Light Therapy

Electromagnetic radiation with wavelengths between 780 nm and 1000  $\mu$ m is known as infrared (IR). According to ISO 20473:2007, IR is separated into three bands: Near-Infrared (NIR, 0.78–3.0  $\mu$ m), Mid-Infrared (MIR, 3.0–50.0  $\mu$ m), and Far-Infrared (FIR, 50.0–1000.0  $\mu$ m). Spectral bands in optics and photonics [4]. According to numerous studies, IR can accelerate photodynamic treatment, treat ophthalmic, neurological, and psychiatric problems, as well as promote the growth of mesenchymal and cardiac stem cells. IR has also been shown to improve skin wound healing and photoprevention [5].

#### **3. METHODOLOGY**

#### 3.1 Block Diagram

The block diagram of the project design, shown in Figure 1, consists of 2 microcontroller and an output from light. The main processor is Arduino UNO and nodeMCU ESP8266. Infrared Light Sensor detects infrared radiation in front of the user as the input. UV light sensor measure the power or intensity of incident ultraviolet (UV)



radiation. As for the output, application mobile that receives input from the sensor to restore history data. Also, to alert the user is buzzer that connects to the product to detect unwanted radiation so it will cause a noise. Then, LED, Infrared, UV light will receive output to display the light with 9V DC rechargeable battery.



Figure 1: Block Diagram of the project

# 3.2 Flowchart

Figure 2 depicts the system's flowchart, which was created to ensure that the primary method of this process was understood without difficulty in the future. It has two different flowchart which one focus to general flowchart and another flowchart more to IoT flowchart. The process will start with the product switch ON and process the Arduino UNO to detect the product and will transfer the data into application mobile by using nodeMCU ESP8266.

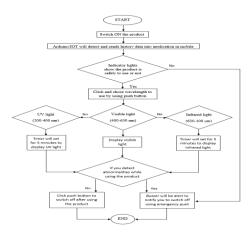


Figure 2 Flowchart



From this flowchart that has been shown in figure 2, it can start using the product by switching ON. Arduino will detect the product so Arduino will send the data to the application mobile by using ESP8266 IoT. After the product is ON, the indicator light will show the product if it can be safe to use. If it does not safe, a buzzer will be activated and notify the user to switch off the product by using the emergency button. If it is safe then the product can be choose any wavelength between 3 light from UV light, Visible light, or Infrared Light. Choosing UV light will set the timer to 5 minutes to display UV light. Choosing visible light will display the light like usual. If choose Infrared light, it will be the same as choosing UV light as it will be set to 5 minutes also. If the product encounters any abnormalities, the buzzer will be activated and notify the user to switch off the product by using the emergency button. If did not encounter such things then the products can been use any longer. After done using the product, switch it OFF the products by pressing the push button.

#### 3.3 Hardware

#### 3.3.1 Arduino UNO

A microcontroller board called Arduino Uno is based on the ATmega328P datasheet, as seen in figure 3. It has a 16 MHz quartz crystal, 6 analogue inputs, 14 digital input/output pins (of which 6 can be used as PWM outputs), a USB port, a power jack, an ICSP header, and a reset button. It comes with everything required to support the microcontroller; to use it, just plug in a USB cable, an AC to DC adapter, or a battery to power it. They can experiment with their UNO without being too concerned about making a mistake; in the worst case, they can replace the chip for a few dollars and start over.



Figure 3 Arduino UNO



#### 3.3.2 NODEMCU ESP8266

The ESP8266 shown in figure 4 is capable of either hosting an application or offloading all WiFi networking functions from another application processor. The general features of this board are as follows:

- Easy to use
- Programmability with Arduino IDE or IUA languages
- Available as an access point or station practicable in Event-driven API applications.
- Having an internal antenna
- Containing 13 GPIO pins, 10 PWM channels, I2C, SPI, ADC, UART, and 1 Wire.



#### Figure 4 NODEMCU ESP8266

### 3.3.3 ML8511 UV DETECTOR SENSOR

UV sensors shown in figure 5 measure the amount of ultraviolet (UV) radiation that is emitted. Although the wavelengths of this type of electromagnetic radiation are less than those of visible light, they are still longer than those of x-rays. UV sensors are used to determine how much ultraviolet light has been exposed to in a laboratory or in the environment.

	GUVA-S12SD
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1 30	keyes 🔘

Figure 5 ML8511 UV Detector Sensor



# 3.3.4 INFRARED SENSOR MODULE

An infrared sensor shown in figure 6 is an electronic device that emits infrared light in order to detect certain features of the environment. An infrared sensor can detect motion as well as measure the heat of an item. A passive IR sensor is one that measures infrared radiation rather than emitting it. Almost all items emit some type of thermal radiation in the infrared range.

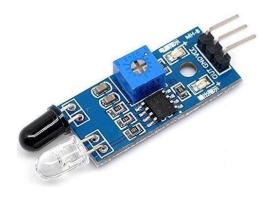


Figure 6 INFRARED SENSOR MODULE

Overall the project can use the 3 light with 3 parameters that has different wavelength to use in 1 device. The connection between 3 light and 3 switch is shown to responding when click for light that has been choose to light ON just like in figure 7.



Figure 7 Project Testing



#### 4. DATA ANALYSIS & DISCUSSION

For the data analysis of the product, it have been tested how the sensor reacts when it can sense the light from the product as shown in table 1. It have made test for 1 week to see if the sensor detects, led will be light on but if the sensor did not detect then the light does not react to the sensor. On days 5 and 7, both UV and Infrared light did not detect by the sensor, therefore led will be no light on. On day 6, only UV light did not detect by the sensor.

DAYS	ULTRAVIOLET LIGHT SENSOR (365nm)	Visible Ligh (400-700 nm)	Infrare Light (600-1000nm)
		LED LIGHT	
DAY 1	Lights On	Lights On	Lights On
DAY 2	Lights On	Lights On	Lights On
DAY3	Lights On	Lights On	Lights On
DAY4	Lights On	Lights On	Lights On
DAY 5	Lights Off	Lights On	Lights Off
DAY 6	Lights Off	Lights On	Lights On
DAY 7	Lights Off	Lights On	Lights Off

Table 1: Sensor reacts to the light that will turn on/off the led

# 5. CONCLUSION

This project is to develop 3 in 1 light therapy by combining ultraviolet, visible, and infrared light in 1 device. The purpose of this project is to improve the product and can be used for future preference. This project also intends to help cure certain diseases by using the developed product. For the wavelength, UV light use 200-400 nm spectrum, visible light use 400-700 nm spectrum and IR use 600nm-1mm spectrum. I am doing a lot of research by finding journals and articles from the website to gather information about this project. For this project, I use ML8511 to scan UV radiation, Infrared sensor module to scan IR radiation and put it into this project. This project use Arduino UNO to receives and transfer to device using NODEMCU ESP8266 for IoT preference. This project will be a good way for people to use for one who feels pain & inflammation and skin infectious with affordable device.

# 6. REFERENCE

M. R. Hamblin and T. N. Demidova, "Mechanisms of low level light therapy," *Mech. Low-Light Ther.*, vol. 6140, no. March, p. 614001, 2006, doi: 10.1117/12.646294.

I. Ahmed *et al.*, "Recent Patents on Light-Based Anti-Infective Approaches," *Recent Pat. Antiinfect.* 



*Drug Discov.*, vol. 13, no. 1, pp. 70–88, 2018, doi: 10.2174/1872213x11666171108104104.

S. Singer and M. Berneburg, "Phototherapy," *JDDG - J. Ger. Soc. Dermatology*, vol. 16, no. 9, pp. 1120–1131, 2018, doi: 10.1111/ddg.13646.

S. Tsai and M. R. Hamblin, "Journal of Photochemistry & Photobiology, B: Biology Biological e ff ects and medical applications of infrared radiation," *J. Photochem. Photobiol. B Biol.*, vol. 170, no. December 2016, pp. 197–207, 2017,

[Online]. Available:

http://dx.doi.org/10.1016/j.jphotobiol.2017.04.01

F. M. Cross, Sarah J. Linker, Kay E. Leslie, "乳鼠心肌提取 HHS Public Access," *Physiol. Behav.*, vol. 176, no. 1, pp. 100–106, 2016, doi: 10.1016/j.jphotobiol.2017.04.014.Biological

L. R. Sklar, F. Almutawa, H. W. Lim, and I. Hamzavi, "Effects of ultraviolet radiation, visible light, and infrared radiation on erythema and pigmentation: A review," *Photochem. Photobiol. Sci.*, vol. 12, no. 1, pp. 54–64, 2013, doi: 10.1039/c2pp25152c.

Lucas, J. (2015, April 30). *What Is Visible Light?* Livescience.Com.

National Aeronautics and Space Administration, Science Mission Directorate. (2010). Visible Light. Retrieved *[insert date - e.g. August 10, 2016]*, from NASA Science website: http://science.nasa.gov/ems/09\_visiblelight



# STUDY ON EFFECTIVENESS OF ENERGY MANAGEMENT IMPLEMENTATION IN COMMERCIAL BUILDINGS

Muhammad Syahmi Shaharudin, Sr Ts Rohaizana Binti Ramli

Civil Department, Polytechnic Sultan Salahuddin Abdul Aziz Shah, Selangor msyahmisahar@gmail.com, rohaizana@psa.edu.my

#### Abstract

This current paper investigates the Effectiveness of Energy Management Implementation in Commercial Buildings. The aim of this research is to promote best practices in Energy Management aspects in Facilities Management Industry. Thus, identifying the guideline for energy management is a basic thing. The next step will be to ascertain the level of implementation of energy management to find new opportunities as a benchmark to track progress in making ongoing energy management because unwatched buildings become less efficient with time. To ensure the building remains effective and archive its maximum potential it is crucial to recommend the importance of energy management in the buildings. A questionnaire is distributed to a team that is involved in energy management. The sample of analysis used is easy-random because the population is homogenous Furthermore, the result confirms the implementation can preserve the building for a long period of time.

# Keywords: ISO Standard, energy audit, energy manager, energy management, energy waste

#### 1. Introduction

Demand-side energy management is becoming increasingly important owing to concerns related to global warming and energy shortages (Kwon et al., 2022). The most striking result to emerge from the data is that commercial buildings are large and load. Consequently, optimal energy exchanges between them and microgrids can reduce the energy consumption cost, greenhouse gas (GHG) emission, and network load deviation (Raza & Malik, 2019). Surprisingly, energy management in the building was found to have attracted a wide range of interested parties over the past few years. Demand-side



management can compensate for this problem by exploiting a bidirectional information channel between utilities and customers to balance the demand with available supply. This includes both promotions of efficiency and conservation. The first possibility is to analyze energy utilization to improve the overall efficiency. This is normally implemented through energy audits, which can take place as surveys and interviews (Monacchi et al., 2015) ]. The fact that buildings are responsible for a large portion of the global energy consumption indicates a need for detailed investigation towards more effective energy performance of buildings.

This study has identified the need for an increase in the capacities of the device used in the buildings as another problem in energy management. (Castro-Camus et al., 2020). Everyone knows that saving energy is a good thing, but most people will only be motivated when you can demonstrate just how much energy they are wasting, and just how much potential it is for them to improve. However, the awareness among non-experts of how much energy is required by different activities and appliances is generally low, which can lead to wrong prioritizations (Halis & Halis, 2022). Therefore, the aim of this study is to see the effectiveness of the energy management implementation in a commercial building in Malaysia.

So far, however, there has been little discussion about the covid-19 pandemic, the fresh supply for closed spaces in the building brings a tremendous energy demand. Such energy demand causing more complicated energy management (Strielkowski et al., 2021). Based on previous study by (Alfaverh et al., 2020) brief about how energy demand that continues to increase. The Energy Information Administration's International Energy Outlook 2021 projects that global energy consumption and carbon dioxide emissions will increase by nearly 50 percent by 2050 due to population and economic growth. EIA expects electricity generation to increase by 68 percent by 2050.

It has previously been observed that, the industry concerns over grid reliability while adapting to an increase demand for renewable source of energy and consistently looked to technology solutions to help balance the supply and demand for energy while reducing costs (Vučković & Pitić, 2022). Today's world is looking for energy solution and alternative due to the threat of energy shortage, skyrocket energy price, unsecure of energy supply and the issue of enormous wastage. The world community should think globally and act locally to solve this issue by creating a long-term program in order to optimize the limited source of energy (Hasan & Trianni, 2020).



Finally, it has been stated that the need to raise public awareness of energy problems. Energy Management problems, associated with rapid social and economic development, have been of critical concern to both national and local governments worldwide for many decades (Mardani et al., 2017).

So that, this study was conducted to find a prove of the effectiveness of energy management.

#### 2. Literature Review

This topic is expanded and important until it involve a few factor that can bring benefit in return. The term "Energy Management" encompasses strategic planning and operation of energy generating and/or consuming units. It can be broadly defined as the systematic, organized, and proactive management of energy use in organizations, industries, or buildings to meet the economic and environmental necessities (Cho & Kim, 2019).

#### 2.1 Google Trends

Google Trends is a website by Google that analyses the popularity of top search queries in Google Search across various regions and languages. The website uses graphs to compare the search volume of different queries over time (Raubenheimer, 2021). It is a useful search trends feature that shows how frequently a given search term is entered into Google's search engine relative to the site's total search volume over a given period. Google Trends can be used for comparative keyword research and to discover eventtriggered spikes in keyword search volume (Mavragani & Ochoa, 2019).



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Implementation - Topic       Holing * * * *         Asset - Topic       +200%         Beland opics       Rising * * 200%	Interest over time (	2		<u>+</u> <> •
1       Selangor       100         2       Federal Territory of Kuala Lumpur       80         3       Johor       54         8       3       Johor       54         8       400%       7       Sapura Energy-Topic       400%         4       4200%       1       sapura energy       430	75 50 25	Oct 17, 2021	Feb 6, 2022	May 29, 2022
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The figure 2.1 shows the rising related topic in Google Trends

What stands out in the table is the rising topic regarding energy management. Which is implementation of energy management that rise until 400% compared to other topic such as Sapura energy 300%, Asset 200%, Electrical grid 200%, and master's degree 110%.



From this figure, we can assume that people still wondering about the implementation of energy management

#### 2.2 Energy Performance Baseline

The purpose of developing energy baseline is to set a reference point for measuring energy performance improvements. The future energy use will be measured against the energy baseline to evaluate its energy performance. Normally energy baseline would be the total amount of energy in the year end before the EnMS is implemented (Hasan & Trianni, 2020). This study has been unable to demonstrate an energy baseline that be used to measure energy performance

2.3 International Standard (ISO 50001)

ISO 50001 is the latest energy management standard which is a successor of ANSI/MSE 2000 and EN 16001. The standard guides an organization to develop and implement a policy to identify significant areas of energy consumption and commit to energy reductions (Suruhanjaya Tenaga, 2019). Preliminary audit or walk-through is a process used to establish an overall picture the potential of energy saving through visual inspection of the premise including air-conditioning system, lighting, metering, building automation, building maintenance and other factors affecting energy consumption of the building (Ludin et al., 2019). The top management must demonstrate commitment to support implementation of the system and subsequently agree to continually improve it to ensure the EnMS will remain relevant and effective to bring benefits to the organization (Raza & Malik, 2019). However, this result has not fully described about the benefit gain from energy management implementation.

#### 2.4 Energy Management Plan

From the article, Energy management measures involve actions or activities which bring results in energy efficiency improvement in the organization, hence continuous improvement in managing energy. The scope may cover from identification of priority areas for energy evaluation, conducting and completing electrical energy evaluation to



reporting and submission to Energy Commission. So, we should recommend energy management to the building's owner if the total energy consumption equal or exceeding 3,000,000 kwh over any period not exceeding six months.

#### 3. Methodology

This chapter reviews related concepts of research methodology and point out the proposed research design for this study (Snyder, 2019). Also referring research methodology as the theory of how research should be undertaken. Research can be stated as an activity that involves finding out, in a systematic way (Huang et al., 2020).

#### 3.1 Research Design

Research design is used to collect the relevant data and technique to facilitate the smooth scaling of the various research operations making yielding maximal information. Research design is also provides backbone structure to researcher for planning of answering the research question or testing from hypothesis (Pawar, 2020). The development of a good research design permits us to obtain the best research data possible. In this chapter, researcher will explain related research methodology involve in finding result. Scientific research philosophy is a system of the research strategy (Khan et al., 2018). Positivism is the name for the scientific study of the social world. A law is a statement about relationships among forces in the universe. In positivism, laws are to be tested against collected data systematically (Govindarajo et al., 2021). Interpretivist approach is based on naturalistic approach of data collection such as interviews and observations (Dudovskiy, 2019). This research uses a qualitative approach.

#### 3.2 Research Instrument

i. Pilot Study is broad. A pilot study also has a specific design feature; it is conducted on a smaller scale than the main or full-scale study (In, 2017). Pilot studies are a fundamental stage of the research process. They can help identify design issues



and evaluate feasibility, practicality, resources, time, and cost of a study before the main research is conducted.

- ii. Document analysis is used in this research. Form of qualitative research that uses a systematic procedure to analyse documentary evidence and answer specific research questions (Bowen, 2021). This is based on theory that disposition positivism.
- Semi structured in-depth interviews are commonly used in qualitative research and are the most frequent qualitative data source (DeJonckheere & Vaughn, 2019). This method typically consists of a dialogue between researcher and participant, guided by a flexible interview protocol and supplemented by follow-up questions, probes and comments.
- iv. In this research, a cross-sectional was conducted in 3 commercial buildings in Malaysia for the reason an open-ended questionnaire has set on five points Likert scale was to get a more accurate and reliable opinion from respondents to evaluate the satisfaction level. In this research, a cross-sectional was conducted in 3 commercial buildings in Malaysia for the reason an open-ended questionnaire has set on five points Likert scale was to get a more accurate and reliable opinion from respondents to evaluate the satisfaction level.
- 3.3 Research sampling

Sampling is the process of selecting a group of people, institutions, places, or phenomena from a large group or research. The sample in this study consisted of experts with experience in energy efficiency practices (Berndt, 2020). Snowball sampling or chain-referral sampling is defined as a non-probability sampling technique in which the samples have traits that are rare to find (Fitriani et al., 2018). Because it is important to find a right person at the right way and right time. So, it prevents the researchers from consume more time. 50 total questionnaire is distributed only 30 responses. Ibrahim (2017) between 30 until 50 respondent is ideal and enough. Isaac & Michael (1995) 10 until 30 can be accepted as respondent.

#### 3.4 Validation



The validation is done by Energy Manager at SSRV company. He is a competent person that has knowledge of the requirement of the act and the regulations. Also, certification from REEM Malaysia and expert with experience in energy management implementation that fulfil an act EMEER 2008.

### 4. Findings

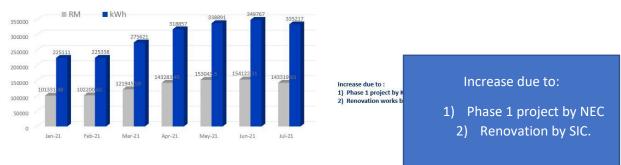
### 4.1 Preliminary audit



The highest kWh usage on April 26, 2022

Figure 4.1(a) shows a trend daily usage by MATRADE building.

From the figure 4.1(a) shows the highest kWh usage is on 26 April 2022. The result from the event that occur on the point date.

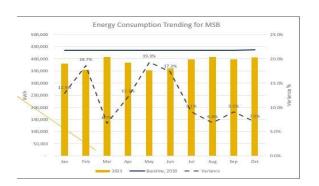


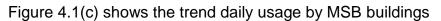
# **ELECTRICAL CONSUMPTION – EXCHANGE SQUARE**

Figure 4.1(b) shows the trend daily usage by Bursa Buildings



From the figure 4.1(b) the reason kWh become surprisingly higher is because contractor work due to Phase 1 project by KEC and Renovation Works by SIC.





From the figure 4.1(c) There are some increments in the Oct billing cycle due to PPN phase 3 moving to phase 4.

# 4.2 Conclusion

In a preliminary energy audit, readily available data are mostly used for a simple analysis of energy use and performance of the plant. This type of audit does not require a lot of measurement and data collection. These audits take a relatively short time, and the results are more general, providing common opportunities for energy efficiency. The economic analysis is typically limited to calculation of the simple payback period, or the time required paying back the initial capital investment through realized energy savings.

#### 5.Summary

The implementation of energy management is important to an organization to control over the energy consumption cost. Thus, increase corporate image and credibility among stakeholders, regulators, customers, prospective clients and public. The organisation of the EnMS, however, enabled many of the critical issues to be overcome, thereby affording considerable advantages: an effective retrofit action plan, which implies a reduction in energy consumption estimated over three years by 15%, and the improvement in the comfort conditions of tenants. As provided by the EN ISO 50001 Standard, a monitoring



phase of retrofitted buildings was started; therefore, in the future, possible gaps between the estimations and real amounts of energy reduction can be investigated. As the facilities and building getting old, the investments towards them in terms of maintenance also increase. Therefore, proper monitoring and assessments should not be left out so the conditions of the facilities including equipment systems, and buildings are in good shapes.

#### 5.1 Discussion

Energy efficiency is decisive for the success of any business. For this reason, the implementation of an Energy Management System is highly advisable. A key component of energy management is monitoring (Pierce & Paulos, 2012).Installation of an energy monitoring system (EMS) in some significant energy users to allow us to calculate the exact amount of energy used for each area or space.

A detailed analysis of the energy management systems standard ISO 50001:2011 was carried out from the viewpoint of sustainable development. The purpose of the analysis was to assess the effectiveness of its implementation, to identify the existence of gaps and to develop improvements capable of fulfilling the identified gaps (António da Silva Gonçalves & Mil-Homens dos Santos, 2019). Need to perform a Detailed Energy Audit (DEA) to enable energy individual profiling for each building and to identify areas of improvement in the future.

#### 5.2 References

- Alfaverh, F., Denai, M., & Sun, Y. (2020). Demand Response Strategy Based on Reinforcement Learning and Fuzzy Reasoning for Home Energy Management. *IEEE Access*, *8*, 39310–39321. https://doi.org/10.1109/ACCESS.2020.2974286
- António da Silva Gonçalves, V., & Mil-Homens dos Santos, F. J. (2019). Energy management system ISO 50001:2011 and energy management for sustainable development. *Energy Policy*, 133. https://doi.org/10.1016/j.enpol.2019.07.004

Berndt, A. E. (2020). Sampling Methods. Journal of Human Lactation, 36(2), 224-226.



https://doi.org/10.1177/0890334420906850

- Bowen, G. A. (2021). Document Analysis as a Qualitative Research Method | Glenn A Bowen - Academia.edu. Qualitative Research Journal, 13. http://www.academia.edu/8434566/Document\_Analysis\_as\_a\_Qualitative\_Researc h\_Method
- Cho, K. H., & Kim, S. S. (2019). Energy performance assessment according to data acquisition levels of existing buildings. *Energies*, 12(6). https://doi.org/10.3390/en12061149
- Dudovskiy, J. (2019). Interpretivism (interpretivist) Research Philosophy Research Methodology. In *Research Methodology* (p. no pagination). https://researchmethodology.net/research-philosophy/interpretivism/
- Halis, M., & Halis, M. (2022). Impact of energy management systems, pro-environmental energy consumption, and awareness on performance outcomes: a serial mediatedmoderated modeling with PLS-SEM. *Environmental Science and Pollution Research*, 29(18), 26910–26921. https://doi.org/10.1007/s11356-021-17867-8
- Hasan, A. S. M. M., & Trianni, A. (2020). A review of energy management assessment models for industrial energy efficiency. *Energies*, 13(21). https://doi.org/10.3390/en13215713
- Huang, J., Lai, Y., Wang, Y., & Hao, Y. (2020). Energy-saving research and development activities and energy intensity in China: A regional comparison perspective. *Energy*, 213. https://doi.org/10.1016/j.energy.2020.118758
- In, J. (2017). Introduction of a pilot study. *Korean Journal of Anesthesiology*, *70*(6), 601–605. https://doi.org/10.4097/kjae.2017.70.6.601
- Khan, M. Z., Khan, M. F., Aslam, M., & Mughal, A. R. (2018). Design of fuzzy sampling plan using the Birnbaum-Saunders distribution. *Mathematics*, *7*(1). https://doi.org/10.3390/math7010009
- Kwon, K., Lee, S., & Kim, S. (2022). AI-Based Home Energy Management System Considering Energy Efficiency and Resident Satisfaction. *IEEE Internet of Things Journal*, 9(2), 1608–1621. https://doi.org/10.1109/JIOT.2021.3104830
- Ludin, N. A., Junedi, M. M., Affandi, N. A. A., Ibrahim, M. A., Sopian, K., Teridi, M. A. M., Sepeai, S., Su'ait, M. S., & Haw, L. C. (2019). Energy efficiency action plan for a



public hospital in Malaysia. *Alam Cipta*, 12(Special Issue 1), 73–79.

- Mardani, A., Zavadskas, E. K., Khalifah, Z., Zakuan, N., Jusoh, A., Nor, K. M., & Khoshnoudi, M. (2017). A review of multi-criteria decision-making applications to solve energy management problems: Two decades from 1995 to 2015. *Renewable* and Sustainable Energy Reviews, 71(November 2016), 216–256. https://doi.org/10.1016/j.rser.2016.12.053
- Mavragani, A., & Ochoa, G. (2019). Google trends in infodemiology and infoveillance: Methodology framework. In *JMIR Public Health and Surveillance* (Vol. 5, Issue 2). JMIR Publications Inc. https://doi.org/10.2196/13439
- Monacchi, A., Versolatto, F., Herold, M., Egarter, D., Tonello, A. M., & Elmenreich, W. (2015). *An Open Solution to Provide Personalized Feedback for Building Energy Management*. http://arxiv.org/abs/1505.01311
- Raubenheimer, J. E. (2021). Google Trends Extraction Tool for Google Trends Extended for Health data. *Software Impacts*, *8*. https://doi.org/10.1016/j.simpa.2021.100060
- Raza, A., & Malik, T. N. (2019). Energy management in commercial building microgrids. *Journal of Renewable and Sustainable Energy*, *11*(1). https://doi.org/10.1063/1.5034352
- Strielkowski, W., Firsova, I., Lukashenko, I., Raudeliūniene, J., & Tvaronavičiene, M. (2021). Effective management of energy consumption during the COVID-19 pandemic: The role of ICT solutions. *Energies*, *14*(4). https://doi.org/10.3390/en14040893
- Suruhanjaya Tenaga. (2019). Malaysia energy statistics handbook 2019. Suruhanjaya Tenaga (Energy Comm), 1–86.
- Vučković, A., & Pitić, G. (2022). New technologies in energy management systems of buildings. *Ekonomika Preduzeca*, 70(1–2), 75–86. https://doi.org/10.5937/ekopre2202075p



# EFFECTIVE OF INVENTORY MANAGEMENT AND STORAGE CONTROL

## Muhammad Hafizuddin Md Teni<sup>1</sup>,Ahmad Luqman Hakimi Azhar<sup>2</sup>, and Akmal Husna Hj Yusup<sup>3</sup>

<sup>2</sup> Mechanical Engineering Department, Politeknik Ungku Omar, Ipoh, Perak Mhafizzuddin33@gmail.com, Ihakimii98@gmail.com

> Company ABC Bukit Beruntung, Selangor akmalhusna.pst@gmail.com

#### Abstract

The main objective of this project is to implement proper inventory management at the CKD area. While the existing storage rack is already good, new designs and methods need to be done for improvements in terms of reducing costs and controlling incoming stock suppliers. The objectives of this project are to complete the fabrication of flow racks using appropriate methods of the FIFO system to minimize holding costs and reduce the hours of preparing items. By studying the appropriate designs and methods for storage layouts for new flow rack fabrications, the work of incoming and storing goods becomes more organized by using the XYZ analysis method and easier to pick up during packing time. In addition, cost-saving factors will also be taken for observation in this project. Data collection and evaluation for the fabrication of flow racks and the effectiveness of the methods performed for the convenience of employees will be made to study the effectiveness of the results of the improvements made.

**Keywords:** Inventory Management, CKD area, FIFO System, Reducing Cost, Flow Rack, XYZ Analysis

#### 1. Introduction



At Company ABC, the store department supplies child parts to the blow line and assembly line and supply materials for the production line. Next, the store officer is

responsible to receive parts and materials from a supplier and verifying labels and quantities against the purchase order. Storing items and materials in appropriate and suitable locations so that they may be found quickly is also the main task of the store department. Other than that, the store department also needs to issue materials to various departments in accordance with material request slips approved by the appropriate department heads and establish a well-organized inventory management system, including doing physical inventories of all stores at regular intervals and maintaining accurate inventory records.

One of the storage areas for child part items at a store is called the CKD area. CKD means Completely Knocked Down. This area stores child parts for vehicles like clips, screws, and sponges before sending it for the assembly process. There are types of child parts located in the CKD area. Proper layout is important in the CKD area to prevent excess parts that can cause high holding costs. The main purpose of this project is to control and monitor incoming and outgoing stock, visualize FIFO, and minimize holding costs by month.

#### **1.1 Problem Statement**

The problems that we faced are no proper inventory management and control method, uncontrol excess parts for storage, no differentiate items due to the same poly box, difficulty for employees to identify specific quantities of parts in each box and no specific arrangement of the part. The main target of this project is also to control excess parts and reduce the holding cost. Many excess parts can cause a high cost of holding costs.

The objectives of this project are:

i. To control and monitor incoming and outgoing child parts that take out from inventory stock



- ii. To design a new rack system with the FIFO (first in first out) system method of the item for traceability
- iii. To reduce and control holding costs by 10 %
- iv. To reduce the Lost Hour with a new layout implemented

The scope of this study is in the CKD area. The improvement is to focus on the CKD area at the store for employees to follow the proper work process. The project will be focused on rearranging the items at the CKD area. The improvement includes visualisation of FIFO with a new layout implemented.

#### 2. Literature Review

Inventory management is the process of tracking and managing inventory levels while also providing effective restocking to meet consumer demand. (Surbhi Mishra, Sourabh Tege, Vishnu Agarwal, 2017) Inventory ties up money and has an impact on performance, therefore determining the optimum inventory level is critical. Profits are much higher with the optimum policy than with cost-based inventory policies, highlighting the importance of profit-driven inventory management.

Inventory management refers to the whole inventory management system. Inventory management is the technique of monitoring and maintaining inventory levels to meet customer demand. (<u>Priniotakis, G., & amp; Argyropoulus, P. 2019</u>) To keep their inventory expenses under control, several firms have used basic inventory management or inventory control approaches. Inventory management is the process of maintaining and monitoring inventory levels to ensure effective restocking to satisfy customer demand. (<u>Priniotakis, Georgios & Argyropoulos, P. 2018</u>)

The corporation must keep track of incoming and departing raw material inventories to determine current stock levels and determine when to buy items from suppliers to avoid inventory voids when customers place orders. FIFO System: FIFO is a First in First Out system which says, "the component which comes first has to dispatch or issue first". This system will support component tracking, which will be beneficial in



keeping OEM (Original Equipment Manufacturer) records. (<u>Trubchenko, T & Kiseleva, E</u> <u>& Loshchilova, M. & Dreval, A & Ryzhakina, T & Shaftelskaya, N. 2020)</u>

ABC and XYZ analysis are methods of work and multi-product inventory grouping procedures explained in detail in professional literature. (H M, M., & amp; Appaiah, S.

2017) XYZ Analysis is a three-category classification of components based on variations in demand, and it gives you the information you need to make stock management decisions. The analysis' findings allow for the division of inventories into groups based on the accuracy of forecasting and/or the regularity of demand for certain material groupings. There are three types of materials in the XYZ analysis, which may be stated as follows:

Group X – Components are less demand from production. The demand is below the 10% required by production.

Group Y – Components are having moderate demand of 10-25%.

Group Z – The group of components that have a high demand for production. The demand is from 25% to 100% of usage from production.

#### 3. Methodology

#### 3.1 Introduction

This chapter will provide a detailed explanation of the methodology that has been applied to complete and successfully complete this project.

#### 3.2 Project Phase

The PDCA cycle was developed with the objective of providing a model for the continuous improvement of the processes. The PDCA approach is beneficial for making continual changes without stopping, which is more future-oriented, flexible, logical, and reasonable



to accomplish, and it includes a description of all plan elements. (S. Isniah, H. Hardi Purba, and F. Debora, 2020)

i. Plan – Identify the problems and state the objective of the project.

Discussion and Briefing Ideas, Project Planning, Method Research and Study, Design Study

ii. Do - monitoring and run the trial

Project development and implementation, Analyzing for improvement

iii. Check – analyze and collect data.

iv. Act – implementation and adopt

The final observation of the project.

#### 3.3 Flow Chart

The flow chart's objective is to equip users with a common language. (<u>Roopa, S & Menta</u> <u>Satya, Rani. 2012</u>) A flowchart is important for illustrating the sequence of processes required to complete a project. It illustrates a process by using symbols.



2<sup>nd</sup> National Conference on TVET Undergraduate Students (NCTS) Politeknik Tuanku Syed Sirajuddin 19-20 July 2022

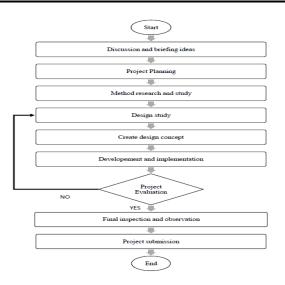


Figure 3.1 Project Flow Chart

#### 3.4 Research Design

The detailed tool design drawings will explain more clearly the layout of the parts or components of this design. The dimensions of the drawing are in millimetrer (mm).

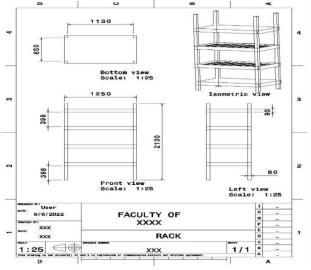


Figure 3.2 Design of The Flow Rack

The figure 3.2 shows the drawing of the flow rack. Dimension of the parts were stated in the drawings. The measurement of each part was stated in millimetres (mm).



#### 3.5 Tools Used for Improvement

For the improvement of this project, there are several tools and requirements that need to be used to complete the project. The tools and requirements that are needed:

#### i. Microsoft excels

						USAGE			FC	RMULA	
PARTMANE	PARTNO	MODEL	TYPES	VENDOR	0.121	Nov-21	Dec 21	Mean	Standard Deviation	Variation	Grade (1//1/7
cur/with:	0535 00467-20203	003L	CHLD PART-	F1450	0	•	۰	0.0	0.0	9%	
IM PRIMER KS20-SLTR	051A 8520		CHLO PART	2458	٥	0	0		0.0	0%	1
NOT MELT GUE STICK	SIRS-GLUE HOTMELT		CHLO FART	7458	1.	٥	٥	6.5	0.5	0%	×
a.#	000N 90457 05171-CHD	0534	CHLO PART (XQ	P5453	44000	43000	29030	41000.0	2160.2	5%	
cu#	0425 90468-05335-CKD	0421	CHLD PART-	FUM	6900	5100	6000	6000.0	408.2	75	]
SCREW, OVAL COUNTER SUNK TAPPING	020N 90043-62504	0334	CHILD PART	P1450	0245	7110	2623	7031.3	1462.4	12%	
CUBIEDN, GLOVE COMPARTMENT DOOR CHECK	500N 55557 40040	0514	CKD	P5418	6548	7366	5548	7646.7	1444.8	16%	1
CUP DESD	0421 90044-05226-010	DH2L	CHILD PART CKO	FOM	65035	54000	90000	51038.5	11242.0	12%	
CUSHION, GLOVE COMPARTMENT DOOR CHECK	5431 55557-82040-CHD	D421	CHILD PART-	PGM	11580	10518	7060	5632.7	2021.1	215	
SCREW OVAL COUNTER SUNK TAPPING	0425 9096-62654-069	0421	CHILD PART CKD	FUM	11100	9 58 1	65/5	9023.0	1004.0	225	
SCREW TAPPING	043L 53540-53012-0X0	D421	CHLD FART	PGM	44900	17758	25076	35911.3	1157.8	23%	1
SCROW TAPPING	020N 93567-35654-CRD	0514	CHILD PART CKD	PMSS	2200	3309	1000	\$158.5	760.5	24%	1
C.P	020N 900H4-68336-CHD	0514	CHLD FART	PSesa	11000	26000	25000	20666.7	6947.5	11%	
SCROW, TAPPING	0531 55567-15014-060	DIG	CHILD PART	PMS8-OOD	121.76	11590	5582	9106.0	3914.1	43%	,
ICROW TAPPING -N2 TUMPOL	0531 53548-15014	0531	CHLD FART CKD	PMSB-CKD	2226	3140	744	1406.7	1178.4	40%	1 1
CUP	038.90467-00581-000	DISL	CHILD PART	PM38	20000	50000	59010	32666.7	19759.7	51%	

Figure 3.3 Microsoft Excel

Microsoft excels is used as software to calculate and analyse inventory holding cost, total lost hour, generate XYZ analysis table and convert work hours to labour cost. By choosing this software, THE calculation of the data is easier and more effective.

ii. FIFO Roller Type 60



Figure 3.4 FIFO Roller Type 60

FIFO roller is one of the tools used for inventory management. The roller makes the rotation of the inventory stock easier and more effective. The length of the roller is cm. The total of the roller needed is 8 pieces for each level.

iii. Measuring tape





Figure 3.5 Measuring Tape

A measuring tape is used to measure the length of things that require measurement. Every part of the rack needs accurate measurement to ensure no gap between the parts.

iv. Stopwatch



Figure 3.6 Stopwatch

A stopwatch is used to measure the time required for preparing the child part. Time taken was recorded in minutes and seconds.

# 4. Result and Discussion

For this chapter, all findings throughout this project will be discussed on this topic. The method used is research, XYZ analysis, collecting data on a monthly basis and questionnaires This chapter also exposed the expected result and data analysis of the project.



#### 4.1 XYZ analysis

						USAGE			FC	RMULA	
PART NAME	PART NO	MODEL	TYPES	VENDOR	Oct-21	Nov-21	Dec-21	Mean	Standard Deviation	Variation	Grade (X/Y/Z)
CLIP,WHITE	D53L 90467-10201	DS3L	CHILD PART	PMSB	0	0	0	0.0	0.0	0%	
3M PRIMER KS20-1LTR	D51A K520	-	CHILD PART	ZASB	0	0	0	0.0	0.0	0%	
HOT MELT GLUE STICK	SUBS-GLUE HOT MELT		CHILD PART	ZASB	1	0	0	0.3	0.5	0%	×
CLIP	D20N 90467-05171-CKD	D51A	CHILD PART	PMSB	44000	43000	39000	42000.0	2160.2	5%	
CLIP	D42L 90468-05135-CKD	D42L	CHILD PART	PGM	6500	5500	6000	6000.0	408.2	7%	
SCREW, OVAL COUNTER SUNK TAPPING	D20N 90041-62504	D51A	CHILD PART	PMSB	6048	7816	9630	7831.3	1462.4	19%	
CUSHION, GLOVE COMPARTMENT DOOR CHECK	D20N 55557-82040	D51A	CHILD PART	PMSB	6048	7344	9548	7646.7	1444.8	19%	
CLIP D63D	D42L 90044-68336-CKD	D42L	CHILD PART	PGM	65031	54000	40000	53010.3	10242.8	19%	1
CUSHION, GLOVE COMPARTMENT DOOR CHECK	D42L 55557-82040-CKD	D42L	CHILD PART	PGM	11580	10918	7000	9832.7	2021.1	21%	¥
SCREW OVAL COUNTER SUNK TAPPING	D42L 90041-62054-CKD	D42L	CHILD PART	PGM	11100	9381	6576	9019.0	1864.6	21%	
SCREW TAPPING	D42L 93540-53012-CKD	D42L	CHILD PART	PGM	44900	37758	25076	35911.3	8197.8	23%	
SCREW TAPPING	D20N 93567-15014-CKD	DS1A	CHILD PART	PMSB	2100	3509	3860	3156.3	760.6	2.4%	ĺ
CLIP	D20N 90044-68336-CKD	D51A	CHILD PART	PMSB	11000	26000	25000	20666.7	6847.5	33%	
SCREW, TAPPING	D53L 93567-15014-CKD	DS3L	CHILD PART	PMSB-CKD	12176	11560	3582	9106.0	3914.1	43%	z
SCREW TAPPING -X2 TUMPOL	D53L 93568-15014	DS3L	CHILD PART	PMSB-CKD	3336	3140	744	2406.7	1178.4	49%	2
CLIP	D38L 90467-10161-CKD	D38L	CHILD PART	PMSB	10000	50000	38000	32666.7	16759.7	51%	

Figure 4.1 XYZ Analysis

Figure 4.1 shows the result of the XYZ analysis. The data was calculated within 3 months by using the mean, standard deviation and variation formula. Then, the calculated data was sorted and divided into different XYZ grades. The lowest usage of the items within 3 months is the clip, white which is 0% of usage while the most frequent item used within 3 months is the clip which is 51%. The data were categorised into 3 different grades. For the X grade, the data is between 0% to 10%. For the Y grade, the data need to be between 11% to 25%. The Z grade is the most frequent item used which is start from 26% to 100%. After the data was sorted, we can identify the most demand items requested from production within 3 months. By using XYZ analysis forecasting, the items can be easily sorted on the rack.

#### 4.2 Daily Inventory Stock Status

				DA	TE:		3	0/11	/202	1			EN	
:	NAME PART	PART NO	UNIT PRICE	UM	STAD PCKG	FREQ	LEAD TIME	MIN STOCK	MAX STOCK	CONTR	STOCK IN HAND	ă≻	STATUS	SYMBO
1	SCREW TAPPING -X2 TUMPOL	D53L 93568- 15014	RM0.0170	PCS	30000	WEEKLY	1 WEEK	9000	45000		45000	5.00	этоск ок	
z	SCREW, TAPPING	D53L 93567- 15014-CKD	RM0.0170	PCS	3000	WEEKLY	1 WEEK	9000	45000	5	64862	7.21	EXCESS	1
з	CLIP	D20N 90044- 68336-CKD	RM0.0110	PCS	10000	WEEKLY	I WEEK	20000	100000	5	84000	4.20	RE-DRDER	
4	CLIP	D20N 90467- 05171-CKD	RM0.0900	PCS	3000	WEEKLY	1 WEEK	20000	100000	5	31000	1.55	RE-DRDER	
5	CUSHION, GLOVE	D20N 55557- B2040	RM0.0020	PCS	10000	WEEKLY	1 WEEK	10000	50000	5	2000	0.20	CRITICAL	×
6	SCREW, OVAL COUNTER SUNK	D20N 90041- 62504	RM0.0150	PCS	30000	WEEKLY	I WEEK	20000	100000	5	140748	7.04	EXCESS	1
7	SCREW TAPPING	D20N 93567- 15014-CKD	RM0.0150	PCS	3000	WEEKLY	I WEEK	9000	45000	5	64226	7.14	EXCESS	
	CLIP	D38L 90467- 10161-CKD	RM0.0120	PCS	1000	WEEKLY	I WEEK	20000	100000		58000	2.90	RE-DROER	
,	CLIP, WHITE	D53L 90467- 10201	RM0.0900	PCS	1000	WEEKLY	1 WEEK	2000	10000	5	10500	5.25	STOCK OK	
10	CLIP	D42L 90468- 05135-CKD	RM0.0110	PCS	1000	WEEKLY	1 WEEK	20000	100000	5	9453	0.47	CRITICAL	×
	CLIP D63D	D42L 90044- 68336-CKD	RM0.0110	PCS	1000	WEEKLY	1 WEEK	20000	100000	5	120000	6.00	STOCK OK	
12	CUSHION, GLOVE	D42L 55557- B2040-CKD	RM0.0020	PCS	10000	WEEKLY	1 WEEK	10000	50000	5	22748	2.27	RE-ORDER	
13	SCREW OVAL COUNTER SUNK	D42L 90041- 62054-CKD	RM0.0150	PCS	30000	WEEKLY	I WEEK	20000	100000	5	51073	2.55	RE-DRDER	
14	SCREW TAPPING	D42L 93540- 53012-CKD	RM0.0150	PCS	•	WEEKLY	I WEEK	20000	100000	5	141412	7.07	EXCESS	

Figure 4.2 Daily Stock Status



Figure 4.2 shows the total parts at the CKD area. There are 14 items that need to be monitored and supervise every month. The data for the items was listed using Microsoft Excel.

TOTAL	SYMBOL	RANGE	%
EXCESS		7>	23
STOCK- OK		5~7	30
RE- ORDER		1~5	39
CRITICAL	×	<1	8

Figure 4.3 Daily Stock Status

By the end of the month, the staff will monitor and supervise. The number of the excess part will be summarised in figure 4.3 for the monthly inventory KPI. The control of the stock for each item is 5 days. The status will be changed to re-order when the items reach between 1 to 5 days. The critical status will appear if the control stock for the items is below 1 day. The range of the stock-ok status will appear when the stock is in hand between 5 to 7 days.

DATE	1-Dec	2-Dec	3-Dec	6-Dec	7-Dec	8-Dec	9-Dec	10-Dec	13-Dec	14-Dec	15-Dec	16-Dec	17-Dec	20-Dec	21-Dec	22-Dec	23-Dec	24-Dec	27-Dec	28-Dec	29-Dec	30-Dec
DAY	MON	TUE	WED	THU	FRI	MON	TUE	WED	THU	FRI	MON	TUE	WED	THU	FRI	MON	TUE	WED	THU	FRI	MON	TUE
total Item	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
EXCESS	3	4	4	4	4	4	5	4	4	4	4	4	3	5	5	4	4	4	5	4	4	4
stock- ok	3	2	4	4	3	3	1	4	3	3	2	2	2	3	4	3	2	1	3	3	2	2
re- Order	6	8	6	5	6	4	6	6	7	6	6	6	7	6	5	6	6	6	5	5	5	5
CRITICAL	2	0	0	1	1	3	2	0	0	1	2	2	2	0	0	1	2	3	1	2	3	3

Figure 4.4 Daily Stock Status

Figure 4.4 shows the daily stock status data recorded in a month. Every status of the items is divided into 4 columns. The staff will update the status of the items every day. The data was recorded for 6 months and the data was recorded starting from November 2021, December 2021, January 2022, February 2022, March 2022 and April 2022.



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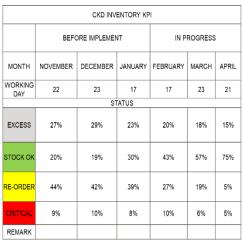
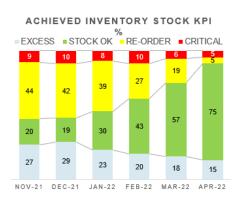


Figure 4.5 CKD Inventory KPI

Figure 4.5 shows the CKD Inventory KPI at Store Department. Before the new method was implemented, the excess part is over the KPI limit which is 15% for the excess part. For stock ok, the range of the items that need to achieve the KPI is 75%. Both re-order and critical items are only. The project was made at the end of January and the progress had showed a positive result. Starting from February 2022, the excess part had decreased by 3%, and achieved the KPI in April 2022 which is 15%. Even though the critical, re-order and stock show the positive output throughout after the project was implemented.



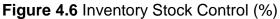


Figure 4.6 shows the inventory stock control bar graph of the KPI achieved started from November 2021 to April 2022. The trend of the data shows the decreasing trend of excess parts and the increasing trend for stock-ok, re-order and critical which are acceptable for inventory stock. Overall, the stock is still safe for 5 days of usage. Some of the parts are critical due to the high request from production.



## 4.3 Inventory Checking on FIFO

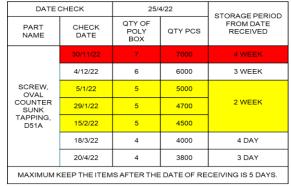


Figure 4.7 FIFO Inventory Checking

Figure 4.7 shows the number of poly boxes stored for more than 5 days. On 30 November, the total of the items that store for more than 5 days is 7 poly boxes. In this month, there is no inventory management and control was implemented at the CKD area. The rotation of the items is poor and the old items are still on the rack. During the progress of the project, the result shows the number of the items had achieved the maximum stock which is 5 days. On April, the total of the poly box is 4 which achieved the required KPI at the CKD area.

# 4.4 Inventory Holding Cost



Table 4.1 Inventory Holding Cost (RM) by Month





Table 4.1 and figure 4.8 show the total inventory holding costs. Before the project was implemented, the total inventory holding is RM32543.66. the highest inventory cost is in December 2021 which is RM11140.40. After the project was implemented, it shows a gradually decrease in inventory cost. On April 2022, the total inventory cost is RM9442.50. Company ABC saves up to RM1475.53 which is 13% of cost savings.

#### 16% 16% PROCESS PREPARATION PART NAME PROCESS TOTAL TIME 4 PRINT MRF PRINT MRF 8% 12 PICK ING PART PICKING PART PROCESS FOR PREPARING CHILD PARTS FOR NOV 2021 PACKING PACKING 25 3 CHECKING 2 CHECKING 12% SEND TO ASSEMBLY SEND TO ASSEMBLY 4 25 minutes **48%** TOTAL

# 4.4 Total lost hours

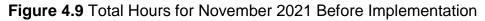


Figure 4.9 shows the Total Hours for November 2021 Before Implementation. Before the implementation of the project, the time taken was recorded to staff (Stocker) for preparing child parts to the assembly line. On November 2021, the average time taken for staff (Stocker) to prepare child parts for each MRF is 25 minutes. The phase of the picking part is the highest time required because there is no proper layout arrangement at the rack. So, the staff (Stocker) needs to walk around to pick up the items. The staff (Stocker) take to more to for preparing each request. The time taken needed to picki the part is 12 minutes which is take 48% of the overall process.

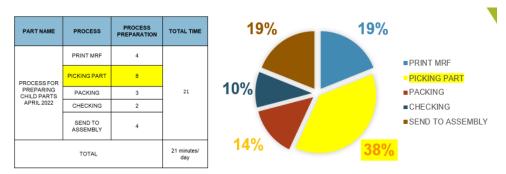


Figure 4.10 Total Hours for January 2021 After Implementation



After the project was made, the new time taken was recorded on April 2022. Figure 4.10 shows the average time required to prepare child parts for assembly is 21 minutes. The time taken needed to pick the part is 8 minutes which only takes 38% of the overall process. The proper implementation of inventory management and control had achieved the objective which is to reduce the lost hour after the new layout was implemented.

MONTH	Nov-21	Dec-21	Jan-22	Feb-22	Mar-22	Apr-22
WORKING	22	22	17	17	23	21
DAYS	22	22	17	17	25	21
AVG TIME	25	27	24	23	22	21
TOTAL	FEO	594	409	201	5 <b>0</b> 6	441
HOURS	550	594	408	391	500	441
HOURS	9.16	10.3	7.2	<mark>6.5</mark> 1	8.43	7.35

 Table 4.2 Total Work Hours by Month

#### TOTAL HOURS



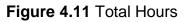
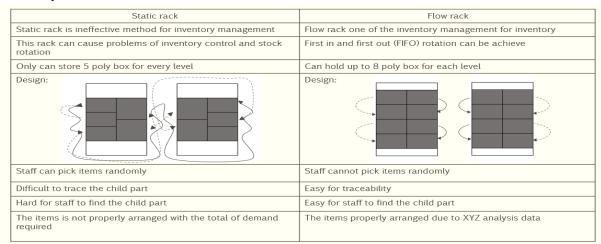


Table 4.2 and figure 4.11 show the total hour required for staff (stocker) to prepare the child part. Before the project was implemented, the average time required is 25 minutes. After the project was implemented, it only took 21 minutes for every preparation. Overall, the time was reduced and achieved the stated objective.





#### 4.4 Comparison between the static rack and flow rack

Figure 4.12 Different between the static rack and flow rack

Figure 4.18 shows the difference between the static rack and the flow rack. Firstly, the static rack is an ineffective method for inventory management and control while the flow rack is one of the most effective inventory management. Second, the static rack can cause problems in inventory control and stock rotation, but the low rack can implement the FIFO system easily. After that, the static rack only can hold up to 5 poly boxes for each level. After improvement had been made, the flow rack can hold up to 8 poly boxes for every level. The staff (Stocker) need to walk around to pick the items for the static rack while they only need to load at the back and pick the items in front of the rack. In conclusion, the flow rack gives good feedback for staff (Stocker) to prepare child parts for assembly.

# 4.5 Staff Feedback and Evaluation for Effectiveness of Inventory Control and Management

The new method was tested by 15 staff. After the method was tested, the staff need to answer 2 types of surveys which are questionnaires before and after the project was implemented. Most of them agree with the new method after implementation. Moreover, most of them agree with the new method compared to the current method.



	Table 4.3 Ques	stionnaire B	efore Imple	mentation o	of New Method	
No	Current method	Strongly Disagree	Disagree	Neutral		Ag ree Strongly Agree
	used at CKD area	1	2	3	4	4 5
	Current method is					
1	difficult to prepare child parts	0	6.67%	6.67%	46.7%	40%
	Current method takes					
2	more time to prepare child parts	0	0	0	40%	60%
3	Current method is hard for traceability	0	0	26.67%	40%	33.33%
4	Current method is hard to use	6.67%	0	26.67%	26.7%	40%
	Current method gives					
5	me an awkward	0	0	0	46.7%	53.33%
	posture Current method is hard for me to					
6	segregate child parts by the FIFO sticker date	0	0	33.33%	46.7%	20%
7	Current method is hard for FIFO rotation	0	0	33.33%	20%	46.7%



	Table 4.4 Question	naire After Iı	mplementati	on of Nev	w Method	
No	New method applies at	Strongly Disagree	Disagree	Neutra I	Agree	Strongly Agree
	CKD area	1	2	3	4	5
1	I was able to prepare the child part easily	0	0	20%	53.33%	26.66%
2	The new layout with the implementation of the FIFO system saves more time than before.	0	0	13.33 %	46.67%	40%
3	The system is easy for traceability.	0	0	20%	46.67%	33.33%
4	In general, I found the new implementation of inventory management is easy to use.	0	0	6.67%	33.33%	60%
5	The new layout gives me more comfortable while preparing child parts	0	0	13.33 %	53.33%	33.33%
6	I can segregate the child parts by the date of the FIFO sticker.	0	0	33.33 %	26.66%	40%
7	The child parts are easy for FIFO rotation.	0	0	13.33 %	40%	46.67%

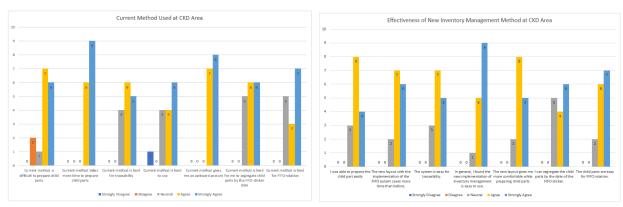


Figure 4.13 Bar Graph Respondent Feedback



Figure 4.13 shows the bar graph for the results of the respondent feedback regarding the existing method. The majority of the respondent indicate on a scale of 3 and above which they agree with the new method. The respondent needs to fill the questionnaire by indicating from rating 1 to rating 5 which rating 1 strongly disagrees and 5 strongly agree.

#### 5. Conclusion

In conclusion, the implementation of inventory management and control is helpful in solving the problems which are related to inventory management at the CKD area. This project helps in reducing inventory costs and controlling incoming and outgoing parts. From no inventory management and control method then upgrade to proper inventory management solution; implement FIFO, XYZ forecast analysis. The company seems can adopt the suggested method for better inventory control of priority scheduling and fabricating new flow racks for storage. By making XYZ forecast analysis, the time taken to prepare child parts is lesser than the static rack. The allocation of the child parts is easy to grab by using XYZ analysis which places the child parts with respect to their importance. Overall, the project has achieved the objectives and gives a lot of benefits to staff (Stocker).

#### References

- H M, M., & Appaiah, S. (2017, June 6). Stabilization of FIFO system and inventory management. www.irjet.net. Retrieved January 23, 2022
- Surbhi Mishra, Sourabh Tege, Vishnu Agarwal, 2017, Analysis of Inventory Management Performance – A Case Study, INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH & TECHNOLOGY (IJERT) Volume 06, Issue 03 (March 2017)
- Priniotakis, G., & amp; Argyropoulus, P. (2019). Inventory Management Concepts and Techniques. Retrieved June 19, 2022
- Priniotakis, Georgios & Argyropoulos, P. (2018). Inventory management concepts and techniques. IOP Conference Series: Materials Science and Engineering. 459. 012060. 10.1088/1757-899X/459/1/012060.



- Trubchenko, T & Kiseleva, E & Loshchilova, M. & Dreval, A & Ryzhakina, T & Shaftelskaya, N. (2020). Application of ABC and XYZ Analysis to Inventory Optimization at a Commercial Enterprise. SHS Web of Conferences. 80. 01007. 10.1051/shsconf/20208001007.
- S. Isniah, H. Hardi Purba, and F. Debora, "Plan do check action (PDCA) method: Literature Review and Research issues," Jurnal Sistem dan Manajemen Industri, vol. 4, no. 1, pp. 72–81, 2020.
- Roopa, S & Menta Satya, Rani. (2012). Questionnaire Designing for a Survey. The Journal of Indian Orthodontic Society. 46. 37-41. 10.5005/jp-journals-10021-1104.



# DEVELOPMENT OF ELECTRONIC AUTOMATED BAG VALVE MASK (BVM) FOR RESPIRATORY PROBLEM WITH IOT

Batrisyia Binti Zalani<sup>1</sup>, Nurul Huda Binti Mohamd Saleh<sup>2</sup>

Department of Electrical Engineering, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor, Malaysia. batrisyiazalani@gmail.com, hudasalehpoli@gmail.com

#### Abstract

Bag Valve Mask (BVM) is a flexible reservoir bag used for artificial ventilation connected by tubing and a non-rebreathing valve to a face mask to provide positive pressure ventilation to a patient who is not breathing or breathing inadequately. However, the high demand and prices for ventilators makes it difficult to get breathing aid at hospital . An automated low-cost Bag Valve Mask was developed to help provide emergency breathing aid to patients with IoT technology on the Blynk application for the easy monitoring system. The project involving software Arduino that combines with motor for compressing air deliver to the patient. The Node MCU is for IoT technology where parameter readings are sent through the mobile phone to facilitate the nurse or health staff to monitor the patient's breathing.The result this device can be as a breathing aid to the patient in emergency which provide the breathing mode tidal volume from 350-700mL, breathing rate from 12-40 bpm and range I/E ratio. As the conclusion, this device can be portable and widely used at the centre and ambulance.

**Keywords:** Respiration, Portable, Bag Valve Mask (BVM), Automation, Emergency, Monitoring

#### 1. Introduction

Breathing is a necessary part of existence, and it is controlled by an unusual arrangement of the entire body. When the respiratory system is harmed by contamination



due to infection or other respiratory illnesses, the natural symphony shifts into a condition of respiratory disappointment. When this happens, the mechanical ventilator (MV) becomes a common breathing aid that should also protect the lungs from further injury(Islam et al., 2020). It provides a positive aviation routelt becomes challenges in getting a mechanical ventilator at the hospital due to the very limited use of ventilators as well as the very high price(Chauhan et al., 2020). Next, the previous BVM very not practical to the patient because of the patient have to compress manually to use and the BVM comes with no indicator indicator that causing patient to only take guesses in delivering air to patient (Petsiuk et al., 2020). This might be life threatening to the patient as it can cause further damage to the patient's lung(Vicente et al., 2016). The objective of this project is to develop an automated Bag Valve Mask as an emergency aid life support to the patient with other respiratory problem by linear actuator mechanism using servo motor. This device is designed for the usage on ambulance and hospital as an initial respiratory aid before further action. This device focuses on delivering oxygen to patients with had respiratory problem such as short breaths, asthma, and chest pain that may require breathing aid support to circulate oxygen in the body to prevent more serious. The goals of this project will be widely used in hospitals and the use of ambulances as a portable life support to treat the patient can restore breathing in a short time which will increase the oxygen in the blood.

#### 2. Literature Review

#### 2.1 Bag Valve Mask

The Bag Valve Mask often known as a "self-inflating bag," is a hand-held device that delivers positive pressure ventilation to the respiratory system of patients who are incapable or insufficiently breathing(Jacob, Divya, 2020). After first inventing a medically innovative suction pump, it was invented by German engineer Holger Hesse and his codeveloper, Danish anaesthetists Henning Ruben in 1953. The device is commonly used in hospitals as part of the standard equipment found in every emergency room and critical care institution. The use of manual resuscitators to provide ventilation to a patient is commonly referred to as "bagging" the patient, and it is frequently required in medical crises when the patient's breathing is considered insufficient or has entirely stopped.



## 2.2 Types of Bag Valve Mask (BVM) Compression Mechanism

### 2.2.1 BVM – Based Ventilator Mechanical Design Components

The compression mechanism transfers rotary motion from the motor to linear oscillating motion required for cyclical compression of the BVM via the mechanism drive. Power is transferred from the motor to the mechanism via the compression drive. The compression pad or plate is connected to the compression mechanism and oversees forcing the BVM into place. For a 1-side compression mode of operation, the cradle holds the BVM in place and provides reactive force to the compression force. Finally, the frame connects the mechanical components.(Calilung et al., 2020).The method compressing BVM- Based Ventilator Mechanism is shown in Figure 1.

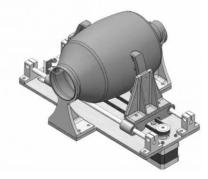


Figure 2: BVM – Based Ventilator Mechanism(REAL, 2020)

#### 3. Methodology

This section is explained about the process and the method to implementing this study with successful that consist designing and implementation of hardware part of the automated bag valve mask, block diagram of the operating system, making flow chart of the operation device, and. The method is use to achieve the objective of the project that adding the automation concept on compressing the BVM.



#### 3.1 Designing and implementation of hardware of the automated bag valve mask

Figure 2 illustrates the design of the automated bag valve mask. The component that used in developing this device is bag valve mask, servo motor, smartphone, and control box.

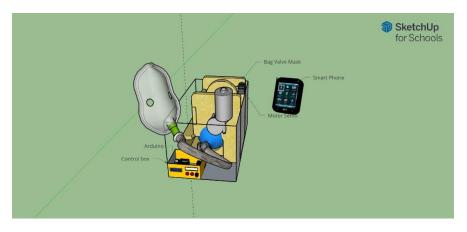


Figure 2: Design of Automated Bag Valve Mask

The automated bag valve mask cosist control box that included Arduino Uno as a microcontroller, three input knobs that controlled by encoder and potentiometer. The LCD display and pressure sensor are attached together on control box which is LCD display reading of tidal volume, breath per minute and I/E ratio while the pressure sensor detect the appropriate pressure and send to servo motor for compressing the bag valve mask. This device use IoT technology where nurses or health staff can monitor tidal volume, breath per minute and I/E ratio serve motor via their mobile phones. The design weighing 5kg which dimensions 400mm × 250mm × 250 mm.

#### 3.2 Block Diagram

In the figure 3,there are three parts : input, process, and output, which are all engaged in the system's operation. When the device had switched on, the setting range



input which is tidal volume and I/E ratio controlled by rotary potentiometer while adjustment set of breath per minute controlled by rotary encoder. The input send to Arduino Uno and the servo motor transfer the signal into mechanical to start compress

the BVM.The air pressure sensor is function to detect the appropriate pressure based on the input variable that had set that send to the motor to compress BVM. The air delivered through tube airway and patient mask and the reading three parameter which is VT, BPM and I/E ratio appears on the LCD display.The ESP32 is for IoT technology where parameter readings are sent through the mobile phone to please the nurse or health staff to monitor the patient's breathing.

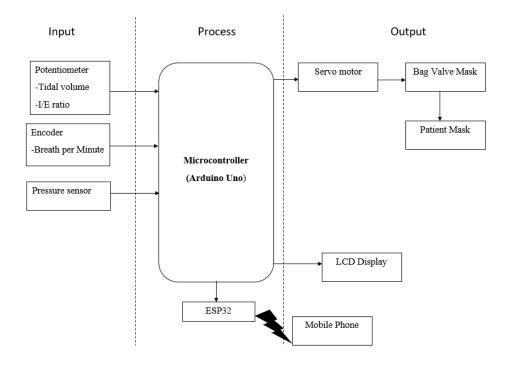


Figure 3: Block Diagram Operation



### 3.3 Schematic Diagram

The schematic diagram of this device are showed in Figure 4. In this figure, there are three parts which input, process and ouput component. The input component consist by adapter and keypad. Next, for process part consist by buck converter, Arduino Uno, and ESP 32 while for the output part consist by servo motor and LCD display. The main

component for this device is servo motor to produce automation compressing Bag Valve Mask. Based on the schematic, input source 12V are supply to operate and connected to the buck converter to step down the output voltage from 12 V to 5V.

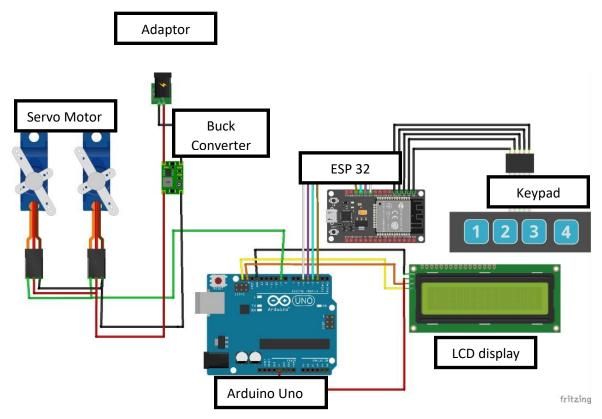


Figure 4: Schematic diagram of Bag Valve Mask



#### 4. Result and Testing

Figure 5 and Figure 6 had showed the development of electronic and mechanical part the automated bag valve mask. The component of the hardware included bag valve mask, servo motor, patient mask, LCD display, keypad, Arduino Uno and ESP 32. The automated bag valve mask's dimensions are 400mm 250mm 250mm, and the mechanism for compressing the BVM is based on the BVM-based Ventilator Mechanical. A test was performed on this BVM to test the functionality of the motor for automation compressing the Bag Valve Mask. During the test, it was found that the device did not function and the BVM was not automatically compressed by the motor. The BVM used is

quite thick causing a high force on the motor to press the valve mask bag so that the pins connected to the motor and getting loose and broken . Some modifications need to be done to improve the functinality of the device.

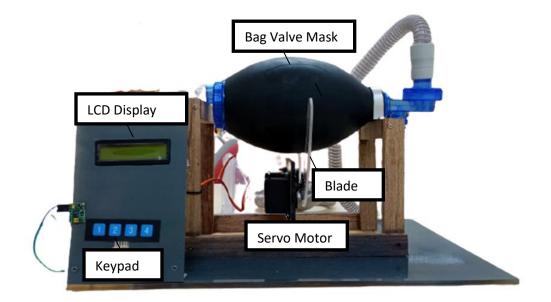


Figure 5: Front View of Bag Valve Mask



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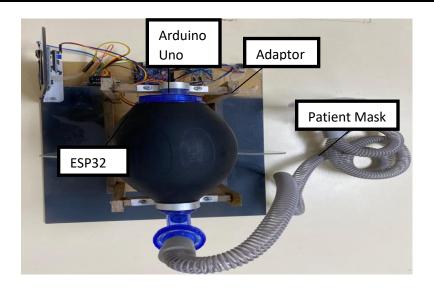


Figure 6: Top View of Bag Valve Mask

#### 5. Conclusion

The hardware designed automated bag valve mask had developed with the dimension 400mm × 250mm × 250 mm according to the proposed specifications. This papers focuses on the development hardware component to produce the automation compressing Bag Valve Mask for delivering air to the patient due to the issues number of patients with respiratory problems is increasing it very challenges in obtaining breathing aids due to the very limited number. The method mechanism of compressing BVM is based on BVM based Ventilator Mechanical that used blade attached together with servo motor as a component to compress the bag valve mask. Based on the findings, there are some recommendations to upgrade the functionality of the device. Firstly, servo motor should be upgraded so that it can give input voltage above 5V so that less force is generated to compress the bag valve mask. Additionally, the way the bag valve mask is compressed needs to alter. Instead of compressing the Bag Valve Mask from the left and right sides, it should rather be done from the top side using the Scoth yoke mechanism.

#### References

Calilung, E., Espanola, J., Dadios, E., Culaba, A., Sybingco, E., Bandala, A., Vicerra, R. R., Madrazo, A. B., Lim, L. G., Billones, R. K., Lopez, S., Ligutan, D. D., Palingcod,



J., & Castillo, C. J. P. (2020). Design and Development of an Automated Compression Mechanism for a Bag-Valve-Mask-Based Emergency Ventilator. 2020 IEEE 12th International Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment, and Management, HNICEM 2020. https://doi.org/10.1109/HNICEM51456.2020.9400150

- Chauhan, R., Sharma, R., & Chauhan, N. (2020). Automatic AMBU bag operating device: creating a boon for high-volume centres in low-income countries. *BMJ Innovations*, *6*(4), 255–258. https://doi.org/10.1136/bmjinnov-2019-000406
- Islam, M. R., Ahmad, M., Hossain, M. S., Islam, M. M., & Ahmed, S. F. U. (2020). Designing and Prototyping of an Electromechanical Ventilator based on Double CAM operation Integrated with Telemedicine Application. 2020 IEEE Region 10 Symposium, TENSYMP 2020, June, 300–303. https://doi.org/10.1109/TENSYMP50017.2020.9230673
- Jacob, Divya, P. D. (2020). What is a bag valve mask? Medicinet.Com.
- Petsiuk, A., Tanikella, N. G., Dertinger, S., Pringle, A., Oberloier, S., & Pearce, J. M. (2020). Partially RepRapable automated open source bag valve mask-based ventilator. *HardwareX*, 8, e00131. https://doi.org/10.1016/j.ohx.2020.e00131
- REAL, R. (2020). Rapid Manufacturing: open-source prototype low cost emergency ventilator.
- Vicente, V. C., Padilla, J. N., & Tanguilig III, B. T. T. I. (2016). Portable automated bagvalve mask with android technology. *International Journal of Advanced Technology and Engineering Exploration*, 3(16), 28–35. https://doi.org/10.19101/ijatee.2016.316004



## FACTORS INFLUENCING THE EFFECTIVENESS OF PARKING MANAGEMENT SYSTEMS IN PUBLIC HOSPITAL

#### Nadeera Mazlam<sup>1</sup>, and Hafidzah Muhamadan<sup>2</sup>

Civil Department, Politeknik Premier Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor. <sup>1</sup>nadeeramazlam@gmail.com, <sup>2</sup>nurhafidzah@psa.edu.my

#### Abstract

This paper is to provide a review on the factors influencing the management of public parking in hospitals. The approach of this paper using literature review on related study from 2017 until 2021 to obtain the information. From the literature review conducted, there are several factors that influence the effectiveness of parking management system which involved space, technology and also safety & security. There are other side factors that also affect the effectiveness of parking management in hospitals, but they can be discussed as a study gap for future studies. This research is very important for the parking management especially for public hospital at the city areas. The results of the information obtained from this study are expected to provide recommendations for the hospital management and and also facilities management field.

**Keywords:** Public Hospital, Factors, Space, Technology, Safety & Security, Parking System, Management.

#### 1. Introduction

Providing a good parking management system is one of the main factors that can attract customers or users. This research to review the factors influence the effectiveness of parking management systems at Public hospital. The objective of this study is to identify the factors influencing the effectiveness of parking management system in public hospital. Space management is always being a hot topic when talking about hospitals, especially hospitals in big cities. In other words, there is uncertainty about how quickly demand for parking spaces will decline during the transition period of years, how much change in the spatial pattern of parking can be expected in the future, and how much time planners have to develop strategies

and adjust for possible changes in this globalisation world. According to (Zhang & Wang, 2020),



The Penang General Hospital (Malay: Hospital Pulau Pinang) is the main public hospital in the city of George Town in Penang, Malaysia. The largest public hospital in Penang, it also serves as the reference hospital within northern Malaysia.

A strong parking management system is essential for a facilities management company to improve its quality. The problem of how to address parking demand concerns in public hospitals has sparked debate among public and transportation planners. An abundance of parking raises building costs and fosters reliance on private vehicles, whereas a scarcity of parking space causes traffic congestion and puts the public at risk. Documented Transportation Demand Management (TDM) practices have mostly come from countries that contrast markedly with Malaysia, which has higher car ownership and lack an organised public transport system (Ali & Hassan, 2020). This management method can also aid in enhancing an organization's image. Furthermore, it can assist us in time management because a good parking management can help boost customer satisfaction, and a parking management system can be upgraded from time to time for continual improvement.

#### 2.0 Parking Management System

Management is an important element to create an effective parking management, for the good framework or planning of the project, starting with a good management system. Management theories are a collection of ideas that recommend general rules for how to manage an organization or business. They address how supervisors implement strategies to accomplish organizational goals and how they motivate employees to perform at their highest ability. Management in parking space system must be continuous improvement because of the increasing in population. Management solutions should be used whenever they are more cost effective than adding more parking supply. (Kong et al., 2018), the supply of parking infrastructures has not been able to keep up with the increasing growth of traffic mobility because of the poor management. Management solutions should be used whenever they are more cost effective than adding more parking supply. Management needs to act before this problem becomes so severe that it affects the image of their organization. Due to the logistical challenges that come along with the problem parking lot management, so the management needs to do a thorough study in ensuring that the management method is in line with the methods used today.



### 2.1 Space

A parking space is a location that is designated for parking, either paved or unpaved. Parking spaces can be in a parking garage, in a parking lot or on a city street. It is usually designated by a white-paint-on-tar rectangle indicated by three lines at the top, left and right of the designated area. Based on article from (Publishing, n.d, 2019) To create an effective parking management system, standards must be followed, such as the minimum size of a standard parking space, which is nine feet wide and eighteen feet long. Parking spots in covered garages must be at least ten feet wide and twenty feet long on the inside. To ensure that there is enough parking, a formal parking or site traffic analysis may be required, especially during peak hours, which are often between 10:00 a.m. and 2:00 p.m. Monday to Friday. A maximum of one space per bed can be estimated for the number of visitors per inpatient and daily visiting patterns (daytime versus evening), but this will be highly dependent on the community, both in terms of the number of visitors per inpatient and daily visiting patterns (daytime versus evening), as well as hospital visitation policies. As we know that the existing parking facilities could be managed more efficiently for example, used another suitable space for parking instead of build something else such as a storage or unnecessary things (Litman, 2019). Parking management has become a key aspect in our urban society especially hospital demand where high vehicle density and parking space shortages require efficient management. Less availability of parking or improper parking people park 2-3 car in the space of 15-30 car parking space (Thromde, 2019).

#### 2.2 Technology

Technology is the application of scientific knowledge to the practical aims of human life or, as it is sometimes phrased, to the change and manipulation of the human environment. Evolution of technology is a stepwise advancement of a complex system of artifact, driven by interaction with sub-systems and other systems, considering technical choices, technical requirements and science advances, which generate new and/or improved products or processes for use or consumption to satisfy increasing (Coccia, 2019). Based on (Das, 2019), states that, Technology can assist save fuel, time, and money, which can then be put to better use elsewhere. We can notice that we frequently spend 5 to 10 minutes looking for a parking spot. Despite the fact that the technology is notorious for its high cost, it is the most cost-effective approach to handle the parking problem. Those who want to reduce the cost of installation and maintenance of a building parking, especially buildings involving the government, such as Penang's hospital, which is one of the government hospitals in Penang, frequently debate the problem of construction costs being too expensive to provide technological parking. This statement proved again with (Lubis et al., 2019) said that, with the growing population, a large parking area the protect horizontally or vertically, is not the best



solution because it costs a lot of money to acquire, build a parking management system, or build a high-rise building, especially for a government hospital, where there is no set number of visitors who come every day per hour. As a result, advanced technology cannot be utilised in government hospitals to manage parking because the finances available are insufficient, even though it is extremely beneficial in addressing the issues that all hospital users experience. However, more research into this topic is needed to improve the quality of parking management in Penang's hospital.

## 2.3 Safety and Security

Security is and often has to do with a group's efforts to protect its members from harm. Safety is most often relates to a personal feeling of being free from harm or danger. Security seems to define efforts and measures that are outside of an individual, while safety is closer to an inner feeling. the theory of safety and security could clarify the issue of safety and security in the whole range of the most general aspects. Helping to ensure that design features support a safe and secure environment for patrons and their vehicles is an important part of establishing an effective parking structure. Car owners and parking lot operators are concerned about their automobiles being stolen from parking lots, so they install CCTV cameras to detect theft. (Andriana et al., 2018), the security system should have a psychological effect on a potential criminal, discourage potential criminal for committing crime. There are so many things that need to be considered when related to safety and security especially hospital because every day has a lot of visitor comes to visit.

#### 3. Discussion

Based on literature from the past of years, due to the rapid growth of vehicles and populations on the streets, finding an available parking space is becoming a big obstacle in modern life. An argue issue to be addressed is for cities with large number of residents or hospital, search for a free parking lot is a major problem and can be a frustrating experience as investigate by (Zacepins et al., 2019). Based on (Bazzi et al., 2017), state that the high cost of the available paid parking system the reason why this kind of technology for parking space management system cannot being used for the government building. (Andriana et al., 2018), The security system should have a psychological effect

on a potential criminal, discourage potential criminal for committing crime. This can be achieved by adequate lighting, the presence of CCTV, security guards, and signs installation indicating the presence of the security system. Most of the previous studies, the implimetation of applications to improve systems and iot are given attention to obtain the effectiveness of public parking management. However, there are research gaps that can still



be identified, especially for visitors parking in hospitals that have very limited space and for the future plan to make a parking for the visitor to the public hospital is find a suitable empty place near to the hospital.

### 4. Conclusion

Based on the reviewed literature, there are continuity between several factors that cause the effectiveness of the parking management system for visitors in the hospital. This research explain about the factors that influencing the effectiveness of parking management system which is space, technology and safety & security. These theories can be used to improve the parking management system at Penang's Hospital and contribute to an effective parking for visitors. Hence, for further improvements that can be extended to this study is conducted more reviewed papers also to focus on a specific system to narrow the related field. This article can being used for facility management's students to gain their knowledge about parking management system at compact area likes city. This research has to be continue to help management in manage the parking system and also for the facility management field.

## References

- Ali, A. R., & Hassan, S. A. (2020). Parking Characteristics in Malaysia Public Hospitals. *IOP Conference Series: Materials Science and Engineering*, *884*(1). <u>https://doi.org/10.1088/1757-899X/884/1/012047</u>
- Andriana, G. M., Agung, A., Agung, G., & Handayani, R. (2018). *IMPLEMENTATION OF SMART PARKING SYSTEM. 18*(2), 277–290.
- Bazzi, A., Ghandour, H., Chebbani, A., Ghareeb, M., Abdul-nabi, S., & Customers, A. (2017). RFID b ased Paid Parking System. 2017 International Conference on Current Trends in Computer, Electrical, Electronics and Communication (CTCEEC), 1238–1241.
- Control, A. (2019). Why RFID for Parking Management Works Best. 1–5.
- Das, S. (2019). A novel parking management system, for smart cities, to save fuel, time, and money. 2019 IEEE 9th Annual Computing and Communication Workshop and Conference, CCWC 2019, 950–954. <u>https://doi.org/10.1109/CCWC.2019.8666537</u>
- Kong, X. T. R., Xu, S. X., Cheng, M., & Huang, G. Q. (2018). IoT-Enabled Parking Space Sharing and Allocation Mechanisms. *IEEE Transactions on Automation Science and Engineering*, 15(4), 1654–1664. <u>https://doi.org/10.1109/TASE.2017.2785241</u>
- Lubis, M., Fauzi, R., Lubis, A. R., & Fauzi, R. (2019). Analysis of Project Integration on Smart Parking System in Telkom University. 2018 6th International Conference on Cyber and



*IT* Service Management, CITSM 2018, Citsm, 1–6. <u>https://doi.org/10.1109/CITSM.2018.8674270</u>

- Publishingw, Q. C. (n.d.). Temecula Municipal Code. *Quality Code Publishing, Seattle, Washington*, 22–25.
- Thromde, T. (2019). *Multi Level car parking project. October*, 656–663. <u>http://www.thimphucity.bt/projects/multi-level-car-parking-project</u>
- Zacepins, A., Komasilovs, V., Kviesis, A., Gatins, A., Skudra, M., & Pierhurovics, A. (2019).
   Implementation of smart parking system in Jelgava City in Latvia. 11th IEEE International Conference on Application of Information and Communication Technologies, AICT 2017 - Proceedings, 1–4. <u>https://doi.org/10.1109/ICAICT.2017.8687287</u>
- Zhang, W., & Wang, K. (2020). Land Use Policy Parking futures : Shared automated vehicles and parking demand reduction trajectories in Atlanta. Land Use Policy, 91(April 2019), 103963. <u>https://doi.org/10.1016/j.landusepol.2019.04.024</u>



### KAJIAN TAHAP KEPUASAN PELANGGAN HOSPITAL TERHADAP PERKHIDMATAN KEMUDAHAN FASILITI SEPANJANG COVID-19

Afiqah Hassan<sup>1</sup> and Sr Norezan Asmangi<sup>2</sup> <sup>1</sup>Jabatan Kejuruteraan Awam, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor afiqahhassan6636@gmail.com <sup>2</sup>norezan@psa.edu.my

#### Abstrak

Memandangkan Covid-19 merupakan sejenis virus baharu yang telah mengancam nyawa seluruh penduduk dunia, janya tidak terkecuali juga telah memberi kesan yang sangat besar terhadap pengurusan fasiliti di hospital.Oleh itu,kajian ini telah dijalankan bagi mengkaji tahap kepuasan pelanggan hospital terhadap perkhidmatan kemudahan fasiliti sepanjang Covid-19 di Unit Kecemasan, Hospital Pulau Pinang. Kaedah kajian secara soal selidik telah dilakukan terhadap pelanggan hospital di Unit Kecemasan. Soal selidik telah diedarkan kepada 200 pelanggan hospital dan sebanyak 132 responden telah menjawab.Hasil dapatan kajian mendapati bahawa rata-rata responden berpuas hati dengan tahap perkhidmatan fasiliti kepuasan kualiti di bangunan hospital (Unit Kecemasan).Walaubagaimanapun,penambahbaikan perlu ditingkatkan lagi dari semasa ke semasa.

Kata Kunci: Kepuasan Pelanggan, Kemudahan Fasiliti, Covid-19, Unit Kecemasan

#### 1. PENGENALAN

Pada masa kini sektor perkhidmatan merupakan salah satu sektor yang menjadi pendorong kepada perkembangan ekonomi negara.Sektor berasaskan perkhidmatan ini menjadi tunjang utama kepada organisasi kerajaan mahupun swasta yang terdiri dalam pelbagai bidang.Antaranya ialah bidang kesihatan. Dalam penjagaan kesihatan, kepuasan pelanggan sangat penting untuk menilai kualiti perkhidmatan dalam perspektif pengguna.(Santos et al., 2017)

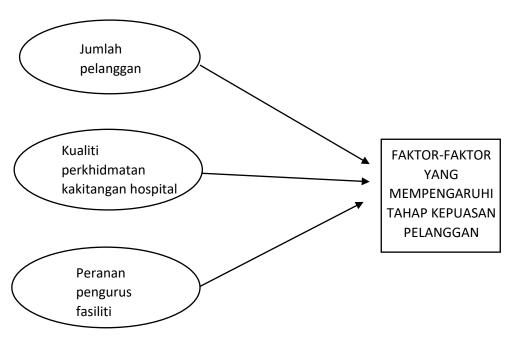
Kepuasan pelanggan dicapai apabila perkhidmatan yang diberikan bersesuaian dengan jangkaan pengguna.Kemudahan tidak hanya terhad kepada kemudahan fizikal yang



disediakan tetapi juga melibatkan aspek perkhidmatan.Kajian ini dijalankan untuk mengenalpasti tahap kepuasan pelanggan hospital terhadap perkhidmatan kemudahan fasiliti sepanjang Covid-19.

## 2. **KAJIAN LITERATUR**

Bagi memahami keseluruhan struktur kajian yang dijalankan,adalah sangat penting untuk memahami sumber yang diperolehi bagi membantu menguatkan kajian ini.Perkara ini termasuk untuk mengetahui beberapa isu yang boleh diketengahkan dan cadangan penambahbaikan bagi menyokong kajian ini terus dijalankan.Di dalam kajian literatur ini,terdapat beberapa sumber dan pengumpulan maklumat yang diperolehi.



Rajah 1: Kerangka Konseptual

Rajah 1 menunjukkan tiga faktor yang mempengaruhi tahap kepuasan pelanggan di Unit Kecemasan.Ketiga tiga faktor ini saling berkait untuk menilai sejauh mana tahap kepuasan kualiti perkhidmatan fasiliti dan cadangan penambahbaikan perkhidmtan fasiliti sepanjang Covid-19.



### 2.1 Jumlah Pelanggan

Unit Kecemasan menjadi titik hubungan pertama bagi ramai pesakit yang dijangkiti Covid-19.Menurut(Patey et al., 2020) kakitangan hospital perlu terus bekerja dalam rangka pelan tindak balas, dan perancangan kendiri akan menjadi kritikal jika lonjakan pesakit berlaku.Oleh itu,jika bilangan pesakit terlalu ramai dalam satu-satu masa akan menyebabkan kurangnya kepuasan dalam kalangan pesakit.

Seperti yang diketahui umum,Unit Kecemasan bertanggungjawab untuk menyediakan penjagaan yang bersesuaian dari segi perubatan,kos yang cekap dan hasil yang optimum. Menurut (Toma et al., 2009) ruang yang sesuai, bersih, kemas dan bersistematik bagi aktiviti penyebatian / pencampuran (compounding) dan pra- pembungkusan perlu diadakan.

## 2.2 Kualiti Perkhidmatan Kakitangan Hospital

Menurut (Mohd Som & Sheikh Dawood, 2021) terdapat empat ciri akses kemudahan kesihatan iaitu ketersediaan *(availability)*,kemampuan *(affordability)*,kesesuaian *(appropriateness)* dan penerimaan *(acceptability)* pesakit terhadap penawaran kesihatan adalah penting untuk melihat sejauh mana pesakit dapat menerima rawatan seterusnya berpuas hati dengan layanan yang diberikan oleh pihak hospital. Hal ini bagi memastikan hubungan dua hala antara pesakit dan pihak hospital. Justeru, kakitangan hospital mesti memenuhi keperluan masyarakat dengan menyediakan perkhidmatan perubatan yang menyeluruh bagi meningkatkan taraf kesihatan seluruh masyarakat terutamanya kemudahan fasiliti sepanjang Covid-19.

Walaubagaimanapun, (Ng, 2010) berpendapat kualiti kemudahan fizikal dan perkhidmatan penjagaan kesihatan adalah penting dalam mencapai fungsi sesebuah pusat kesihatan.Ini adalah kerana Unit Kecemasan merupakan jabatan yang terpenting di hospital dimana ianya berfungsi dan beroperasi 24 jamsehari,7 hari seminggu dan berperanan sebagai barisan hadapan dalam memberikan perkhidmatan kepada pesakit kritikal,separa kritikal dan tidak kritikal.



### 2.3 Peranan Pengurus Fasiliti

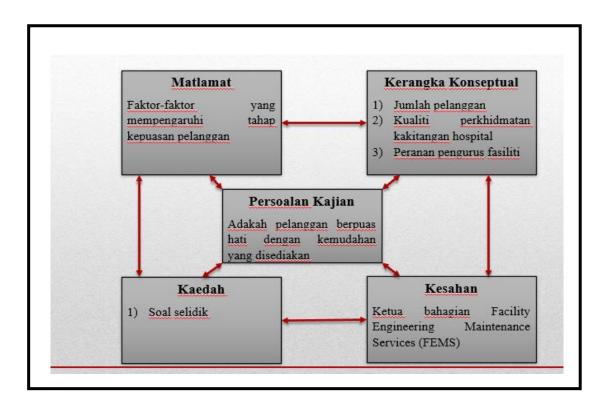
Peranan pengurus fasiliti merujuk kepada sejauh mana jenis kemudahan tertentu berjaya memenuhi keperluan pengguna dan memberikan kepuasan kepada pengguna iaitu kakitangan hospital (Ng, 2010). Berdasarkan pendapat (Zakaria et al., 2010) secara umumnya pengurus fasiliti terlibat dalam pelbagai disiplin dan aktiviti yang diguna pakai oleh semua organisasi sama ada sektor awam atau swasta.

Prestasi bangunan hospital dan komponen bergantung pada strategi pengurusan penyelenggaraan. Pengurus fasiliti memainkan peranan penting dalam pengurusan penyelenggaraan dan operasi bangunan kerana fungsi semua kemudahan dan struktur berdasarkan kepakaran, sikap, dan aspirasi pengurus.Berdasarkan pendapat (Fotovatfard & Heravi, 2021) kemudahan kesihatan cenderung berjalan 24 jam sehari, memastikan kecekapan kemudahan di hospital adalah kritikal. Sektor ini tidak mampu mempunyai "percubaan dan kesilapan" pendekatan atau kegagalan perkhidmatan dengan pesakit, kerana kesilapan mungkin boleh mengorbankan nyawa manusia.

## 3. METODOLOGI KAJIAN

Metodologi merupakan satu proses sistematik dalam mengumpul dan menganalisis data atau maklumat untuk tujuan tertentu.Jadi,dalam menjalankan kajian ini adalah sangat penting untuk mendapatkan maklumat yang tepat dan kesahihan yang tinggi bagi mendapat keputusan yang diingini.





## Rajah 2: Carta Alir Reka Bentuk Kajian Penyelidikan

Matlamat merupakan komponen yang pertama dan saling berhubungkait bersama komponen kedua iaitu kerangka konseptual,persoalan kajian dan kaedah.Matlamat di dalam kajian ini adalah untuk mengetahui faktor-faktor yang mempengaruhi tahap kepuasan pelanggan.Merujuk kepada kerangka konseptual kajian ini terdiri daripada 3 konstruk yang mewakili faktor-faktor yang mempengaruhi tahap kepuasan pelanggan.Terdapat petunjuk yang boleh diukur melalui 3 konstruk tersebut.Antaranya (1) jumlah pelanggan,(2) Kualiti perkhidmatan kakitangan hospital,dan (3) peranan pengurus fasiliti.

Manakala,persoalan kajian merupakan salah satu aspek penting dalam kajian ini.Terdapat beberapa persoalan kajian yang menjadi isu bagi melaksanakan kajian ini dan perlu dilihat serta diberi perhatian.

Kaedah kajian yang digunakan adalah kuantitatif (soal selidik) yang melibatkan pelanggan yang pernah menggunakan kemudahan fasiliti di Unit Kecemasan,Hospital Pulau Pinang.Kesahan untuk dapatan kajian inggadalah daripada Ketua Jabatan Bahagian



Pengurusan Kejuruteraan Fasiliti Syarikat Edgenta Medi-Serve Sdn.Bhd di bangunan hospital untuk memastikan item-item yang digunakan dalam borang soal selidik memenuhi kehendak kajian.

## 4. DAPATAN KAJIAN

4.1 Penemuan untuk objektif 1



### Rajah 3: Menilai Tahap Kepuasan Pelanggan Hospital di Unit Kecemasan Terhadap Kemudahan Asas

Berdasarkan rajah 3 diatas,54 daripada 132 responden sangat berpuas hati dengan kemudahan asas yang disediakan di Unit Kecemasan.Manakala hanya 8.3% sahaja daripada responden menyatakan bahawa kemudahan asas di Unit Kecemasan adalah kurang memuaskan.

4.2 Penemuan untuk objektif 2





Rajah 4 : Menilai Tahap Kepuasan Kualiti Perkhidmatan

Berdasarkan rajah 4 diatas,42 daripada 132 responden sangat berpuas hati dengan tahap kepuasan kualiti perkhidmatan di Unit Kecemasan.Diikuti oleh 41 daripada 132 responden pula menyatakan bahawa tahap kepuasan kualititi perkhidmatan berada pada tahap baik diikuti 26.5% adalah memuaskan dan yang terakhir 8.3% adalah kurang memuaskan.



Rajah 5: Tahap Kepuasan Pelanggan Secara Keseluruhan

Berdasarkan rajah 5 diatas,66.7% pelanggan berpuas hati terhadap perkhidmatan kemudahan fasiliti Covid-19.Manakala 0% responden sangat tidak puas hati.Ini menunjukkan kemudahan fasiliti di Unit Kecemasan Hospital Pulau Pinang berada dalam keadaan optimum dan terbaik.



#### 5. KESIMPULAN

Berdasarkan dapatan soal selidik mendapati bahawa responden memahami kehendak soalan.Maklumbalas yang diberikan oleh responden juga sangat positif dan terdapat beberapa cadangan yang diberikan oleh pihak responden untuk menambahbaik perkhidmatan fasiliti di masa akan datang.Berdasarkan nilai skor yang diberikan oleh responden mendapati bahawa pelanggan hospital sangat cakna akan keperluan kemudahan fasiliti.

Kesimpulannya,pengkaji mendapati kajian berkaitan tahap kepuasan pelanggan hospital terhadap perkhidmatan kemudahan fasiliti sepanjang Covid-19 di dalam artikel ini telah dibincangkan secara menyeluruh dan lengkap.Objektif dalam kajian ini telah dicapai melalui analisis yang telah dibuat melalui borang soal selidik.

### RUJUKAN

- Fotovatfard, A., & Heravi, G. (2021). Identifying key performance indicators for healthcare facilities maintenance. *Journal of Building Engineering*, *4*2(June), 102838. https://doi.org/10.1016/j.jobe.2021.102838
- Mohd Som, S. H., & Sheikh Dawood, S. R. (2021). Tahap Kepuasan Pelajar Universiti Sains Malaysia (USM) Terhadap Perkhidmatan Kemudahan Kesihatan dalam Kampus Induk. *Malaysian Journal of Social Sciences and Humanities (MJSSH)*, 6(2), 65–74. https://doi.org/10.47405/mjssh.v6i2.670
- Ng, A. S. Y. (2010). Facilities Management Service Performance In A University Health Center.
- Patey, C., Asghari, S., Norman, P., & Hurley, O. (2020). Redesign of a rural emergency department to prepare for the COVID-19 pandemic. *Cmaj*, *192*(19), E518–E520. https://doi.org/10.1503/cmaj.200509
- Santos, M. A. Dos, Sardinha, A. H. de L., & Santos, L. N. Dos. (2017). User satisfaction with the care of nurses. *Revista Gaucha de Enfermagem*, *38*(1), e57506. https://doi.org/10.1590/1983-1447.2017.01.57506
- Toma, G., Triner, W., & McNutt, L. A. (2009). Patient Satisfaction as a Function of Emergency Department Previsit Expectations. *Annals of Emergency Medicine*, 54(3), 360-367.e6. https://doi.org/10.1016/j.annemergmed.2009.01.024



Zakaria, H., Arifin, K., Ahmad, S., & Aiyub, K. (2010). Pengurusan Fasiliti Dalam Penyelenggaraan Bangunan:Amalan Kualiti, Keselamatan dan Kesihatan. *Journal of Techno Social*, 2(1), 23–36.



#### KEBERKESANAN PENGURUSAN FASILITI DALAM MENGURUSKAN KEBERSIHAN DI HOSPITAL KETIKA PANDEMIK

#### Muhammad Syahin Syahmi Bin Bahaldin<sup>1</sup> Raja Nurul Waheeda binti Raja Zilan<sup>1</sup>

7. Jabatan Kejuruteraan Awam, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor syahin45@gmail.com

### ABSTRAK

Pada 25 Januari 2020, kes pertama COVID-19 dikesan di Malaysia dan dikesan kembali kepada 3 warga China yang sebelum ini mempunyai hubungan rapat dengan orang yang dijangkiti di Singapura. Untuk mengawal wabak COVID-19 dari terus meningkat, Perdana Menteri Malaysia mengumumkan Perintah Kawalan Pergerakan. Hospital telah menempatkan beribu pesakit yang mempunyai latar belakang penyakit yang berbeza. Pekerja pembersihan hospital lebih berisiko dijangkiti covid-19 berbanding kakitangan ICU dan ini menunjukkan bahawa pekerja pembersihan yang menghadapi segala jenis bakteria dan kuman yang berada dihospital. Oleh itu, kajian ini telah mengenalpasti kaedah pengurusan pembersihan di hospital semasa pandemik. Data dikumpul dengan menggunakan kaedah mono iaitu data dikumpul melalui satu kaedah sahaja dengan temubual bersama responden dan akan diajukan beberapa soalan. Pendekatan ini telah berjaya dilaksanakan dengan mengumpul data yang sebenar dari tiga lokasi iaitu Hospital Pulau Pinang, Hospital Selayang dan Pusat Perubatan UIA, Kuantan. Hasil daripada kajian mendapati dalam pengurusan pembersihan di hospital ketika pandemik perlu tambah baik dari segi alatan, tenaga kerja dan peruntukan kewangan.

Keywords: Pandemik, Covid-19, Pengursan Fasiliti, Pengurusan Pembersihan

#### 1. PENGENALAN

Pada akhir tahun 2019, dunia digemparkan dengan kemunculan virus covid-19. Covid-19 ialah penyakit yang disebabkan oleh jenis coronavirus baharu (SARS-CoV-2), yang pertama kali dikenal pasti dalam Perbandaran China di Wuhan pada akhir Disember 2019



(Goniewicz et al., 2020). Ketika itu, terdapatnya jangkitan awal direkodkan di wilayah Wuhan, China dan sedikit demi sedikit kes jangkitan disebabkan coronavirus meningkat. Dengan peningkatan kes yang mendadak dan penyebaran wabak ini amat mudah hanya melalui sentuhan, maka Pertubuhan Kesihatan Dunia (WHO) telah mengisytiharkan bahawa wabak coronavirus sebagai pandemik. Pandemik COVID-19 telah memberikan tekanan yang kuat kepada sistem penjagaan kesihatan negara dan kemudahan hospital.

Dengan kemunculan wabak yang begitu bahaya dan mudah tersebar seperti ini memberikan impak yang besar terhadap ekonomi dunia terutama sekali terhadap pengurusan kebersihan di hospital. Koronavirus cepat merebak dan menyebabkan kerosakan yang ketara, seakan-akan penyebaran virus komputer dalam rangkaian (Megahed & Ghoneim, 2020). Covid-19 ini dijadikan contoh seperti virus yang berada didalam computer yang mudah tersebar ke merata fail.

Hospital telah menempatkan beribu pesakit yang mempunyai latar belakang penyakit yang berbeza. Pekerja pembersihan hospital lebih berisiko dijangkiti covid-19 berbanding kakitangan ICU (Mediacorp, 2020) dan ini menunjukkan bahawa pekerja pembersih yang menghadapi segala jenis bakteria dan kuman yang berada dihospital. Selain itu, pengurusan fasiliti dihospital agak meruncing bagi memastikan pengoperasian hospital berjalan dengan lancar dan kekurangan strategi atau perancangan bagi menghadapi pandemik covid-19 (Amos et al., 2021). Tujuan utama penyelidikan ini adalah untuk memberi cadangan penambahbaikan kepada syarikat pengurusan fasiliti dalam menguruskan kerja-kerja pembersihan di waktu pandemik.

Kajian ini memberikan maklumat penting kepada pembaca yang ingin mengetahui cara pengurus fasiliti dalam pengurusan kebersihan di hospital ketika pandemik melanda negara. Dengan itu, kajian ini membantu pengurusan fasiliti bagi meningkatkan prestasi dalam pengurusan kebersihan. Seterusnya, kajian ini dapat membantu meningkatkan keberkesanan kebersihan dihospital dan pembangunan yang lain. Dalam masa yang sama, pelajar pengurusan fasiliti juga boleh menjadikan kajian ini sebagai rujukan untuk melihat dan menambah pengetahuan yang lebih mendalam mengenai skop dalam bidang pengurusan fasiliti.

#### 2. KAJIAN LITERATUR



Wabak penyakit koronavirus (COVID-19) pertama kali muncul di Wuhan, Wilayah Hubei, China, pada Disember 2019 (X. Lai et al., 2020). Pada 30 Januari, 2020, Pertubuhan Kesihatan Sedunia mengisytiharkan kecemasan kesihatan awam yang membimbangkan antarabangsa (Wu et al., 2020). Dengan peningkatan kes yang mendadak dan penyebaran wabak ini amat mudah hanya melalui sentuhan, maka Pertubuhan Kesihatan Dunia (WHO) telah mengisytiharkan bahawa wabak coronavirus sebagai pandemik. Menurut (Anderson et al., 2020) novel coronavirus, dinamakan Severe Acute Respiratory

Syndrome Coravirus 2 (SARS-CoV-2), telah berkembang pesat di seluruh dunia, dan impak terhadap sistem kesihatan, sains dan masyarakat tidak pernah berlaku sebelum ini.

Oleh itu, kajian ini menumpukan untuk memberi panduan kepada syarikat pengurusan fasiliti dalam menguruskan kerja-kerja pembersihan di waktu pandemik di hospital. Kajian ini serba sedikit akan memberikan gambaran serta strategi yang perlu dilakukan oleh pihak pengurusan fasiliti bagi menguruskan kebersihan di hospital jika berlakunya pandemik. Kebersihan di hospital merupakan salah satu aspek yang penting bagi memastikan pesakit mahupun kakitangan hospital tidak dijangkiti bakteria terutama sekali semasa pandemik ini. Perkara ini disokong oleh (Jiang et al., 2020) yang mengatakan bahawa adalah penting untuk menilai kebersihan persekitaran hospital untuk memahami isu alam sekitar yang paling penting untuk mengawal penyebaran covid-19 di hospital. Ini bermakna petugas kebersihan juga antara barisan hadapan bagi memastikan hospital sentiasa bersih dan membendung wabak dari tersebar.

Walaubagaimanapun, sudah semestinya terdapat beberapa isu yang telah berbangkit mengenai perkhidmatan pembersihan di hospital. Ini kerana hospital merupakan sebuah tempat yang begitu penting untuk menempatkan dan merawat pesakit. Perkara ini bertambah rungsing apabila kemunculan pandemik covid-19 yang telah melanda keseluruh dunia kini memberikan kesan yang amat besar terhadap hospital. Penyebaran covid-19 berlaku melalui titisan, feco-oral, dan sentuhan langsung dengan tempoh inkubasi 2-14 hari walaupun banyak kes tempoh inkubasi yang lebih tinggi telah dilaporkan (Ibad Sha et al., 2020). Dalam kata mudah covid-19 ini merupakan wabak yang begitu mudah untuk merebak tidak kira melalui sentuhan ataupun titisan yang keluar dari mulut atau hidung.



### 2.1 Peralatan Pembersihan

Kebersihan di hospital merupakan satu aspek yang penting bagi memastikan tiada bakteria yang tersebar serta mengekang dari orang awam dan petugas kesihatan dari mendapat jangkitan. Penggunaan alatan yang tepat merupakan salam satu medium yang sangat penting bagi mendapatkan tahap kebersihan yang optimum. Lantai juga merupakan satu medium tempat dimana bakteria membiak dan tersebar. Menurut kenyataan dari (Mustapha et al., 2018), beliau mengatakan bahawa lantai di kemudahan penjagaan kesihatan mungkin merupakan sumber yang tinggi untuk penularan pathogen. Alatan yang sering digunakan untuk membersihkan lantai di hospital adalah dengan menggunakan mop. Mengemop lantai juga merupakan penyelenggaraan rutin yang perlu dilakukan setiap hari oleh pekerja pembersih bagi memastikan dapat mengawal dan menghalang penyebaran bakteria dalam persekitaran hospital terutama dibahagian lantai.

Perkara ini disokong oleh (Andersen et al., 2019) yang mengatakan bahawa rutin kebersihan yang baik berdasarkan pembersihan permukaan disyorkan untuk membantu mengawal penyebaran patogen dalam persekitaran hospital. Untuk memastikan penggunaan alatan yang bersesuaian di hospital ketika pandemik supaya covid-19 dapat ditangani dari terus merebak dikawasan hospital. Berdasarkan kenyataan dari (Dancer, 2016) mengatakan bahawa kajian semula ini menganggap peranan pembersihan sebagai berkesan bermakna untuk mengawal jangkitan dan menerangkan lokasi takungan patogen serta peralatan yang efektif kebersihan di hospital. Dari kenyataan tersebut telah mengatakan bahawa penggunaan sesuatu alatan kebersihan yang betul akan menjadikan tahap kebersihan di hospital menjadi lebih baik. Bekalan alatan dan penggunaan alatan yang tepat mampu membantu pekerja kebersihan untuk membersihkan kawasan hospital pada tahap optimum ketika pandemik.

#### 2.2 Peruntukan Perbelanjaan

Dalam perkhidmatan kebersihan, peruntukan atau kos merupakan salah satu aspek yang sangat penting kerana setiap perkara yang dilakukan dan bahan serta peralatan yang digunakan perlukan kos. Nilai untuk wang terdiri daripada kedua-duanya kos (kecekapan) dan kualiti (keberkesanan) perkhidmatan dalam pembersihan hospital (Elkomy et al., 2019). Peruntukan yang dikeluarkan juga perlu selari dengan kualiti atau hasil kerja yang dilakukan dalam kerja-kerja pembersihan. Secara amnya kualiti kerja yang baik memerlukan peruntukan yang tinggi disebabkan penggunaan alatan yang berkesan dan menggunakan tenaga kerja yang mencukupi.



Dari kenyataan yang dikeluarkan menggambarkan bahawa setiap kerja yang mendatangkan hasil kualiti yang baik terutama terhadap kebersihan di hospital memerlukan kos. Ini bermakna peruntukan dapat membantu meningkatkan keberkesanan kebersihan di hospital ketika pandemik. Kos dan kaedah diperlukan untuk meningkatkan perbelanjaan dalam pembersihan (White et al., 2020). Kos dan kaedah perlu dibuat penambahan supaya kerja-kerja pembersihan akan menjadi lebih baik. Dalam erti kata lain kos untuk perkhidmatan pembersihan tinggi maka boleh mendapatkan tahap kebersihan hospital yang optimum. Secara ringkasnya, peruntukan yang cukup dalam kerja pembersihan dapat meningkatkan prestasi dan kualiti kerja

pembersihan di hospital. Dengan adanya peruntukan yang cukup boleh menambahbaik alatan pembersihan yang sedia ada dan boleh menambah tenaga kerja.

### 2.3 SOP Perkhidmatan Pembersihan

SOP merupakan perkara utama yang ditekankan kepada pekerja pembersihan ketika ini kerana untuk mengelakkan dari virus covid-19 ini semakin merebak. Ditambah lagi kenyataan dari (Ishak, 2020) yang mengatakan bahawa ketika pandemik pemakaian peralatan perlindungan diri (PPE) merupakan perkara utama semasa melakukan kerja dikawasan covid-19 di hospital dan Malaysia sejak peringkat awal sistem penjagaan kesihatan awam telah berhadapan dengan kekurangan peralatan perlindungan diri (PPE). Kekurangan PPE bermakna petugas kebersihan juga akan menjadi terhad untuk melakukan kerja-kerja pembersihan kerana mereka perlu memakai PPE sebagai pelindungan diri dari dijangkiti covid-19. Pemakaian PPE juga merupakan prosedur operasi standard (SOP) yang telah ditetapkan kerajaan untuk melakukan kerja dikawasan covid-19 (KKM, 2020).



Rajah 2.4 Peralatan Perlindungan Diri (PPE)



Terdapat 18 item atau jenis PPE utama yang oleh anggota kesihatan semasa bertugas untuk menangani COVID-19 seperti pelitup muka, sarung tangan, pelindung muka, plastik apron, sarung kasut dan sebagainya (KKM, 2020).

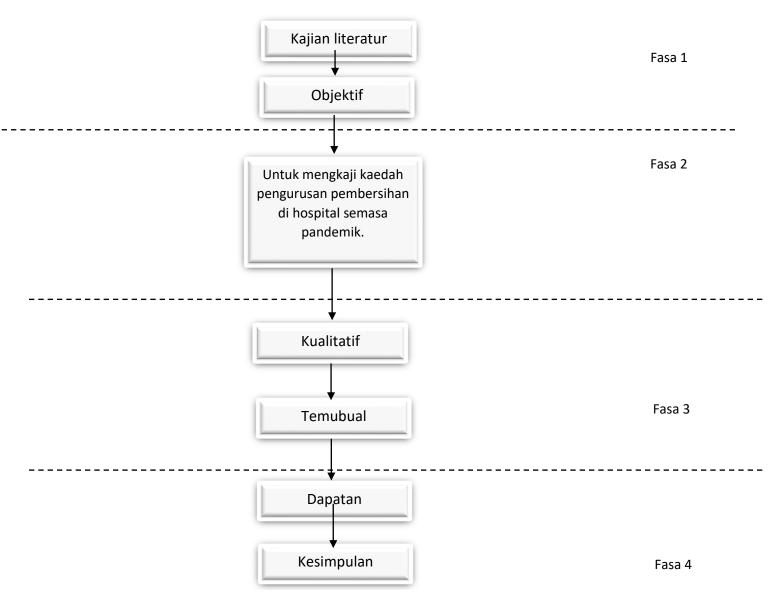
## 3. METODOLOGI KAJIAN

Metodologi kajian ialah mengenai cara penyelidik secara sistematik mereka bentuk kajian untuk memastikan keputusan yang sah dan boleh dipercayai yang menangani matlamat dan objektif penyelidikan (Derek & Kerryn, 2020). Dalam erti kata lain, bab metodologi

harus mewajarkan pilihan reka bentuk, dengan menunjukkan bahawa kaedah dan teknik yang dipilih adalah paling sesuai untuk tujuan dan objektif penyelidikan, dan akan memberikan hasil yang sah dan boleh dipercayai. Metodologi kajian yang baik memberikan penemuan yang kukuh secara saintifik, manakala metodologi yang lemah tidak.

Temubual ini boleh membantu penyelidik untuk mengumpul data dan menganalisis daripada ketua bagi kerja-kerja pembersihan. Instrumen temubual yang digunakan penyelidik adalah temubual mendalam dimana penyelidik akan menemubual orang berkelayakan sahaja untuk menjawab segala pertanyaan yang akan diajukan. Temubual akan dilakukan kepada pengurus bahagian kerja-kerja pembersihan sahaja. Ini disebabkan soalan untuk temubual ini perlu dijawab oleh orang yang berkelayakan dan orang yang menguruskan fasiliti di hospital.





Rajah 3 Reka Bentuk Kajian



#### 4. DAPATAN KAJIAN

Objektif pertama bagi kajian ini ialah untuk mengkaji kaedah pengurusan pembersihan di hospital semasa pandemik. Bagi mencapai objektif, kaedah temubual telah dilakukan dan data-data telah direkodkan seperti berikut.

		Kuantan (IIUM)		
Peralatan Pembersihan				
Ya	Ya	Tidak		
Mop, Kain lap, penyembur sanitasi	Mop, Kain lap, penyembur sanitasi	Mop, Kain lap, penyembur sanitasi		
Ada dilakukan setiap taklimat pagi	Ada dilakukan seminggu sekali	Ada		
Peruntukan Perbelanjaan				
Ada	Ada	Ada		
Segala peruntukan mencukupi	Mencukupi dan boleh menampung kos perbelanjaan	Mencukupi kerana tidak menggunakan kos yang banyak		
Membuat penjadualan semula berdasarkan permintaan dari pengguna hospital	Membuat penyusunan semula pekerja mengikut keperluan	Memberikan taklimat kepada semua pekerja dan membahagikan mengikut tugasan baru		
	Mop, Kain lap, penyembur sanitasi Ada dilakukan setiap taklimat pagi Ada Segala peruntukan mencukupi Membuat penjadualan semula berdasarkan permintaan dari	Mop, Kain lap, penyembur sanitasiMop, Kain lap, penyembur sanitasiAda dilakukan setiap taklimat pagiAda dilakukan seminggu sekaliAdaAda dilakukan seminggu sekaliAdaAdaAdaAdaAdaAdaMencukupiMencukupi dan boleh menampung kos perbelanjaanMembuat penjadualan pengguna hospitalMembuat penyusunan semula pekerja mengikut keperluan		



Adakah SOP syarikat untuk kerja pembersihan berubah ketika pandemik?	Ya	Ya	Ya
Siapakah yang mengeluarkan SOP tersebut?	Kementerian Kesihatan Malaysia (KKM) dan unit kawalan jangkitan	Kementerian Kesihatan Malaysia (KKM) dan unit kawalan jangkitan	Kementerian Kesihatan Malaysia (KKM) dan unit kawalan jangkitan
Adakah pekerja didedahkan terhadap SOP kerja ketika pandemik?	Ada didedahkan pada setiap taklimat sebelum melakukan kerja	Ada didedahkan pada setiap taklimat sebelum melakukan kerja	Ada didedahkan pada setiap taklimat sebelum melakukan kerja

Berdasarkan jadual yang telah di lampirkan diatas, untuk peralatan pembersihan pengkaji mendapati IIUM tidak mempunyai penambahan alatan kerana terdapat hanya 2 wad yang dibuka untuk covid-19 manakala untuk HPP dan HS merupakan antara hospital utama kerajaan yang dijadikan tempat pesakit covid-19. Alatan yang kerap digunakan semasa pandemik adalah seperti mop, kain lap dan penyembur sanitasi. Ini kerana setiap tempat dikawasan hospital perlu sentiasa disanitasi bagi mengelakkan penyebaran covid-19. Setiap pekerja pembersihan telah diberikan tunjuk ajar mengenai alatan pembersihan yang digunakan.

Bagi peruntukan perbelanjaan pula, terdapat peruntukan tambahan bagi ketiga-tiga hospital dan peruntukan tambahan yang telah dikeluarkan mencukupi bagi menampung kos pembersihan ketika pandemik. Tindakan awal yang dilakukan ketika berlakunya pandemik adalah dengan Menyusun semula jadual kerja mengikut keperluan tempat atau zon wad covid-19. Pekerja pembersihan yang berada diwad zon merah tidak dibenarkan keluar sehingga tamat waktu bekerja.

Seterusnya, ketiga-tiga hospital terdapat perubahan SOP dari segi pemakaian alat pelindung diri (PPE) dan setiap laluan pesakit covid-19 perlu disanitasi dengan segera. SOP ini dikeluarkan dan dikuatkuasakan oleh Kementerian Kesihatan Malaysia (KKM) dan Unit Kawalan Jangkitan. Setiap SOP kerja ketika pandemik, ketiga-tiga hospital memberikan taklimat setiap pagi supaya pekerja lebih peka terhadap kerja yang dilakukan.



#### 5. KESIMPULAN

Merujuk pada kajian literatur yang telah diberi menunjukkan kepentingan dan faktor yang mempengaruhi dalam mendapatkan keberkesanan pengurusan kebersihan di hospital ketika pandemik. Ketika pandemik melanda dunia, hospital merupakan kawasan tumpuan dimana pelbagai latar belakang pesakit berada di hospital dan ia ditambah lagi dengan kemasukan pesakit yang dijangkiti covid-19. Covid-19 telah memberikan tekanan yang kuat pada sistem kesihatan nasional yang merangkumi fasiliti dan kemudahan di hospital serta kakitangan kesihatan profesional dan juga perkhidmatan sokongan. Disini dapat dilihat perkhidmatan sokongan atau pengurusan fasiliti merupakan menjadi peranan penting di hospital dan menjadi antara barisan hadapan bagi melawan virus covid-19 ini.

Perkhidmatan sokongan yang efisyen terhadap sistem kesihatan ini adalah sangat penting kerana sistem ini bergerak 24 jam setiap hari dan tidak boleh ada ruang untuk berlakunya gangguan terhadap fasiliti dan peralatan perubatan yang boleh memudaratkan pesakit-pesakit ini. Pengurus fasiliti sangat diperlukan bagi menyokong perkhidmatan kesihatan dan mencari solusi yang terbaik untuk mengoptimumkan strategi dalam melawan virus Covid-19. Dengan adanya kajian ini dapat memberikan panduan kepada pengurusan fasiliti dalam menguruskan kerja-kerja pembersihan di hospital jika berlakunya pandemik dan pengurusan fasiliti boleh mendapatkan tindakan awal sekiranya wabak pandemik seperti ini berulang. Untuk jangka masa panjang juga pengurusan fasiliti boleh merujuk kajian ini bagi menambahbaik sistem pengurusan pembersihan hospital ketika ini kepada yang lebih baik.

#### 4. RUJUKAN

- Amos, D., Au-Yong, C. P., & Musa, Z. N. (2021). Enhancing the role of facilities management in the fight against the COVID-19 (SARS-CoV-2) pandemic in developing countries' public hospitals. *Journal of Facilities Management*, 19(1), 22–31. https://doi.org/10.1108/JFM-06-2020-0034
- Andersen, B. M., Rasch, M., Kvist, J., Tollefsen, T., Lukkassen, R., Sandvik, L., & Welo, A. (2019). Floor cleaning: effect on bacteria and organic materials in hospital rooms. *Journal of Hospital Infection*, 71(1), 57–65. https://doi.org/10.1016/j.jhin.2008.09.014
- Anderson, M., McKee, M., & Mossialos, E. (2020). Covid-19 exposes weaknesses in European response to outbreaks. *The BMJ*, *368*, 1–2. https://doi.org/10.1136/bmj.m1075
- Dancer, Stephanie J. (2016). Dos and don'ts for hospital cleaning. *Current Opinion in Infectious Diseases*, *29*(4), 415–423. https://doi.org/10.1097/QCO.00000000000289



Daudin-Schotte, M., Bisschoff, M., Joosten, I., van Keulen, H., & van den Berg, K. J. (2013). Dry Cleaning Approaches for Unvarnished Paint Surfaces. *New Insights into the Cleaning of Paintings, November 2010*, 209–219.

Derek, J., & Kerryn, W. (2020). What (Exactly) Is Research Methodology? Gradcoach, 1.

- Elkomy, S., Cookson, G., & Jones, S. (2019). Cheap and Dirty: The Effect of Contracting Out Cleaning on Efficiency and Effectiveness. In *Public Administration Review* (Vol. 79, Issue 2). https://doi.org/10.1111/puar.13031
- Goniewicz, K., Khorram-Manesh, A., Hertelendy, A. J., Goniewicz, M., Naylor, K., & Burkle, F. M. (2020). Current response and management decisions of the European Union to the COVID-19 outbreak: A review. *Sustainability (Switzerland)*, *12*(9). https://doi.org/10.3390/su12093838
- Ibad Sha, I., Edwin, A., George, J., Shah, N., & Roshna, S. R. (2020). COVID-19 Awareness among final year medical students in India: A questionnaire-based survey. *International Journal of Public Health and Safety*, 5(4), 1–3. https://doi.org/10.37421/ijphs.2020.5.193
- Jiang, Y., Wang, H., Chen, Y., He, J., Chen, L., Liu, Y., Hu, X., Li, A., Liu, S., Zhang, P., Zou, H., & Hua, S. (2020). Clinical data on hospital environmental hygiene monitoring and medical staff protection during the Coronavirus disease 2019 outbreak. *MedRxiv*. https://doi.org/10.1101/2020.02.25.20028043
- KKM, K. K. M. (2020). BAGI FASILITI KKM. 98.
- Lai, X., Wang, M., Qin, C., Tan, L., Ran, L., Chen, D., Zhang, H., Shang, K., Xia, C., Wang, S., Xu, S., & Wang, W. (2020). Coronavirus Disease 2019 (COVID-2019) Infection among Health Care Workers and Implications for Prevention Measures in a Tertiary Hospital in Wuhan, China. *JAMA Network Open*, 3(5), 1–12. https://doi.org/10.1001/jamanetworkopen.2020.9666
- Mediacorp, B. (2020). Pekerja pembersih hospital lebih berisiko dijangkiti covid-19 berbanding kakitangan ICU. Mediacorp.
- Megahed, N. A., & Ghoneim, E. M. (2020). Antivirus-built environment: Lessons learned from Covid-19 pandemic. *Sustainable Cities and Society*, *61*, 102350. https://doi.org/10.1016/j.scs.2020.102350
- Mustapha, A., Alhmidi, H., Cadnum, J. L., Jencson, A. L., & Donskey, C. J. (2018). Efficacy of manual cleaning and an ultraviolet C room decontamination device in reducing health care–associated pathogens on hospital floors. *American Journal of Infection Control*, 46(5), 584–586. https://doi.org/10.1016/j.ajic.2017.10.025
- White, N. M., Barnett, A. G., Hall, L., Mitchell, B. G., Farrington, A., Halton, K., Paterson, D. L., Riley, T. V., Gardner, A., Page, K<sub>98</sub>Gericke, C. A., & Graves, N. (2020). Cost-



effectiveness of an environmental cleaning bundle for reducing healthcare-associated infections. *Clinical Infectious Diseases*, *70*(12), 2461–2468. https://doi.org/10.1093/cid/ciz717

Wu, C., Chen, X., Cai, Y., Xia, J., Zhou, X., Xu, S., Huang, H., Zhang, L., Zhou, X., Du, C., Zhang, Y., Song, J., Wang, S., Chao, Y., Yang, Z., Xu, J., Zhou, X., Chen, D., Xiong, W., ... Song, Y. (2020). Risk Factors Associated with Acute Respiratory Distress Syndrome and Death in Patients with Coronavirus Disease 2019 Pneumonia in Wuhan, China. JAMA Internal Medicine, 180(7), 934–943. https://doi.org/10.1001/jamainternmed.2020.0994



# KAJIAN AMALAN PENGURUSAN PENYELENGGARAAN BANGUNAN DI HOSPITAL PULAU PINANG

Izzul Hasif Borhan Nordin<sup>1</sup>, Raja Nurul Waheeda Raja Zilan<sup>2</sup>

Jabatan Kejuruteraan Awam, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor izzulborhan@gmail.com

#### ABSTRAK

Penyelenggaraan bangunan merupakan perkhidmatan termasuk kerja-kerja penyelenggaraan rutin dan pencegahan dalam memastikan bangunan dan utiliti dalam tahap yang memuaskan dan beroperasi dalam keadaan yang selamat. Pengurusan penyelengaraan adalah suatu prosedur dan sistem yang direka dan diwujudkan bagi membolehkan pemilik atau pengurus menjaga bangunan secara efisien dan pada kos yang efektif. Tujuan kajian ini dijalankan adalah untuk menambah baik amalan pengurusan penyelenggaraan bangunan sedia ada di Hospital Pulau Pinang. Populasi sasaran bagi kajian ini adalah seramai 80 orang responden termasuk pengurus kemudahan serta juruteknik. Oleh yang demikian, seramai 65 orang responden terlibat dalam kajian ini. Objektif kajian ini adalah untuk mengenal pasti faktor-faktor yang mempengaruhi keberkesanan pengurusan penyelenggaraan bangunan dan untuk menilai pengurusan penyelenggaraan bangunan sedia ada. Penemuan menunjukkan bahawa

Keywords: amalan penyelenggaraan bangunan, penyelenggaraan, pengurusan

#### 1. PENGENALAN

Amalan pengurusan penyelenggaraan bangunan adalah elemen yang penting bagi sesuatu bangunan tersebut dapat digunakan serta beroperasi dengan selamat dan selesa. Namun begitu, budaya penambahbaikan yang berterusan, penggunaan pemerkasaan pekerja yang tidak mencukupi, kakitangan yang tidak mencukupi, kekurangan kerja berpasukan, ketidakupayaan untuk melihat penyewa sebagai pelanggan, kekurangan motivasi, pendidikan dan latihan pengurus hartanah dan perancangan yang lemah antara lain merupakan faktor paling penting yang



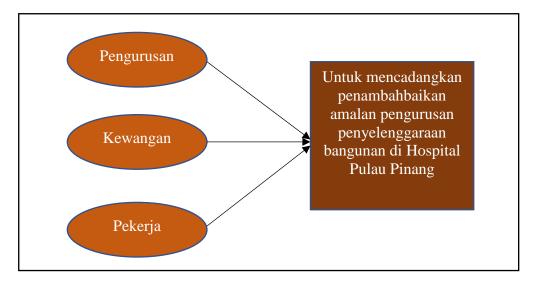
mempengaruhi kualiti perkhidmatan. (Ojekalu et al., 2019). Selain daripada itu, terdapat juga masalah lain yang dilontarkan oleh pengkaji sebelum ini untuk dikaji iaitu tingkah laku kakitangan penyelenggaraan adalah penting untuk meyakinkan pengguna mahupun pelanggan dalam melaksanakan tugas penyelenggaraan dan untuk mengurangkan berlakunya kecacatan.(Chua et al., 2018).

Amalan penyelenggaraan bangunan adalah amalan yang mesti diambil kira oleh pengurus kemudahan bangunan atau pemilik bangunan. Ia melibatkan operasi harian untuk memastikan pengguna akhir boleh bekerja atau hidup dengan selesa dan selamat. Melalui amalan penyelenggaraan yang berkesan, fungsi kemudahan bangunan sedia ada dapat dikekalkan dan memenuhi keperluan pengguna bangunan. (Hauashdh et al., 2020) Matlamat kajian adalah untuk mengesyorkan strategi yang paling sesuai untuk meningkatkan kualiti kerja penyelenggaraan pada bangunan.

Penyelenggaraan yang berkesan boleh dicapai dengan objektif, strategi dan dasar penyelenggaraan yang betul pada peringkat awal. (Khalid et al., 2019) matlamat kajian adalah untuk mencadangkan penambahbaikan amalan pengurusan penyelenggaraan bangunan sedia ada.

## 2. KAJIAN LITERATUR

Terdapat banyak kajian lepas yang telah dikaji oleh pengkaji lepas tentang amalan pengurusan penyelenggaraan bangunan. Rajah 1 menunjukkan kerangka konseptual cadangan penambahbaikan amalan pengurusan penyelenggaraan di Hospital Pulau Pinang





#### 2.1 Pengurusan

Kebanyakan syarikat pengurusan hartanah masih menggunakan sistem pengurusan penyelenggaraan tradisional untuk menguruskan bangunan. Selain itu, sistem pengurusan penyelenggaraan tradisional masih relevan dan sesuai digunakan dalam keadaan bangunan semasa ini. Pengurusan penyelenggaraan di sektor swasta dan awam telah berubah dengan pantas sepanjang tahun. Ini disebabkan oleh beberapa faktor seperti peningkatan teknologi canggih, globalisasi dan perubahan ekonomi. (Zulkarnain et al., 2011) Kerosakan berlaku disebabkan oleh kelemahan dalam pengurusan fasiliti terutamanya dalam aspek penyelenggaraan bangunan. Aduan sering kedengaran mengenai bangunan awam yang mempunyai tahap penyelenggaraan, keselamatan dan kebersihan yang lebih rendah berbanding bangunan persendirian yang biasanya lebih diselenggara dengan baik. (Fadhil Azha, 2020)

Perdana menteri Malaysia sebelum ini, Tun Abdullah Ahmad Badawi, juga ada menyatakan bahawa Malaysia kehilangan berbilion ringgit kerana amalan penyelenggaraan Bangunan yang buruk perancangan pentadbiran penyelenggaraan. Beliau juga menekankan hakikat bahawa terdapat kelemahan dalam penyelenggaraan bangunan awam. (Hauashdh et al., 2020)

#### 2.2 Kewangan

Kekurangan dana dilihat sebagai faktor utama yang menghalang amalan penyelenggaraan yang betul dalam institusi yang dikenal pasti. (Aghimien et al., 2019) Faktor kewangan terdiri daripada dua komponen utama iaitu bajet yang ada dan kos yang diperlukan. Untuk melaksanakan pelan penyelenggaraan, pengurus kemudahan perlu mengambil kira kedua-dua belanjawan dan kos. Peruntukan belanjawan mempunyai kesan yang besar ke atas keseluruhan perancangan penyelenggaraan. (Chong et al., 2019)

Pendekatan pembangunan kewangan dalam industri penyelenggaraan bangunan menyumbang kepada kejayaan penyelenggaraan dengan menguruskan belanjawan, memastikan keseimbangan pendapatan dan perbelanjaan serta menyediakan nilai untuk kos. (Hauashdh et al., 2021)

#### 2.3 Pekerja

Kekurangan latihan untuk kakitangan penyelenggaraan memberi kesan kepada prestasi kerja mereka. Oleh itu, bilangan penyelia yang tinggi tidak memahami cara mengawal rangka kerja operasi penyelenggaraan, yang membawa kepada hasil penyelenggaraan



yang tidak berkualiti (Hauashdh et al., 2020)Kekurangan pemahaman dan kejelasan dalam matlamat dan objektif organisasi boleh

menjejaskan prestasi penyelenggaraan kerana matlamat dan objektif organisasi bertindak sebagai panduan utama perniagaan. Menetapkan matlamat dan objektif yang betul untuk penyelenggaraan adalah penting kerana ia menetapkan penanda aras untuk penilaian prestasi penyelenggaraan dan justifikasi yang diperlukan untuk melaksanakan keutamaan penyelenggaraan. (Chong et al., 2019)

Kakitangan mesti mempunyai pengalaman dalam kerja penyelenggaraan bangunan, mempunyai kapasiti kewangan dan peralatan serta kakitangan berkelayakan yang mencukupi, serta ketersediaan individu berpengalaman dengan kemahiran yang diperlukan, tenaga kerja mahir dan reputasi yang baik dalam industri penyelenggaraan. (Hauashdh et al., 2021) Ketersediaan profesional pembinaan dan penyelenggaraan yang berkelayakan dan cekap adalah faktor penting yang akan menjejaskan pemacu ke arah mencapai operasi penyelenggaraan yang berkualiti. Kekurangan tenaga kerja mahir untuk menyelenggara kerja dalam bangunan juga merupakan masalah utama yang menjejaskan penyelenggaraan bangunan. (Aghimien et al., 2019)

#### 3. METODOLOGI KAJIAN

Untuk mengetahui tiga faktor yang boleh memberikan kesan terhadap amalan pengurusan penyelenggaraan bangunan pada Hospital Pulau Pinang, kaedah yang digunakan adalah kualitatif iaitu





Rajah 2: Reka Bentuk Kajian

Berdasarkan rajah yang ditunjukkan di atas, fasa pertama digunakan untuk mengenal pasti masalah yang mempengaruhi keberkesanan amalan pengurusan penyelenggaraan bangunan. Dengan menganalisis kandungan dokumen yang dikumpul, objektif kajian lebih mudah diperolehi. Untuk menganalisis tahap keberkesanan amalan pengurusan penyelenggaraan bangunan menggunakan instrumen soal selidik dan temu bual di mana soalan dijawab oleh kakitangan pengurusan bangunan. Bagi kaedah analisis data, SPSS versi 27.0 akan digunakan untuk mengetahui nilai min dan sisihan piawai.

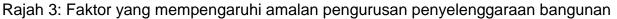
Selain itu, instrumen untuk mendapatkan cadangan dan penambahbaikan bagi strategi yang paling sesuai untuk meningkatkan kualiti kerja-kerja penyelenggaraan adalah dengan menggunakan kaedah temu bual. Strategi pengumpulan data yang digunakan dalam kajian ini adalah dengan melaksanakan kaedah campuran. Dengan pendekatan abduktif, ia menggabungkan kaedah pengumpulan data kualitatif dan kuantitatif. Seperti yang dinyatakan sebelum ini, pendekatan kaedah campuran telah diterima pakai untuk kajian ini.

#### 4. DAPATAN KAJIAN

Kajian dijalankan di Hospital Pulau Pinang dan jumlah keseluruhan responden yang menjawab soal selidik ini ialah 65 orang daripada 80 orang.







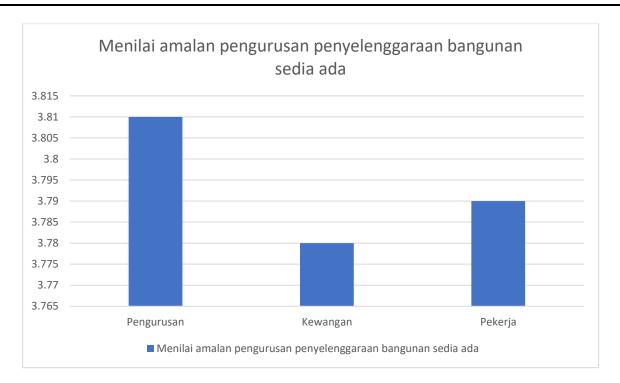
Berdasarkan rajah 3 diatas, kajian ini dapat disimpulkan bahawa pengurusan menjadi faktor utama dengan jumlah min 4.13 untuk faktor yang mempengaruhi amalan pengurusan penyelenggaraan. Responden bersetuju bahawa pengurusan memainkan peranan utama kepada amalan pengurusan penyelenggaraan bangunan. Ini disebabkan pengurusan yang baik dapat membantu untuk perlaksanaan kerja-kerja penyelenggaraan dilakukakan tanpa sebarang masalah yang timbul.

Disamping itu, diikuti faktor kedua tertinggi ialah faktor kewangan dengan jumlah nilai min 4.11. Dapat dilihat faktor ini juga menjadi pilihan responden kerana kewangan juga memainkan peranan yang penting bagi perlaksanaan kerja penyelenggaraan ini untuk dilakukan.

Seterusnya, faktor terendah ialah pekerja dengan jumlah nilai min 3.63 untuk faktor pekerja. Faktor ini terendah disebabkan oleh kurangnya penglibatan pekerja dalam bidang pengurusan. Ini disebabkan pekerja melakukan kerja mengikut arahan yang diberikan oleh pengurusan dan mereka melaksanakannya.

#### 4.2 Penemuan untuk objektif 2





#### Rajah 4 Menilai amalan pengurusan penyelenggaraan bangunan

Berdasakan rajah 4 diatas, kajian ini dapat disimpulkan bahawa faktor pengurusan mempunyai nilai min tertinggi dengan nilai 3.81 untuk amalan pengurusan penyelenggaraan bangunan sedia ada. Ini disebabkan responden bersetuju bahawa pengurusan yang baik dapat meningkatkan kualiti kerja penyelenggaraan bangunan.

Sementara itu, nilai min kedua tertinggi adalah faktor pekerja dengan nilai min 3.79. ini disebabkan, responden bersetuju bahawa pekerja memainkan peranan yang besar dalam kerja-kerja penyelenggaraan bangunan dan mereka juga yang banyak melakukan kerja penyelenggaraan.

Seterusnya, nilai min terendah adalah faktor kewangan dengan nilai 3.78. faktorkewangan bukannya tidak penting dalam penyelenggaraan akan tetapi faktor pengurusan dan faktor pekerja memainkan peranan yang lebih besar dalam amalan pengurusan penyelenggaraan bangunan.

#### 5. KESIMPULAN

Berdasarkan dapatan soal selidik di atas, pengkaji dapat membuat kesimpulan bahawa kebanyakan responden memberikan komen yang positif dan juga mereka memahami kehendak soal selidik. Pengkaji merumuskan bahawa responden mempunyai kefahaman tentang tahap keberkesanan amalan pengurusan penyelenggaraan bangunan melihat responden bersetuju dengan faktor yang



diberikan. Dapatan ini menunjukkan bahawa tahap kesedaran responden berada pada tahap yang tinggi. Berdasarkan nilai skor yang diperolehi didapati semua cadangan yang diberikan adalah positif.

Kesimpulannya, pengkaji mendapati kajian berkaitan keberkesanan amalan pengurusan penyelenggaraan bangunan telah dibincangkan dengan lengkap dan baik untuk kajian ini. Rata-rata objektif kajian ini adalah dalam keadaan tinggi dan baik. Ini telah dibuktikan daripada analisis yang telah dibuat melalui soal selidik

#### 6. RUJUKAN

- Aghimien, D., Oke, A., & Aigbavboa, C. (2019). Barriers of building maintenance in private tertiary institutions in Nigeria. In Advances in Intelligent Systems and Computing (Vol. 788). Springer International Publishing. https://doi.org/10.1007/978-3-319-94199-8\_30
- Chong, A. K. W., Mohammed, A. H., Abdullah, M. N., & Rahman, M. S. A. (2019). Maintenance prioritization – a review on factors and methods. Journal of Facilities Management, 17(1), 18-39. https://doi.org/10.1108/JFM-11-2017-0058
- Chua, S. J. L., Au-Yong, C. P., Ali, A. S., & Hasim, M. S. (2018). Building maintenance practices towards the common defects and resident's satisfaction of elderly homes. Journal of 2018(1). 62-71. Design and Built Environment, https://doi.org/10.22452/JDBE.SP2018NO1.6
- Fadhil Azha. (2020). Penilaian Amalan Pengurusan Penyenggaraan Bangunan Di Bangunan Kerajaan Di Putrajaya.
- Hauashdh, A., Jailani, J., Abdul Rahman, I., & AL-fadhali, N. (2020). Building maintenance practices in Malaysia: a systematic review of issues, effects and the way forward. International Journal of Building Pathology and Adaptation, 38(5), 653–672. https://doi.org/10.1108/IJBPA-10-2019-0093
- Hauashdh, A., Jailani, J., Rahman, I. A., & AL-fadhali, N. (2021). Strategic approaches towards achieving sustainable and effective building maintenance practices in maintenance-managed buildings: A combination of expert interviews and a literature review. Journal Buildina Engineering, 45(August of 2021), 103490. https://doi.org/10.1016/j.jobe.2021.103490
- Ojekalu, S. O., Ojo, O., Oladokun, T. T., & Olabisi, S. A. (2019). Factors influencing service quality: An empirical evidence from property managers of shopping complexes in Ibadan, Nigeria. Property Management, 37(2), 215-228. https://doi.org/10.1108/PM-05-2018-0035



Zulkarnain, S. H., Zawawi, E. M. A., Rahman, M. Y. A., & Mustafa, N. K. F. (2011). A review of critical success factor in building maintenance management practice for university sector. *World Academy of Science, Engineering and Technology*, 77(5), 195–199. https://doi.org/10.5281/zenodo.1082233



# KAJIAN INI MEMBERI TUMPUAN IMPAK PANDEMIK COVID 19 TERHADAP KAKITANGAN DI SYARIKAT PENGURUSAN FASILITI DAN STRATEGI DALAM MENGHADAPINYA.

Nur Ain Binti Amran

Faculty of Facility Management, Persiaran Usahawan, Politeknik Sultan Salahuddin Abdul Aziz Shah, 40150 Shah Alam, Selangor, www.psa.edu.my

#### Abstrak

Abstrak:Pandemik COVID-19 adalah penyakit yang berjangkit yang disebabkan oleh virus SARS-CoV-2 dimana penyakit ini telah menular secara global faktor daripada coronavirus sindrom pernafasan yang teruk(SARs-Cov-2).kajian objektif ini mengenal pasti,mengukur dan strategi semasa staff bekerja semasa musim Pandemik dimana skopnya adalah melakukan penyebaran soal selidik online pada 5 syarikat seperti Syarikat Utusan Sdn Bhd ,Syarikat SSRV Sdn.Bhd,Syarikat UEM Edgenta Sdn.Bhd ,Advance Pact Sdn.Bhd dan Wangsa Ultima Sdn.Bhd.Hasil kajian ini menyerlahkan peluang dan ancaman yang timbul daripada pandemik serta yang paling inovatif langkah-langkah yang dilaksanakan, khususnya dalam bidang pengurusan fasiliti.Penerangan amalan utama yang dikenal pasti dan ilustrasinya melalui pelbagai contoh menunjukkan kepentingannya kemapanan korporat dalam mengurus wabak dan menunjukkan sifat silang krisis ini, yang menjejaskan kebanyakan fungsi korporat secara serentak. Kajian ini juga memungkinkan untuk mengenal pasti pendekatan pemimpin tertentu yang boleh dianggap sebagai contoh atau, sebaliknya, yang sepatutnya dielakkan, sambil menonjolkan paradoks dan kesukaran menilai tanggungjawab sosial korporat dalam masa krisis.

Kata kunci:, Amalan Pengurusan Fasiliti, Pekerja Pengurusan Fasiliti. Covid -19

#### PENDAHULUAN

Pada era globalisasi ini, sektor perkhidmatan pengurusan fasiliti merupakan satu sektor yang telah menyumbang perkembangan ekonomi negara. Tambahan pula, bagi setiap syarikat mempunyai keinginan untuk meningkatkan produktiviti kakitangan. Seterusnya, apabila kurang kehadiran pekerja disebabkan faktor pandemik covid -19 produktiviti operasi kerja menurun (Atmaja & Puspitawati 2018). Oleh



demikian,Suasana yang selamat akan menjadikan operasi kerja oleh kaki tangan berjalan dengan lancar(Atmaja Puspawati 2018).Dengan kata lain, pengurusan fasiliti yang dikenali sebagai pengurusan penyelenggaraan bangunan,pengurusan aset bangunan dan perkhidmatan dalaman.(Atkins & Bildsten 2017).Lantaran daripada itu,infrastruktur besar dimana organisasi yang lama menggunakan perkhidmatan kemudahan.Namun begitu, perkhidmatan pengurusan fasiliti didefinisikan sebagai perkhidmatan yang mengintegrasikan orang,lokasi,proses dan teknologi demi memastikan operasi persekitaran yang dibina(Oladokun & Ajay 2018).

Penyakit coronavirus -19 telah dikesan pada penghujung tahun 2019 di wuhan dimana menjejaskan 22 juta orang di seluruh dunia.Wabak ini mempunyai kesan kehidupan sosial dana ekonomi,kekurangan bekalan dan penjarakan fizikal(Aydemic et al 2021).

# IMPAK PANDEMIK COVID 19 TERHADAP KAKITANGAN DI SYARIKAT PENGURUSAN FASILITI DAN STRATEGI DALAM MENGHADAPINYA.

Nama Pengarang: Mohamad Adib Bin Mohamad Hazlan

**Alamat Gabungan**: Persiaran Usahawan, Politeknik Sultan Salahuddin Abdul Aziz Shah, 40150 Shah Alam, Selangor.

Abstrak:Pandemik COVID-19 adalah penyakit yang berjangkit yang disebabkan oleh virus SARS-CoV-2 dimana penyakit ini telah menular secara global faktor daripada coronavirus sindrom pernafasan yang teruk(SARs-Cov-2).kajian objektif ini mengenal pasti,mengukur dan strategi semasa staff bekerja semasa musim Pandemik dimana skopnya adalah melakukan penyebaran soal selidik online pada 5 syarikat seperti Syarikat Utusan Sdn Bhd ,Syarikat SSRV Sdn.Bhd,Syarikat UEM Edgenta Sdn.Bhd ,Advance Pact Sdn.Bhd dan Wangsa Ultima Sdn.Bhd.Hasil kajian ini menyerlahkan peluang dan ancaman yang timbul daripada pandemik serta yang paling inovatif langkah-langkah yang dilaksanakan, khususnya dalam bidang pengurusan fasiliti.Penerangan amalan utama yang dikenal pasti dan ilustrasinya melalui pelbagai contoh menunjukkan

kepentingannya kemapanan korporat dalam mengurus wabak dan menunjukkan sifat silang krisis ini, yang menjejaskan kebanyakan fungsi korporat secara serentak. Kajian ini juga memungkinkan untuk mengenal pasti pendekatan pemimpin tertentu yang boleh dianggap sebagai contoh atau, sebaliknya, yang sepatutnya dielakkan, sambil menonjolkan paradoks dan kesukaran menilai tanggungjawab sosial korporat dalam masa krisis.

Kata kunci:, Amalan Pengurusan Fasiliti, Pekerja Pengurusan Fasiliti. Covid -19

# <u>Kajian literatur</u>



# 2.3.1 Impak positif covid-19 dalam pengurusan fasiliti dalam bangunan hospital IIUM.

## 2.3.2. Komunikasi & kerjasama penggunaan telefon alih mudah atau laptop.

Dalam era globalisasi pada tahun 2020 majoriti pengguna menggunakan telefon dan laptop untuk komunikasi secara maya terutama musim pandemik covid-19 di mana tidak perlu keluar rumah untuk bekerja seperti melakukan meeting hanya penggunaan aplikasi seperti Microsoft Team,Zoom,Google Meet,GoToMeeting dan Skype for Business.

Sehubungan dengan itu,FM telah menggunakan cara komunikasi seperti bermesyuarat secara online dengan pelanggan,pekerja dan pembekal bahan dengan menggunakan aplikasi tadi demi mengelak berkumpul secara bersemuka antara satu sama lain demi mencegah staff daripada penyakit covid-19.Langkah-langkah utama pengurus fasiliti tangani masalah covid 19 ialah jadikan digital(CAMSIS) yang menguruskan sistem rekod secara online demi memudahkan diakses semua staff akses untuk update work

order,ppm dan ri.Sistem digital (CAMSIS)ialah sistem yang memberi maklumat terkini tentang status pesanan kerja, peralatan rosak fungsi, tahap inventori, status acara dan banyak lagi.

#### Kesan COVID-19 kepada Industri Pengurusan Fasiliti

Sebagai contoh, Gumble (2020, hlm. 18) menegaskan bahawa "sebagai masyarakat dan sebagai industri, kita tidak akan sama apabila ini berakhir. Kami menyesuaikan diri untuk bekerja secara berbeza dengan agak berjaya (walaupun lengkung pembelajaran saya yang curam dengan Skype!)". Ini menunjukkan bahawa persekitaran maya akan lebih disepadukan ke dalam aktiviti pembinaan kami sebagai "norma baru" dan akan terdapat lebih fleksibilitas bekerja kerana penyesuaian alat teknologi ini. Kenyataan Gumble (2020, p. 18) turut disokong oleh Kale (2020) yang menyatakan bahawa "Saya mengesyaki terdapat banyak peranan pembinaan berasaskan pejabat yang boleh dilakukan di rumah, dan tempoh ini berkemungkinan telah membuktikan bahawa fleksibiliti sedemikian adalah berdaya maju. dan harus diterima dengan lebih meluas". Ini disokong oleh Jones (2020), menyatakan bahawa kemajuan teknologi pembinaan yang inovatif sentiasa menggerakkan pembinaan ke hadapan.

# Kesan Ekonomi syarikat

walau bagaimanapun,majoriti syarikat merasa tekanan untuk beroperasi pada musim pandemik ini terutama syarikat pengurusan fasiliti di mana mempunyai sumber kewangan diketatkan,sumber bahan penyenggaraan susut kerana untuk dapat pembekal murah



sangat sukar kerana penutupan jalan oleh kerajaan,arahan kerja banyak sedangkan

pekerja semakin berkurang kerana segelintir staff terpaksa kuarantin kerana kontak rapat dengan pesakit covid-19.Sebagai lanjutan ini,pengurus fasiliti harus berkomunikasi secara prolifik mengenai isu-isu relevan di mana memberi keutamaan kepada hal kesihatan,keselamatan staff daripada covid dan kewangan,baik secara dalaman atau luaran.Bersangkutan dengan hal,dengan sedia maklum syarikat advance pact Sdn.Bhd merupakan syarikat yang menyediakan perkhidmatan penyelenggaraan aset bangunan Hospital IIUM.Namun begitu,syarikat advance pact beroperasi dengan ramai orang di mana perlu pertimbangkan keselamatan penting untuk komunikasi dengan luar contohnya pengurus fasiliti perlu memastikan pekerja juruteknik sivil dan elektrik selamat daripada penyakit covid-19 daripada pesakit dan staff iaitu klient kepada syarikat tersebut.Oleh hal demikian,syarikat perlu menitik beratkan tentang kesukaran yang mereka dan pelanggan mereka hadapi(George 2020)

#### Pengurusan krisis perancangan operasi kerja pengurusan fasiliti di Hospital IIUM.

Dengan kata lain,penyakit coronavirus telah memberi impak negatif kepada industri pengurusan fasiliti terutama pengurus fasiliti advance pact dimana menghadapi kesukaran dalam perancangan operasi kerja supaya mencegah staf bawahan terkena penyakit covid-19 di mana Hospital merupakan tempat paling tinggi risiko terkena penyakit covid -19 dimana ramai pesakit kuarantin di Hospital IIUM.Disingkapkan,pengurus fasiliti memainkan peranan penting untuk mengembalikan semula organisasi mereka normal baharu semasa musim pandemik covid-19 dan mencari cara supaya lebih bersedia sekiranya ada wabak baru akan datang pada masa

depan.Apa yang saya pelajari di syarikat Advance pact adalah pengurus fasiliti mereka telah mempelajari teknik selesaikan masalah melalui web 7 (Lessons Learned Across Thousands)

#### Metodologi

Pengkaji amat memerlukan metodologi untuk memilih kaedah yang berkesan dan sesuai demi menjawab segala semua permasalahan dalam kajian.Lantaran itu, kaedah kajian yang akan dijangka akan merangkumi reka bentuk kajian,prosedur analisis data,prosedur analisis data,sampel kajian dan prosedur kajian.Tambahan pula,metodologi ialah prosedur yang amat sistematik di mana ia digabung dalam segi pendekatan analisis data dan saliran bertujuan memastikan prestasi kajian penyelidikan dapat dicapai dengan baik.(Othman Mohamed 2001)

#### Saiz Persampelan

Menentukan saiz sampel yang diperlukan untuk mewakili populasi tertentu sedang meningkatkan permintaan untuk penyelidikan telah mewujudkan keperluan untuk kaedah



yang cekap. Dalam artikel itu, bahagian penyelidikan Persatuan Pendidikan Kebangsaan telah menerbitkan formula untuk menentukan saiz sampel.

S= X2 NP(1-P) / d2 (N-1) + X2 P (1-P)

S = saiz sampel yang diperlukan

X2= nilai jadual khi kuasa dua untuk 1 darjah kebebasan pada tahap keyakinan yang dikehendaki (3.841).

N= perkadaran penduduk

d= darjah ketepatan dinyatakan sebagai perkadaran

Objektif 1: Mengenal Pasti Impak(Positif Dan Negatif)Pandemik Covid 19 Terhadap Kakitangan Di Syarikat Pengurusan Fasiliti.

: Analisis ini dibuat bertujuan untuk mengkaji Kesedaran tentang pelbagai elemen / domain yang berkaitan dengan impak pandemik covid 19 terhadap kakitangan di syarikat pengurusan fasiliti dan strategi dalam menghadapinya.

Skala lima mata telah ditetapkan seperti Jadual

No	Questions	purata
	Adakah anda bersetuju bahawa anda mengalami impak yang di senaraikan seperti di bawah semasa pandemik covid 19 tersebar di negara kita.(Impak Negatif)	
1	Saya tak dapat fokus bekerja online kerana suasana bekerja yang tidak kondusif	3.32
2	Saya mengalami tekanan perasaan semasa operasi kerja selenggara semasa pandemik covid merebak.	3.16
3	Saya tidak dapat fokus kerja kerana risau dijangkiti covid dan menyebarkan kepada ahli keluarga lain yang terkena covid.	3.22
4	Prestasi kerja menurun dalam tempoh PKP	3.56
5	Saya merasa risau akan kehilangan pekerjaan	3.94
6	Saya mengalami cabaran mendapatkan alat ganti yang diperlukan sewaktu pelaksana tugas	3.306



7	Motivasi kerja saya menurun perintah PKP dilaksanakan	3.68
8	Saya sukar menerima sop baharu kerana prosedur kerja semakin ketat semasa melakukan penyelenggaraan aset semasa covid 19 merebak	3.14
9	Pendapatan bulanan saya terjejas ketika arahan PKP	3.52
10.	Pemberian arahan tugas secara online sering di keluarkan di luar waktu kerja	3.34
11.	Saya merasakan pekerjaan sukar di laksanakan di sebabkan pengiliran jadual	3.72

berupaya 9: Analisis Skor Min untuk Kesedaran tentang pelbagai elemen / domain yang berkaitan dengan impak covid-19 terhadap kakitangan di syarikat pengurusan fasiliti dalam menghadapinya.Oleh demikian skor min 3.32 dimana pekerja tidak dapat fokus semasa bekerja online daripada rumah Pentaraki dan Burkholder (2017).Dalam kata lain,emosi semasa bekerja jarak jauh menyukarkan staff susah memahami tugasan yang diberikan oleh majikan juga punca emosi fokus kerja terganggu dimana skor paling tinggi iaitu 3.16 (Reilly et al. (2012).Bagi poin kedua pula pekerja mengalami tekanan perasaan semasa operasi kerja kerana kesukaran diri menghadapi peristiwa kehidupan(Cummins et al., 2015; Drapeau et al., 2011; Marchand, 2004).Namun begitu,kesihatan mental banyak terganggu sejak pandemik covid -19 terutama semasa dan selepas wabak ini.Oleh itu dalam bahagian inni kami telah membuat perbezaan tekanan semasa dan selepas covid 19 dimana ia juga faktor masalah.(Mirowsky & Ross, 2003).

Oleh itu,pekerja bekerja operasi kerja tidak dapat fokus kerja kerana khawatir dijangkiti covid-19 sekaligus menyebarkan kepada ahli keluarga kerana terkena covid-19.Selain itu,prestasi staff bekerja menurun dalam tempoh PKP dimana skornya ialah 3.56 (Chick, 2013).Seterusnya,

Syarikat mengalami cabaran mendapatkan alat ganti yang diperlukan sewaktu pelaksana tugas kerana faktor penyakit covid 19 berleluasa merebak.Lantaran daripada itu,semangat motivasi pekerja menurun sejak perintah PKP dilaksanakan iaitu skor min 3.68 sahaja.Prestasi pekerja melibatkan kualiti dan kuantiti keluaran, kehadiran di tempat kerja, sifat akomodatif dan membantu serta ketepatan masa keluaran. Menurut hasil kajian Yang (2008) terhadap prestasi individu menunjukkan prestasi individu tersebut tidak dapat dipastikan.Walau Bagaimana segelintir staff sukar menerima prosedur kerja

ketat semasa penyelenggaraan aset dimana covid merebak iaitu purata 3.14.Jelaslah bahawa,pendapatana gaji bulanan saya terjejas kerana faktor bila pembelian ubatan atau alat cegah covid yaitu sebanyak 3.53.



#### **Reliability Statistics**

Cronbach's Alpha	N of Items
.74	9

Jadual 10 : Alpha Cronbach untuk Kesedaran tentang pelbagai elemen / domain yang berkaitan impak pandemik covid 19 terhadap kakitangan di syarikat pengurusan fasiliti dalam menghadapinya.Berdasar jadual di atas Alpha Cronbach adalah 0.74 yang telah tunjukkan tentang pelbagai elemen/domain yang berkaitan dengan impak pandemic

covid 19 terhadap kakitangan di syarikat pengurusan fasiliti dalam menghadapinya.Hasilnya, dapat disimpulkan bahawa dapatan yang diperoleh daripada objektif pertama ini juga digunakan sebagai alat sokongan untuk mendapatkan jawapan yang lebih spesifik bagi objektif kedua.

OBJEKTIF 3 : Mengukur Impak Pasca Pandemik Covid -19 Terhadap Kakitangan Dan Pekerja Di Syarikat Pengurusan Fasiliti Ketika Melaksanakan Tugas Mereka.

Mengukur tahap impak pasca pandemik covid 19 terhadap kakitangan dan pekerja di syarikat pengurusan fasiliti ketika melaksanakan tugas mereka.	purata
1.Apakah tahap keberkesanan pandemik covid 19 terhadap diri anda dan persekitaran pekerjaan ketika berada di peringkat pasca pendemik covid 19? [Motivasi pekerja untuk bekerja secara bersemuka]	3.92
2.Apakah tahap keberkesanan pandemik covid 19 terhadap diri anda dan persekitaran pekerjaan ketika berada di peringkat pasca pendemik covid 19? [Aktiviti harian di kalangan kakitangan dan pekerja dalam pengurusan fasiliti]	3.72
3.Apakah tahap keberkesanan pandemik covid 19 terhadap diri anda dan persekitaran pekerjaan ketika berada di	3.4



peringkat pasca pendemik covid 19? [Penggunaan teknologi/ Social media dalam aktiviti harian syarikat ]	
4.Apakah tahap keberkesanan pandemik covid 19 terhadap diri anda dan persekitaran pekerjaan ketika berada di peringkat pasca pendemik covid 19? [Penguasaan kemahiran menggunakan komputer dan social media di kalangan pekerja]	3.64
5.pakah tahap keberkesanan pandemik covid 19 terhadap diri anda dan persekitaran pekerjaan ketika berada di peringkat pasca pendemik covid 19? [Pembayaran kerja lebih masa bagi aktiviti pengurusan fasiliti]	3.68
6 Apakah tahap keberkesanan pandemik covid 19 terhadap diri anda dan persekitaran pekerjaan ketika berada di peringkat pasca pendemik covid 19? [Hubungan dikalangan rakan sekerja]	3.34
7Apakah tahap keberkesanan pandemik covid 19 terhadap diri anda dan persekitaran pekerjaan ketika berada di peringkat pasca pendemik covid 19? [Pendapatan bulanan kakitangan dan pekerja]	3.62
8 Apakah tahap keberkesanan pandemik covid 19 terhadap diri anda dan persekitaran pekerjaan ketika berada di peringkat pasca pendemik covid 19? [Disiplin kakitangan dan pekerja dalam mematuhi SOP yang telah ditetapkan]	3.92
9.Apakah tahap keberkesanan pandemik covid 19 terhadap diri anda dan persekitaran pekerjaan ketika berada di peringkat pasca pendemik covid 19? [Pendapatan bulanan kakitangan dan pekerja]	3.62
10.Apakah tahap keberkesanan pandemik covid 19 terhadap diri anda dan persekitaran pekerjaan ketika berada di	3.6



2<sup>nd</sup> National Conference on TVET Undergraduate Students (NCTS) Politeknik Tuanku Syed Sirajuddin 19-20 July 2022

peringkat pasca pendemik covid 19? [Bebanan kerja yang diterima secara dalam talian ]

Rajah di atas menunjukkan mengenai impak pasca pandemik covid 19 terhadap kakitangan dan pekerja di syarikat pengurusan fasiliti ketika melaksanakan tugas iaitu tahap keberkesanan pandemik covid 19 terhadap persekitaran pekerjaan ketika berada di peringkat pasca pendemik covid 19 dimana motivasi pekerja untuk bekerja secara bersemuka dan disiplin kakitangan dan pekerja dalam mematuhi SOP yang telah ditetapkan rating purata paling tinggi iaitu 3.92. (Paulson & McCormick, 2020). Dengan kata lain, apabila rantaian bekalan alatan selenggara berkurangan automatik banyak arahan kerja tertangguh kerana kesukaran dapat bekalan alatan selenggara yang murah di kawasan Bandar Kuantan.Bersangkutan dengan hal, pemimpin telah merangka dokumentasi garis panduan,langkah dan amalan terbaik dalam mencipta pelan kesinambungan perniagaan.tambahan pula, Article ini diterbitkan oleh Chris Matt Editor Urusan di Facilities Net pada tahun 2011.Seterusnya, bagi rating paling rendah dalam tahap keberkesanan covid 19 ialah hubungan dikalangan rakan sekerja purata sebanyak 3.34 sahaja.Beberapa kajian telah memberi sokongan cadangan dimana persekitaran mungkin lebih bergantung kepada ciri pekerja,status sambilan kerja atau penuh (Paulson & McCormick. 2020). Tambahan pula, komunikasi antara staf dan klien memberi cabaran khusus kepada pengurus fasiliti untuk merangka strategi operasi kerja demi mengelak krisis penyakit covid terkena kepada mereka. (Colorado Nonprofit Association. Crisis Communication Plan Nonprofit Toolkit 2011).

#### RUJUKAN

Adult Mental Health Survey. (2020, April). https://www.activeminds.org/wpcontent/uploads/2020/04/Student-Survey-Infographic.pdf.https://reader.elsevier.com/reader/sd/pii/S0305750X21000176?toke n=CC91FB2791AA8ECB5E9D7EA7FA6A8B34FDCB0F07AD0F599D8AD8FAAEE CD3CC0B5FA3E3A365A502AE4ED240D7B78007FA&originRegion=eu-west-1&originCreation=20220411012352https://journals.sagepub.com/doi/full/10.1177/0 8944393211007314

https://journals.sagepub.com/doi/full/10.1177/08944393211007314



ElsevierEnhancedReaderhttps://reader.elsevier.com/reader/sd/pii/S0278431921001808?to ken=3764F3B3394A624DF2874B3E9EA58B83A6CB9C695980FB8EB334A8D992 5142F16ED49F74787FD17CCEB8BC3434DC82B3&originRegion=eu-west-1&originCreation=20220411012504.

https://reader.elsevier.com/reader/sd/pii/S2405844020312433?token=1753FF90D338E7B EF392DBADC6902FD329C48F266555F4DA3AA1C93B87008EAB8547743519DD71915A 67F862CCB31020&originRegion=eu-west-1&originCreation=20220411014621

https://reader.elsevier.com/reader/sd/pii/S0165032720324460?token=EB3709055A2DB9F 00FD9B67016214D38DB311242749D0EA66954876790C613556D8B7EE972645505E58 07F6006C49D54&originRegion=eu-west-1&originCreation=20220411014723

https://reader.elsevier.com/reader/sd/pii/S0165032720325301?token=80650864FCE74152 42CB98EDC7441FDFA865C413B471DC4357A3B1C7743894588AFAE553A93BD4C961 B5730F770602F0&originRegion=eu-west-1&originCreation=20220411014902

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7342058/pdf/emeraldopenres-2-14621.pd



# CABARAN TERHADAP FUNGSI DAN PENGGUNAAN SISTEM TAKUNGAN AIR HUJAN PADA BANGUNAN AWAM

Nurul Azieatul Atika Binti Mohd Sharin<sup>1</sup> dan Shahida Binti Sharuddin<sup>2</sup>

<sup>1</sup>Jabatan Kejuruteraan Awam, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor Zieaamohd @gmail.com

<sup>2</sup>Jabatan Kejuruteraan Awam, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor shahida.s@psa.edu.my

#### ABSTRAK

Air adalah salah satu sumber utama manusia untuk meneruskan kehidupan. Tanpa bekalan air atau bekalan air tidak mencukupi, manusia akan memperolehi kesan yang negatif dalam kehidupan seharian mereka. Bagi mengelakkan berlaku gangguan bekalan air kepada manusia dan ekonomi, maka satu sistem telah diwujudkan iaitu sistem takungan air hujan. Oleh itu, kajian ini dijalankan bagi mengenalpasti cabaran terhadap fungsi dan penggunaan sistem takungan air hujan pada bangunan awam. Kajian ini menggunakan kaedah kualitatif di mana instrument kajian melalui pemerhatian di lokasi pembinaan sistem dan Analisa kandungan dokumen-dokumen berkaitan sistem takungan air hujan tersebut. Hasil kajian mendapati bahawa rekabentuk sistem memberi kesan paling ketara terhadap keberkesanan dan kemudahan untuk menggunakannya. Kajian ini menjadi bukti kepada kerjaaan dan masyarakat di Malaysia bahawa terdapat organisasi dan institusi yang menggunakan sistem takungan air hujan air hujan dalam mengekalkan kelestarian alam dan mengurangkan kos perbelanjaan institusi mahupun organisasi tersebut.

**Kata Kunci:** Sistem Takungan Air Hujan, Bekalan Air, Fungsi dan Penggunaan Sistem Takungan Air Hujan,



#### **1.0 PENGENALAN**

Tanpa bekalan air atau bekalan air tidak mencukupi, manusia akan memperolehi kesan yang negatif dalam kehidupan seharian mereka. Bagi mengelakkan berlaku gangguan bekalan air kepada manusia dan ekonomi, maka satu sistem telah diwujudkan iaitu sistem takungan air hujan. Sistem takungan air hujan ini bertujuan untuk membekalkan sumber air kepada manusia dan ekonomi jika berlaku apa-apa kerosakan pada pembekalan sumber air utama. Menurut (Man *et al.*, 2014) Sistem Takungan Air Hujan adalah kaedah pengurusan terbaik yang diamalkan di Malaysia.

Sistem Takungan Air Hujan telah dicipta kerana timbulnya beberapa isu mengenai sumber bekalan air kepada manusia, ekonomi dan negara. Antara isu-isu tersebut ialah seperti penggunaan sumber air yang semakin meningkat dalam kalangan rakyat Malaysia. Hal ini telah dinyatakan dalam kajian (Man *et al.*, 2014) bahawa permintaan air semakin meningkat di kalangan rakyat Malaysia sejak beberapa tahun kebelakangan ini. Selain itu, penggunaan sumber air dengan baik juga sering menjadi isu dikalangan rakyat Malaysia. Menurut (Kabbashi *et al.*, 2020)masyarakat tidak memanfaatkan air hujan yang turun sebanyak 314 mm air hujan pada setiap tahun bagi kegunaan harian mereka. Bagi mengelakkan berlakunya masalah kekurangan bekalan air dan memenuhi permintaan air masyarakat, penadahan air hujan perlu dilaksanakan dan diterapkan secara menyeluruh dikalangan rakyat Malaysia.

Kajian ini sangat penting kepada pihak pengurusan sistem takungan air hujan untuk mengenalpasti tahap keberkesanan sistem takungan air hujan tersebut kepada pengguna. Selain itu, kajian ini juga dapat menjadi bukti kepada kerjaaan dan masyarakat di Malaysia bahawa terdapat beberapa organisasi dan institusi yang menggunakan sistem takungan air hujan ini bagi mengekalkan kelestarian alam dan mengurangkan kos perbelanjaan institusi mahupun organisasi tersebut.

#### 2.0 KAJIAN LITERATURE

Kajian ini telah merujuk banyak kajian lepas yang telah dikaji oleh para penyelidik mengenai sistem takungan air hujan. Antara faktor-faktor yang sering di beri penekanan ialah seperti rekabentuk sistem takungan air hujan dan fungsi-fungsi sistem takungan air hujan pada bangunan mahupun kediaman. Beberapa penyelidik telah pun mengkaji reka bentuk yang sesuai digunakan mengikut jenis lokasi penggunaan sistem. Sebagai contoh, lokasi yang dipilih ialah jenis kediaman, maka pengkaji mengkaji jenis-jenis reka bentuk yang sesuai digunakan pada kediaman tersebut. Selain itu, kajian-kajian lepas juga banyak menyentuh mengenai fungsi dan penggunaan sistem takungan air hujan.



Sebagai contoh, aktiviti-aktivti yang menggunakan sumber daripada sistem takungan air hujan seperti aktivti mencuci dan menyiram tanaman.

Gambar rajah di bawah menunjukkan tiga konsep yang digunakan di dalam kajian mengenai cabaran terhadap fungsi dan penggunaan sistem takungan air hujan pada bangunan awam. Tiga konsep kajian ini adalah sangat penting, kerana tiga konsep kajian ini sebagai panduan untuk memastikan objektif kajian tercapai seterusnya menjawab persoalan kajian dan mencapai matlamat kajian. Tiga konsep ini juga akan membawa kepada penemuan tentang data yang diperlukan, daripada siapa data diperolehi, dan bagaimana ia akan menjawab persoalan kajian.



# Rajah 1: Kerangka Konseptual Untuk Menambahbaik Fungsi Dan Penggunaan Sistem Takungan Air Hujan Pada Bangunan Awam Bagi Mencapai Tahap Penggunaan Yang Optimum.

2.1 Reka Bentuk Sistem Takungan Air Hujan

Reka bentuk sistem takungan air hujan ialah reka bentuk yang perlu menitik beratkan beberapa infrastruktur yang membantu dalam menyampaikan bekalan air kepada pengguna. Hal ini turut disokong oleh (Azhar, 2006)yang menyatakan bahawa reka bentuk sistem takungan air hujan ini melibatkan beberapa struktur rangkaian kemudahan infrastruktur yang terdiri daripada sistem bekalan air di dalam banguan, sistem pengagihan dan sistem retikulasi. Sistem takungan air hujan perlulah direka mengikut kesesuaian lokasi dan situasi dimana ia akan dibina. Selain itu, reka bentuk sistem takungan air hujan juga memainkan peranan penting dalam menguji tahap keberkesanan sistem tersebut.



Kebiasaanya reka bentuk sistem takungan air hujan dilakukan berdasarkan reka bentuk bangunan di lokasi pembinaan sistem itu sendiri. Hal ini telah dinyatakan dalam kajian (Yusoff *et al.*, 2020)bahawa reka bentuk bangunan juga memainkan peranan penting dalam pelaksanaan sistem takungan air hujan tersebut. Jika reka bentuk yang direka kurang sistematik maka ia akan memberi kesan kepada keberkesanan dalam penggunaan sistem takungan air hujan tersebut. Selain itu, (Miswan *et al.*, 2021)turut menyatakan bahawa sistem takungan air hujan ini tidak dapat digunakan dengan lebih cekap menyebabkan pengguna tidak dapat manfaat yang sepenuhnya daripada sistem tersebut. Ini menunjukkan bahawa reka bentuk sistem takungan air hujan ini sangat penting dalam faktor penggunaan sistem agar sistem takungan air tersebut dapat menyampaikan fungsi dan penggunaan yang optimum.

#### 2.2 Kaedah Penggunaan Sistem Takungan Air Hujan

Konsep seterusnya ialah kaedah penggunaan sistem takungan air hujan. Kaedah penggunaan sistem takungan air hujan di dalam konteks ini bermaksud cara bekalan air hujan tersebut disampaikan kepada pengguna dengan menggunakan peralatan tertentu Sebagai contoh, menurut laporan Jabatan Perancangan Bandar dan Desa (2013) di dalam Laporan Panduan Pelaksanaan Inisiatif Pembangunan Kejiranan Hijau (Sistem Pengumpulan dan Penggunaan Semula Air Hujan) yang menyatakan bahawa antara peralatan yang digunakan bagi menyampaikan bekalan air hujan di bahagian luaran tersebut ialah seperti *sprinkler / handheld hose, drip sistem, hosing path / driveways* dan lain lain.

Kesemua peralatan tersebut mempunyai cara penggunaan yang berbeza-beza seterusnya akan memberi kesan kepada tahap kemudahan mengenai cara penggunaan sistem tersebut kepada pengguna. Untuk mengenalpasti tahap kemudahan sistem takungan air hujan, kaedah penggunaan yang digunakan bagi menyampaikan bekalan air kepada pengguna perlu dikenalpasti. Hal ini adalah kerana, kaedah penggunaan juga merupakan faktor utama dalam menentukan tahap keberkesanan sistem takungan air hujan sama ada ia lebih memudahkan pengguna mahupun sebaliknya. Selain itu, cara pembersihan sistem takungan air hujan juga termasuk dibawah kaedah penggunaan. Ini adalah kerana terdapat beberapa jenis sistem takungan air hujan yang agak sukar untuk dibersihkan dan ia menyebabkan tahap kemudahan menggunakan sistem takungan air hujan terkesan.



#### 2.3 Aktiviti Yang Dijalankan

Konsep yang terakhir ialah aktiviti yang dijalan menggunakan sistem takungan air hujan. Aktiviti yang dijalankan ini bermaksud mengenalpasti jenis aktiviti yang dijalankan menggunakan sumber bekalan takungan air hujan tersebut. Hal ini adalah kerana dengan mengenalpasti jenis-jenis aktiviti yang dijalankan menggunakan sistem takungan air hujan pengkaji dapat membuat perbandingan diantara lokasi-lokasi yang terpilih seterusnya membuat penambahbaikan pada sistem takungan air hujan tersebut.

Di Malaysia, sumber bekalan takungan air hujan ini kebiasaanya digunakan bagi aktiviti aktiviti domestik. Hal ini telah dinyatakan oleh (Hanifah Mahat, Koh Liew See, 2016)yang menyatakan bahawa air hujan mampu membawa manfaat kepada masyarakat untuk pelbagai kegunaan domestik luar rumah seperti mencuci lantai koridor, cuci kenderaan, menyiram pokok bunga atau tanaman dan mengepam atau mencuci tandas. Selain itu, terdapat beberapa penulisan yang menyatakan bahawa air takungan hujan ini juga boleh digunakan sebagai air minuman.

Walaubagaimanapun, menurut laporan Jabatan Perancangan Bandar dan Desa (2013) yang menyatakan bahawa air hujan yang digunakan untuk tujuan minuman/makan hendaklah dirawat terlebih dahulu, khususnya air hujan di kawasan bandar kerana mengandungi toksik logam yang melebihi garis panduan WHO (World Health Organisation). Kesimpulannya, sumber bekalan air bersih perlu digunakan sebaik mungkin bagi kegunaan yang lebih penting seperti memasak, mandi, makan, minum dan lain lain yang lebih penting dan perlu diutamakan bagi meneruskan kehidupan masyarakat.

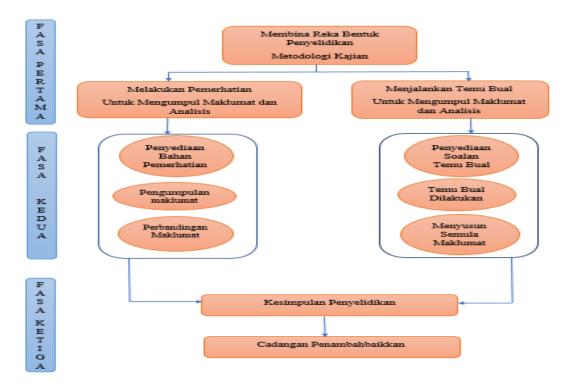
#### 3.0 METODOLOGI KAJIAN

Reka bentuk kajian ialah carta aliran yang akan menerangkah proses dan langkahlankah mendapatkan maklumat dan dapat bagi mencapai matlamat kajian. Menurut (Kamarul, 2017) reka bentuk kajian ialah satu tatacara pengolahan data yang diambil berdasarkan perancangan khusus dan sistematik terhadap konsep pembentukan rangkaian hubungan antara pembolehubah-pembolehubah yang teryang terlibat. Berikut ialah reka bentuk kajian terhadap keberkesanan fungsi dan penggunaan sistem takungan air hujan pada bangunan awam.

Instrument bagi mengenalpasti fungsi dan penggunaan sistem takungan air hujan menggunakan kaedah pemerhatian. Pemerhatian dilakukan pada dua lokasi iaitu pusat rehabilitasi perkeso dan hospital pulau pinang. Untuk melakukan kaedah pemerhatian,



pengkaji akan menyediakan bahan pemerhatian seperti dokumen-dokumen berkaitan sistem dengan persetujuan dan kebenaran orang bertanggungjawab. Bagi proses menganalisis data pula, pengkaji akan melakukan proses mengumpul maklumat pada kedua-dua lokasi. Pengkaji juga akan melakukan pemerhatian di kedua-dua tapak lokasi pembinaan sistem. Seterusnya, barulah perbandingan maklumat dilakukan sebelum pengkaji melakukan kesimpulan dan cadangan penambahbaikan.



Rajah 2: Carta Alir Reka Bentuk Kajian Yang Digunakan.

#### 4.0 Dapatan Kajian

Objektif pertama bagi kajian ini ialah untuk mengenal pasti fungsi dan penggunaan sistem takungan air hujan pada bangunan awam. Bagi mencapai objektif tersebut, kaedah pemerhatian telah dilakukan. Data-data yang diambil adalah berdasarkan senarai semak yang telah disediakan oleh pengkaji.



PERKARA	PUSAT REHABILITASI PERKESO	HOSPITAL PULAU PINANG	CATATAN			
REKA BENTUK						
Reka bentuk yang digunakan dilokasi tersebut.	Segi empat tepat.	Silinder	Kedua-dua bentuk adalah bersifat praktikal dan sesuai digunakan pada bangunan awam.			
Kedudukan dan Iokasi sistem takungan air hujan.	Pada setiap bangunan dibawah tanah.	Hanya ada pada block ACC di atas tanah.	Kedudukan sistem di atas tanah seperti yang berada di hospital pulau pinang lebih baik kerana memudahkan kerja- kerj penyelenggaraan.			
Jenis pam yang digunakan.	Supatuf (Waterco)	Weida (Dd Tech)	Kedua-dua jenis pam adalah bersifat praktikal dan sesuai digunakan pada bangunan awam.			
Saiz ukuran reka bentuk yang digunakan.	Rujuk floor plan. Tangki 1 (2500 x 2100) Tangki 2 (3900 x 4500)	Rujuk floor plan.	Saiz ukuran di pusat rehabilitasi lebih baik kerana boleh menyimpan dan mengumpul air dengan lebih banyak.			
Material yang digunakan bagi peralatan sistem.	Konkrit	Plastic pvc	Material jenis konkrit lebih baik kerana kualitinya yang tahan lasak.			
	CARA PENG	GUNAAN				
Jenis peralatan yang digunakan untuk menyampaikan bekalan air.	Sprinkle dan paip air.	Paip air.	Pusat rehabilitasi lebih praktikal kerana menggunakan 2 jenis peralatan bagi menyampaikan bekalan air.			
Cara memperolehi bekalan air hujan.	Air hujan akan ditadah di bahagian atas bangunan dan dikumpul seterusnya disalurkan pada bagaian bawah tanah dan akan dibekalkan kepada pengguna melaui springkler dan paip.	Air hujan akan ditadah di bahagian atas bangunan dan dikumpul seterusnya disalurkan pada bagaian bawah tanah dan akan di pam ke atas tangki dan dihantar kepada pengguna melaui paip air.	Kedua-dua kaedah adalah praktikal dan sesuai digunakan pada bangunan awam.			



	1	1	
Aktiviti yang menggunakan bekalan air hujan	Mencuci dan menyiram tanaman.	Kegunaan paip tandas. (Flush)	Pusat rehabilitasi lebih baik kerana lebih banyak aktiviti yang menggunakan bekalan air hujan tersebut.
	CARA MENYEL	ENGGARA	
Jenis penyelenggaraan yang dilakukan. (servis/ membaiki)	Membersihkan dan membaiki panel / pam.	Membersihkan dan menyelenggara sistem (PPM)	Pusat rehabilitasi lebih sering mengalami kerosakan kerana tangki dan pam sistem berada di bawah tanah.
Peralatan yang digunakan untuk menyelenggara.	Tangga dan peralatan menyelenggara yang diperlukan	Tangga dan peralatan menyelenggara yang diperlukan.	Kedua-duanya adalah praktikal dan sesuai digunakan pada bangunan awam.
Peralatan keselamatan yang digunakan untuk menyelenggara.	Topi keselamatan dan glove	Topi keselamatan dan glove	Kedua-duanya adalah praktikal dan sesuai digunakan pada bangunan awam.
Orang yang melakukan penyelenggaraan	Pekerja teknikal. (sumber dalaman)	Pekerja teknikal. (sumber dalaman)	Kedua-duanya adalah praktikal dan sesuai digunakan pada bangunan awam.
Gambar sistem takungan air hujan	(tangki berada di atas tanah)	(tangki berada di bawah tanah)	Sistem di hospital Pulau Pinang kelihatan lebih kemas, bersih dan mudah untuk diselenggra berbanding di pusat rehabilitasi.

Berdasarkan senarai semak yang disediakan, pengkaji bagi konsep pertama iaitu reka bentuk sistem takungan air hujan di pusat rehabilitasi lebih praktikal dan sesuai digunakan dari aspek material dan saiz ukuran. Manakala hospital pulau pinang pula, lebih baik dari segi lokasi dan kedudukan sistem takungan air hujan kerana tangkinya yang berada di atas tanah memudahkan kerja-kerja pembersihan dan penyelenggaraan. Walaubagaimanapun, hospital pulau pinang dan pusat rehabilitasi kedua-duanya sesuai digunakan dari aspek jenis pam dan reka bentuk sama ada berbentuk segi empat tepat mahupun silinder.

Bagi konsep kedua pula iaitu cara penggunaan sistem takungan air hujan, pengkaji mendapati di pusat rehabilitasi perkeso lebih praktikel dan sesuai digunakan dari aspek jenis peralatan yang digunkaan untuk menyampaikan bekalan dan aspek kepelbagaian aktiviti yang menggunakan sumber bekalan takungan air hujan tersebut. Walaubagaimanapun, kedua-dua lokasi iaitu hospital pulau pinang dan pusat rehabilitasi bersifat praktikal dan sesuai digunakaan pada bangunan awam dari aspek cara memperolehi air hujan kerana kedua-duanya menggunakan kaedah yang sama.



Untuk konsep yang terakhir iaitu cara menyelenggara kedua-dua lokasi iaitu hospital pulau pinang dan pusat rehabilitasi bersifat praktikal dan sesuai digunakaan pada bangunan awam dari aspek peralatan yang digunakan untuk menyelenggara dan orang yang menyelenggara sistem takungan air hujan tersebut kerana kedua-dua lokasi melakukan penyelenggaraan, menggunakan peralatan dan sumber yang sama. Walaubagaimanapun, hospital pulau pinang lebih praktikal dan sesuai digunakan berbanding pusat rehabilitasi perkeso kerana tangkinya yang berada di atas tanah memudahkan kerja-kerja pembersihan dan penyelenggaraan.

#### 5.0 Kesimpulan

Kesimpulannya, objektid kajian dapat dicapai. Keseluruhan kajian ini mendapati, setiap jenis sistem takungan air hujan mempunyai kebaikan dan keburukannya tersendiri. Kajian ini sangat penting kepada pihak pengurusan sistem takungan air hujan dalam proses menambahbaik sistem yang digunakan bagi mengurangkan berlakunya masalah-masalah yang tidak diingini seperti kesukaran untuk menyelenggara sistem tersebut dan penukaran alat-alat sistem yang rosak. Hal ini adalah kerana setiap masalah yang berlaku pasti akan memakan belanja yang besar. Di samping itu, kajian ini juga dapat menjadi bukti kepada kerajaan dan masyarakat di Malaysia bahawa terdapat beberapa organisasi dan institusi yang menggunakan sistem takungan air hujan ini bagi mengekalkan kelestarian alam dan mengurangkan kos perbelanjaan mereka. Selain itu, pengkaji juga dapat mengumpulkan maklumat-maklumat yang berbeza-beza hasil daripada kaedah pemerhatian yang dijalankan. Seterusnya, pengkaji dapat membuat kesimpulan berdasarkan hasil dapatan kajian yang diperolehi yang akan membantu dalam proses penambahbaikkan. Akhir sekali, kajian ini juga dapat membantu pelajar mahupun pengkaji-pengkaji yang ingin mendapatkan maklumat mengenai system takungan air hujan melalui kajian ini

#### Rujukan

Azhar, K. (2006) 'REKABENTUK SISTEM BEKALAN AIR BASUHAN MELALUI KAEDAH

PENGUMPULAN AIR HUJAN .', pp. 1–118.

Hanifah Mahat, Koh Liew See, S. B. N. (2016) 'Kesedaran terhadap sistem penuaian air

hujan dalam kalangan komuniti Tanjong Malim, Perak', Geografi, 4(1), pp. 35–42.

Kabbashi, N. A. et al. (2020) 'Rainwater harvesting quality assessment and evaluation:

IIUM case study', IIUM Engineering Journal, 21(1), pp. 12-22. doi:



10.31436/iiumej.v21i1.1139.

Kamarul, D. (2017) Reka bentuk Kajian Dr. Kamarul. Available at:

https://www.slideshare.net/wmkfirdaus/reka-bentuk-kajian-dr-kamarul.

MALAYSIA, J. P. B. D. D. S. (2013) Panduan Pelaksanaan Inisiatif Pembangunan

Kejiranan Hijau (Sistem Pengumpulan & Penggunaan Semula Air Hujan).

Available at: http://www.townplan.gov.my/download/LAPORAN\_MANUAL\_RT\_EDISI\_2013\_041 12013.pdf.

Man, S. et al. (2014) 'Kebolehupayaan sistem penuaian hujan sebagai bekalan air

alternatif di Malaysia: Suatu penelitian awal (The reliability of rainwater harvesting

system as an alternative source of water supply in Malaysia: A preliminary study)', *Geografia : Malaysian Journal of Society and Space*, 10(6), pp. 97–104.

Miswan, R. et al. (2021) 'Reka Bentuk Sistem Penuaian Air Hujan Pelbagai Fungsi

Terhadap Rumah Lot Banglo', 2(2), pp. 460–477.

Yusoff, N. M. et al. (2020) 'Projek rekabentuk lestari: pemasangan sistem penuaian air

hujan di kawasan luar bandar', pp. 342–349.



# KAJIAN TERHADAP FASILITI ORANG KELAINAN UPAYA DI PUSAT REHABILITASI, AYER KEROH, MELAKA (PRPTAR)

Nurfaizah Dolbahrin<sup>1</sup>, Sr Ts. Rohaizana Ramli<sup>2</sup> <sup>1</sup>Nurfaizah Dolbahrin

Civil Department, Polytechnic Sultan Salahuddin Abdul Aziz Shah, Selangor faizahdolbahrin@gmail.com, <sup>2</sup>rohaizana@psa.edu.my

#### Abstrak

Golongan Orang Kelainan Upaya (OKU) merupakan individu yang mempunyai kekurangan keupayaan jangka panjang dari segi fizikal, mental, intelektual dan deria yang dapat menghalang mereka untuk meyertai dengan masyarakat. Hal ini menyebabkankan golongan OKU menghadapi masalah dalam melakukan pergerakan. kesedaran tentang operasi dan keperluan kemudahan bagi golongan ini adalah sangat rendah. Sesetengah kemudahan fasiliti ini dibuat tidak mengikuti spesifikasi dan standard yang ditetapkan. Kajian ini bertujuan untuk meninjau reka bentuk fasiliti OKU di Pusat Rehabilitasi Ayer Keroh, Melaka (PRPTAR) dimana pengkaji melihat sejauh mana fasiliti yang terdapat di PRPTAR menepati dan mengikut garis panduan dan undang undang yang terlibat. Analisis terhadap Malaysian Standard 1184 dan 1331 telah dibuat sebelum satu senarai semak berkenaan reka bentuk fasiliti OKU dibuat. Pemerhatian dilakukan dengan berpandukan senarai semak yang telah dibuat. Dalam pemerhatian tersebut mendapati, masih lagi terdapat beberapa fasiliti yang tidak mengikut standard yang ditetapkan. Fasiliti yang baik dan mengikut standard adalah sangat penting untuk menjaga kelestarian rekabentuk dan kegunaan masyarakat dan golongan OKU.

Kata Kunci: Fasiliti, Orang Kelainan Upaya, reka bentuk fasiliti, aksesibiliti

#### **1.0 PENGENALAN**

Pusat Rehabilitasi secara khususnya adalah sebuah tempat untuk memulihkan pesakit selepas mengalami kecederaan yang mengehadkan aktiviti harian mereka. Ia merangkumi penjagaan, rawatan dan sokongan yang diperlukan untuk membolehkan



pesakit berdikari sendiri. Pusat rehab bukan sahaja memberikan khidmat kesihatan pada pesakit, tetapi ia juga menjamin keselamatan dan keselesaan kepada semua pengguna bangunan.Untuk menjamin keselamatan dan keselesaan OKU di Pusat Rehab, penyediaan terhadap sesuatu fasiliti untuk OKU adalah penting. Antara kemudahan yang dsediakan bagi golongan OKU termasuklah pemegang tangan (handrail), tangga, anak tangga, ramp, tandas, papan tanda dan symbol symbol.

Persekitaran keadaan mempunyai kesan yang besar terhadap pengalaman dan tahap ketidakupayaan. Persekitaran yang tidak boleh diakses mewujudkan halangan yang sering menghalang penyertaan penuh dan berkesan OKU dalam masyarakat secara sama rata dengan orang lain. Kemajuan untuk meningkatkan penyertaan sosial boleh dibuat dengan menangani halangan ini dan memudahkan orang kurang upaya dalam kehidupan seharian mereka. Oleh itu pengiktirafan kepentingan kerjasama antara kerajaan Malaysia dengan sektor swasta dan pertubuhan bukan kerajaan dalam memastikan penyertaan dan penglibatan penuh dan berkesan. Sebagai contoh, pihak kerajaan dan swasta bersamasama menyediakan kemudahan fasiliti yang mencukupi dan terbaik untuk golongan OKU, dan berterusan tetap diberikan penhatian agar fasiliti tersebut data digunakan dengan berkesan dan memudahkan pelaksanaan aktiviti harian mereka bersama golongan masyarakat normal.

#### 2.0 KAJIAN LITERATUR

#### 2.1 UNDANG- UNDANG DAN GARIS PANDUAN

Pada tahun 2007, Jabatan Kebajikan Masyarakat telah merangka dasar Orang Kurang Upaya Negara bagi membantu golongan OKU. Perkara yang dijadikan asas kepada dasar ini adalah pengiktrirafan bahawa golongan OKU ini merupakan sebahagian daripada masyarakat. Oleh itu, mereka mempunyai hak dan peluang yang sama rata untuk menjalani kehidupan seperti anggota masyarakat yang lain. (Tahir et al., 2020). Pendekatan yang digunakan oleh dasar ini adalah berasaskan kepada hak dan juga perlindungan bagi menjamin kepentingan dan kesejahteraan OKU (JKM, 2019). Seterusnya Malaysian Standard 1184 dan 1331 juga digunakan dan ia merupakan dokumen berkaitan dengan penggunaan fasiliti dalam bangunan bagi golongan OKU sama ada untuk institusi pendidikan mahupun bangunan awam serta persendirian yang lainya, yang mana ia menerangkan dengan jelas tentang fasiliti yang perlu ada di dalam dan di luar bangunan OKU.



#### 2.2 SPESIFIKASI REKA BENTUK FASILITI OKU

Bangunan awam seharusnya dibina dengan reka bentuk yang mesra pengguna dan bebas daripada sebarang halangan untuk memenuhi keperluan setiap bangunan. (Hashim et al., 2012). Reka bentuk boleh diakses meluaskan reka bentuk standard kepada orang yang mempunyai had mobiliti. Tujuan utamanya adalah untuk meningkatkan bilangan orang yang boleh menggunakan produk, bangunan atau perkhidmatan dengan mudah. Ini boleh dicapai sama ada dengan mereka bentuk produk, perkhidmatan dan persekitaran yang mudah digunakan oleh pengguna tanpa sebarang pengubahsuaian atau antara muka piawai yang serasi dengan produk khas untuk orang kurang upaya. Kemudahan dinilai berdasarkan reka bentuk dan keadaan sama ada ia mengikut reka bentuk standard dan keperluan seperti yang dinyatakan dalam Amalan Terbaik Antarabangsa dalam Pengangkutan Awam Boleh Akses untuk Orang Kurang Upaya. Setiap kemudahan dibahagikan kepada setiap kriteria dan kriteria telah dinilai dan penilaian diberikan berdasarkan kriteria yang dinyatakan dalam Mangung diang dinyatakan dalam Orang Kurang Upaya (Ramli et al., 2017)

#### 2.3 KEBOLEHCAPAIAN FASILITI OKU

Menurut (Ramli et al., 2017) golongan OKU secara konsisten melaporkan bahawa mereka tidak mempunyai peluang yang sama rata seperti orang lain untuk mengambil bahagian dalam kehidupan masyarakat. Hal ini dapat menganggu pergerakan golongan ini. M,KO Berikutan daripada dapatan kajian yang dibuat oleh (Hashim et al., 2012) untuk melihat beberapa lokasi kajian, berkenaan dengan spesikasi fasiliti OKU yang dibina (Hashim et al., 2012) berpendapat, walaupun akses umum dan kebolehcapaian fasiliti kemudahan OKU di bangunan tersebut berada pada tahap memuaskan, namun banyak lagi yang perlu dilakukan untuk memberi golongan ini kualiti hidup yang lebih baik selaras dengan masyarakat penyanyang yang dipupuk oleh masyarakat di Malaysia

# 3.0 METODOLOGI KAJIAN

Dalam kajian ini, pengkaji telah menggunakan satu instrument iaitu dengan menggunakan pemerhatian ke atas fasiliti fasiliti OKU yang terdapat di PRPTAR. Kajian kes dalam kajian melibatkan tiga buah bangunan yang terdapat di PRPTAR iaitu Bangunan Rehab, Asrama dan Blok vokasional. Kaedah pemerhatian dilakukan bagi mendapatkan data mengenai reka bentuk fasiliti OKU yang disediakan di setiap bangunan tersebut samada memenuhi kriteria Standard MS1184 dan MS1331. Senarai semak telah diwujudkan bagi memudahkan pengkaji untuk melakukan Analisa kepada setiap jenis fasiliti OKU yang disediakan. Data data ini akan diperolehi dalam bentuk jadual<sub>1021</sub>



#### 4.0 DAPATAN KAJIAN

Jadual 1 menunjukkan kesemua hasil pemerhatian yang telah dilakukan terhadap ketiga-tiga bangunan yang dipilih di PRPTAR. Berdasarkan senarai yang telah disediakan, jika kemudahan mengikut semua keperluan dalam senarai ia akan ditandakan dengan ' $\sqrt{}$ '. Kemudahan yang tidak mengikut senarai akan ditanda 'X', manakala kemudahan yang tidak disediakan

Tempat Letak Kereta (OKU)         Parkir kereta OKU disediakan berdekatan dengan       V       V         pintu masuk utama dan tidak melebihi 50m       X       X         Simbol parkir untuk pengguna kerusi roda pada       X       X         permukaan parkir dapat dilihat dengan jelas       X       X         Bilangan parkir OKU yang perlu disediakan adalah       V       V         sekurang ya l parkir       Laluan Keluar Masuk       V         Laluan Keluar Masuk       Laluan ke bangunan perlu disediakan       V       V         Pastikan laluan mempunyai warna berbeza       V       V       V         dengan warna disekitarnya       Laluan akses kebangunan perlulah rata dan selamat       V       V       V         Tactile hendaklah disediakan bermula dari jalan hingga ke pintu masuk       V       V       V       V         Bagi mana mana laluan untuk akses ke bangunan yang berkecerunan melebihi 1:20 ramp handaklah       V       V       V         Laluan Pejalan Kaki       Laluan pejalan Kaki untuk akses ke bangunan hidak licin serta mempunyai warna dan tekstur       V       V       V         Laluan pejalan kaki untuk akses ke bangunan hidak kurang 1800mm (laluan utama dua hala)       V       V       V       V         Laluan pejalan kaki dalah:         V	KEMUDAHAN	BLOK REHAB	ASRAMA	BLOK VOKASIONAL
pintu masuk utama dan tidak melebihi 50m       N       N       N         Simbol parkir untuk pengguna kerusi roda pada permukaan parkir dapat dilihat dengan jelas       X       X       √         Bilangan parkir dapat dilihat dengan jelas       X       X       √       √         Bilangan parkir OKU yang perlu disediakan adalah sekurang kurangnya 1 parkir       √       √       √         Laluan Keluar Masuk       ✓       √       √       √         Laluan ke bangunan perlu disediakan       √       √       √       √         Pastikan laluan mempunyai warna berbeza dengan warna disekitarnya       √       √       √         Laluan akses kebangunan perlulah rata dan selamat       √       √       √       √         Tactile hendaklah disediakan bermula dari jalan hingga ke pintu masuk       √       √       √       √         Bagi mana mana laluan untuk akses ke bangunan yang berkecerunan melebihi 1:20 ramp handaklah       √       √       NA         Laluan pejalan Kaki       Ultuk akses       Ke bangunan hendaklah disediakan tanpa sebarang halangan fizikal       √       √       √         Laluan pejalan kaki untuk akses ke bangunan hendaklah kukuh, rata, menyerap air dan tidak licin serta mempunyai warna dan tekstur yang berbeza       √       √       √         Laluan hendaklah kukuh, rata, menyerap air dan tidak	Tempat Letak Kereta (OKU)			
pintu masuk utama dan tidak melebihi 50m   Simbol parkir untuk pengguna kerusi roda pada permukaan parkir dapat dilihat dengan jelas   Bilangan parkir OKU yang perlu disediakan adalah sekurang kurangnya 1 parkir   Laluan Keluar Masuk   Laluan ke bangunan perlu disediakan   Laluan ke bangunan perlu disediakan   V   Pastikan laluan mempunyai warna berbeza dengan warna disekitarnya   Laluan akses kebangunan perlulah rata dan selamat   V   Tactile hendaklah disediakan bermula dari jalan hingga ke pintu masuk   M   Bagi mana mana laluan untuk akses ke bangunan yang berkecerunan melebihi 1:20 ramp handaklah disediakan   Laluan Pejalan Kaki   Laluan pejalan kaki untuk akses ke bangunan diseki iserta mempunyai warna dan tekstur yang berbeza   Laluan pejalan kaki adalah:   Tidak kurang 1800mm (laluan utam adua hala)   V   V   V   J   Laluan pejalan Kaki   Laluan pejalan kaki adalah:   Tidak kurang 1800mm (laluan utama dua hala) <tr< td=""><td>Parkir kereta OKU disediakan berdekatan dengan</td><td></td><td></td><td></td></tr<>	Parkir kereta OKU disediakan berdekatan dengan			
permukaan parkir dapat dilihat dengan jelas       ∧       √		N	N	N
permukaan parkir dapat dilihat dengan jelas Bilangan parkir OKU yang perlu disediakan adalah sekurang kurangnya 1 parkir Laluan Keluar Masuk Laluan ke bangunan perlu disediakan dengan warna disekitarnya Laluan akses kebangunan perlulah rata dan selamat Tactile hendaklah disediakan bermula dari jalan hingga ke pintu masuk Bagi mana mana laluan untuk akses ke bangunan yang berkecerunan melebihi 1:20 ramp handaklah disediakan Laluan Pejalan Kaki Laluan pejalan Kaki Laluan hendaklah kisediakan tanpa sebarang halangan fizikal Laluan hendaklah kukuh, rata, menyerap air dan tidak licin serta mempunyai warna dan tekstur yang berbeza Lebar laluan pejalan kaki adalah: Tidak kurang 1800mm (laluan utama dua hala) Drainage grating pada laluan akses atau ramp hendaklah fiush in dengan permukaan lantai Ramp Ramp perlu disediakan bagi sebarang perubahan	Simbol parkir untuk pengguna kerusi roda pada	v	v	
sekurang kurangnya 1 parkir       N       N       N         Laluan Keluar Masuk       Laluan Keluar Masuk       Italuan Keluar Masuk         Laluan ke bangunan perlu disediakan       √       √       √         Pastikan laluan mempunyai warna berbeza       √       √       √         Laluan akses kebangunan perlulah rata dan selamat       √       √       √         Tactile hendaklah disediakan bermula dari jalan hingga ke pintu masuk       √       √       √         Bagi mana mana laluan untuk akses ke bangunan yang berkecerunan melebihi 1:20 ramp handaklah       √       √       NA         Laluan Pejalan Kaki       Laluan pejalan Kaki untuk akses ke bangunan hendaklah disediakan tanpa sebarang halangan fizikal       √       √       √         Laluan hendaklah kukuh, rata, menyerap air dan tidak licin serta mempunyai warna dan tekstur yang berbeza       ✓       √       √         Laluan pejalan kaki adalah:       Italuan tegalan kaki adalah:       ✓       √       √         Tidak kurang 1500mm (laluan utama dua hala)       √       √       √       √         Drainage grating pada laluan akses atau ramp hendaklah flush in dengan permukaan lantai       √       √       √         Ramp perlu       Galauan akses atau ramp hendaklah flush in dengan permukaan lantai       √       √       √ <td></td> <td>^</td> <td>^</td> <td>V</td>		^	^	V
sekurang kurangnya 1 parkir       Image: Constraint of the second	Bilangan parkir OKU yang perlu disediakan adalah	2		2
Laluan ke bangunan perlu disediakan       √       √       √         Pastikan laluan mempunyai warna berbeza       √       √       √         Laluan akses kebangunan perlulah rata dan selamat       √       √       √         Tactile hendaklah disediakan bermula dari jalan hingga ke pintu masuk       √       √       √         Bagi mana mana laluan untuk akses ke bangunan yang berkecerunan melebihi 1:20 ramp handaklah disediakan       √       √       NA         Laluan Pejalan Kaki       Laluan pejalan Kaki       ✓       √       √         Laluan pejalan kaki untuk akses ke bangunan yang berkecerunan melebihi 1:20 ramp handaklah disediakan       √       √       √         Laluan Pejalan Kaki       Laluan pejalan Kaki       ✓       √       √       √         Laluan pejalan kaki untuk akses ke bangunan fizikal       √       √       √       √         Laluan hendaklah kukuh, rata, menyerap air dan tidak licin serta mempunyai warna dan tekstur yang berbeza       ✓       √       √         Lebar laluan pejalan kaki adalah:        ✓       ✓       √       √         Tidak kurang 1800mm (laluan utama dua hala)       √       √       √       √       √         Drainage grating pada laluan akses atau ramp hendaklah flush in dengan permukaan lantai       √       √       √		N	N	V
Pastikan laluan mempunyai warna berbeza dengan warna disekitarnya       √       √       √         Laluan akses kebangunan perlulah rata dan selamat       √       √       √       √         Tactile hendaklah disediakan bermula dari jalan hingga ke pintu masuk       √       √       √       √         Bagi mana mana laluan untuk akses ke bangunan yang berkecerunan melebihi 1:20 ramp handaklah disediakan       √       √       NA         Laluan Pejalan Kaki       Laluan pejalan Kaki       √       √       NA         Laluan pejalan kaki untuk akses ke bangunan hendaklah disediakan tanpa sebarang halangan fizikal       √       √       √         Laluan hendaklah kukuh, rata, menyerap air dan tidak licin serta mempunyai warna dan tekstur yang berbeza       √       √       √         Labar laluan pejalan kaki adalah:       I       I       I       I         Tidak kurang 1500mm (laluan utama dua hala)       √       √       √         Drainage grating pada laluan akses atau ramp hendaklah flush in dengan permukaan lantai       √       √       √         Ramp        √       √       √       √         Ramp perlu disediakan bagi sebarang perubahan       √       √       √	Laluan Keluar Masuk			
dengan warna disekitarnya       N       N       N         Laluan akses kebangunan perlulah rata dan selamat       √       √       √         Tactile hendaklah disediakan bermula dari jalan hingga ke pintu masuk       √       √       √         Bagi mana mana laluan untuk akses ke bangunan yang berkecerunan melebihi 1:20 ramp handaklah disediakan       √       √       NA         Laluan Pejalan Kaki       Laluan pejalan Kaki       √       √       NA         Laluan pejalan kaki untuk akses ke bangunan hendaklah disediakan tanpa sebarang halangan fizikal       √       √       √         Laluan hendaklah kukuh, rata, menyerap air dan tidak licin serta mempunyai warna dan tekstur yang berbeza       √       √       √         Lebar laluan pejalan kaki adalah:        ✓       √       √         Tidak kurang 1800mm (laluan utama dua hala)       √       √       √       √         Drainage grating pada laluan akses atau ramp hendaklah flush in dengan permukaan lantai       √       √       √         Ramp       Ramp perlu disediakan bagi sebarang perubahan       √       √       √	Laluan ke bangunan perlu disediakan			
dengan warna disekitarnya       Image: Selection of the selection of the selection of the selecitarity of the selecitarity of the selection of the selectical of the selection of the selection of the selection of the sele		2		2
selamat       v       v       v       v         Tactile hendaklah disediakan bermula dari jalan hingga ke pintu masuk       √       √       √         Bagi mana mana laluan untuk akses ke bangunan yang berkecerunan melebihi 1:20 ramp handaklah disediakan       √       √       NA         Laluan Pejalan Kaki       √       √       NA         Laluan Pejalan Kaki       ✓       √       √         Laluan Pejalan Kaki untuk akses ke bangunan hendaklah disediakan tanpa sebarang halangan fizikal       √       √       √         Laluan hendaklah kukuh, rata, menyerap air dan tidak licin serta mempunyai warna dan tekstur yang berbeza       √       ✓       X       X         Lebar laluan pejalan kaki adalah:         ✓       √       √       √         Tidak kurang 1800mm (laluan utama dua hala)       √       √       √       √       √       √         Drainage grating pada laluan akses atau ramp hendaklah flush in dengan permukaan lantai       √       √       √       √         Ramp perlu disediakan bagi sebarang perubahan       √       √       √       √       √		N	N	V
selamatImage of the selamatTactile hendaklah disediakan bermula dari jalan hingga ke pintu masuk $\sqrt{1}$ Bagi mana mana laluan untuk akses ke bangunan yang berkecerunan melebihi 1:20 ramp handaklah disediakan $\sqrt{1}$ Laluan Pejalan KakiImage of the selamat Laluan pejalan kaki untuk akses ke bangunan hendaklah disediakan tanpa sebarang halangan fizikal $\sqrt{1}$ Laluan hendaklah kukuh, rata, menyerap air dan tidak licin serta mempunyai warna dan tekstur yang berbeza $\sqrt{1}$ Lebar laluan pejalan kaki adalah: $\sqrt{1}$ Tidak kurang 1800mm (laluan utama dua hala) dengan passing space disediakan setiap jarak 25m $\sqrt{1}$ Drainage grating pada laluan akses atau ramp hendaklah flush in dengan permukaan lantai $\sqrt{1}$ Ramp Ramp perlu disediakan bagi sebarang perubahan $\sqrt{1}$	Laluan akses kebangunan perlulah rata dan	2	2	2
hingga ke pintu masuk       N       N       N         Bagi mana mana laluan untuk akses ke bangunan yang berkecerunan melebihi 1:20 ramp handaklah disediakan       √       √       NA         Laluan Pejalan Kaki       ✓       √       NA         Laluan Pejalan Kaki       ✓       √       NA         Laluan Pejalan Kaki       ✓       √       √       √         Laluan pejalan kaki untuk akses ke bangunan hendaklah disediakan tanpa sebarang halangan fizikal       √       √       √         Laluan hendaklah kukuh, rata, menyerap air dan tidak licin serta mempunyai warna dan tekstur yang berbeza       √       X       X         Lebar laluan pejalan kaki adalah:       ✓       ✓       √       √         Tidak kurang 1800mm (laluan utama dua hala)       √       √       √       √         Jidak kurang 1500mm (laluan kerap dua hala)       √       √       √       √         Drainage grating pada laluan akses atau ramp hendaklah flush in dengan permukaan lantai       √       √       √       √         Ramp       Eamp perlu disediakan bagi sebarang perubahan       √       √       √       √		N	N	V
hingga ke pintu masuk       Bagi mana mana laluan untuk akses ke bangunan yang berkecerunan melebihi 1:20 ramp handaklah        √       √       NA         Laluan Pejalan Kaki       Laluan Pejalan Kaki untuk akses ke bangunan hendaklah disediakan tanpa sebarang halangan fizikal       √       √       √       √         Laluan hendaklah kukuh, rata, menyerap air dan tidak licin serta mempunyai warna dan tekstur yang berbeza       √       ✓       <	Tactile hendaklah disediakan bermula dari jalan		al	
yang berkecerunan melebihi 1:20 ramp handaklah disediakan       √       NA         Laluan Pejalan Kaki       Nu       NA         Laluan Pejalan Kaki       Nu       NA         Laluan pejalan kaki untuk akses ke bangunan hendaklah disediakan tanpa sebarang halangan fizikal       √       √       √         Laluan hendaklah kukuh, rata, menyerap air dan tidak licin serta mempunyai warna dan tekstur yang berbeza       √       X       X         Lebar laluan pejalan kaki adalah:       ✓       √       √       √         Tidak kurang 1800mm (laluan utama dua hala)       √       √       √       √         Tidak kurang 1500mm (laluan utama dua hala)       √       √       √       √         Drainage grating pada laluan akses atau ramp hendaklah flush in dengan permukaan lantai       √       √       √       √         Ramp       Eamp perlu disediakan bagi sebarang perubahan       √       √       √       √		N	N	V
disediakan         Laluan Pejalan Kaki         Laluan pejalan kaki untuk akses ke bangunan hendaklah disediakan tanpa sebarang halangan fizikal         Laluan hendaklah kukuh, rata, menyerap air dan tidak licin serta mempunyai warna dan tekstur yang berbeza         Lebar laluan pejalan kaki adalah:         Tidak kurang 1800mm (laluan utama dua hala)         √         Tidak kurang 1500mm (laluan kerap dua hala)         dengan passing space disediakan setiap jarak 25m         Drainage grating pada laluan akses atau ramp hendaklah flush in dengan permukaan lantai         Ramp         Ramp perlu disediakan bagi sebarang perubahan	Bagi mana mana laluan untuk akses ke bangunan			
Laluan Pejalan KakiLaluan pejalan kaki untuk akses ke bangunan hendaklah disediakan tanpa sebarang halangan fizikal $\sqrt{1}$ Laluan hendaklah kukuh, rata, menyerap air dan tidak licin serta mempunyai warna dan tekstur yang berbeza $\sqrt{1}$ Lebar laluan pejalan kaki adalah: Tidak kurang 1800mm (laluan utama dua hala) dengan passing space disediakan setiap jarak $25m$ $\sqrt{1}$ Drainage grating pada laluan akses atau ramp hendaklah flush in dengan permukaan lantai $\sqrt{1}$ RampRamp	yang berkecerunan melebihi 1:20 ramp handaklah		$\checkmark$	NA
Laluan pejalan kaki untuk akses ke bangunan hendaklah disediakan tanpa sebarang halangan fizikal $$ $$ Laluan hendaklah kukuh, rata, menyerap air dan tidak licin serta mempunyai warna dan tekstur yang berbeza $$ XXLebar laluan pejalan kaki adalah: Tidak kurang 1800mm (laluan utama dua hala) $$ $$ $$ Tidak kurang 1500mm (laluan kerap dua hala) dengan passing space disediakan setiap jarak 25m $$ $$ $$ Drainage grating pada laluan akses atau ramp hendaklah flush in dengan permukaan lantai $$ $$ $$ Ramp Ramp perlu disediakan bagi sebarang perubahan $$ $$ $$	disediakan			
hendaklah disediakan tanpa sebarang halangan fizikal $$ $$ $$ Laluan hendaklah kukuh, rata, menyerap air dan tidak licin serta mempunyai warna dan tekstur yang berbeza $$ $X$ $X$ Lebar laluan pejalan kaki adalah: Tidak kurang 1800mm (laluan utama dua hala) $$ $$ $$ Tidak kurang 1500mm (laluan kerap dua hala) dengan passing space disediakan setiap jarak 25m $$ $$ $$ Drainage grating pada laluan akses atau ramp hendaklah flush in dengan permukaan lantai $$ $$ $$ Ramp Ramp perlu disediakan bagi sebarang perubahan $$ $$ $$	Laluan Pejalan Kaki			
fizikalLaluan hendaklah kukuh, rata, menyerap air dan tidak licin serta mempunyai warna dan tekstur yang berbeza $\sqrt{X}$ XLebar laluan pejalan kaki adalah: $\sqrt{\sqrt{V}}$ XXTidak kurang 1800mm (laluan utama dua hala) $\sqrt{\sqrt{V}}$ $\sqrt{\sqrt{V}}$ Tidak kurang 1500mm (laluan kerap dua hala) dengan passing space disediakan setiap jarak 25m $\sqrt{\sqrt{V}}$ $\sqrt{\sqrt{V}}$ Drainage grating pada laluan akses atau ramp hendaklah flush in dengan permukaan lantai $\sqrt{\sqrt{V}}$ $\sqrt{\sqrt{V}}$ RampKamp perlu disediakan bagi sebarang perubahan $\sqrt{\sqrt{V}}$ $\sqrt{V}$	Laluan pejalan kaki untuk akses ke bangunan			
Laluan hendaklah kukuh, rata, menyerap air dan tidak licin serta mempunyai warna dan tekstur yang berbeza $$ XXLebar laluan pejalan kaki adalah: Tidak kurang 1800mm (laluan utama dua hala) $$ $$ $$ $$ Tidak kurang 1500mm (laluan kerap dua hala) dengan passing space disediakan setiap jarak 25m $$ $$ $$ Drainage grating pada laluan akses atau ramp hendaklah flush in dengan permukaan lantai $$ $$ $$ RampV $$ $$ $$	hendaklah disediakan tanpa sebarang halangan		$\checkmark$	
tidak licin serta mempunyai warna dan tekstur yang berbeza $$ XXLebar laluan pejalan kaki adalah: $$ $$ $$ $$ Tidak kurang 1800mm (laluan utama dua hala) $$ $$ $$ Tidak kurang 1500mm (laluan kerap dua hala) dengan passing space disediakan setiap jarak 25m $$ $$ Drainage grating pada laluan akses atau ramp hendaklah flush in dengan permukaan lantai $$ $$ Ramp $$ $$ $$				
yang berbeza          Lebar laluan pejalan kaki adalah:       Image: second	Laluan hendaklah kukuh, rata, menyerap air dan			
Lebar laluan pejalan kaki adalah:         Tidak kurang 1800mm (laluan utama dua hala)       √       √         Tidak kurang 1500mm (laluan kerap dua hala)       √       √         Tidak kurang 1500mm (laluan kerap dua hala)       √       √         dengan passing space disediakan setiap jarak       √       √         25m        √       √         Drainage grating pada laluan akses atau ramp hendaklah flush in dengan permukaan lantai       √       √         Ramp        √       √	tidak licin serta mempunyai warna dan tekstur		Х	X
Tidak kurang 1800mm (laluan utama dua hala)       √       √       √         Tidak kurang 1500mm (laluan kerap dua hala)       √       √       √       √         dengan passing space disediakan setiap jarak       √       √       √       √       √         25m       Drainage grating pada laluan akses atau ramp hendaklah flush in dengan permukaan lantai       √       √       √       √         Ramp       Kamp perlu disediakan bagi sebarang perubahan       √       √       √       √				
Tidak kurang 1500mm (laluan kerap dua hala) dengan passing space disediakan setiap jarak 25m√√√Drainage grating pada laluan akses atau ramp hendaklah flush in dengan permukaan lantai√√√RampRamp perlu disediakan bagi sebarang perubahan				
dengan passing space disediakan setiap jarak 25m√√√Drainage grating pada laluan akses atau ramp hendaklah flush in dengan permukaan lantai√√√RampRamp perlu disediakan bagi sebarang perubahan	Tidak kurang 1800mm (laluan utama dua hala)			
25m				
Drainage grating pada laluan akses atau ramp hendaklah flush in dengan permukaan lantai       √       √         Ramp				
hendaklah flush in dengan permukaan lantai     v     v       Ramp       Ramp perlu disediakan bagi sebarang perubahan     v     v				
Ramp       Ramp perlu disediakan bagi sebarang perubahan		2	2	2
Ramp perlu disediakan bagi sebarang perubahan	hendaklah flush in dengan permukaan lantai	v	v	v
ketinggian permukaan laluan	Ramp perlu disediakan bagi sebarang perubahan	2	2	2
		N	N	N
Tangga perlu disediakan bersebelahan dengan $$ $$		2	2	2
ramp jika perbezaan aras melebihi 300mm		N	N	V
Lebar ramp tidak kurang dari 1200mm. bagi ramp $$		2	2	2
yang mempunyai handrails			N	V



	1	,	1
Jarak minimum antara handrails adalah 1000mm			
Handrails hendaklah disediakan di kedua dua sisi	,	1	1
bagi laluan ramp yang melebihi 800mm Panjang.		$\checkmark$	$\checkmark$
Jarak minimum antara handrail adalah 1000mm			
Permukaan ramp mestilah stabil dan tidak licin		х	$\checkmark$
samada dalam keadaan kering dan basah	N	~	N
Tangga			
Anak tangga mempunyai ketinggian (riser) tidak			
melebihi 180mm dan Panjang (tread) tidak kurang		$\checkmark$	NA
dari 260mm			
Lebar tangga tidak kurang daripada 1200mm			NA
Anti-slip nosing tile hendaklah disediakan di bucu			
	$\checkmark$		NA
tangga dengan kelebaran antara 50mm – 65mm			
Tactile warning block hendaklah dipasang di		Х	NA
permulaan dan akhir tangga setiap aras			
Tulisan braille perlu disediakan di permulaan dan	1	1	
akhir susur tangan sebagai panduan kepada OKU			NA
penglihatan			
Susur tangan dengan ukuran diameter tidak			
melebihi 45mm hendaklah disediakan pada		$\checkmark$	NA
ketinggian 850mm-1000mm.			
Lif			
Kedudukan lif perlu berdekatan dengan pintu	.1	v	NI A
masuk utama atau kaunter penyambut tetamu		X	NA
Bagi premis yang tiada kaunter penyambut	1		
tetamu, tactile hendaklah dipasang hingga ke lif		Х	NA
Saiz minimum dalaman lif adalah 1100mm x			
1400mm dan cermin perlu dipasang berhadapan			NA
pintu lif untuk keselamatan	v	v	
Butang butang lif hendaklah diletakkan pada			
		$\checkmark$	NA
ketinggian antara 900mm dan 1200mm			
Pintu lif hendaklah mempunyai kelebaran minima		$\checkmark$	NA
900mm			
Grab bar dipasang dibahagian tepi dan belakang	1	1	
lif dengan ketinggian antara 800mm dan 900mm			NA
dari paras kemas lantai			
Pintu			
Lebar pintu untuk laluan kerusi roda adalah			
sekurang-kurangnya 850mm			
Ketinggian pintu sekurang-kurangnya 2100mm		$\checkmark$	
Warning tactile hendaklah disediakan dihadapan		х	
pintu masuk (300mm daripada pintu)	N	~	N
Directional tactile perlu disediakan menuju pintu			
masuk utama berterusan daripada drop-off atau		Х	$\checkmark$
laluan pejalan kaki berhampiran			
Bagi pintu dan dinding jenis kaca, petunjuk yang			
jelas dan kontra dengan minimum ketinggian	,		,
75mm dipasang dengan ketinggian 900mm-		NA	
1000mm dan 1300mm-1400mm dari aras lantai			
Tandas			
Kemudahan tandas awam hendaklah menyediakan sekurang kurangnya satu bilik			
i menyeulakan sekulang Kulangnya salu DIIK I			al
			N
tandas yang boleh diakses oleh kerusi roda dan mempunyai sinki tangan	N	N	V



Tandas awam bagi OKU perlu mempunyai symbol yang mudah dikenalpasti dan di pamerkan	$\checkmark$	$\checkmark$	$\checkmark$
Penggera bantuan kecemasan perlu disediakan di semua tandas OKU pada ketinggian antara 800mm-1100mm dari aras lantai	$\checkmark$	$\checkmark$	$\checkmark$
Ruang masuk didepan tandas harus minimum 900mm		$\checkmark$	$\checkmark$
Lantai tidak licin	$\checkmark$		
Ruang tandas minimum 1700mm x 2200mm (PxL) untuk penggunaan kerusi roda			
Simbol Grafik, Papan Tanda dan Kontras Visual			
Papan tanda yang menunjukkan arah accessible route hendaklah disediakan bagi memandu arah OKU terutamanya OKU berkserusi roda.			$\checkmark$
Tulisan Braille yang jelas (raised and domed) dan mudah dikesan perlu disediakan pada papan tanda/ symbol untuk memudahkan aksesibiliti OKU penglihatan.		$\checkmark$	$\checkmark$
Simbol grafik yang digunakan bersesuaian dan betul sebagai panduan dan tanda arah kepada OKU	$\checkmark$	$\checkmark$	$\checkmark$
Simbol grafik digunakan untuk menunjukkan bahagian-bahagian tertentu kemudahan berdasarkan jenis kelainan upaya	$\checkmark$	$\checkmark$	$\checkmark$
Simbol grafik disediakan bagi OKU mobility untuk menunjukkan lokasi: i. Letak kereta/ garaj ii. Akses ke bangunan lif, tandas, tangga, bilik persalinan dan lain-lain.	$\checkmark$	$\checkmark$	$\checkmark$
Perbezaan warna pada pintu, aras lantai atau bangunan perlu mengikut skala LRV. Elakkan kombinasi warna merah dan hijau			$\checkmark$
Papan tanda perlulah jelas, terang dan mudah difahami sama ada oleh orang yang sedang duduk, berdiri atau berjalan.			$\checkmark$

#### Jadual 1: Senarai Semak Reka Bentuk Fasiliti OKU

#### 4.1 TEMPAT LETAK KERETA OKU

Berdasarkan daripada jadual 1, pada fasiliti tempat letak kereta OKU yang disediakan dilihat agak memuaskan dimana, kesemuanya dibuat berhampiran dengan pintu masuk. Ia adalah keperluan untuk menyediakan tempat letak kereta untuk golongan OKU seperti yang dinyatakan dalam keperluan standard yang telah digunakan di seluruh

dunia. Keperluan ini penting kerana orang kurang upaya mesti mempunyai keistimewaan istimewa untuk mengakses bangunan awam. Namun begitu, simbol parkir untuk pengguna kerusi roda pada permukaan parkir tidak kelihatan.



#### 4.2 LALUAN KELUAR MASUK

Pintu masuk merupakan laluan utama yang akan digunakan oleh orang ramai untuk memasuki bangunan terutamanya hospital awam. Penyediaan pintu masuk yang betul juga dinyatakan dalam Piawaian Malaysia 1184 untuk memastikan orang kurang upaya boleh masuk ke dalam bangunan awam tanpa sebarang halangan. Pintu masuk mesti boleh diakses, bebas daripada halangan dan berdekatan dengan tempat letak kenderaan orang kurang upaya

### 4.3 LALUAN PEJALAN KAKI

Melalui pemerhatian yang dibuat pada fasiliti laluan pejalan kaki, pihak PRPTAR menyediakan akses kebangunan tanpa sebarang halangan fizikal. Namun begitu, masih terdapat beberapa penambahbaikan yang perlu dilakukan oleh pihak pengurusan memandangkan kemudahan yang disediakan tidak sepenuhnya mematuhi piawaian keperluan. Laluan di sekitar Kawasan asrama tidak dalam keadaan yang rata seperti yang dikehendaki oleh standard. Perkara ini memberikan risiko kepada golongan OKU yang melalui Kawasan tersebut.

#### 4.4 RAMP

Ramp merupakan satu medium akses yang biasanya akan digunakan oleh golongan OKU. Ramp boleh memudahkan pergerakan OKU terutamanya yang berkerusi roda. Menurut Malaysian Standard MS 1184, ramp mestilah tidak kurang daripada 1200mm lebar dan kawasan pendaratan pada setiap 6000mm. Keperluan ini telah dipenuhi oleh ramp yang disediakan di PRPTAR. Keadaan ramp di Bangunan Rehab dan Blok Vokasional berada dalam keadaan baik. Namun, ramp pada asrama tidak mengikut standard yang ditetapkan dimana, ramp yang disediakan licin apabila dalam keadaan basah dan berlumut.

# 4.5 TANGGA

Tangga juga merupakan salah satu kemudahan penting kerana ia akan digunakan oleh orang kurang upaya untuk bergerak dari satu tingkat ke satu tingkat. Justeru, kemudahan ini perlu mesra OKU kerana ia akan memudahkan pergerakan semua kategori orang. Berdasarkan pemerhatian, tangga di asrama tidak mempunyai tactile warning block.

#### 4.6 LIF

Semua bangunan memenuhi keperluan dengan menyediakan lif. Walau bagaimanapun, sebahagian daripada mereka tidak memenuhi syarat yang disertakan dengan lif. Sebagai contoh, lif tidak disediakan berdekatan dengan pintu masuk utama di Asrama. Seterusnya, tactile juga tidak dipasang hingga ke lif. 1025



#### 4.7 PINTU

kesemua pintu yang disediakan mematuhi keperluan. Dengan merujuk kepada ketiga-tiga bangunan tersebut, tiada satu pun daripada mereka disediakan dengan spesifikasi yang bertentangan dengan standard yang ditetapkan.

# 4.8 TANDAS

Tandas OKU direka dan dibina untuk Orang yang Kurang Upayagolongan OKU terutamanya OKU fizikal disebabkan mereka mempunyai limitasi pergerakan dan memerlukan ruang yang besar di dalam tandas.Pemerhatian mendapati ketiga-tiga hospital tersebut menyediakan tandas khas untuk OKU di setiap bangunan mengikut standard yang telah ditetapkan.

# 4.9 SIMBOL, GRAFIK, PAPAN TANDA DAN KONTRAS VISUAL

Berdasarkan dari lawatan yang dibuat, semua papan tanda yang disediakan adalah jelas dan mudah difahami oleh semua orang. Hal ini menunjukkan papan tanda ini telah mengikut standard yang ditetapkan. Seterusnya, lokasi papan tanda disediakan ditempat yang tidak tersorok dan mudah dilihat.

# 5.0 KESIMPULAN

Hasil kajian mendapati tahap fasiliti orang kelainan upaya (OKU) yang disediakan di PRPTAR masih berada pada tahap yang memuaskan dan masih terdapat beberapa kekurangan yang perlu ditambahbaik baik dari segi fasiliti di dalam bangunan mahupun diluar bangunan yang mana terdapat kekurangan dalam fasiliti yang terdapat dalam MS1184 dan MS1331 yang dapat diperbaiki dan di selenggara dengan baik. Penyediaan fasiliti kemudahan yang berpandukan garis panduan adalah sangat penting bagi golongan OKU. Dengan adanya kajian ini, ia dapat membantu pihak pengurusan fasiliti di PRPTAR dalam mengenalpasti apakah kelemahan fasiliti yang ada di pusat rehab. Hal ini adalah penting kerana dapat membuat penambahbaikan diatas kelemahan yang wujud sekali gus dapat mengurangkan risiko kemalangan dan kecederaan berpunca daripada fasiliti yang tidak baik.

# RUJUKAN

Hafiz Ahmad, M. N., Rosli, H. F., Takril, N. F<sub>10</sub> Ahmad Sabri, S. (2017). Penyediaan Fasiliti



Orang Kurang Upaya (Oku) Di Institusi Pengajian Tinggi Di Lembah Klang : Satu Kajian Kes. *Proceeding-2nd Putrajaya Conference on Children. Women, Elderly and Disabled Peaple (PICCWED), May,* 20–21.

- Hartblay, C. (2017). Good ramps, bad ramps: Centralized design standards and disability access in urban Russian infrastructure. *American Ethnologist*, *44*(1), 9–22. https://doi.org/10.1111/amet.12422
- Hashim, A. E., Samikon, S. A., Ismail, F., Kamarudin, H., Jalil, M. N. M., & Arrif, N. M. (2012). Access and Accessibility Audit in Commercial Complex: Effectiveness in Respect to People with Disabilities (PWDs). *Procedia - Social and Behavioral Sciences*, 50(July), 452–461. https://doi.org/10.1016/j.sbspro.2012.08.049
- Mohamed, S., & Ismail, M. Z. (2020). *DI MASJID-MASJID NEGERI SEMBILAN KE ARAH MASJID ( Provision of Disabled People ' s Amenities at Negeri Sembilan Mosques Towards Community-Friendly Mosque ).* 13(2), 75–88.
- Ramli, M. Z., Hasnol, J. N. E., Hamid, N. B., Ismail, N., Zawawi, M. H., & Zainal, M. Z. (2017). Assessment of accessible facilities for disabled passenger movement in aerodrome terminals in Klang Valley. *AIP Conference Proceedings*, 1885. https://doi.org/10.1063/1.5002308
- Surani, H. M., Yassin, A., & Masram, H. (2020). *Fasiliti di Stesen Monorel : Cabaran kepada Orang Kelainan Upaya*. *1*(1), 767–781.
- Tahir, Z., Thambapillay, S., Zabdi, J., Yusoff, M., Saufi, A., Rahman, A., & Undang-Undang,
  F. (2020). UNDANG-UNDANG BERKENAAN ORANG KURANG UPAYA: SATU
  ANALISIS PERKEMBANGAN PERUNDANGAN DI MALAYSIA (Laws Concerning Disabled Persons: An Analysis of Legal Development in Malaysia). *The Malaysian Journal of Social Administration*, *14*, 96–114.



# DEVELOPMENT OF ELECTROCARDIOGRAPH (ECG) TRAINING KIT SYSTEM BASED ON INTERNET OF THING VIA THINGSPEAK APPLICATION

Azra Syakirah Azni<sup>1</sup>, Nurul Huda Mohamd Saleh<sup>2</sup>

Department of Electrical Engineering, Politeknik Sultan Salahuddin Abdul Aziz Shah Shah Alam, Selangor, Malaysia azrasyakirah90@gmail.com msnurulhuda@psa.edu.my

#### Abstract

The Electrocardiograph (ECG) training kit is an instrument used to record the electrical activity of the heart. Due to the difficulties for teachers to teach provide a description of each subtopic taught more accurately in terms of concepts and situations, therefore there is a need for a training kit as a learning aid to improve students' understanding of ECG. This makes it tough for students to comprehend the information related to ECG in detail. Therefore, the objective of this study was to develop an ECG training kit and design a practical laboratory application-based 6-lead ECG sensor kit. Besides that, to evaluate the effectiveness of the use in the learning and teaching process using ECG training kit for a topic related to ECG. The ECG sensor detects the produced ECG signal from the simulator in the ECG training kit. The entire circuit will be operated and processed by the ARDUINO UNO. On Thingspeak, a simulation of the heart rate (BPM) and ECG wave procedure is presented. The output of BPM is also presented on LCD in the ECG training kit. The application-based simulation aid in-class collaboration during practical lab experiments. The project generally consists of two parts, namely hardware development and IoT implementation to prototype boards. For hardware development, an ECG prototype board will be developed using ESP8266 as a microcontroller and Wi-fi module. The ECG sensor module is the AD3282 ECG Sensor kit. ECG data transceiver site will be developed using a ThingSpeak application on a laptop. After successfully performing ECG data capture, the application software will display real-time ECG simulations such as heart rate and output waveform based on a 6-lead ECG electrode. The ECG training kit was considered usable by students and suitable for educational purposes by the lecturer. Future research using this



training kit will be required to assess students' learning and retention of information about ECG interpretation.

Keywords: Training kit, ESP8266, AD3282, ThingsSpeak, Learning

#### **1.0 Introduction**

The process of learning and teaching is a type of communicative activity that involves both the lecturer and the student in the educational process. Communication between those parties is primarily the process of communicating knowledge from one to another, as is common between a lecturer and a student. The learning process is mostly carried out in the classroom, where the knowledge is supplied by the lecturer and the student serves as the recipient (Kob, Abdullah, Shamsuddin, 2019). In addition, practical activity or hands-on learning is a component of the learning process, which is typically carried out in a laboratory. According to, laboratory experience while completing the practical lab is designed to improve student comprehension of certain facts and concepts as well as the scientific organization of the facts and concepts. As a result, theory and practical classes are very important in the learning process. Learning aids are a significant tool for enabling information transfer between lecturer and student at the polytechnic, particularly among engineering students, where student-centred learning is viewed as a useful strategy to improve learning effectiveness (Kob, Abdullah, Shamsuddin, 2019). This project is to create an ECG training kit that can be utilized as a learning aid to improve student knowledge reception. The intended learning aids will be created using a practical learning approach.

Biomedical Engineering students also learn medical instruments such as ECG machines. As is well known, the current ECG training kit technologies are costly to be purchased individually either by students or lecturers to support the learning and teaching process in topic related with ECG (Kiak, Ibrahim, And Ramli,2020). Besides, the teaching and learning process, especially for the topic related to ECG, focuses on two-part namely theoretical and practical. Therefore, it is difficult for teachers to provide a description of each subtopic taught more accurately in terms of concepts and situations, which makes it difficult for students to understand the content in more depth (Kob, Abdullah, Shamsuddin, 2019).

The objectives of this project are to develop a kit for 6-lead ECG trainer kit for learning aids with IoT via the ThingSpeak application. To design an ECG Training Kit System for the practical lab from the 6-leads ECG by using<sub>2</sub>the ThingSpeak Application and to improve



students' understanding of ECG signals with easy-to-understand methods when performing practical activities. The main function is to detect the heart rate of 6 lead ECG electrodes. This project will focus on the education sector. This training kit is helpful to biomedical engineering students to do their practical work and also to the lecturer for the teaching materials.

### 2.0 The Important of Using Training Kit Materials Among Students

The importance of a training kit in the teaching and learning process cannot be overstated. Learning kits can make the process of exchanging knowledge among students on subjects taught more clearly easier. The objective of the training kit is to make it easier and more systematic for students to comprehend the topic. In reality, it may be used to stimulate a student's interest in learning about the ECG machine and ECG signal, as well as to assist them in learning about the ECG machine and ECG signal through a manipulative experience (Kob, Abdullah,Shamsuddin, 2019).

The teaching and learning process, particularly as it relates to topics involving ECG machines and ECG signals, is divided into two parts: theoretical and practical. These two divisions play a vital role in ensuring that students are able to understand the topic in line with the specified objectives, according to the Ministry of Education's curriculum. The emphasis on this topic related to ECG machines and ECG signals is on an application in the form of hands-on work (Kob, Abdullah,Shamsuddin, 2019).

Furthermore, the topic of ECG machines and ECG signals not only need theoretical but also practical knowledge. Because they are more quickly aware of a lesson through hands-on experience than through theoretical understanding alone, most students are very weak with this technology. As a reason, lecturers must apply effective learning kits for students in order to improve their knowledge of a topic while also saving time and retaining student interest. Making teaching and learning easier and more effective than verbal explanations with the suitable selection of learning kit for the topic related to ECG machine and ECG signal (Kob, Abdullah, Shamsuddin, 2019).

#### 3.0 Previous Study

#### 3.1 ThingSpeak Cloud Computing Platform Based ECG Diagnose System



Figure 3 shown there are two main parts to the IoT ECG health monitoring system based on the ThingSpeak platform. The ECG sensor nodes are used to collect raw ECG data using a Node-MCU with a Wi-Fi built-in module and a central broker. The data is

collected, saved as a text file, and delivered to the central broker via an online MATLAB program. For categorization purposes, the software reads and analyses stored data using the PCA technique (Mohamad,Et Al.,2019).

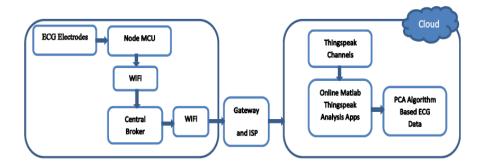


Figure 1: Structure of proposed system

# 3.2 Designing ECG monitoring Healthcare System Based on Internet of Things Blynk Application

At figure 2, the proposed ECG healthcare system enables the doctor to monitor the patient's remotely using IoT Blynk application installed on his smartphone. The system consists of a set of hardware and software components that are interacted together. These components can be divided into four units, the data collecting unit, Arduino Uno microcontroller, ESP Wi-Fi module and Bynk IoT application (Hasan and Ismaeel, 2020)

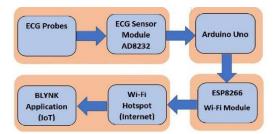


Figure 2: Flow diagram of ECG Monitoring Healthcare System



This system consists of the design of the project, the flow chart and block diagram on how the device works, the sensors that are used, and more.

## 4.1 Design Project

Figure 3 shows the project's design. It's a description of the project in progress. The overall training kit system is built, including software, hardware, and even a laptop that shows output simulations such as the 6-lead ECG wave, heart rate, and heart rhythm conditions.

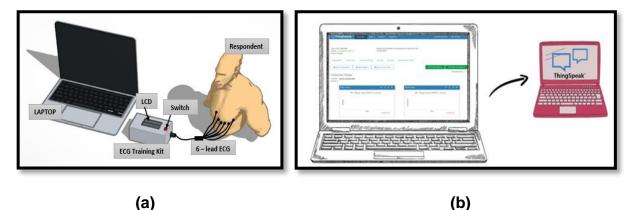


Figure 3: (a) ECG Training Kit. (b) Software Design ECG Training Kit via Thingspeak Using Laptop

This project used some sensors and Node-MCU to design and implement the ECG training kit system based on IoT. The system senses the ECG signal from the ECG simulator (the ECG simulator is not included in the idea of this project) or the human body (respondent) through 6 – leads ECG electrodes via AD8232. This sensor was used to measure the heart's electrical activity called ECG signal. In this project, Arduino UNO is used to convert the analog signal to digital data and transfer the signal via Node-MCU ESP 8266 to the laptop through the ThingSpeak Application.

The ECG monitoring system is also integrated into the training kit system, reading and displaying the cardiac simulation generated by the ECG Simulator. The ECG monitor

will define and show measurements such as pulse rate (bpm) and display a waveform from 6 – leads ECG electrode. Finally, in this training kit, ThingSpeak application software is used to display the whole functioning of the training kit system.



### 4.2 Block Diagram

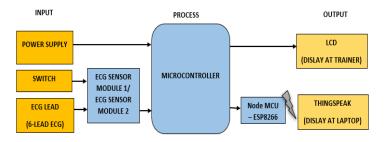


Figure 4: Block Diagram of IoT ECG Trainer kit

Figure 4 shows the input in designing this training kit, its circuit is powered by a direct source which causes the circuit to start operating and has a switch of selection ECG sensor 1 and ECG sensor 2. This project included an aspect of the ECG training kit. Sometimes known as an ECG machine. In showing the signal the ECG signal used by The ECG simulator (the ECG simulator is not included in the idea of this project) or the human body (respondent). The 6 – leads ECG electrode will collect the raw ECG data (analog signal) from the ECG simulator or human body.

The data from 6 – lead ECG electrodes is received by the ECG sensor module (AD8232), which is then sent to the microcontroller (Arduino UNO) and converted to digital data by the microcontroller and the output will display through LCD. While, the Wi-fi module (Node-MCU ESP8266) delivers the digital data to the laptop through the ThingSpeak Application.

A bpm is presented through LCD on the ECG training kit. The output simulation of the ECG is also presented on the Software Application through a laptop when synchronizing it. The software will show a graph from the 6-lead ECG sensor kit and initialize the heart rate value (BPM). The application-based simulation aids in-class collaboration during the practical lab.

#### 4.3 Flow Chart

# 4.3.1 Flow Chart of IoT ECG Training Kit



The flow chart in Figure 5 is the operational implementation of the project. It is the procedure of the project. This procedure shown steps on how the whole device work:

- i. Place on the 6-electrode ECG leads to an ECG simulator or human body.
- ii. If the switch is low ECG sensor 1 will detect the signal for lead 1 until 3, while if the switch is high ECG sensor 2 will detect the signal for lead 4 until 6 and measure the electrical activity heart generated from ECG simulator or human body The heart rhythm condition will be analyzed depending on the PQRST value. If the ECG signal cannot be detected, check the connection AD8232 ECG sensor kit with lead.
- iii. The data will be processed by ESP8266 and connected to the access point. If it is not connected, check connection with ESP8266 to the access point.
- iv. After getting a connection, the ECG signal is sent to the ThingSpeak application.
- v. The output simulation from the simulator will display on the LCD (ECG trainer kit) and the ThingSpeak application (laptop).

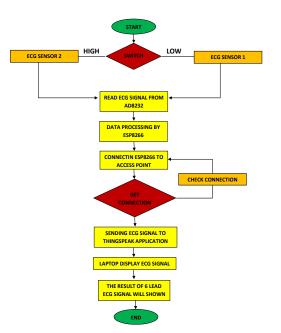


Figure 5: Flow Chart of IoT ECG Training Kit

## 4.3.2 Flow Chart for SOP of ECG Training Kit

Figure 6 depicts the flow Chart for SOP of ECG Training Kit. This is a project process that displays the wave from a 6-lead ECG electrode, as well as the heart rate and rhythm



condition. Respondents can learn or practice on a laptop using the ThingSpeak application's display.

- i. Use a search engine to find a ThingSpeak Application.
- ii. Log in to the ThingSpeak App and enter the username and password.
- iii. ECG electrodes with 6 leads should be placed on the ECG simulator or responder.
- iv. The data will be sent to the cloud through API, and a wave from 6 lead ECG will display in a few seconds in ThingSpeak Application.
- v. The heart rate is measured in beats per minute (bpm).

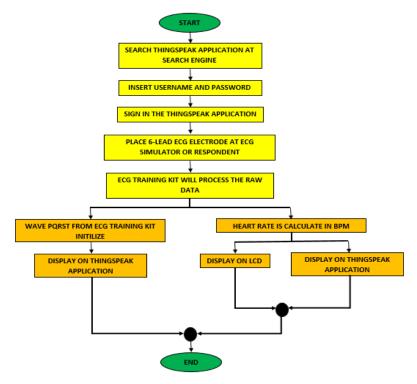


Figure 6: Flow Chart for SOP of ECG Training Kit

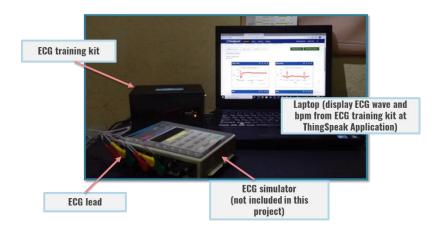
#### 5.0 Result

#### 5.1 ECG Training Kit System

The ECG Training Kit system as shown in Figure 7 is developed which comes with elements of ECG training kit and software (ThingSpeak Application). The ECG simulator



(not included in this project) acts as ECG signal generation and provides the heart rate generation, while the ECG training kit and Software is to display output simulation of ECG such as Heart Rate and Heart Rhythm. The main objective in developing an Electrocardiograph (ECG) training kit system as for learning media is achieved and the physical development outcome as shown in figure 7.



## Figure 7: ECG Training Kit System with IoT via ThingSpeak Application

#### **5.1 ECG Training Kit Application**

Figure 8 is referred to. In implementing the software-based ECG training kit system, the application software is built to display the output simulation. The ThingSpeak Application is used to create application software. Few main elements are designed to be displayed on the front layout (of Application software) such as heart rate and ECG Waveform visualization. The side elements such as time, reset save /export data are also

have on the application for display. The function of every designated element is as follows:

- Heart Rate: displays heart rate value in beats per minute
- Heart Waveform Visual: displays the heart waveform depending its heart rate.
- Time: displays time
- Reset: deletes all data
- Save /export data: the data will save into Microsoft Excel



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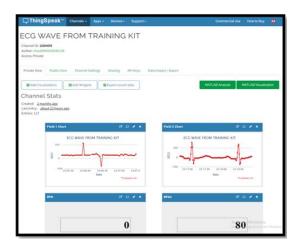


Figure 8: ECG Training Kit Application

#### 6.0 ECG Training Kit Application

#### 6.1 Questionnaire

Figure 9 shows the survey about the development of an ECG training kit system based on the Internet of Things via the Thingspeak application. There are 8 questions have been asked to 25 respondents involved.

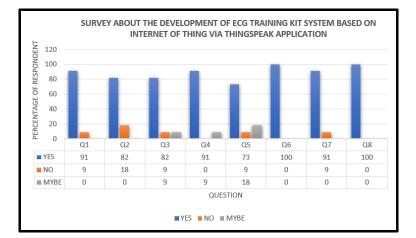
The impact of the implementation of the ECG Training Kit system was evaluated from the survey feedback. The feedback data is processed and graphed as in Figure 36

for this study. The data analysis of the survey was conducted from a questionnaire which distributed to respondents. For question one (Q1), 91% of the respondents agree that the ECG training kit can improve students learning process. For question two (Q2), 82% of respondents agree that the ECG training kit can help students learn and understand topics related to machine ECG quickly, the rest 18% disagree that the ECG training kit can help students learn and understand topics related to machine ECG quickly.

For question three (Q3) in the product design/features section, 82% of the user think the features in this ECG training kit device and the ThingSpeak application are easy to use and 91% of the user think the devices is a portable or easy-to-carry device in the question four (Q4). For question five (Q5), 73% of the respondents love the software-based features implemented in the ECG training kit.



In the third section, the learning material is applied to the questionnaire. In question six (Q6), 100% of the respondents respondent satisfied with the implemented learning material of ECG in the training kit. In the second last question (Q7), 91% of the respondents believe that the presence of a display on the ECG application software (e.g.: PQRST wave) on the system is very beneficial to students in completing practical lab in the face -to -face or online. Lastly, in question eight (Q8), 100% of the respondent understand the concept of electrocardiogram (6-leads ECG placement). Most of the respondents were able to analyze and recognize the output simulation generated through the ECG training kit. Overall, the majority of respondents that have tried the ECG training kit system are giving positive feedback. The majority of the respondents agree that this product can improve their knowledge of electrocardiographs (ECG).



# Figure 9: Survey about development of ECG training kit system based on internet of thing via thingspeak application.

#### 6.2 Data Analysis for Transmission Data and Connection Test

Testing of data transmission was carried out to determine any disturbances or errors during the data transmission process. The sensor data from the database (displayed on the ThingSpeak Application) compared with data from the LCD display. The results are presented in Table 1, shows heart rate in bpm data from AD8323. The data on ThingSpeak Application and the data on the LCD display are all the same. It revealed that the transmission data and connection test between data display at ThingSpeak Application and LCD is a success since the data is transferred directly, supported by the connection which it is stable with 0 % of error for normal, tachycardia, ventricular fibrillation, atrial fibrillation and bradycardia.



	Heart Rate(bpm)				
Subject	LCD Display	ThingSpeak Apps	Error (%)		
Normal	80	80	0		
Tachycardiac	108	108	0		
Ventricular fibrillation	36	36	0		
Atrial fibrillation	120	120	0		
Bradycardia	46	46	0		

# Table 1: Transmission Data and Connection Test on LCD and ThingSpeakApplication for Heart Rate

# 6.3 Comparison ECG Measurement Between ECG Wave (Theoretical) and ECG Wave from Training Kit (Project)

Table 2 tabulates the number of subjects their reading of value PQRST wave. In general, it found that each value from both theoretical and ECG training kits had a significant difference. The P amplitude for the theoretical value is 0.15 mV while the measured value from the ECG training kit is 0.17 mV and the percentage error is 13,3%. The QRS height in theoretical is 1.5 but at ECG training kit is 1.8 with the percentage of error is 20%. At the ST level, the theoretical is 0 same value as the ECG training kit. So that the percentage of error is 0% for the ST level. Lastly, the T amplitude in theoretical is 0.3 while the ECG training kit measure is 0.32 and the percentage of error is 6.7%.

# Table 2: Data Collection between ECG training kit and theoretical for value of PQRST wave

	PQRST wave (mV)				
Subject	True value	Measured	Error (%)		
P amplitude	0.15	0.17	13.30		
QRS height	1.50	1.80	20.00		
ST level	0.00	0.00	0.00		
T amplitude	0.30	0.32	6.70		

## 7.0 Conclusion

The development of an electrocardiograph (ECG) training kit system based on the Internet of Things via the Thingspeak application is successful done in this project. The developed training kit system is significant as its benefits overcome the issues faced by biomedical



students and lecturers. It also achieves its' objective when it analyzed when an ECG training kit has been developed for learning materials, a software-based training kit system to facilitate students doing practical lab via online learning or face-to-face. Lastly, to improve students' understanding of ECG signals with easy-to-understand methods when performing practical activities.

#### 8.0 Recommendation

This project leads to various promising topics for future investigations. Many elements have to be implemented and improved in the training kit system. For example, using a better application or system there is no delay to get real-time PQRST waves. This will give the real-like experience of the user in performing the ECG. This also will increase the improvement in gaining knowledge among the students.

Secondly, produce a smaller or half size from the developed life-size ECG training kit. It will be easy for users to bring anytime and anywhere. Thirdly the addition of 12-leads ECG also can be improvised to make it varied and add more ECG learning material in it. Lastly, The ECG wave can produce for each lead.

#### Acknowledgment

I would like to express my heartfelt gratitude to my supervisor, Puan Nurul Huda Binti Mohamd Saleh, who assisted me in conducting extensive research and helps me in developing this project.

#### Reference

- ACLS Medical Training. (2020, September 16). *Rhythm Recognition*. <u>https://www.aclsmedicaltraining.com/rhythm-recognition/</u>.
- A.H. Mohamad, Et Al., A. (2019). Thingspeak Cloud Computing Platform Based ECG Diagnose System. International Journal of Computing and Digital Systems, 8(1), 11– 18. <u>https://doi.org/10.12785/ijcds/080102</u>
- Anugrah, D., & Waluyanti, S. (2019). A Heart Rate Measuring Trainer Kit as a Medical Electronics Practice Learning Media. *Journal of Physics: Conference Series*, 1413(1), 012004. <u>https://doi.org/10.1088/1742-6596/1413/1/012004</u>



- Brown Macheso, P. S., & G Meela, A. (2021). IoT Based Patient Health Monitoring using ESP8266 and Arduino. *International Journal of Computer Communication and Informatics*, *3*(2), 75–83. <u>https://doi.org/10.34256/ijcci2127</u>
- C. P. Kiak, N. S. Ibrahim, And D. A. Ramli. (2020). Development of Low Cost and Portable ECG Detection Kit for Biometric Identification. *MACE Tech*, *2*, 15–20.
- Hasan, D., & Ismaeel, A. (2020). Designing ECG Monitoring Healthcare System Based on Internet of Things Blynk Application. *Journal of Applied Science and Technology Trends*, 1(3), 106–111. <u>https://doi.org/10.38094/jastt1336</u>
- Kob, C. G. C., Abdullah, A. S., & Shamsuddin, H. (2019). Effects of Learning Aid (KIT) on Student Performance for Electric Circuits Topics. International Journal of Academic Research in Business and Social Sciences, 9(1). <u>https://doi.org/10.6007/ijarbss/v9i1/5400</u>
- Rahman, M. M., Rimon, M. A. H., Hoque, M. A., & Sammir, M. R. (2019). Affordable Smart ECG Monitoring Using Arduino & Bluetooth Module. 2019 1st International Conference on Advances in Science, Engineering and Robotics Technology (ICASERT). https://doi.org/10.1109/icasert.2019.8934498
- Sampson, M. (2018). Continuous ECG monitoring in hospital: part 2, practical issues. *British Journal of Cardiac Nursing*, *13*(3), 128–134. <u>https://doi.org/10.12968/bjca.2018.13.3.128</u>
- Soaduon Simanjuntak, J. E., Khodra, M. L., & Tosima Manullang, M. C. (2020). Design Methods of Detecting Atrial Fibrillation Using the Recurrent Neural Network Algorithm on the Arduino AD8232 ECG Module. *IOP Conference Series: Earth and Environmental Science*, 537(1), 012022. <u>https://doi.org/10.1088/1755-1315/537/1/012022</u>



# DEVELOPMENT OF CUFF-LESS CONTINUOUS BLOOD PRESSURE MONITORING SYSTEM USING PULSE TRANSIT TIME TECHNIQUE WITH IOT

Siti Aisyah Binti Amram<sup>1</sup> and Nurul Huda Binti Mohamd Saleh<sup>2</sup>

Electrical Engineering Department, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor <sup>1</sup>aisyahamram258@gmail.com <sup>2</sup>hudasalehpoli@gmail.com

#### Abstract

Blood pressure (BP) Blood pressure (BP) is one of the vital indicators that must be checked for hypertension and cardiovascular health by measured systolic and diastolic blood pressure. The current blood pressure detection method uses an oscillometric. This method required inflation and was followed by deflation of the cuff. However, the selection of the correct cuff size is important for accurate BP measurement and misdiagnosis of hypertension also leads to psychological stress and unnecessary exposure to adverse side effects. This paper presents the cuff-less BP device which is based on the Pulse Transit Time (PTT) with Blynk apps to facilitate blood pressure monitoring. The MAX30102 sensor is used to get an estimate of Systolic and Diastolic BP. After that, the data acquisition from the photoplethysmography (PPG) signal will be sent to the application through the WiFi module ESP8266. The result showed an accuracy and tolerance systolic parameter with an average of  $\pm 5\%$  followed by diastolic with an average of  $\pm 8\%$  comparable to cuff-based Noninvasive Blood Pressure (NIBP). This cuff-less device can be concluded as a device that is easy to use at any time, especially for home use where it is a portable and wireless device.

**Keywords:** Blood pressure (BP), Pulse transit time (PTT), photoplethysmography (PPG), Cuff-less BP, Non-Invasive Blood Pressure (NIBP).

#### 1.0 Introduction

High Blood Pressure or Hypertension is a primary and most reliable measurement for continuous patient monitoring for their personal health care and patient cardiac system. It is observed that stress is the main reason for many severe diseases, and cardiac disease is also one of them. Hypertension is rarely accompanied by any symptom, and



its identification is usually through screening of continuous monitoring of blood pressure (Singh & Singh, 2015). BP measurement at home is used increasingly for the management of hypertension. Several approaches for cuff-free BP measurement, both invasive and noninvasive methods, have been established in a wide range of research; thus a non-invasive methodology based on pulse transit time (PTT) has been established that can measure BP (Zhang et al., 2020). In simpler terms, pulse transit time is the time it takes for a pulse wave to transit from the heart to the site where a ading is obtained, in this context, the fingertip. This time is related to the propagation velocity of the pulse wave. The pulse wave travels along with the elastic arterial walls. The physiological reason for the elastic nature of the arterial wall is to buffer the pulsatile ejection of blood from the heart and to provide constant flow in the capillary beds. The pulse wave velocity (PWV) can describe the state of the artery. The speed at which the arterial pressure wave travels is directly proportional to blood pressure (BP).

#### 2.0 Related Work

This section discussed about parameters that be measured and evaluated from this Cuffless Blood Pressure and NIBP device. This parameter is specifically for systolic and diastolic blood pressure. This section also introduce the principle of measure and the estimation of the blood pressure using the PTT.

#### 2.1 Blood Pressure

Table 1: Classification and Prevalence of Elevated Blood Pressure for Adults (Kario et al.,

Classification	SBP (mmHg)	DBP (mmHg)	Prevalence in Malaysia
Optimal	<120 and	<80	32%
Normal	<130 and	<85	20%
High Normal	130 – 139 and/or	85 - 89	17%
Hypertension			
Stage I	140 – 159 and/or	90 - 99	20%
Stage II	160 – 179 and/or	100–109	8%
Stage III	≥180 and/or	≥110	4%

2018)

Blood pressure is the force exerted by blood against the artery walls. Arteries transport blood from the heart to the parts of the body. Throughout the day, blood pressure generally rises and falls (High Blood Pressure, 2021). Blood pressure is measured in two parts: systolic and diastolic. Systolic blood pressure (SBP) is the pressure in the arteries 1043



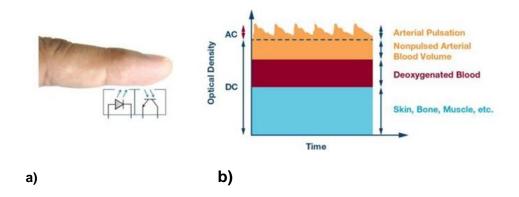
while the heart beats, and diastolic blood pressure (DBP) is the pressure in the arteries when the heart rests between beats. Hypertension is defined as a persistent increase of systolic blood pressure of 140 mmHg or higher

and/or diastolic blood pressure of 90 mmHg or higher (Kario et al., 2018). This definition is based on the average of two or more adequately measured, seated blood pressure readings taken during two or more clinic visits. When SBP and DBP are classified differently, the greater category should be used to classify the individual's blood pressure.

#### 2.2 Principle of Measure: PPG

The pressure wave varies periodically between two extremes which are systolic and diastolic and it causes dilation of the arterial walls. Moreover, on its path, it moves faster than the blood flow (Chia & Kario, 2020). This pressure can be detected by measuring the variation of the oxygen content of the blood, caused by influx of oxygenated blood on the arrival of the pressure wave. The PPG signal is used to determine and register the variations in blood flow in the body, which occur at each heartbeat. The PPG is captured by a pulse oximeter that is composed by a light source and a light detector: It detects the cardio-vascular pulse wave that propagates through the body.

The PPG signal has an AC and a DC component. The AC component is the result of pulsating changes in arterial blood volume that is synchronous with the heartbeat. The DC component is related to the average blood volume and to the tissues. The AC component must be filtered out from the DC component in order to get the needed pulse signal. These concepts are visualized in Figure 1.





**Figure 39:** Principle of photoplethysmography (PPG) measurement. **(a)** Schematics of the LED and the receiver: the LED emits light at the specific wavelength at which the absorption of the oxy-hemoglobin is maximum; the receiver collects the back scattered light. (b) The PPG signal is composed by a DC component, due to the not-changing part in the tissue and the AC component due to the blood whose concentration of oxy and deoxy-hemoglobin changes as the pulse (Chia & Kario, 2020).

The arrival of the pressure wave is visible as the first peak on the PPG waveform (Lazazzera et al., 2019). The direct wave of the PPG waveform (systolic component) is the result of pressure transmission from the aortic root to the distal place where the signal is acquired. The second part (diastolic component) is formed by pressure transmitted from the ventricle along the aorta to the lower body where it is reflected back along the aorta to the distal place. The upper limb provides a common channel for both the directly transmitted pressure wave and the reflected wave and, therefore, has little influence on the contour of the PPG signal.

#### 3.0 Methodology

This section is essential in order to complete this research investigation properly. The Pulse Transit Time approach was utilized to detect systolic and diastolic parameters using the MAX30102 sensor. This sensor and NIBP are used in this instrument to retrieve patient data. Figure 2 illustrates the methodological process in more detail.

#### 3.1 Block Diagram of the Operating System

Figure 2 shows a block diagram of the hardware architecture for Cuffless BP Monitoring process. This block diagram cover the system's components, which include three main parts: inputs, processes, and outputs for generating PPG signals simultaneously. Each part provides a particular function, and the block diagram in Figure 7 illustrates how each component is linked. The first three blocks are packed inside that represent an input. The input sensor is responsible for detecting and sending signals to the microcontroller which is the MAX30102 sensor. The PTT is obtained by optically measuring the changes in the volume of blood over the fingertip, whereas the PPG signal is used to determine and register the variations in blood flow in the body, which occur at each heartbeat. The sensor generates a signal from the fingertip where the desired PPG signals are collected with higher quality. ESP8266 is used to send the data from the measuring device to the IoT device via a Wi-Fi



connection. The measuring devices instrumentation is powered by a Li-Ion battery that can be recharged. The Blynk Apps is smartphone application that can be installed on any Android and iPhone device. The application purpose to display the output of the blood pressure reading (systolic and diastolic) on the smartphone. The calibration results are used to compare the accuracy of this Cuffless Blood Pressure with NIBP device that is commercially accessible.

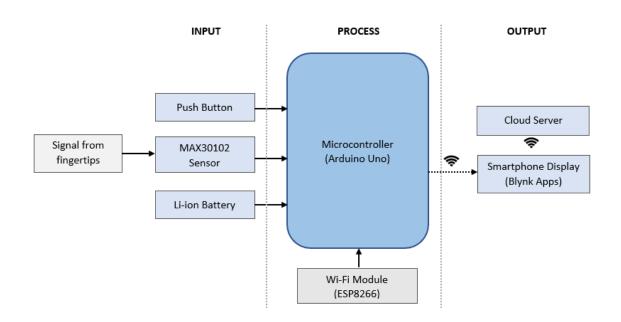


Figure 40: Block Diagram of Cuffless BP Monitoring

#### 3.2 SBP and DBP Analysis

Through rigorous mathematical analysis of the PPG signals, a mathematical model was established at (Chowdhury et al., 2020) to estimate predicting SBP and DBP. Systolic and diastolic blood pressure levels were estimated using the pulse transit time (PTT) in (Sharma et al., 2017) (Chowdhury et al., 2020) and a combination of Pulse Arrival Time (PAT) and heart rate, with the combination outperforming PTT alone. The following equations provide the linear formulation of the model in the variables Time Delay (Delay) and HR:

$$SBP = A_S * Delay + B_S + HR + C_S$$
(1)  
1046



$$DBP = A_D * Delay + B_D + HR + C_D$$
(2)

These equations are used to produce SBP and DBP after calibration to preserve accuracy:

$$SBP = 184.3 - 1.329 * HR_{bpm} + 0.0848 * Td$$
(3)

$$DBP = 55.96 - 0.02912 * HR_{bpm} + 0.02302 * Td$$
(4)

$$Td = HR_{ms} - TimeDelay \tag{5}$$

#### 3.3 Data Collection

The data collection is gained by taking the reading from the subject using the developed product and current medical product which is NIBP device. There are five subjects involved in this project. The process was repeated for systolic and diastolic blood pressure readings taken in the morning and evening. The flow chart shows that as soon as the subject places a finger on the device, blood pressure monitoring even begins with the operating system detecting and calculating the subject's parameters. After that, the smartphone display shows the SBP and DBP readings of the subject and then the data of these parameters are collected to be evaluated and analyzed. The data that has been analyzed is recorded and stored into the Cloud server.



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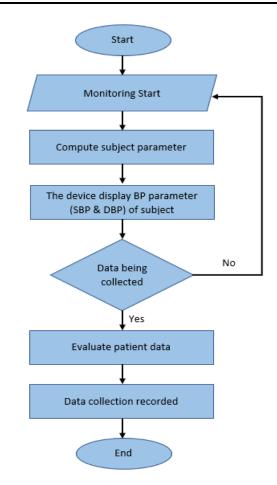


Figure 41: Data Collection Method

## 4.0 Result and Analysis

This section discussed on blood pressure obtained from the subject at morning and evening session by using Cuff-Less Continuous Blood Pressure and Non-Invasive Blood Pressure (NIBP).

# 4.1 Comparison Data Between Cuffless BP and Product in the Market (NIBP) for Blood Pressure Measurement

Table 1 tabulates the Cuff-Less Continuous Blood Pressure for systolic and diastolic in the morning session. There 30 readings from five subjects were taken in the morning which is 15 readings are cuffless BP and 15 readings are NIBP. It shows that the cuffless

BP reading is average from (110.33) to (128.78) and the NIBP reading (114.00) to (128.67), for systolic. It shows that the cuffless BP reading is average from (56.67) to (60.67) and the NIBP reading (63.00) to (70.00), for diastolic. It was found that for systolic Cuffless BP is reliable as the tolerance is within the different range 1.33 to 3.67, this per cent is acceptable. However, for diastolic, the difference is between 4.33 to 9.33. It is interesting to see that for



subjects 2 and 4, the difference is between Cuff-less and NIBP, the value is great due to the systematic error.

			sessio	on			
MORNING							
Subject	Number of	SYSTOLIC			DIASTOLIC		
Subject	readings	Cuffless BP	NIBP	Different	Cuffless BP	NIBP	Different
1	1	131.00	133.00	2.00	57.00	56.00	1.00
-	2	125.00	125.00	0.00	56.00	64.00	8.00
-	3	130.00	128.00	2.00	62.00	69.00	7.00
	Average	128.78	128.67	1.33	58.33	63.00	5.33
2	1	120.00	122.00	2.00	56.00	59.00	3.00
-	2	122.00	125.00	3.00	58.00	64.00	6.00
-	3	119.00	119.00	0.00	56.00	70.00	4.00
	Average	120.33	122.00	1.67	56.67	64.33	4.33
3	1	117.00	117.00	0.00	56.00	62.00	6.00
-	2	125.00	127.00	2.00	60.00	68.00	8.00
-	3	115.00	119.00	4.00	57.00	65.00	8.00
	Average	119.00	121.00	2.00	57.67	65.00	7.33
4	1	109.00	110.00	1.00	65.00	73.00	8.00
-	2	112.00	114.00	2.00	58.00	69.00	11.00
-	3	110.00	118.00	8.00	59.00	68.00	9.00
	Average	110.33	114.00	3.67	60.67	70.00	9.33
5	1	109.00	110.00	1.00	63.00	75.00	12.00
-	2	117.00	119.00	2.00	61.00	69.00	8.00
-	3	118.00	120.00	2.00	64.00	70.00	6.00
	Average	114.67	116.33	1.67	62.67	71.33	8.67

 Table 1: Cuff-Less Continuous Blood Pressure for systolic and diastolic in the morning

Table 2 tabulates the Cuff-Less Continuous Blood Pressure for systolic and diastolic in the morning session. There 30 readings from five subjects were taken in the morning which is 15 readings are cuffless BP and 15 readings are NIBP. It shows that the cuffless BP reading is average from (106.67) to (129.00) and the NIBP reading (104.33) to (134.00), for systolic. It shows that the cuffless BP reading is average from (56.67) to (65.67) and the NIBP reading (59.67) to (71.67), for diastolic. It was found that for systolic Cuff-less BP is reliable as the difference is within 1.00 to 4.00, this per cent is acceptable. However, for diastolic, the difference between cuffless and NIBP is 3.00 to 9.33. It is interesting to see that for subjects



2 and 5, the difference is between Cuff-less BP and NIBP, however, it is still within the accepted range and this device works well.

session EVENING							
Subject	readings	Cuffless BP	NIBP	difference	Cuffless BP	NIBP	difference
1	1	128.00	129.00	1.00	69.00	75.00	6.00
-	2	130.00	130.00	0.00	62.00	72.00	10.00
-	3	122.00	125.00	3.00	59.00	68.00	9.00
	Average	129.00	134.00	1.33	65.67	71.67	8.33
2	1	119.00	117.00	2.00	60.00	69.00	9.00
-	2	110.00	115.00	5.00	58.00	68.00	10.00
	3	117.00	115.00	2.00	56.00	65.00	9.00
	Average	115.33	115.67	3.00	58.00	68.33	9.33
3	1	109.00	112.00	3.00	60.00	69.00	9.00
-	2	110.00	105.00	5.00	58.00	60.00	2.00
-	3	107.00	103.00	4.00	60.00	68.00	8.00
	Average	108.67	106.67	4.00	59.00	65.67	6.33
4	1	110.00	109.00	1.00	58.00	60.00	2.00
-	2	105.00	105.00	0.00	67.00	70.00	3.00
-	3	115.00	112.00	2.00	65.00	71.00	6.00
	Average	110.00	108.67	1.00	63.33	67.00	3.67
5	1	108.00	102.00	6.00	56.00	56.00	0.00
-	2	102.00	102.00	0.00	56.00	61.00	5.00
-	3	110.00	109.00	1.00	58.00	62.00	4.00
	Average	106.67	104.33	2.33	56.67	59.67	3.00

 Table 2: Cuff-Less Continuous Blood Pressure for systolic and diastolic in the evening

From this observation, the different measurement value between two devices in term of two parameters which is systolic and diastolic have a significant difference. The systolic values produced are very satisfactory but the diastolic values show a fairly significant difference

#### 5.0 Conclusions

There are various types of blood pressure devices on the market in this innovative world advancement, cuffless blood pressure is specially designed for all, especially if users



have been diagnosed with high blood pressure or hypertension. The developed device produces a cuff-less blood pressure (BP) reading based on the pulse transit time (PTT), allowing the patient to utilise it at any time as long. Following that, the device comes with the design of a mobile application that can facilitate real-time blood pressure monitoring with IoT. Furthermore, this project can analyse blood pressure data (systolic and diastolic) by comparing readings from non-invasive blood pressure (NIBP) device with a cuffless blood pressure device. It is simpler without the use of a cuff. It will allow keeping track of any changes in blood pressure readings on a daily basis without having to visit the doctor. The developed device is important as it is beneficial to hypertension as well as the related field of patients' cardiac systems.

#### Acknowledgment

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#### References

- Chia, Y. C., & Kario, K. (2020). Asian management of hypertension: Current status, home blood pressure, and specific concerns in Malaysia. In *Journal of Clinical Hypertension* (Vol. 22, Issue 3, pp. 497–500). Blackwell Publishing Inc. https://doi.org/10.1111/jch.13721
- Chowdhury, M. H., Shuzan, M. N. I., Chowdhury, M. E. H., Mahbub, Z. B., Monir Uddin, M., Khandakar, A., & Reaz, M. B. I. (2020). Estimating blood pressure from the photoplethysmogram signal and demographic features using machine learning techniques. *Sensors (Switzerland)*, 20(11). https://doi.org/10.3390/s20113127
- *High Blood Pressure*. (2021). Centers for Disease Control and Prevention. https://www.cdc.gov/bloodpressure/about.htm



- Kario, K., Tomitani, N., Buranakitjaroen, P., Chia, Y. C., Park, S., Chen, C. H., Divinagracia, R., Shin, J., Siddique, S., Sison, J., Ann Soenarta, A., Sogunuru, G. P., Tay, J. C., Turana, Y., Zhang, Y., Nailes, J., Wanthong, S., Hoshide, S., Matsushita, N., ... Wang, J. G. (2018). Home blood pressure control status in 2017-2018 for hypertension specialist centers in Asia: Results of the Asia BP@Home study. *Journal of Clinical Hypertension*, 20(12), 1686–1695. https://doi.org/10.1111/jch.13415
- Lazazzera, R., Belhaj, Y., & Carrault, G. (2019). A newwearable device for blood pressure estimation using photoplethysmogram. *Sensors (Switzerland)*, *19*(11). https://doi.org/10.3390/s19112557
- Sharma, M., Barbosa, K., Ho, V., Griggs, D., Ghirmai, T., Krishnan, S., Hsiai, T., Chiao, J.-C., & Cao, H. (2017). Cuff-Less and Continuous Blood Pressure Monitoring: A Methodological Review. *Technologies*, 5(2), 21. https://doi.org/10.3390/technologies5020021
- Singh, H., & Singh, M. (2015, September 9). Design and development of Pulse transit time based cuffless Blood Pressure monitoring system. *International Conference on Electrical, Electronics, Signals, Communication and Optimization, EESCO 2015.* https://doi.org/10.1109/EESCO.2015.7254004
- Zhang, Y., Zhou, C., Huang, Z., & Ye, X. (2020). Development of a continuous blood pressure monitoring system based on pulse transit time and hemodynamic covariates. BIODEVICES 2020 - 13th International Conference on Biomedical Electronics and Devices, Proceedings; Part of 13th International Joint Conference on Biomedical Engineering Systems and Technologies, BIOSTEC 2020, 1(Biostec 2020), 33–39. https://doi.org/10.5220/0008944800330039



# ACUTE MUSCLE LASER THERAPY

Muhammad Iqmal Bin Ramli<sup>1</sup>, Ku Lee Chin<sup>2</sup>

Department of Electrical Engineering, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor, Malaysia. <sup>1</sup>iqmalramli99@gmail.com <sup>2</sup>lohleechin1@gmail.com.my

#### Abstract

Acute Laser Muscle Therapy is intended to speed soft tissue regeneration in treating acute and chronic muscular discomfort without causing pain or other side effects. It is possible to improve the quality and strength of tissue repair by using a low-level laser (650nm). When the wavelength of a low-level laser exceeds 700nm-770nm inefficiency to penetrate muscle tissue, it is usual for it to have an unstable wavelength. Excessive light (in terms of energy density) for a lengthy time at the target location will not give the most desirable outcomes in muscle recovery, regardless of how long the light is used. This research aims to develop a laser with a wavelength of 650nm for the treatment of acute muscle discomfort. Furthermore, this study aims to design a laser therapy device that uses a static magnetic field to produce stable wavelengths. The Arduino Nano integrated board, which controls the 650nm laser, OLED screen, HC-05 Bluetooth Module, and buzzer, is at the heart of this product's operation. To enable the Internet of Things (IoT) capabilities and the ability to record treatment history, the Bluetooth module (HC-05) will be installed. Both the patient and the user can manually set the timer for therapy. To give the best potential outcome for patients, the procedure is often conducted 3-5 times per week, with each treatment lasting 10-15 minutes per session, on average. This device has an adjustable strap band that allows it to be adjusted to fit patients and users of various sizes. The statistics and information displayed on the OLED panel and the Blynk application are part of this project. The program will keep track of each therapy and determine how many sessions were required for the patient to regain muscular function and live everyday life without experiencing muscle soreness.

Keywords: low-level laser, laser therapy, tissue repair, wavelength, muscle tissue.

#### 1. Introduction



Acute Muscle Laser Therapy uses a low-level laser to heal tissue damage and relieve acute and chronic muscle discomfort. It is not as intense as a surgical laser. Muscle Pain Therapy is entirely safe and painless. Low-level laser therapy is often used to speed up tissue repair, reduce inflammation, and relieve pain. Over 100 successful randomized, double-blind RCTs and 1000 published laboratory research have confirmed muscle pain therapy. Back and neck pain are among the conditions being studied.

Other research has indicated that most laser with wavelengths 630-800 nm transit around 23 cm through the skin (light input) and muscle (light output) before arriving at the photon detector [1]. Photonic Therapy, also called red light therapy, is a non-invasive, pain-relieving procedure. Applicable to the skin, this product produces 650nm red laser because it can penetrate deep into tissues. This approach has been studied for over 40 years and has minor side effects.

Shorter wavelengths enhance surface healing. A wavelength of 600-700nm heals surface wounds. They're used to treat superficial wounds. This laser's depth is estimated to be 1cm. Also useful for diabetic ulcers, bedsores, and surgical incisions [2].

#### 2. Methodology

This chapter will describe the technique for constructing this project, which consists of key hardware components. This chapter also describes the many features used by this project. In addition, this section will describe the project's construction and the methodology utilized for this investigation. In addition, this chapter will detail the components of the flowchart used to design an Acute Muscle Laser Therapy for muscle pain. In addition, a block diagram will provide more information to define the workflow in this project. The next step involves estimating the project's cost and predicted outcome. This methodological part will play a significant role in implementing this research and software.

#### 2.1 Developing the hardware and IoT implementation of Acute Muscle Laser Therapy



Figure 42 Circuit Connection



Figure 1 shows the circuit of the Acute Muscle Laser Therapy. All hardware installations follow the schematic circuit made in Fritzing software. Arduino Nano, HC-05 Bluetooth Module, 7.4V Battery, and 650nm Laser Module were used for the project. Small, breadboard-compatible Arduino Nano. It has the same connectivity and specs as Arduino Uno but is smaller. Arduino Nano has 30 male I/O headers that may be programmed using the Arduino IDE (IDE).



Figure 43 Project's Device

Figure 2 above shows the complete product of the project. The left box represents the project device then user/patient will wear the strap band at at muscle discomfort bedore start the treatment. The data will be shown on the OLED display. The data shown on the screen display are sync with application in smartphone. The data is also displayed on the smartphone so the user can track the data history after using it.



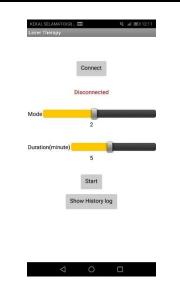


Figure 44 Application on Android smartphone

The interface of IoT implementation using the MIT App Inventor application for collecting the data from the sensor is shown on Figure 3 above. The MIT App Inventor application is easy to download for android smartphones. The user can track their health record easily by using the application.

No.	Button	
1	Mode	
2	Timer	
3.	History button	

Table 17 Function button on the MIT App Inventor application

Table 1 above shows the function of each button of the MIT App Inventor application. No. 1 is Mode that user or patient must select before therapy session. No. 2 is Timer that user or patient can choose how long treatment will be going. No. 3 is history button to shows all the recorded therapy. The user can track their history by pushing the history button.



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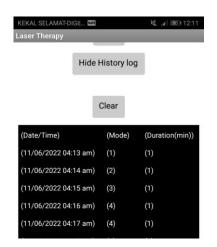


Figure 45 History data

Figure 4 shows the history data when the user push the history button. The application will record and save information such as date, time, mode and duration. This record is saved as private and confidential files to keep the privacy of patient information.

#### 2.2 Block Diagram of the Operating System

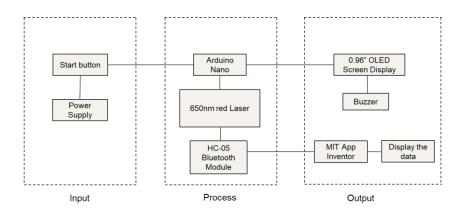


Figure 46 Block Diagram of The Project

Figure 5 indicate block diagram of the project and shows all component that will use to running the device. This project's components will all be attached to Acute Muscle Laser Therapy. Not only that, but the device will have an application that will allow users to select the mode, set a timer, receive alerts in the form of alarms, and receive notifications regarding therapeutic schedules.



#### 2.3 Making Flow Chart of the Operation Device

In Figure 6, users turn on the device and choose from a menu of modes manually established on the device or via the mobile application. Second, the user can select a mode and a timer based on the length of the therapeutic session. The device's first and second processes are set up in a single application. After the therapy session, the device's alarm will sound, the LED will light up, and the app's alarm will ring for 3 seconds.

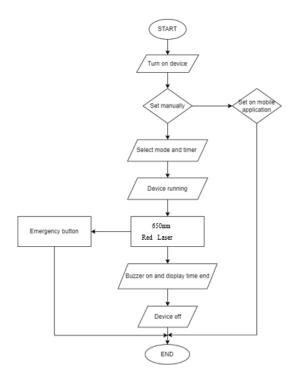


Figure 47 Project's Flow chart

#### 2.4 Data Collection Method

#### 2.4.1 Calculation of Healing Data

All data collected from Feedback of Acute Muscle Laser Therapy. Then, the calculation of healing data from first week occurs by result from first day until seventh day. Therefore, the data gets from the average healing percentage from the seventh day. The formula of calculation shows as below.

Average data healing = 
$$\frac{sum \ of \ healing \ percentage}{7 \ days}$$

3. Result and Discussion



#### 3.1 Data Treatment of The Patients

Table 2 showed result percentage of healing from first day to seventh day for first week until third week. This result gets from three subject which is Patient A, Patient B and Patient C. Furthermore, it just takes a result from last session duration treatment of subject from first day. It has increase of healing data from first week to third week. The method to calculate the data is get a total of healing then divide by seven. The method that used to get the answer is mean operation of mathematical. Therefore, the data get from average healing data from week 1 until week 3.

		Patient A	Patient B	Patient C
		Healing %	Healing %	Healing %
	1	6	5	4
	2	7	6	9
	3	9	8	11
Week 1	4	11	12	13
	5	13	13	14
	6	14	15	17
	7	17	17	18
	1	18	19	19
	2	22	21	23
	3	23	23	24
Week 2	4	24	25	27
	5	27	29	29
	6	29	33	31
	7	32	35	34
	1	33	36	36
	2	35	37	38
	3	37	38	40
Week 3	4	38	40	41
	5	39	42	43
	6	42	44	44
	7	44	45	46
Total		Week 1 = 11%	Week 1 = 11%	Week 1 = 12%
Averag	e	Week 2 = 25%	Week 2 = 26%	Week 2 = 27%
		Week 3 = 38%	Week 3 = 40%	Week 3 = 41%

#### 3.1.1 Comparison of Patient's Healing Data

Table 3 shows the first week until the third week of data Patient A, Patient B and Patient C conducting for 4 times per day and from treatment, the level of healing for Patient A and Patient B get 11% meanwhile Patient C get the highest percentage among others which 12% for first week treatment. The second week for conducting the treatment, the result increased. The percentage of healing process for Patient A is 25% and for Patient B is 26% and the highest is Patient C get 27% of healing data. The third week of treatment, the result



increase positively. The percentage of healing for Patient A is 38%, Patient B is 40% and Patient C is 41% for third week treatment. This data is derived from three.

Number of	Name of Patient	Level of Light	Time Duration	Duration treatment	Level healing
	Fatient		Duration		
Weeks					
	Patient A	All laser ON	10min	4 times/day	11%
Week 1	Patient B	All laser ON	10min	4 times/day	11%
	Patient C	All laser ON	10min	4 times/day	12%
	Patient A	All laser ON	10min	4 times/day	25%
Week 2	Patient B	All laser ON	10min	4 times/day	26%
	Patient C	All laser ON	10min	4 times/day	27%
	Patient A	All laser ON	10min	4 times/day	38%
Week 3	Patient B	All laser ON	10min	4 times/day	40%
	Patient C	All laser ON	10min	4 times/day	41%

Table 19 Result for all weeks

Bar chart in Figure 7 below show the increasement of healing process for three patients from week 1 until week 3.

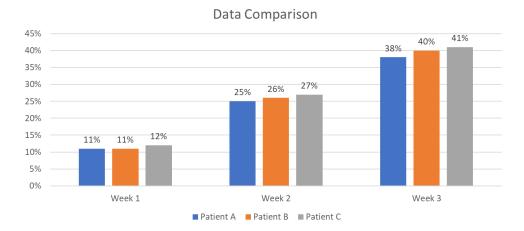


Figure 48 Bar Chart of Data Comparison

#### 4. Conclusion

In conclusion, Acute Muscle Laser Therapy involves the application of a red laser (650nm wavelength) to tissue lesions to enhance soft tissue recovery and provide relief for both acute and chronic muscle pain. This project is a device that is easy to use, and it may be utilized anywhere and at any time if a muscle suddenly feels discomfort. This device can control using the MIT App Inventor, which is easy to access. The HC-05 Bluetooth module



will make the connection between the phone and this device. This project will be a budget device and affordable for people who need muscle pain treatment.

#### 5. Acknowledgment

İ would like to thank you to Mrs. Ku Lee Chin, lecturer of Polytechnic Sultan Salahuddin Abdul Aziz Shah for a valuable advice and technical assistance during the development of my final year project.

#### 6. References

- Eells, J. T., Wong-Riley, M. T. T., VerHoeve, J., Henry, M., Buchman, E. v., Kane, M. P., Gould, L. J., Das, R., Jett, M., Hodgson, B. D., Margolis, D., & Whelan, H. T. (2004). Mitochondrial signal transduction in accelerated wound and retinal healing by near-infrared light therapy. *Mitochondrion*, *4*(5-6 SPEC. ISS.), 559–567. https://doi.org/10.1016/j.mito.2004.07.033
- Semin Cutan Med Surg. (2013). Low-level laser (light) therapy (LLLT) in skin: Stimulating, healing, restoring. *HHS Public Access*, 41–52. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4126803/
- Frykberg, R. G., & Banks, J. (2015). Challenges in the Treatment of Chronic Wounds. *Advances in Wound Care, 4*(9), 560–582. https://doi.org/10.1089/wound.2015.0635
- Hamblin, M. R., & Demidova, T. N. (2006). Mechanisms of low-level light therapy. *Mechanisms for Low-Light Therapy*, 6140, 614001. https://doi.org/10.1117/12.646294
- Ash, C., Dubec, M., Donne, K., & Bashford, T. (2017). Effect of wavelength and beam width on penetration in light-tissue interaction using computational methods. *Lasers in Medical Science*, 32(8), 1909–1918. https://doi.org/10.1007/s10103-017-2317-4



- B Cotler, H. (2015). The Use of Low-Level Laser Therapy (LLLT) For Musculoskeletal Pain. MOJ Orthopedics & Rheumatology, 2(5). https://doi.org/10.15406/mojor.2015.02.00068
- Whelton, R. (2020). APPLICATION OF LOW-LEVEL LASER THERAPY. Central Physical Therapy. https://www.centralptonline.com/application-of-low-level-laser-therapy/
- Whelton, R. (2020). APPLICATION OF LOW-LEVEL LASER THERAPY. Central Physical Therapy. https://www.centralptonline.com/application-of-low-level-laser-therapy/
- Gross, A. R., Dziengo, S., Boers, O., Goldsmith, C. H., Graham, N., Lilge, L., Burnie, S., & White, R. (2013). Send Orders for Reprints to reprints@benthamscience.net Low Level Laser Therapy (LLLT) for Neck Pain: A Systematic Review and Meta-Regression. In *The Open Orthopaedics Journal* (Issue 7).



## FACTOR OF USER SATISFACTION IN OUTSOURCED CLEANING SERVICES FOR COMMERCIAL BUILDINGS

Muhammad Shafiq Bin Hamdan<sup>1</sup>, and Nik Zety Akhtar Abdul Aziz <sup>2</sup> <sup>1</sup> Civil Engineering Department, Polytechnic SultanSalahuddin Abdul Aziz Shah, Shah Alam, Selangor <sup>1</sup>Shafiqhamdan11@gmail.com, <sup>2</sup> nikzetypsa@gmail.com

#### Abstract

Outsourcing is an important consideration for any organization mainly in a commercial building facility.Services including landscaping, street sweeping, washing the concrete and walkways, cleaning windows, washing vehicles and janitorial service and general office tidiness are some of most outsourced cleaning servicesTherefore, to manage commercial building facilities more efficiently, outsourcing is one of the decisions to have a more organized and cost effective selection. The objective of this research is to identify the factor of outsourcing in cleaning services,.There are 3 comparisons of commercial buildings to obtain 120 total respondents from different classifications. This research study suggests tofind out the best practise service quality outsourced in cleaning in commercial building.

Keywords: Outsourcing, Commercial building Facility, Cleaning services, Cost-Effective

#### 1. Introduction

Clean facilities are vital to the health and satisfaction of their occupant (Klungseth & Blakstad, 2016). The practical value of cleaning is widely accepted either in a healthcare environment or property management. Cleaning is one of the support service in facilities management that aims at improving and maintaining the overall life cycle of the facility and at the same time provides human support for an effective working environment to the occupier of the building (Kyengo, 2007). Facility manager needs to understand the core business of the building in order to give good cleaning services to its users (Klungseth & Emanuel, 2013). To ensure that the cleaning services meet appropriate quality standards and add value to the core business, facility managers must have ample knowledge related to the cleaning services industry (Klungseth & Blaks



The act of transfer of some in-house activities to a third party best describes outsourcing. It is making of an agreement between the organization (customer) and the third party (supplier) for provision of services and goods that were initially being provide by the organization. Outsourcing levels in this study are legal, cleaning, security and ICT services.

#### 2. Background and Literature Review

In this chapter, the information is gathered from related articles and journals. This paper also discussed the relevant topics and issues. Therefore, the purpose of doing a literature review is togive a broad overview of what is the research is about and identify the gap research that can be addressed.

# Satisfaction

Satisfaction in its conceptualisation is generally subjective and value-laden (Sirgy, 2012), because it is based on set standard, which can be expectations, cherished values and beliefs among others as can be gleaned from literature on satisfaction. ). The focus on Facilities Management in the workplace appears to be a generality (Wan Mohd Rani, 2018). Facilities Management's responsibilities, according to some studies, include organizing, managing, and coordinating the operational and strategic management of facilities and buildings. The focus on Facilities Management in the workplace appears to be a generality (Wan Mohd Rani, 2018). Facilities and buildings. The focus on Facilities Management in the workplace appears to be a generality (Wan Mohd Rani, 2018). Facilities Management's responsibilities, according to some studies, include organizing, managing, and coordinating the operational and strategic management's responsibilities, according to some studies, include organizing, managing, and coordinating the operational and strategic management of according to some studies, include organizing, managing, and coordinating the operational and strategic management of facilities and buildings.

# Outsourcing

The act of transfer of some in-house activities to a third party best describes outsourcing. It is making of an agreement between the organization (customer) and the third party (supplier) for provision of services and goods that were initially being provide by the organization. Outsourcing levels in this study are legal, cleaning, security and ICT services.

Services including landscaping, street sweeping, washing the concrete and walkways, cleaning windows, washing vehicles and janitorial service and general office tidiness are some of most outsourced cleaning services. According to Diamond & Allcorn (2005) cleaning services also extends to groundwork. This includes and not limited to fence and grass as well as trimming the flowers. Assaf (2010), on a research on



maintenance service outsourcing, pointed out that factors that "improved quality requirements" and "achievement of higher quality of service for competitive advantage" had the highest mean rankings. He suggested that this was due to the fact that contractors were better equipped with gear and labor to perform the maintenance services. The use

of external professional personnel and professional equipment. Through outsourcing of cleaning services, the organization reduces the need of for special training needed to operate the equipment and safety hazard are reduced (Raghubalan, 2015)

### **Cleaning Services**

Clean facilities are vital to the health and satisfaction of their occupant (Klungseth & Blakstad, 2016). The practical value of cleaning is widely accepted either in a healthcare environment or property management. Cleaning is one of the support service in facilities management that aims at improving and maintaining the overall life cycle of the facility and at the same time provides human support for an effective working environment to the occupier of the building (Kyengo, 2007). Facility manager needs to understand the core business of the building in order to give good cleaning services to its users (Klungseth & Emanuel, 2013). To ensure that the cleaning services meet appropriate quality standards and add value to the core business, facility managers must have ample knowledge related to the cleaning services industry (Klungseth & Blakstad, 2016).'

# 2.1 Facilities Management Outsourcing

Outsourcing facilities management is a cost-effective method of lowering costs, increasing efficiencies, reducing internal workload constraints, and mitigating hazards. As a result, many firms are selecting to outsource their facilities management needs. Facilities management outsourcing allows a company to concentrate on the core functions of its business while cutting down on time spent on property and facility management. It also eliminates the need to work withindividual contractors. If subcontracting the services to a trusted specialist, they will benefit from the business . To put it another way, the duty for managing Facilities Management services is transferring to either expert partners or outsourcing the complete package to a total facilities management business (Ikediashi & Odesola, 2016). Meanwhile, outsourcing means outsourcing support services to an outside contractor for all maintenance work to control and deliver quality and service standards, typically for big projects (Osita et al., 2021). However, Facilities Management services are a cost-effective solution to ensure that your facility requirements are met. Hence, your facility management concerns are handled by a third party (Cubitt James, 2020).



#### 2.2 Research Conceptual Framework

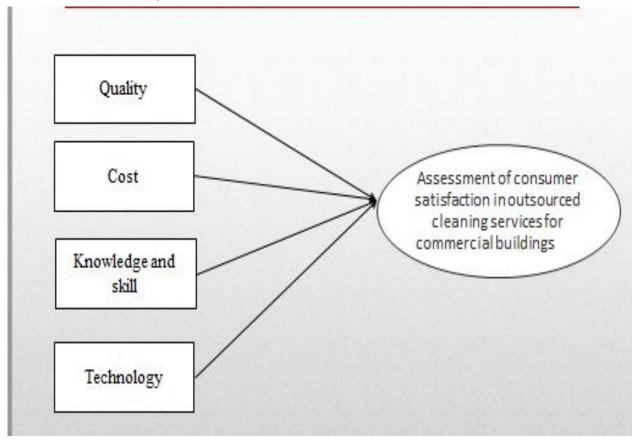


Figure 1 Conceptual Framework

# 2.2.1 Quality

One of the key reasons organisations choose to outsource, according to the literature, is to provide quality service. According to Pahiranthan (2017), when clients are deciding which business strategy to use to suit their needs, the quality of service can be a major element. Despite the fact that cleaning is a non-core job in an academic context, maintaining a clean atmosphere is essential to the health of students, educators, and the scholars as a whole. Diseases are less likely to spread in a clean environment. In a filthy environment, no learner wants to read. In a filthy workplace, no one can work effectively. As a result, it must always be maintained clean. To summarise, any institution that wishes to achieve its major objectives of instruction, research, and community service would, at some point, need to consider outsourcing support services such as cleaning and information technology, besides the perceived risks of outsourcing.



# 2.2.2 Cost

According to most surveys, the primary motivation for outsourcing tasks is to save money for the company. To achieve cost savings, businesses require a competitive strategy. The most common reason for outsourcing is to save money on labor, materials, and other resources. When the estimated expenses of outsourcing a task are less than performing it in-house, the job is outsourced. In other words, if the cost of an activity in an organization rises beyond the estimated cost of outsourcing, the possibility of outsourcing increases as well (Kavosi et al., 2018).. According to Wachira, Brookes, and Haines (2016), Total power hypotheses show that outsourcing as a strategy can assist reduce transaction costs, reduce the size of the organisation, and increase productivity. They support the reduction of employees, physical assets, and other things in an organisation.

Framework emphasises that organisations like universities may choose to outsource support activities like cleaning even if they have the financial and human resources to do so, as long as the total cost of executing the activity through an external service provider is less than the cost of doing it in-house.

# 2.2.3 Knowledge And Skill

The need for specialist management is related to the skills of the company's employees and senior executives, which influence outsourcing decisions. A shortage of skilled and specialised employees to conduct operations in organisations is one of the causes for outsourcing. As a result, when the staff is insufficient, external contractors are sometimes engaged to manage and deliver critical services. Outsourcing a service or activity is sometimes necessary due to the complexity of managing it (Ikediashi & Odesola, 2016). Service performance and management are influenced by design, control, and execution. These factors have the potential to save management time, reduce management load, prompt specific management, increase the speed of implementation, manage difficult functions, manage safety considerations, improve management control, develop career paths, and improve operational efficiencies/productivity (Suweero et al., 2017). Furthermore, strong coordination in the case of the management team, according to (Lok et al., 2018), may assist them survive in a difficult business climate. Nowadays, the efficiency and effectiveness of providing services to users is quite great. Managers must collaborate well in order to achieve high service standards. The importance of effective and successful operation cannot be overstated.



#### 2.2.4 Technology

Expanding the organization's capacity to leverage technical skills and experience, as well as management exploring new ideas, appear to be critical variables in outsourcing. However, one of the main reasons for outsourcing is to gain access to critical technology. Outsourcing allows the organisation to gain new skills and information while also increasing its ability to maintain high-level technologies (Kavosi et al., 2018). However, according to (Suweero et al., 2017), technological factors are the collection of instruments, skills, methods, and processes used to attain objectives. Some of these include gaining flexibility as technology changes, initiating innovative ideas and technology, increasing efficiency for advanced technologies, analysis competitive advantage. resolving requirement uncertainties, filling a need for specialist knowledge, gaining experience or technological expertise, and comparing competition. Globalization and the growing importance of information technology, according to (Lok et al., 2018), are causing advanced FM technology evolve quickly. to

#### 3. Method of Data Collection and Analysis

Data analysis is the process used to collect, model and analyze large amounts of data to develop effective and efficient results. Therefore, there are various methods and strategies used to perform this type of analysis. All of these different data analysis approaches are essentially based on two main areas of research: quantitative methods and qualitative methods (Bernardita, 2021). Therefore, this study uses qualitative (interviews) and quantitative (questionnaire) approaches. In addition, the methodology of this study will involve the building care sector and employees from upper management to lower management. In the analysis, percentages, means and frequencies will be developed. And after the interviews are conducted and the questions are distributed, all the results will be written, and the information obtained will be generated as the results obtained.

One of the most important research components is the research questions, conceptual framework, and appropriate procedures for collecting and validating research data. There are various research topics that are of concern to carry out this study that must be seen and addressed. These research questions serve as a valuable guide for conducting research.

#### 3.1 Sampling and Data Collection

Results and determination of the sample size were based on Krejcie and Morgan's (1970) table.Population of this study refers to the scope of the study which is 3 different buildings withtotal sample size of 180(n).



Building	Total Population N
А	40
В	64
С	16

### Table 1

#### 4. Results and Finding

Age	Percent
18-25	19
26-35	76
36-50	2
51-above	2



# 4.1 Findings for 1<sup>st</sup> Objective

First objective: identify the factor of outsourcing in cleaning services. The data collection instrument used in this study was a questionnaire specifically to achieve the objective of the study. Each item using 5 Likert scales namely (5) Strongly Agree, (4) Agree, (3) Neutral, (2) Disagree and (1) Strongly Disagree.



No	Item	Ave rag e
1	Cleaning services contribute to customer satisfaction by maintaining service quality.	4.6 0
2	Outsourcing in cleaning services has a positive effect on the quality of cleaning in a building	4.5 4
3	Cleaning services skill has a positive impact on the quality of work conducted	4.5 5
4	Cleaning services has a quality impact on customer and tenant satisfaction of the building	4.6 2
5	High-quality outsourced performance can result in long-term advantages	4.61
6	outsourcing in cleaning services can reduce costs	4.37
7	Improving service quality can create customer value and increase company profits.	4.59
8	Technology and skill could improve facilities to enhance operational efficiencies.	4.60
9	Cleaning skill has a positive impact on the quality of output conducted.	4.50
10	Cleaning services can gain flexibility with technology advancement	4.60
11	When there are trained and experienced staff, cleaning services can lessen risk	4.61
12	Cleaning services can help improve and maintain relationships between client in the long term	4.54
13	Technology's accessibility benefits in improving flexibility in a competitive industry.	4.60
14	Technology can promote adaptability in a market that really is competitive.	4.55

# 5. Conclusion

Outsourcing cleaning services is an important consideration for any organization. Quality, cost, and other considerations all play a role in this selection. Customers are also involved in the decision-makingprocess. As the globe becomes increasingly international,



low-cost countries may see their costs rise. Many businesses rely on outsourcing to increase productivity and profitability. Many outsourcing firms may be located all around the globe. Therefore, outsourcing plays a vital role inachieving the company goals and objective by focusing on the core business. Thus, outsourcingcontribute to the growth of the organization depending on what they outsource.

#### 6. Acknowledgement

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References

Dan, A. P., Idah, F. P., & Planning, U. (2017). 20,921. July 2015.

Pahirathan, A. (2018). The Effectiveness of Services Outsourcing in Sri Lankan State Universities. Asian Journal of Economics, Business and Accounting, 8(3), 1–21. <u>https://doi.org/10.9734/ajeba/2018/43542</u>

IKENWA, K. O., & OLUSEGUN, B. S. (2019). Impact of Outsourcing on Cleaning Service Quality: a Study of the University of Lagos. UNILAG Journal of Business, 5(2), 40–55.

- Osita, C., Chinedu, P., & Jessica, D. (2021). Outsourcing and In-house Facilities Management Practices: Advantages and disadvantages. *International Journal of Innovation Science and Research Technology*, 6(4), 338–344.
- Ahmad, M. H. S., Perera, B. A. K. S., & Illankoon, I. M. C. S. (2013). In-house vs outsourcing facilities management: A framework for value- added selection in Sri Lanka commercial buildings. *The Second World Construction*, 7(2), 2–7.
- Amos, D., & Gadzekpo, A. (2016). Cost of in-house vs outsourced facilities management services in public polytechnics in Ghana. *Asia Pacific Insitute of Advanced Research*.
- Taponen, S., & Kauppi, K. (2020). Service outsourcing decisions a process framework. Journal of Global Operations and Strategic Sourcing, 13(2), 171–194. https://doi.org/10.1108/JGOSS-02-2019-0012



- Mohd Hafizal Ishak, & Nurul Najihah Mohd Anasir. (2020). An Assessment of Cleanliness Level from Service Level Agreement and User's Perception in Universiti Tun Hussein Onn Malaysia. *Research in Management of Technology and Business*, 1(1), 663–676.
- Kurdi, M. K., Abdul-Tharim, A. H., Jaffar, N., Azli, M. S., Shuib, M. N., & Ab-Wahid, A. M. (2011). Outsourcing in facilities management A literature review. *Procedia Engineering*, 20, 445–457. https://doi.org/10.1016/j.proeng.2011.11.187
- Musita, D. O., Miroga, J., & Mudi, B. I. (2020). Effect of outsourced cleaning service empathy on service delivery in the county government of Kakamega, Kenya. *Academia.Edu*, 1–6.
- https://www.academia.edu/download/63727464/outsourced\_cleaning\_service\_empathy20 200624-10931-2s5u95.pdf
- Dan, A. P., Idah, F. P., & Planning, U. (2017). 20,921. July 2015.
- Ogbogu, O. (2017). An Evaluation of Outsourcing Process in a Nigerian University : Benefits and Challenges. 8(20).
- Mutero, M. N. (2016). The Effects Of Outsourcing On The Cost And Performance Of Non-Core Organizational Functions: A Case Study Of Cleaning Services At The University Of Nairobi. 1–91.
- IKENWA, K. O., & OLUSEGUN, B. S. (2019). Impact of Outsourcing on Cleaning Service Quality: a Study of the University of Lagos. *UNILAG Journal of Business*, *5*(2), 40–55.
- Lok, K. L., & Baldry, D. (2015). Facilities management outsourcing relationships in the higher education institutes. *Facilities*, *33*(13–14), 819–848. https://doi.org/10.1108/F-05-2014-0043
- Escortell, R., Baquero, A., & Delgado, B. (2020). The impact of transformational leadership on the job satisfaction of internal employees and outsourced workers. *Cogent Business and Management*, 7(1). https://doi.org/10.1080/23311975.2020.1837460



# PENGLIBATAN GOLONGAN REMAJA DALAM POLITIK NEGARA

Navinesh Raman, Vikknes Kaliappan, Siti Nurfilzah Athilah Mohamad Zahir, Muhammad Asyraf Bin Che Hashim

Jabatan Perdagangan, Politeknik Tuanku Syed Sirajuddin, Perlis nnavineshraman@gmail.com, vikkneskaliappan0881@gmail.com, Zahirathilah2001@gmail.com, asyeraphashim@gmail.com

### Abstrak

Dalam era globalisasi kini, penglibatan remaja dalam politik negara dilihat agak hambar dalam siasah negara Malaysia. Demi kemajuan dan ketamadunan negara bangsa, penglibatan remaja dalam politik sangat penting dalam mencorakkan masa hadapan pemerintahan negara. Difahamkan juga bahawa golongan muda merupakan kumpulan yang mempunyai tipikal tingkah laku dan budaya politik yang bersikap kritis dan sikap ingin tahu yang mendalam terhadap sesuatu perkara dan menekankan aspek ketelusan dan intergriti. Sehubungan dengan itu, kajian ini dijalankan bagi mengenal pasti faktorfaktor yang terlibat dalam penglibatan golongan remaja dalam politik negara. Fokus kajian tertumpu kepada kepada pemboleh ubah yang terkait dengan penglibatan remaja dalam politik negara iaitu peranan institusi pendidikan tinggi, dorongan keluarga, perkembangan teknologi maklumat, tekanan kehidupan, kematangan anak muda, kepercayaan, kekecewaan dan pandangan sinisme terhadap politik. Kajian berbentuk kuantitatif ini dijalankan dengan instrumen soal selidik yang digunakan dalam pengutipan data dilapangan. Data yang terkumpul dianalisis secara kuantitatif melalui deskriptif dan korelasi menggunakan perisian SPSS. Beberapa cadangan turut dikemukakan kepada pihak-pihak berkaitan. Responden sasaran membabitkan para pelajar institusi pendidikan tinggi di bidang TVET dimana merangkumi pelajar Politeknik Tuanku Syed Sirajuddin, Politeknik Sultan Abdul Halim Mu`adzam Shah, Kolej Komuniti Arau dan Kolej Komuniti Bandar Darulaman. Kajian ini menyasarkan responden yang berumur lingkungan 18 hingga 21 tahun.

# 1.0 Pengenalan

Politik merupakan sebuah sistem pemerintahan yang melaksanakan sistem demokrasi berparlimen dalam mentadbir sesebuah negara merdeka. Pemimpin bagi sistem



demokrasi berparlimen tersebut dipilih secara langsung oleh rakyat melalui sistem pilihan raya umum. Politik adalah satu unsur yang sangat penting, dalam memastikkan sesebuah negara tersebut aman dan Makmur. Selain itu, amatlah penting untuk memastikan sistem politik kukuh bagi memudahkan perancangan dan penerapan dalam membangunan ekonomi negara. Seterusnya, dengan sistem politik yang kukuh sesebuah kerajaan tersebut dapat melaksanakan pelbagai dasar dan udang-udang bagi meningkatkan taraf hidup rakyat dan ekonomi negara. Tambahan pula, ia dapat membuka langkah kepada negara dalam menerajui industri dan teknologi baharu untuk menjadi yang berdaya saing dan pencorak ekomoni dunia. Oleh itu, menjadi tanggungjawab rakyat untuk memilih pemimpin dan ahli parlimen yang tepat.

Sehubungan dengan itu, amatlah penting kepada rakyat terutama golongan remaja yang telah layak mengundi untuk memahami sistem politik dan pilihan raya. Golongan remaja atau muda merupakan kumpulan yang terbesar dalam populasi negara Malaysia. Golongan tersebut mempunyai sikap, tingkah laku dan budaya tersendiri, yang diperlukan oleh politik masa kini. Mengikut peredaran zaman, golongan remaja sekarang merupakan penentu nasib kepada sesebuah negara tersebut dimasa akan datang. Amatlah penting bagi memastikan golongan tersebut mempunyai pengetahuan yang secukupnya bagi menjamin masa hadapan yang cerah buat negara itu.

Pada pasca PRU 2018, Malaysia telah mengumumkan undang-undang yang berkaitan dengan mengundi yang baru digubalkan. Iaitu had umur mengundi dari 21 ke 18 tahun, hal ini telah mendapat sokongan dari pihak kerajaan dan pembangankang. Justeru itu, undang-undang tersebut telah menimbulkan pelbagai isu dari segi penerimaan dan persediaan golongan remaja tersebut untuk melibatkan diri dalam politik pilihan raya, penambahan baget dalam melaksanakan pilihan raya, peningkatan jumlah tenaga kerja untuk menguruskan pilihan raya dan kesesuaian logistik dan lain-lain perkara yang bakal dihadapi dari hasil undang-undang baru tersebut. Oleh itu, penelidikan ini bertujuan untuk mengkaji faktor penglibatan golongan muda dalam politik negara.

# 1.2 Latar Belakang Kajian

Pada masa kini, usaha ke arah pendemokrasian dan pilihan raya yang matang, adil serta saksama merupakan perkara yang perlu diberi tumpuan bagi memacu kemajuan pembangunan sosial dan politik. Di Malaysia, pilihan raya boleh dianggap sebagai kemuncak pendemokrasian, maka Rang Undang-Undang (RUU) Perkara 119 Pindaan 2019 menjadi manifestasi misi besar proses pendemokrasian dengan menurunkan had



umur kelayakan mengundi dan bertanding daripada 21 ke 18 tahun (Mohd Nizah & Mohd Sharif, 2020). Pertemuan secara peribadi oleh YB Syed Saddiq Syed Abdul Rahman, ahli Parlimen Muar dan pencetus idea Undi 18 ini telah diadakan dengan semua pemimpin pembangkang pada waktu itu bagi mendapatkan pendapat dan sokongan mereka (Astro Awani, 19 Julai 2019).

Berhubung dengan perkara tersebut pada 16 Julai 2019 negara kita iaitu Malaysia telah mencipta sejarah baru, dimana Dewan Rakyat telah meluluskan Rang Undang-undang (RUU) Perlembagaan (Pindaan) 2019, Hal ini, adalah atas dasar penurunan had umur dari 21 kepada 18 tahun bagi membolehkan golongan remaja untuk mengundi, pendaftaran automatik dan juga untuk membolehkan mereka menjadi calon untuk bertanding dalam pilihan raya (Sinar Harian, 19 Februari 2019). Dasar ini diusulkan oleh Syed Saddiq pada sesi parlimen Mac 2019 (Astro Awani, 11 Julai 2019). Hal ini telah diperkatakan olehnya bahawa beliau akan berjuang dalam memperkasaan belia dan memastikan suara belia dapat didengari (Berita Harian, 5 December 2019).

Selain itu, dasar ini telah dibentangkan oleh Perdana Menteri Malaysia, iaitu Mahatir Mohamad yang mengandungi cadangan untuk meminda perenggan (b) perkara 47 Perlembagaan persekutuan dalam penurunan had umur warganegara yang layak menjadi ahli dewan rakyat, perenggan (a) Fasal 1 Perkara 119 Perlembagaan Persekutuan untuk menurunkan had umur warganegara untuk mengundi dan cadangan bagi pendaftaran secara automatik selepas mereka mencapai had umur 18 tahun (Mstar Online, 16 Julai 2019). Ketika itu juga, Mahathir Mohamad menyatakan bahawa dengan adanya RUU tersebut kerajaan menjangka terdapat peningkatan jumlah pengundi baru seramai 7.8 juta yang akan dikemaskini kedalam data pemilihan secara automatik pada setiap tahun sehingga 2023. Dapat dikenalpasti bahawa perkara tersebut boleh tercapai sekiranya pendaftaran secara automatik dikuatkuasakan bersama-sama dengan

Sehubungan dengan itu, Mahathir Mohamad juga telah menyatakan bahawa pindaan tentang kelayakan mengundi pada umur 18 tahun di Malaysia telah digubal dengan rasminya pada 1 Disember 2021. Seksyen 3(a) dan (b) Akta Perlembagaan (pindaan) 2019 itu juga telah diwartakan kepada P.U(B)615/2021 dan telah berkuatkuasa pada 15 Disember 2019 selepas perkara tersebut diperkenankan oleh Yang di-Pertuan Agong (Berita Harian, 2 Disember 2021). Selain itu, dalam perbentangan tersebut terdapat juga cadangan tentang pendataran secara automatik setelah mereka mencecah had umur 18 tahun. Hal ini dipercayai dapat menggantikan system terdahulu dimana rakyat Malaysia perlu memohon untuk menjadi pengundi dengannya ia boleh melancarkan lagi proses



untuk mengundi. Pendaftaran automatik ini bermula bulan Februari tahun ini (2022). Dengan pembaharuan ini penganalisis mendapati bahawa dengan pelaksanaan. Undi 18, akan memberikan kesan positif kepada parti–parti politik dan dasar kerajaan dalam jangka masa yang panjang.

Akhir sekali, Kajian yang dibuat adalah bertujuan untuk melihat sekiranya ada perkara perkara yang timbul setelah Undi 18 tersebut dilaksanakan. Hal ini adalah kerana dipercayai bahawa terdapat beberapa isu yang muncul terhadap penglibatan remaja dalam politik. Setelah selesai kajian ini kami berharap agar kita dapat menangani isu–isu tersebut dengan baik.

# 1.3 Penyataan Masalah

Menurut kajian terdahulu Malaysia mencipta sejarah baru dengan menurunkan had umur untuk mengundi dan penglibatan dalam politik dari 21 ke 18 tahun, telah didapati bahawa terdapat beberapa isu yang mempengaruhi penglibatan remaja dalam politik. Setiap isuisu mengarah kepada dua kemungkinan yang sama, iaitu kemungkinan golongan remaja akan terlibat atau tidak terlibat dalam politik negara.

Antara isu yang terlibat adalah peranan institusi pendidikan tinggi. Peranan institusi pendidikan tinggi adalah untuk memberi pengetahuan literasi kepada pelajar atau golongan remaja. Berdasarkan kenyataan yang diberikan oleh Hands (1992) menyatakan bahawa literasi politik merupakan satu pengetahuan dan pemahaman terhadap politik dan isu-isu yang berkaitan dengannya. Menurut beliau juga, pemahaman dan pengetahuan tentang politik dapat meningkatkan kemungkinan seseorang warganegara tersebut menjalankan tanggungjawabnya dan peranannya kepada negara. Tambahan pula, berdasarkan kenyataan yang diberi oleh Zyngier (2012) dalam bukunya menyatakan bahawa pendidikan yang baik merupakan satu hal yang penting dalam meningkatkan jumlah penglibatan berpolitik dari warganegara dalam sistem demokrasi yang menawarkan keadilan dari segi sosial dan literasi politik kepada semua.

Terdapat sebuah kajian yang menyatakan bahawa, beberapa institusi pendidikan tinggi itu sendiri tidak begitu menekankan subjek literasi dalam sistem kurikulum, sedangkan konsep literasi tersebut merupakan satu subjek yang penting kepada golongan remaja agar mereka dapat menyertai politik dan mengatasi isu-isu politik dan sosial (Turner, 1999). Difahami bahawa terdapat sejumlah kecil golongan remaja yang endah dengan isu politik, dan sejumlah kecil golongan remaja tersebut mempunyai keiginan untuk mengundi, akan tetapi dengan pengetahuan yang sedikit tentang politik menyebabkan



mereka ragu-ragu untuk terlibat dalam mengundi (Smith et al., 2021.), Dalam konteks ini menunjukan bahawa tanpa adanya pengetahuan ilmu sivik yang baik, golongan muda akan mengalami kesukaran untuk membuat pilihan semasa pengundian (Livingstone & Markham, 2008). Selain itu, pemahaman dalam politik akan membolehkan golongan remaja mendapat manfaat dalam menyertai politik dan hal ini juga dapat mencetuskan sikap yang positif terhadap politik (Rafni & Suryanef, 2019). Akan tetapi walaupun adanya ilmu yang mencukupi, tanpa dorongan keluarga tidak menjamin seseorang itu akan terlibat dalam politik.

Keluarga juga memainkan peranan yang penting dalam mendorong golongan muda untuk terlibat dengan politik. Terdapat sebuah kajian yang menyatakan bahawa golongan remaja yang tidak mendapat sokongan dan dorongan yang diperlukan oleh keluarga tidak terlibat dengan politik (Bhatti & Hansen, 2012). Hal ini kerana, ahli keluarga terutamanya ibubapa merupakan sumber pengetahuan pertama semasa perkembangan awal kanakkanak. Selain itu, ibubapa atau keluarga merupakan contoh teladan utama kepada anakanak. Terdapat beberapa perkara yang boleh dilakukan yang secara tidak langsung dapat menarik minat anak-anak dalam politik, perkara tersebut adalah dengan menunjukkan contoh, memberikan pandangan atau berbincang tentang politik dirumah (Perri klass, 2016). Pada masa kini bukan sahaja contoh daripada ahli keluarga sahaja, golongan remaja juga boleh mencari maklumat dan contoh-contoh lain dengan menggunakkan teknologi yang berkembang dan menyebabkan maklumat yang diperlukan berada dihujung jari.

Teknologi maklumat juga memainkan peranan penting dalam mendorong golongan remaja untuk terlibat dalam politik negara. Perkembangan teknologi maklumat adalah merupakan teknologi yang diperlukan untuk pemprosesan data. Ruang lingkup tajuknya sangat luas dan berkenaan segala aspek dalam pengurusan dan pemprosesan maklumat secara tepat dan mudah. perkembangan teknologi maklumat dan media baru menyebabkan golongan muda tidak lagi mengakses maklumat daripada media konvensional tetapi mencipta maklumat dan membentuk pandangan tersendiri. (MalaysiaKini, 15 Mac 2010).

Berdasarkan kenyataan yang diberikan oleh Nursyahida Zulkifli (2021) bahawa belia menggunakan akhbar dalam talian untuk memperoleh berita dan maklumat politik, serta golongan belia juga didapati lebih gemar menggunakan media atas talian untuk menyampaikan pendapat seperti menyertai kumpulan perbincangan yang mengupas isuisu semasa melalui media sosial seperti Facebook, Twitter dan Blog. Tambahan pula, Nursyahida Zulkifli (2021) juga mengesahkan bahawa menurut satu kajian di kalangan



belia Cina di bandar, disimpulkan bahawa teknologi maklumat membantu memperluaskan ruang bersuara masyarakat dan secara tidak langsung meningkatkan partisipasi politik pengundi (Zulkifli et al., 2021).

Terdapat sesebuah kajian yang menyatakan bahawa golongan remaja menggunakan teknologi maklumat untuk mendapatkan maklumat politik dan keadaan semasa negara dan hal ini termasuklah menyuarakan pandangan dan pendapat mereka menggunakan teknologi maklumat (Nadia Fauzi, 2017). Difahami bahawa teknologi maklumat lebih cekap, mudah untuk diakses dan tiada batasan yang menyebabkan golongan remaja minat menggunakannya (Amirah et al., 2020). Selain itu, dari kajian-kajian lepas, dapat dikonklusikan bahawa golongan remaja adalah golongan yang paling aktif menggunakan teknologi maklumat (Andrew et al., 2020). Golongan remaja lebih selesa dan lebih arif

dalam menggunakan teknologi maklumat berbanding dengan golongan lain. Teknologi maklumat yang disokong oleh kemudahan internet ini telah digunakan oleh golongan remaja dalam segenap aspek kehidupan dan aktiviti harian mereka. Hal ini termasuk dalam aspek politik golongan ini. Golongan remaja menggunakan teknologi maklumat untuk menyebar dan mengetahui hal ehwal semasa negara. Akan tetapi walaupun adanya teknologi maklumat yang berkembang pesat, tanpa kematangan tidak menjamin golongan remaja terlibat dalam politik (Syazwana Aziz et al., 2021).

Tekanan kehidupan merupakan salah satu faktor yang berkait dengan penglibatan golongan remaja dalam politik. Tekanan merupakan suatu kuasa asing yang mengetatkan atau kompres sesuatu. Tekanan juga boleh didefinisikan sebagai paksaan yang diberikan oleh seseorang atau sekumpulan orang pada individual atau rakyat untuk melakukan sesuatu perkara. Manakala, kehidupan adalah jumlah beberapa perkara, keadaan dan segmen. Sebagai contohnya, kewangan, kesihatan, kerohanian dan lainlain. Jadi tekanan kehidupan akan berwujud apabila seseorang manusia tidak boleh mendapatkan perkara-perkara kehidupan tersebut dengan mudah. Hal ini juga menyebabkan seseorang individu berkerja keras tanpa berehat untuk mendapatkan perkara tersebut. Akibatnya, manusia terpaksa kurang fokus dalam hal lain-lain.

Selain itu, remaja kini tidak dapat mengelakkan tekanan kehidupannya kerana mereka mempunyai tanggungjawab yang terlalu banyak pada usia yang kecil (Majalah Sains, 25 Mac 2010). Seseorang itu akan menghadapi tekanan kehidupan apabila mengalami ketidakstabilan sama ada fizikal atau mental (Ismaal, 2012). Ahli-ahli keluarga merupakan punca utama yang 7 menyebabkan seseorang itu mengalami tekanan kehidupan (SinarHarian, 27 Januari 2021). Tekanan kehidupan juga akan diakibatkan



oleh kebebanan urusan kerja yang terlalu banyak. Sebagai contoh, sebahagian majikan memaksakan pekerjanya berkerja lebih masa sehingga pekerja tersebut tidak ada masa untuk melegakan tekanannya.

Dengan ini, tekanan kehidupan memberi pelbagai kesan-kesan negative kepada manusia. Salah satu kesannya adalah golongan remaja tidak mempunyai kesedaran tentang isu-isu politik dan menyebabkan mereka tidak terlibat dalam politik (HarianMetro, 23 April 2018). Tekanan kehidupan juga menyebabkan golongan remaja melupakan tanggunjawab terhadap negara dan politik negara (Malaysiakini, 5 Julai 2021).

Selain daripada itu, kematangan golongan remaja juga memainkan peranan penting dalam mendorong golongan remaja untuk terlibat dalam politik negara. Seterusnya kematangan politik seseorang terzahir serta boleh dinilai melalui pandangan atau tindakan yang diluahkannya mengenai isu politik khususnya atau kenegaraan amnya, selain kesediaan menerima kritikan dari pihak lain dalam keadaan emosi yang stabil (Nor Azlina Endut, 2020).

Tahap kematangan anak muda adalah terlaksananya dengan baik tugas-tugas pertumbuhan dan perkembangan seseorang menuju struktur tingkah laku yang lebih tinggi. Ismail Sulaiman berkata, adakah umur 18 tahun sudah cukup matang untuk membuat keputusan sendiri dan bukan dipengaruhi orang lain dalam menentukan calon dan parti mana yang terbaik untuk mereka. Selain itu, rata-rata anak golongan remaja kurang berminat dalam politik dan ramai menganggap mereka kurang berminat dalam politik dan internet (Sinar Harian, 10 November).

Tahap kepercayaan adalah suatu pegangan yang diyakini dapat menjadi panduan dalam kehidupan. Selain itu, kepercayaan telah berkembang dengan pesat dalam beberapa tahun kebelakangan ini, sebahagiannya sebagai tindak balas kepada persepsi bahawa kepercayaan politik terhadap golongan remaja semakin merosot. Menurut Mohd Rafiq Naizamohideen berkata kepercayaan rakyat kepada pemimpin politik dan parti-parti politik berada pada tahap terendah ketika ini dan kemelut berpanjangan dan tidak berkesudahan itu juga menyebabkan rakyat semakin marah, apatah lagi apabila negara masih bergelut dengan penularan wabak Covid-19 dan kembali melonjak wabak Covid-19 (Utusan Malaysia, 17 Oktober 2020). Implikasinya, golongan remaja tidak lagi percaya pada pemimpin politik, dan telah mengambil sikap yang lebih konstruktif dan liberal untuk menilai masalah (Malaysiakini, 15 Mac 2010). Selain itu, isu pemberian vaksin kepada rakyat Malaysia seolah-olah pihak kerjaan tidak mambuat kajian tentang dan mengatakan bahawa boleh meringankan beban rakyat.



Tahap kekecewaan juga boleh berkait dengan penglibatan golongan remeja dalam politik. Tahap kekecewaan adalah bermaksud kewujudan perasaan tidak puas hati atau kesedihan terhadap harapan seseorang individu. Kekecewaan juga akan diwujud apabila seseorang itu berasa bimbang Ketika mereka tidak dapat mencapai tujuannya. Hal ini adalah situasi yang sangat biasa yang semua orang menghadap dalam kehidupan seharian seperti apabila tidak mendapat menyelesaikan tugasan yang diberi disebabkan pelbagai halangan berlaku. Golongan remaja bersetuju keyakinan terhadap sistem demokrasi yang semakin menurun adalah dipengaruhi oleh tindak tanduk ahli politik sendiri.

Tahap kekecewaan golongan remaja akan meningkat apabila mereka menghadpi kehilangan minat atau keseronokan dalam suatu perkara atau aktiviti (MedMalay, 7 Jun 2021). Seterusnya, ekspektasi yang terlalu tinggi juga menyebabkan golongan remaja berasa kecewa (IdnTimes, 9 16 Ogos 2020). Selain itu, isu-isu seharian yang berkaitan dengan politik kini yang boleh menyebabkan golongan remaja tidak berkeyakinan dengan politik juga menjadi salah satu faktor golongan remaja kurang melibatkan diri dalam politik.

Menurut kenyataan yang diberi oleh Sharifah Syahirah Syed Sheikh, golongan remaja kini berasa marah, kecewa sehingga mereka tidak peduli tentang politik (Astro Awani, 26 Februari 2020). Hal ini menyebabkan kekurangan penglibatan golongan remaja dalam politik di negara kita. Tahap kekecewaan golongan remaja akan meningkat apabila golongan remaja berasa tidak puas hati terhadap politik apabila espektasi golongan remaja tidak dicapai.

Pandangan sinikal adalah pandangan sinis bersifat mengejek atau memandang rendah. Saifuddin Abdullah berkata secara umum, generasi muda cenderung bersikap skeptikal dan sinikal terhadap politik, namun rata-ratanya masih mempunyai keyakinan kepada amalan demokrasi dan untuk mendapatkan keyakinan mereka, demokrasi perlu ditambah baik. Dalam banyak cara, lakukan transformasi terhadap proses dan struktur institusi demokrasi (Malaysia Kini, 13 Oktober 2012).

Menurut Amin Ahmad golongan remaja kecenderung bersikap sinis terhadap politik disebabkan orang politik yang memberi harapan tentang perjuangan agama, bangsa, dan negara serta membentuk pentadbiran politik yang bersih dan cekap tetapi tidak dilakukan. Oleh itu, pemimpin politik menggunakan golongan remaja untuk inisiatif golongan remaja



untuk kepentingan politik serta menganggap jiwa golongan remaja boleh dibeli dengan wang (Malaysia Kini, 20 Jun 2012).

# 1.4 Objektif Kajian

Berikut merupakan lapan objektif utama kajian bagi mengenalpasti penglibatan golongan remaja dalam politik negara:

- a) Untuk menentukan hubungan antara peranan institusi pendidikan tinggi dengan penglibatan remaja dalam politik negara
- b) Untuk menentukan hubungan antara dorongan keluarga dengan penglibatan remaja dalam politik negara
- c) Untuk menentukan hubungan antara perkembangan teknologi maklumat dengan penglibatan remaja dalam politik negara
- d) Untuk menentukan hubungan antara tekanan kehidupan dengan penglibatan remaja dalam politik negara
- e) Untuk menentukan hubungan antara kematangan anak muda dengan penglibatan remaja dalam politik negara
- f) Untuk menentukan hubungan antara kepercayaan dengan penglibatan remaja dalam politik negara
- g) Untuk menentukan hubungan antara kekecewaan dengan penglibatan remaja dalam politik negara
- h) Untuk menentukan hubungan antara pandangan sinisme terhadap politik dengan penglibatan remaja dalam politik negara

# 1.5 Persoalan Kajian

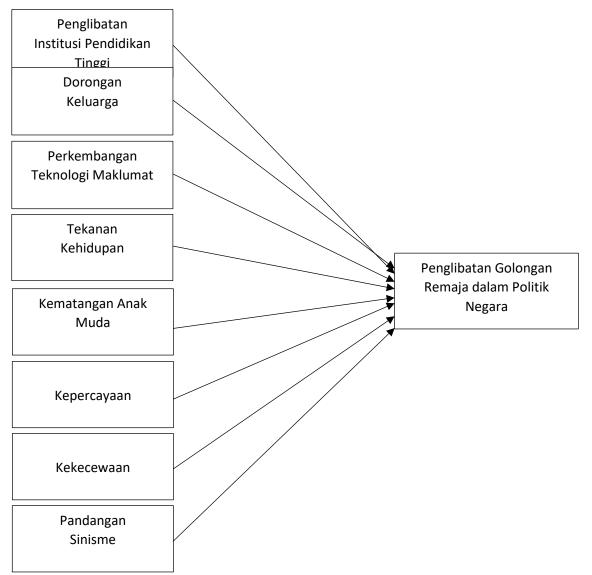
Berikut merupakan lapan persoalan yang ada pada kajian ini:

- a) Adakah peranan institusi peranan institusi pengajian tinggi mempunyai hubungan langsung dengan penglibatan remaja dalam politk negara
- b) Adakah dorongan keluarga mempunyai hubungan langsung dengan penglibatan remaja dalam politik negara
- c) Adakah tahap perkembangan teknologi matlumat mempunyai hubungan langsung dengan penglibatan remaja dalam politik negara



- d) Adakah tekanan kehidupan mempunyai hubungan langsung dengan penglibatan remaja dalam politik negara
- e) Adakah kematangan anak muda mempunyai hubungan langsung dengan penglibatan remaja dalam politik negara
- f) Adakah kepercayaan mempunyai hubungan langsung dengan penglibatan remaja dalam politik negara
- g) Adakah kekecewaan mempunyai hubungan langsung dengan penglibatan remaja delam politik negara
- h) Adakah pandangan sinisme mempunyai hubungan langsung dengan penglibatan remaja dalam politik negara

# 1.6 Kerangka Kerja Kajian





# 2.0 Ulasan Karya

Penglibatan bermaksud apabila seseorang mengikuti atau melibatkan diri dalam sesuatu perkara. Remaja pula ialah individu yang berumur 13 hingga 24 tahun yang masih belum 21 berkahwin. Politik pula bermaksud satu aktiviti yang berasakan sistem demokrasi untuk memimpin rakyat dan negara. Golongan remaja merupakan asset penting dalam sesebuah masyarakat di Malaysia. Hal ini kerana remaja merupakan lapisan yang akan mendominasi negara. Perkembangan politik Malaysia yang semakin sulit kini menuntut remaja untuk terlibat di bindang politk. Golongan remaja juga akan melanjutkan kepemimpinan politik dan memimpin negara di masa hadapan. Selain itu, penglibatan politik juga didefinsikan sebagai sejauh mana rakyat menggunakan hak mereka untuk mempengaruhi dalam kegiatan politik (Trevor St Georhe, 2002).

# 2.1 Faktor Peranan Institusi Pendidikan Tinggi

Faktor yang berkaitan dengan penglibatan remaja dalam politik negara yang seterusnya ialah Institusi pendidikan tinggi. Institusi ialah suatu badan yang ditubuhkan atas tujuan tertentu. Seterusnya pendidikan tinggi pula, berbeza disebahagian negara. Sistem pendidikan yang dilaksanakan mempunyai beberapa tahap yang berbeza iaitu, pendidikan awal kanak-kanak, sekolah rendah, sekolah menegah dan pendidikan tinggi. Pendidikan tinggi yang dilaksanakan diperingkat universiti pula mempunyai tempoh dan struktur tertentu dan boleh bertukar mengikut undang-undang negara tersebut. Institusi Pendidikan merupakan sumber ilmu pengetahuan yang utama kepada setiap remaja. Berdasarkan kajian yang telah dibuat kesedaran dan pengetahuan tentang politik dalam kalangan remaja adalah penting bagi memastikan mereka memahami tentang politik dan masalah yang dialami kepada bangsa dan negara (Shamsinar Rahman & Che Hamdan, 2018). Hal ini menunjukkan bahawa, institusi pendidikan tinggi perlu menerapkan ilmu sivik kepada remaja kerana dipercayai yang kurangnya ilmu pengetahuan sivik menjadi punca kemunculan undi rosak yang terjadi dalam pilihan raya (The Star Online, 14 Mac 2004).

Tambahan pula, institusi juga perlu mengadakan pilihanraya dalam institusi, untuk mengajar anak-anak muda dan membuka mata mereka untuk memahami tentang tanggungjawab yang perlu dipikul sebagai seorang individu (Shamsinar Rahman & Che Hamdan, 2018). Tambahan pula, sebuah kajian yang dijalankan oleh Star Education dalam mengukur tahap kesedaran pelajar, dan mereka mendapati bahawa pelajar-pelajar tersebut kurang peka dan kurang bersemangat tentang politik nasional mahupun antarabangsa. Oleh itu pemilihan didalam kampus perlu dilaksanakan agar dapat



mengajar dan memberi pengalaman kepada pelajar dengan kronologi pilihan raya yang sebenar (Muzammil, 2011).

# 2.2 Faktor Dorongan Keluarga

Keluarga adalah unit sosial minimum yang terdiri daripada ayah, ibu dan anak-anak. Adalah menjadi tanggungjawab keluarga dalam menerapkan pendidikan dan tingkah laku yang baik dalam persekitaran sosial. Begitu juga, memberikan pendidikan yang umum dalam kehidupan, mempraktikkan nilai moral yang baik dan juga memberikan penerangan tentang tanggungjawab yang bakal dipikul. Yang paling penting ialah keluarga, terutamanya ibubapa perlulah memperkenalkan kepada remaja-remaja kepada idea dan menerapkan norma bersosial dan berpolitik agar mereka menjadi lebih rasional dalam keterlibatan mereka. Bukan itu sahaja, perkara itu juga mampu untuk mengubah struktur dan identiti politik membolehkan remajaremaja tersebut memahami lebih lagi tentang dunia politik (Moshidi et al., 2021). Tambahan pula, mengikut kajian yang dibuat oleh Fowler, Baker, & Dawes, (2008) menyatakan bahawa dengan mengundi dapat dilihat bahawa sifat dan ciri-ciri seseorang itu diwarisi melalui ginetik yang turun dari kedua ibubapa.(Bhatti & Hansen, 2012).

Seterusnya, pengetahuan tentang politik dalam golongan muda amatlah penting dalam memastikan mereka memahami tentang agenda-agenda dalam berpolitik dan masalah yang dihadapi oleh negara dari masa ke masa (Nadia, 2012). Tambahan pula, berdasarkan kajian yang pernah dibuat menunjukkan bahawa ramaja atau golongan muda yang masih menetap bersama keluarga mempunyai kecenderungan yang lebih tinggi untuk mengundi kerana ibubapa mereka menjadi pengaruh yang kuat terhadap pemilihan anak-anak mereka (Bhatti & Hansen, 2012).

# 2.3 Faktor Perkembangan Teknologi Maklumat

Teknologi menjadi hal utama untuk menunjang segala aspek, salah satunya di dalam peranan media, di era revolusi industry 4.0 ini. Anak muda atau generasi Z akan menyebarkan pengaruh mereka kepada sesama pengguna media sosial dalam partisipasi politiknya. Penglibatan politik golongan remaja masa kini tidak terbuka dan diberikan oleh media sosial yang mereka gunakan.

Seterusnya, terdapat banyak keraguan tentang menggunakan media sosial. Tanpa disedari, sebahagian daripada golongan remaja masih belum mengetahui isu berkaitan politik negara menyebabkan mereka percaya bahawa mereka tidak perlu tahu tentang keadaan semasa di negara mereka. Oleh sebab itu, peneliti melihat bagaimana persepsi



pemilih pemula, yang dalam hal ini adalah siswa dan mahasiswa saat menerima pesan politik pemilihan umum 2019 di dalam media sosial.

# 2.4 Faktor Tekanan Kehidupan

Tekanan kehidupan merupakan satu perkara yang diakibatkan oleh kesibukan kerja seharian yang dihadapi oleh golongan remaja menyebabkan mereka kurang melibatkan diri dalam politik. Beberapa kajian telah membuktikan bahawa tekanan kehidupan yang dihadapi oleh golongan remaja berhubung kait dengan penglibatan remaja dalam politik. (Gimpel & Schuknecht, 2003) mengatakan bahawa golongan remaja lebih menumpukan kesibukan 24 seharian seperti di tempat kerja, keluarga dan sekolah mengakibatkan fokus terhadap politik dalam golongan remaja berkurang.

Golongan remaja kini menjadi sibuk dalam membina kehidupan yang cemerlang serta mengakibatkan kekurangan remaja dalam penglibatan dalam politik (Neundorf Anja, Kaat Smets & Garcia Albacete, 2013). Selain daripada itu, golongan remaja juga turut berasa kehidupan adalah lebih penting daripada politik.

Tekanan kehidupan sering menjadi suatu halangan untuk remaja melibatkan diri dalam politik (Besar et al., 2020). Sehubangan dengan itu, golongan remaja kini mencuba untuk mengelakkan tekanan kehidupan dan mencari penyelesaian untuk menikmati kehidupan sejahtera (Hamid et al., 2015). Hal ini menyebabkan golongan remaja tidak memberi tumpuan dalam politik.

# 2.5 Faktor Kematangan Anak Muda

Kematangan politik remaja adalah membimbangkan kerana kebanyakan mereka belum mempunyai pengetahuan politik yang mencukupi. Noor Sulastry Yurni Ahmad (2015) berkata bahwa kebanyakan remaja hanya bertindak sebagai pasukan sorak atau penyokong atas pagar dengan sekadar membaca, melihat, dan mendengar di lamanlaman sosial dan Beliau turut mempersoalkan sama ada golongan remaja untuk membuat keputusan yang tepat justifikasi kepada media sosial sebagai sumber pengetahuan politik. Kematangan politik adakalanya sukar dijangka dan ramai yang terkeliru serta menganggapnya sebagai produk akademik (Berita Harian, 9 November 2015).

# 2.6 Faktor Kepercayaan

Kajian tinjauan ini menggunakan instrumen yang dibina dan diguna pakai oleh para penyelidik lepas untuk menilai kepercayaan golongan remaja terhadap politik. Menurut Paige (1991), yang menentukan tinggi rendahnya partisipasi politik seseorang adalah kesadaran politik serta kepercayaan terhadap pemerintah atau sistem politik.



Kepercayaan politik adalah suatu orientasi evaluatif masyarakat terhadap sistem politik atau bagian dari sistem politik atau bagian dari sistem tersebut yang berdasarkan pada harapan normatif (Hetherington, 1998).

Selain itu, Menurut Miller and Listhaug (1990), kepercayaan politik merupakan pusat dari teori demokrasi di mana hal tersebut mencerminkan evaluasi politik dan lembaga yang melakukannya sesuai dengan harapan normatif. Sehubungan itu, sering dipertikaikan bahawa tumpuan yang semakin meningkat terhadap skandal dan rasuah telah banyak memberi kesan kepada pengundi, Seterusnya, telah dicerminkan dalam apa yang boleh diistilahkan sebagai pengurangan kepercayaan terhadap politik. Hal ini, telah memberi kesan yang mendalam terhadap persepsi awam terhadap politik (Fieschi & Heywood, 2004).

# 2.7 Kekecewaan

Kekecewaan adalah bermaksud kekurangan keyakinan diri terhadap kehidupan, politik, negara dan lain-lain. Hal ini disebabkan oleh pemimpin-pemimpin negara tidak melaksanakan tugasannya dengan sempurna dan tidak menepati janji. Sebuhungan dengan itu, tahap kekecewaan juga boleh dikaitkan dengan penglibatan remaja dalam politik sehingga golongan remaja berasa kecewa terhadap politik (Marshelayanti, Siti Noranizahhafizah Boyman, Nafisah Ilham Huissin & Wan Asna, 2013). Selain itu, kekecewaan golongan remaja terhadap politik sering meningkat kerana mereka menggangap kepimpinan kini menjadi ancaman untuk negara. Hal ini menyebabkan golongan remaja kehilangan minat dalam isu-isu politik serta tidak megalakkan golongan remaja untuk melibatkan diri dalam politik.

# 2.8 Faktor Pandangan Sinisme

Pandangan sinisme adalah orang yang syak wasangka yang menghina motif manusia. Jesturu, sinikal mempersoalkan atau menolak kejujuran dan kebenaran dan balas dengan rasa tidak percaya serta sindiran tindakan manusia yang tidak bersalah dan berniat baik (Navia,1996). Selain itu, kelemahan moral dan tidak mengendahkan jiran tertangga atau politik negara yang dipimpin tanpa tujuan serta orang yang percaya politik (Opdycke et al., 2013). Sinis dikenali sebagai tidak tahu malu, tidak tahu perasaan orang lain dan tidak memerlukan pertolongan orang lain. Mereka percaya kepada kebebasan bersuara, dan apabila bercakap secara bebas, ia selalunya akan menyinggung perasaan orang di sekelilingnya (Navia, 1996).

Secara ringkasnya, pandangan sini bertambah apabila golongan remaja kurang keyakinan terhadap pemimpin politik dan golongan remaja merasakan pemimpin masa



kini tidak boleh dipercayai kerana golongan remaja merasakan bahawa ahli politik tidak pernah memberi tahu apa yang meraka lakukan. Selain itu, golongan remaja berfikir bahawa ahli politik berjanji lebih daripada apa yang mereka mampu laksanakan walaupun mereka lebih mengetahuinya.

Selain itu menurut kajian di Belanda dalam Pilihan Raya Parlimen telah memaparkan tahap sinis politik dari sejak dahulu lagi. Dalam erti kata lain sinis politik juga menjadi lebih tidak 27 menentu. Dalam golongan remaja boleh dikira sebagai sinis terhadap politik (Adriaansen, 2011). Pandangan sinis terhadap politik semakin meningkat dalam banyak negara demokrasi. Disamping itu, pandangan sinis boleh ditujukan kepada objek yang berbeza antara, masyarakat politik secara umun, prinsip kerajaan yang merupakan prinsip demokrasi, norma dan prosedur kerjaan yang merangkumi pencapaian sistem dan institusi kerajaan.

# 3.0 Metodologi

Metodologi kajian merupakan hal yang sangat penting dalam melakukan penyelidikan. Hasil dari kajian yang diperolehi juga sanagt bergantung kepada metodologi yang digunapakai dalam sebuah kajian. Tanpa metodologi kajian yang jelas, data yang diperolehi akan dipersoalkan dan kesimpulan kajian juga tidak diboleh pakai. Oleh itu demikian, bahagian ini akan menghuraikan tentang populasi dan saiz sampel, lokasi dan unit analisis, maklum balas dan instrumen kajian. Hal ini dilakukan untuk membentuk metodologi yang baik, sehingga mengasilkan kajian yang berkualiti.

# 3.1 Populasi / Saiz Sampel

Populasi kajian terdiri daripada pelajar di Politeknik Tuanku Syed Sirajuddin berjumlah 3,388, Politeknik Sultan Abdul Halim Mu`adzam Shah berjumlah 4,640, Kolej Komuniti Arau berjumlah 352 dan Kolej Komuniti Bandar Darulaman berjumlah 365. Jumlah keseluruhan populasi adalah seramai 8,745 orang pelajar yang aktif. Oleh itu, saiz sampel yang ditetapkan bagi kajian ini adalah sebanyak 368 pelajar yang aktif.

#### 3.2 Lokasi

Lokasi kajian ini memulakan dengan mengenalpasti jumlah populasi keseluruhan di kalangan pelajar di Politeknik Tuanku Syed Sirajuddin, Politeknik Sultan Abdul Halim Mu`adzam Shah, Kolej Komuniti Arau dan Kolej Komuniti Bandar Darulaman.



### 3.3 Maklum Balas

Sebanyak 368 borang soal selidik diedarkan, daripada jumlah itu sebanyak 340 dianalisa dan diguna pakai. Ini setelah ditolak borang soal selidik yang rosak dan pelbagai ralat.

# 3.5 Instrumen kajian

Instrumen kajian hasil adaptasi beberapa kajian berikut antaranya bagi pembolehubah bersandar iaitu penglibatan golongan remaja dalam politik ialah dari Abdul Hadi Samsi, (2013). Selain itu, terdapat lapan pembolehubah tidak bersandar yang pertama iaitu penglibatan institusi pendidikan tinggi ialah dari Khairunisa & Junaidi Awang Besar, (2020) dan, pembolehubah tidak bersadar yang kedua adalah golongan keluarga ialah dari Muddiman et al., (2019). Manakala Pembolehubah tidak bersandar yang ketiga

adalah perkembangan teknologi maklumat ialah dari Samsudina Rahim, (2013) dan, yang keempat adalah kematangan anak muda ialah dari (Berita Harian, 14 September 2021), yang kelima adalah tekanan kehidupan ialah dari Jaharudin, (2013), dan Noor Atirah & Hasrina Mustafa, (2018). Seterunya, pembolehubah tidak bersandar yang keenam adalah kepercayaan ialah dari Muhamad Ali Embi, (2005), selain itu, pembolehubah tidak bersandar yang ketujuh adalah kekecewaan ialah dari Sani & Suhana, (2018) dan yang terakhir adalah pandangan sinisme ialah dari Foley, (2015).

Jadual 4.1: Jumlah skor min bagi setiap pembolehubah					
Pemboleh Ubah	Min	Sisihan Piawai	Tafsiran		
Penglibatan Golongan Remaja dalam	3.56	.892	Setuju		
Politik					
Peranan Institusi Pendidikan Tinggi	3.52	.796	Setuju		
Dorongan Keluarga	3.19	.963	Setuju		
Perkembangan Teknologi Maklumat	3.59	.833	Setuju		
Tekanan Kehidupan	3.38	1.188	Setuju		
Kematangan Anak Muda	3.49	.859	Setuju		
Kepercayaan	3.15	.951	Setuju		
Kekekcewaan	3.47	.905	Setuju		
Pandangan Sinisme	3.61	.806	Setuju		

# 4.0 Dapatan Kajian



Jadual 4.1: Jumlah skor min bagi pembolehubah bersandar iaitu penglibantan golongan remaja dalam politik negara, dapatan menunjukkan skor min yang diperolehi 3.56, dan sisihan piawai 0.892, dengan taksiran "setuju". Selain itu, pembolehubah tidak bersandar yang pertama adalah peranan institusi pendidikan tinggi, dapatan menunjukkan skor min vang diperolehi 3.52, dan sisihan piawai 0.796, dengan taksiran "setuju", dan pembolehubah tidak bersandar yang kedua adalah dorongan keluarga, dapatan menunjukkan skor min yang diperolehi 3.19, dan sisihan piawai 0.963, dengan taksiran "setuju". Seterusnya, yang ketiga adalah perkembangan teknologi maklumat, dapatan menunjukkan skor min yang diperolehi 3.59, dan sisihan piawai 0.833, dengan taksiran setuju, dan yang keempat adalah tekanan kehidupan , dapatan menunjukkan skor min yang diperolehi 3.38, dan sisihan piawai 1.188, dengan taksiran "setuju", manakala yang kelima adalah kematangan anak muda, dapatan menunjukkan skor min yang diperolehi 3.49, dan sisihan piawai 0.859, dengan taksiran "setuju". Disamping itu, pembolehubah tidak bersandar yang keenam adalah kepercayaan, dapatan menunjukkan skor min yang diperolehi 3.15, dan sisihan piawai 0.951, dengan taksiran "setuju", pembolehubah tidak bersadar yang ketujuh adalah kekekcewaan, dapatan menunjukkan skor min yang diperolehi 3.47, dan sisihan piawai 0.905, dengan taksiran "setuju" dan yang terakhir adalah pandangan sinisme, dapatan menunjukkan skor min yang diperolehi 3.61, dan sisihan piawai 0.806, dengan taksiran "setuju".

# 5.0 Cadangan Kajian Masa Hadapan

Dalam bahagian ini, akan membahaskan tentang beberapa bentuk cadangan yang boleh dijadikan sebagai garis panduan kepada para penyelidik yang akan datang. Kajian ini telah memfokuskan kepada golongan remaja yang berada dalam institusi pendidikan tinggi. Dicadangkan untuk kajian berikutnya, pengkaji boleh memfokuskan golongan remaja yang berada diluar institusi pendidikan tinggi, hal ini supaya dapat memberi impak yang lebih luas terhadap bidang ini.

Selain itu, cadangan kajian pada masa akan datang, dicadangkan supaya membuat satu kajian terhadap pengaruh rakan sebaya yang kini menjadi salah satu isu dalam perkembangan golongan remaja. Dengan penyelidikan tersebut penyelidik dapat membuat orang ramai lebih peka dan tahu cara untuk menyelesaikan isu tersebut dalam penglibatan golongan remaja dalam politik negara. Tambahan pula, dicadangkan supaya membuat satu kajian terhadap faktor ekonomi yang menjadi salah satu kebimbangan kepada seseorang. Hasil dari kajian tersebut dapat memberi cadangan untuk membantu dalam meringankan beban yang dihadapi oleh seseorang yang disebabkan oleh ekonomi.



Kajian mengenai penglibatan golongan remaja dalam politik negara ini wajar diteruskan supaya dapat mengenal pasti dan membawa perubahan yang lebih baik terhadap penglibatan remaja. Kajian yang berkaitan dengan faktor yang mempengaruh penglibatan golongan remaja amatlah kurang. Saranan kepada pengkaji supaya kajian yang berkaitan perlu sentiasa dikembangkan dan diteruskan agar dapat membuat suatu perubahan yang baharu terhadap sistem politik dikalangan rakyat khususnya golongan remaja.

# Rujukan

- Abdul Hadi Samsi, A. A. R. & K. H. (2013). Persepsi Belia Terhadap Parti Politik Dan. *Malaysian Journal of Youth Studies*, 107–120
- Adriaansen, M. L. (2011). Versatile citizens: Media reporting, political cynicism and voter behavior.
- Amirah, N., Marzuki, A., Tahir, Z., & Nasri, N. M. (2020). Penguasaan Kemahiran Teknologi Komunikasi Dan Maklumat (Ict) Terhadap Kecekapan Kerja. *Journal of Social Sciences Dan Humanities*, 17(9), 140–157
- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T
- AstroAwani. (2019, July 11). Fikirkan impak positif undi 18 tahun Syed Saddiq. Retrieved from Astroawani.com website: https://www.astroawani.com/beritamalaysia/fikirkan-impak-positif-undi-18-tahun-syed%20saddiq-212431?amp=1
- AstroAwani. (2019, February 19). Syed Saddiq bawa usul turunkan had umur mengundi pada sesi parlimen Mac ini. Retrieved from Astroawani.com website: https://www.astroawani.com/berita-malaysia/syed-%20%20saddiq-bawa-usulturunkan-had-umur-%20mengundi-pada-sesi-parlimen-mac-ini-199008?amp=1
- Astro Awani. (2020, February 26). *Marah, kecewa, tidak peduli antara reaksi orang ramai dalam kemelut politik kini*. Astroawani.com. https://www.astroawani.com/berita-politik/marah-kecewa-tidak-peduli-antara-reaksi-orang-ramai-dalam-kemelut-politik-kini-231744
- Berita Harian. (2015, November 9). Tahap kematangan politik golongan muda membimbangkan. Retrieved from Berita Harian website: https://www.bharian.com.my/berita/nasional/2015/11/95685/tahap-kematanganpolitik-golongan-muda-membimbangkan
- Berita Harian. (2019, December 5). Pandangan Tun M mengenai orang muda tepat -<br/>SyedSyedSaddiq.BeritaHarian;BeritaHarian.



https://www.bharian.com.my/berita/nasional/2019/12/635528/pandangan-tun-m mengenai-orang-muda-tepat-syed-saddiq

- Berita Harian. (2019, December 5). *Pandangan Tun M mengenai orang muda tepat Syed Saddiq*. Berita Harian; Berita Harian. https://www.bharian.com.my/berita/nasional/2019/12/635528/pandangan-tun-m-mengenai-orang-muda-tepat-syed-saddiq
- Berita Harian. (2021, September 14). "Skop politik anak muda bukan soal kepartian sahaja." Retrieved from Berita Harian website: https://www.bharian.com.my/kolumnis/2021/09/863729/skop-politik-anak-mudabukan-soal-kepartian-sahaja
- Berita Harian. (2021, December 2). *Pindaan peraturan pilihan raya akan dibentang di Parlimen*. https://www.bharian.com.my/berita/nasional/2021/12/894334/pindaan-peraturan-pilihan-raya-akan-dibentang-di-parlimen
- Besar, J. A., Yew, V. W. C., Lyndon, N., & Asli, O. (2020). Pengaruh Taraf Hidup Dan Penglibatan Politik Pilihan Raya Dalam Membentuk Kesejahteraan Hidup Komuniti Orang Asli. *E-Bangi*, *17*(6), 49–67.
- Bhatti, Y., & Hansen, K. M. (2012). Leaving the Nest and the Social Act of Voting: Turnout among First-Time Voters. *Journal of Elections, Public Opinion and Parties*, 22(4), 380–406. https://doi.org/10.1080/17457289.2012.721375
- David, Denver, & Hands Gordon. (1992). *Issues and controversies in British Electoral Behaviour.* Prentice-Hall
- Dr Christine Huebner, Dr Katherine A. Smith, Dr Andrew Mycock, Dr Thomas Loughran, Dr

Jan Eichhorn. (2021). Making Votes-at-16 Work in Wales Lessons for the Future

- Fieschi, C., & Heywood, P. (2004). Trust, cynicism and populist anti-politics. *Journal of Political Ideologies*, *9*(3), 289–309. https://doi.org/10.1080/1356931042000263537
- Fowler, J. H., Baker, L. A., & Dawes, C. T. (2008). Genetic Variation in Political Participation. American Political Science Review, 102(2), 233–248. https://doi.org/10.1017/s0003055408080209
- Foley, J. (2015). A Thesis Submitted to the Graduate Faculty of W. Habitat.
- Gimpel, J. G., & Schuknecht, J. E. (2003). Political participation and the accessibility of the ballot box. *Political Geography*, 22(5), 471–488. https://doi.org/10.1016/S0962-6298(03)00029-5
- Hamid, N. H., Ahmad, A. R., Awang, M. M., & Pendidikan, F. (2015). *Modal Insan Dan Meningkatkan Kualiti Hidup Belia*. *1*(2012), 408–416.



- Harian Metro. (2018, April 23). *Kesedaran berpolitik masih rendah*. https://www.hmetro.com.my/nuansa/2018/04/333123/kesedaran-berpolitikmasih-rendah
- Hetherington, M. J. (1998). The Political Relevance of Political Trust. *American Political Science Review*, *92*(4), 791–808. https://doi.org/10.2307/2586304
- Idn Times. (2020, August 16). 5 Penyebab Rasa Kecewa yang Berasal dari Diri Sendiri, Bikin Nyesel! https://www.idntimes.com/life/inspiration/yanuar-ramadhan-1/penyebab-rasa-kecewa-c1c2
- Ismaal, I. H. (2012). Stress dan kesihatan. *Universiti Teknologi Malaysia*. https://kl.utm.my/pendaftar/files/2017/10/Stress-dan-kesihatan-Dr.-Izzat-Hazmirbin-Ismaal.
- Jaharudin, M. H. (2013). Perkembangan Dan Penglibatan Politik Anak Muda Malaysia Pasca Reformasi 1998: Tumpuan Universiti Bangsar Utama (Ubu). http://ethesis.usm.my/jspui/handle/123456789/9031.
- Khairunisa'a Mohamad Noor, & Junaidi Awang Besar. (2020). Persepsi terhadap penurunan had umur mengundi daripada 21 tahun kepada 18 tahun : Kajian kes di Dewan Undangan Negeri (DUN) Dengkil. Jurnal Wacana Sarjana, 4(3), 1–20.
- Krejcie, R. V., & Morgan, D. W. (1970). Using methods of data collection. Advanced Public and Community Health Nursing Practice: Population Assessment, Program Planning and Evaluation, Second Edition, 38, 127–153. https://doi.org/10.1891/9780826138446.0006
- Livingstone, S., & Markham, T. (2008). The contribution of media consumption to civic participation1. British Journal of Sociology, 59(2), 351–371. https://doi.org/10.1111/j.1468-4446.2008.00197.x
- Malaysia Kini. (2012, October 13). "Generasi muda cenderung sinikal pada politik." https://www.malaysiakini.com/news/211567
- Malaysia Kini. (2012a, June 20). *Kenapa orang muda sinikal pada politik*. https://www.malaysiakini.com/letters/201471
- Malaysia Kini. (2010, March 15). *Golongan muda tak minat politik?* Malaysiakini; Malaysiakini. https://www.malaysiakini.com/news/126585
- Majalah Sains. (2010, March 25). *Tekanan Hidup : Kawal atau Gagal*. Majalah Sains & Teknologi Untuk Masyarakat. https://www.majalahsains.com/tekanan-hidup
- Marshelayanti Mohamad Razali, Siti Noranizahhafizah Boyman, Nafisah Ilham Hussin, & Wan Asna Wan Mohd Nor. (2013). Penglibatan Politik Belia: Satu Analisis Penyertaan Konvensional di Malaysia Youth Political Participation: An Analysis of Conventional Investments in Malaysia. *Jurnal Persepektif*, *8*(2), 70–78.



- Muddiman, E., Taylor, C., Power, S., & Moles, K. (2019). Young people, family relationships and civic participation. *Journal of Civil Society*, *15*(1), 82–98. https://doi.org/10.1080/17448689.2018.1550903
- Med Malay. (2021, June 7). *Gejala dan penyebab kemurungan remaja*. http://medmalay.com/gejala-dan-penyebab-kemurungan-remaja
- Miller, A. H., & Listhaug, O. (1990). Political Parties and Confidence in Government: A Comparison of Norway, Sweden and the United States. *British Journal of Political Science*, *20*(3), 357–386. https://doi.org/10.1017/s0007123400005883
- Mohd Nizah, M. A., & Mohd Sharif, S. (2020). Undi 18: Belia dan Politik Konvensional. *Sains Insani*, *5*(1), 180–186. https://doi.org/10.33102/sainsinsani.vol5no1.181
- Mstar. (2019, July 16). *Sejarah tercipta, Parlimen lulus RUU undi 18 tahun.* Mstar.com.my. https://www.mstar.com.my/lokal/semasa/2019/07/16/ruu-18-tahun
- Muzammil (2011), President of Persatuan Mahasiswa Universiti Kebangsaan Malaysia (PMUKM)

Muhamad Ali Embi, A. F. A. H. (2005). Kepercayaan Mahasiswa Terhadap Kerajaan. 77–92.

- Nadia Fauzi. (2017). Penggunaan Media Sosial Dalam Dunia Tanpa Sempadan : Suatu Kebaikan Atau Keburukan ? *Institut Latihan Kehakiman Dan Perundangan*, *ILKAP*, 1–34.
- Nadia (2012). Political awareness among students. Retrieved from https://ir.uitm.edu.my/id/eprint/29447/1/29447.pdf
- Navia, L.E. (1996). Classical cynicism: a critical study. Westport, CT: Greenwood Press
- Neundorf, Anja; Smets, Kaat; García Albacete, G. M. (2013). Homemade citizens: The development of political interest during adolescence and young adulthood. *Acta Politica*, *48*(1), 92–116. https://doi.org/10.1057/ap.2012.23
- Noor Atirah Eliya Mohd Nor, & Hasrina Mustafa. (2018). Analisis Faktor-Faktor Yang Menyumbang Kepada Penglibatan Politik dalam Kalangan Penduduk Pulau Pinang. *Sains Humanika*, 1(1977), 37–47.
- Opdycke, K., Segura, P., & Vasquez, A. M. (2013). The Effects of Political Cynicism, Political Information Efficacy and Media Consumption on Intended Voter Participation. *Colloquy*, *9*, 75–97.
- Paige, J. M. (1991). Coffee and Power: Revolution and the Rise of Democracy in Central America. Cambridge, MA: Harvard University Press
- Perri Klass. (2016). Pediatrics and Childhood Poverty in the United States. *New England Journal of Medicine*, 374(23), 2201–2205.



- Rafni, A., & Suryanef, S. (2019). The Development of Election Smart House As A Tool Of Political Education Based On Local Wisdom. *MIMBAR: Jurnal Sosial Dan Pembangunan*, 35(1), 69–77. <u>https://doi.org/10.29313/mimbar.v35i1.4122</u>
- Samsudina.Rahim, A. A. W. &. (2013). Kredibiliti Media Dan Penyertaan Media Credibilitiy and Participation in a Democratised Media Environment in. Jurnal Komunikasi, 29(1), 141–160.
- Sani, M., & Suhana, S. (2018). PERLAKSANAAN DAN CABARAN PENGLIBATAN BELIA DALAM PARLIMEN BELIA MALAYSIA (The implementation and challenges of youth engagement in Youth Parliament of Malaysia). Retrieved from https://www.semanticscholar.org/paper/PERLAKSANAAN-DAN-CABARAN-PENGLIBATAN-BELIA-DALAM-of-Sani-

Saad/0e9f6d13eb7e24b35622214b22b87e88b1ae3e9d

- Shamsinar Rahman & Che Hamdan. (2018). Political Awareness Among Students. *Gading*, 22(Special Issue), 130–133.
- Sinar Harian. (2019, November 10). 18 tahun, matangkah mereka? https://www.sinarharian.com.my/article/56471/KOLUMNIS/18-tahun-matangkahmereka
- Sinar Harian. (2021, January 27). *Keluarga antara punca individu alami tekanan*. https://www.sinarharian.com.my/article/121101/KHAS/
- Smith, K. A., Mycock, A., Loughran, T., & Eichhorn, J. (2021). *Making Votes-at-16 Work in Wales Lessons for the Future*.
- Syazwana Aziz, Noraini Abdol Raop, & Muhammad Fadzil Ahmad Shukor. (2021). Pengaruh faktor teknologi maklumat dan komunikasi terhadap kualiti hidup dalam kalangan belia. *Jurnal 'Ulwan*, *1*(6), 110–126. https://kuim.edu.my/journal/index.php/JULWAN/article/view/848
- The Star Online. (2004, March 13). *Political awareness lacking*. The Star. https://www.thestar.com.my/news/education/2004/03/14/political-awareness-lacking
- Trevor St Georhe, M. (2002). *An Introduction to Politics* ((3third ed). Steohenson's Litho Press.
- Turner, P. (1999). Education for Citizenship and the Teaching of Democracy in Schools.TeachingPublicAdministration,19(2),46–49.https://doi.org/10.1177/014473949901900204
- Utusan Malaysia. (2020, October 17). Kepercayaan rakyat terhadap politik rendah Naib Presiden Bersatu. Retrieved from https://www.utusan.com.my/berita/2020/10/kepercayaan-rakyat-terhadap-politikrendah-naib-presiden-bersatu/



- Zulkifli, N., Omar, S. K., Johari, N. F., & Hassan, M. S. (2021). Pengaruh Media Baru dan Penglibatan Politik. *Advances in Humanities and Contemporary Studies*, 2(January), 63–77.
- Zyngier, D. (2012). Rethinking the thinking on democracy in education: What are educators thinking and doing about democracy? *Education Sciences*, 2(1), 1–21. https://doi.org/10.3390/educ2010001



# **IONTOPHORESIS DEVICE WITH A SWEAT RATE SENSOR AND IOT**

Muhammad Luqman Jakaria<sup>1</sup>, Ku Lee Chin<sup>2</sup>

Department of Electrical Engineering, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor, Malaysia. <sup>1</sup>luqmanjakaria27@gmail.com <sup>2</sup>lohleechin1@gmail.com.my

### Abstract

This project is about the development of an iontophoresis device with a sweat rate and IoT system for hyperhidrosis disorder patient. Sweating is a natural reaction to a variety of circumstances, including hot weather, physical exertion, stress, and thoughts of fear or wrath but a person will sweat more than usual for no obvious reason if you have hyperhidrosis. Which form of hyperhidrosis a person has determines the underlying reason. The current device is created only to treat hyperhidrosis disease without a specific sensor to detect the sweating rate of the person. This product also can detect human sweat rate ('normal'/moderate sweat rate (for a healthy adult) during extended exercise at a decent intensity is around 1-1.5L per hour) using a humidity sensor (DHT-11) and a safety button as the safety. Bluetooth module (HC-05) will be attached to add IoT functionality and allow the treatment history to be recorded. This device consists of Arduino UNO as the microcontroller, push-button to operate the product, and a current sensor (ACS712) to calculate and measure the current applied. The user can also manually set the current and time of the treatment. The procedure is typically repeated 3 - 5 times each week (10 - 20 minutes each session) until the desired outcomes are achieved.

**Keywords:** hyperhidrosis, excessive sweating iontophoresis, sweat sensor, humidity sensor



### 1. Introduction

Excessive sweating is caused by hyperhidrosis, which may or may not is caused by a medical condition. People with hyperhidrosis sweat excessively, to the point that wetness may practically flow from their palms. Sweat glands usually create perspiration that is transferred to the skin's surface when the air temperature rises, you get a fever, exercise, or anxious, apprehensive, or stressed. When such circumstances are no longer a concern, the nerves that cause perspiration are silenced.

The sweat glands do not shut down in the 1% to 2% of the population with hyperhidrosis. They sweat even when the conditions are not conducive to it, such as when they are sitting in air conditioning or watching television. Some people even tell their physicians that they sweat a lot in the pool.

The causes of hyperhidrosis depend on the sweating that is happening. In certain circumstances, doctors are baffled as to why patients sweat excessively. In certain circumstances, the causes of hyperhidrosis are medical conditions that you should be aware of.

People who regularly sweat excessively or continuously for no apparent reason may have hyperhidrosis disorder. One sort of therapy that can be utilized to alleviate symptoms of this ailment is iontophoresis. People suffering from hyperhidrosis may require numerous iontophoresis sessions each week, each lasting 20 to 40 minutes. It may be hard for doctors to keep track of the previous treatment because patients usually do the treatment several times per week. The current product in the market does not have IoT to record and transfer history data of the treatment.

lontophoresis is a machine to threat hyperhidrosis, and it was first used as a therapy for excessive sweating over 50 years ago. Its specific mode of action is unknown, although it most likely acts by temporarily blocking the sweat duct. The current device is created only to treat hyperhidrosis, and it does not have a specific sensor to detect the sweating rate of the person.



The purpose of this project is to develop a device called iontophoresis that can help treat excessive sweating of the feet and hands, and other areas of the body. This product also can detect human sweat rate using a humidity sensor and a safety button as the safety.

# 2. Methodology

The steps and strategies needed to carry out this project successfully are described in this chapter. The stages of this research include designing and developing the iontophoresis device with a sweat rate and IoT, creating block diagrams, operating device flow charts, and making the device wireless. Data was gathered in order to examine the output's error. This approach is utilised to complete projects with ideal outcomes.

In order to create an iontophoresis device with a sweat rate and IoT, this project integrates software (systems) and hardware (device). The software for the Arduino platform has been created using MIT App Inventor for Graphic User Interface (GUI) on smartphones. The patient's treatment data are controlled and monitored by this application. The project's whole data output became the application.

#### 2.1 Developing the hardware and IoT implementation of the Patient Monitor

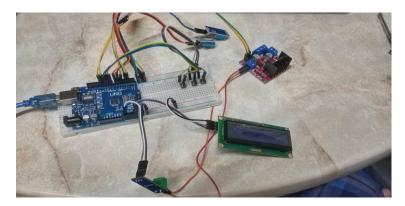


Figure 49: Circuit Testing



Figure 1 above shows testing of the connection of the project. Using Arduino as the central controller and 2 DHT-11 are connected to the input pin and three push buttons as the mode selection button, start button, and emergency button. The output port is a Dual bridge motor, current sensor, and LCD display. The 7.4v battery will be the primary source for the bridge motor to carry the current to the water container.

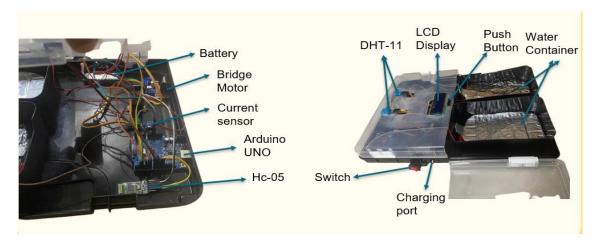


Figure 50: Device Label



Figure 51: Final Product



Based on the feedback of the 3D design that was posted on the pre-survey form, the final design of the device was design. Figure 17 shown the product label and figure 18 will show the final design of the device.

	Connect	
	Connected	
Mode		
	1 mA	
	Start	
	Show History log	

Figure 52: IoT Interface

Figure 4 depicts the UI for IoT deployment using the MIT Software Inventor app to get data from the sensor. It is simple to download the MIT App Inventor app for Android mobile devices. Using the tool, the user may conveniently track their medical history.

Iontophoresis Device		
	_	
Hide	History log	
	Clear	
(Date/Time)	(Mode)	(Duration(min))
(06/06/2022 05:37 pm)		(10)
(06/06/2022 05:58 pm)	) (18)	(20)
(11/06/2022 12:07 am)		(20)
(11/06/2022 12:08 am)	(18)	(20)
(11/06/2022 12:09 am)	(18)	(20)
(11/06/2022 12:09 am)		(10)
(11/06/2022 12:11 am)	(2)	(10)
(11/06/2022 12:15 am)	(31)	(20)
(06/06/2022 05:58 pm)	) (18)	(20)
(06/06/2022 05:59 pm)	) (18)	(20)
(06/06/2022 05:59 pm)	(28)	(20)
(10/06/2022 01:10 am)	(16)	(20)

Figure 53: Treatment History Data



Figure 5 above show the treatment history of the device. The application will record and save information such as date and time, mode and duration of the treatment.

# 2.2 Block Diagram of the Operating System

The components of this project will all be connected in IoT Iontophoresis Device with Sweat Rate Sensor. Not only that, but the gadget will include an interface that will allow users to select the mode, set a timeframe, and receive treatment schedule notifications.

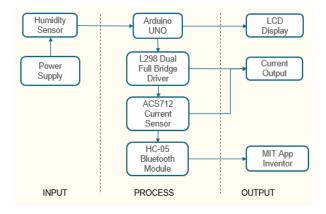


Figure 54: Block Diagram of the Project

## 2.3 Making Flow Chart of the Operation Device

The flow chart (figure 7) shows the application of IoT Iontophoresis Device with Sweat Rate Sensor. The process will start with the patient using the sweat sensor to indicate the sweat rate. Then it will be 3 recommended modes based on the sweat rate, or the patient can set it manually, and the device will start. After the treatment is finished, it will store the treatment history in the mobile application.



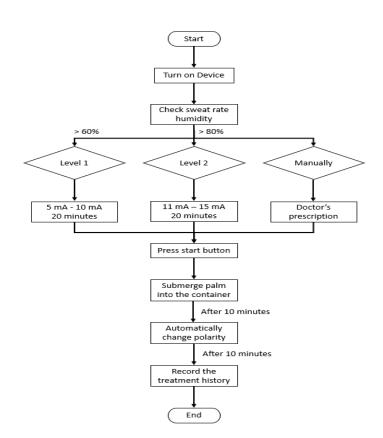


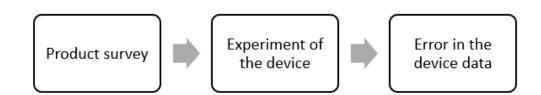
Figure 55: Flow Chart of the Project

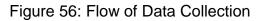
## 2.4 Data Collection Method

Data collection is collecting, measuring, and analyzing accurate insights for study following established accepted techniques. A researcher may evaluate the project's hypothesis based on the collected data. Data collection is typically the first and most crucial step of the research process, regardless of the field of study.

There are three methods of data collection (figure 19). On the issue, we have produced a series of surveys, project experiments, and errors in the data.







#### 3. Result and Discussion

#### 3.1 Data Analysis of the Device

Table 1 show the data treatment for patients A, B, and C. Patients A and B have almost the same humidity rate, which is 77% and 78% respectively, and both have a similar current value (5-10mA) that is used for the treatment. While patient C has a higher humidity rate, and the current value is 11-15mA.

		Patient A		Patient B		Patient C	
Week	Treatment	Humidity	Current	Humidity	Current	Humidity	Current
	per week	Percentage	Value	Percentage	Value	Percentage	Value
	-	(%)	(mA)	(%)	(mA)	(%)	(mA)
Week 1	Treatment 1	77	5 - 10	78	5-10	91	11 – 15
	Treatment 2	75	5 - 10	75	5-10	89	11 – 15
	Treatment 3	73	5 - 10	73	5 - 10	87	11 – 15
Week 2	Treatment	71	5 - 10	69	5-10	85	11 – 15
	Treatment 2	69	5 – 10	68	5-10	83	11 – 15
	Treatment 3	69	5 - 10	66	5-10	80	11 – 15
Week 3	Treatment 1	67	5 - 10	66	5-10	77	5-10
	Treatment 2	65	5 - 10	65	5-10	77	5 - 10
	Treatment 3	65	5 - 10	65	5-10	75	5-10
Week 4	Treatment 1	60	5 - 10	63	5-10	73	5-10
	Treatment 2	60	5 - 10	63	5-10	72	5-10
	Treatment	60	5-10	62	5-10	70	5-10

Table 20: Treatment Data for patient



## 3.2 Error of Device Data

Table 2 shows the device error, which is the target current is the current that was supposed to be the output of the device. Serial monitor reading is the reading from the Arduino connected to the current sensor, and the multimeter reading is the reading that has been measured manually across the output of the device.

Patient	Age	Humidity	Target Current	Serial Monitor	Multimete r
Patient A	23	77.0%	5-10mA	-0.348	0.1A
Patient B	23	78.0%	5-10mA	-0.346	0.1A
Patient C	24	91.0%	11-15mA	-0.266	0.1A



### 4. Conclusion

In conclusion, an iontophoresis device with sweat rate and IoT is a device that is compact and user-friendly. It is easy, economical, and affordable for patients. It should be utilized more often to ease the unpleasant symptoms. The built-in humidity sensor can improve the device's functionality, and it also helps the patient measure the sweat rate. Moreover, the IoT function can help the patient see the history of the treatment, and it will make it easier for a doctor to facilitate and plan follow-up maintenance treatments.

### 5. Acknowledgment

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### 6. References

Haider, A. (2005). Focal hyperhidrosis: diagnosis and management. Canadian Medical Association Journal, 172(1), 69–75. https://doi.org/10.1503/cmaj.1040708



- Doolittle, J., Walker, P., Mills, T., & Thurston, J. (2016). Hyperhidrosis: an update on prevalence and severity in the United States. Archives of Dermatological Research, 308(10), 743–749. <u>https://doi.org/10.1007/s00403-016-1697-9</u>
- (20) Lee, K. Y., & Levell, N. J. (2014). Turning the tide: a history and review of hyperhidrosis treatment. JRSM Open, 5(1), 204253331350551. <u>https://doi.org/10.1177/2042533313505511</u>
- Griffen, B. D. (2018). Proposed mechanism of action of tap water iontophoresis for treatment of hyperhidrosis. Cogent Medicine, 5(1), 1486783. https://doi.org/10.1080/2331205x.2018.1486783
- Wortmann, F., & Flüchter, K. (2015). Internet of Things. Business & Information Systems Engineering, 57(3), 221–224. <u>https://doi.org/10.1007/s12599-015-0383-</u> <u>3</u>
- Roth, E. (2021, February 8). Iontophoresis. Healthline. https://www.healthline.com/health/iontophoresis#effectiveness



# PERSEPSI MASYARAKAT TERHADAP URUSAN PEMBELIAN ATAS TALIAN DI KAWASAN KANGAR

# Siti Amalizzati Binti Ahmad<sup>1</sup>, Nur Syafiqah Binti Abdul Halim<sup>2</sup>, Muhammad Akmal Bin Hambali<sup>3</sup>, Rashdan Rashid<sup>4</sup>

<sup>1</sup> amalizzatiahmad @gmail.com<sup>, 2</sup>pieqahhalim @gmail.com, <sup>3</sup>akmalhambali.67 @gmail.com

## Abstrak

Membeli-belah dalam talian telah menerima kejutan hangat dalam masyarakat Malaysia. Membeli dalam talian lebih mudah dan menjimatkan masa berbanding pembelian tradisional yang memerlukan pengambilan peribadi di kedai kerana semua transaksi dilakukan secara maya. Kemudahan ini sesuai untuk semua kejiranan dengan kekangan masa untuk keluar membeli-belah, dan mereka yang inginkan sesuatu yang cepat dan mudah. Oleh itu, kajian ini bertujuan untuk menentukan persepsi masyarakat terhadap pembelian dalam talian yang mempengaruhi kehidupan seharian. Kajian kuantitatif menggunakan soal selidik yang dijalankan dengan 200 orang responden daripada komuniti di wilayah Kangar. Dapatan kajian mendapati faktor kepercayaan dan risiko dikenal pasti sebagai perspektif utama penggunaan beli-belah dalam talian dalam masyarakat masa kini..

Katakunci: Pembelian Atas Talian, Persepsi

## 1. Pengenalan

Sikap pengguna telah berubah secara dramatik, mereka lebih suka tinggal di rumah dan melayari Internet, dan perniagaan dalam talian sudah pasti menjadi salah satu aktiviti paling hangat di zaman Internet. Iklan semasa menggunakan Internet. Ia menjadi semakin popular kerana ia adalah cara yang paling mudah untuk orang ramai kerana mereka tidak perlu tergesa-gesa untuk membeli barangan yang mereka perlukan. Simpan untuk mendapatkan produk atau perkhidmatan. Kehadiran pandemik Covid-19 yang melanda negara sebahagiannya menjejaskan peningkatan peratusan pembelian dalam talian oleh masyarakat. Cara orang ramai membeli juga berubah sejak pelaksanaan Perintah Kawalan Pergerakan (PKP).Kebanyakan masyarakat mula



membuat pembelian di hujung jari dengan kepelbagaian medium dalam talian (Esa & Basri, 2018).

Dalam aktiviti pembelian dalam talian, kebanyakan pengguna membuat pembelian berdasarkan bentuk luaran produk atau perkhidmatan, seperti gambar, maklumat berkualiti, klip video, dll., yang bukan representasi sebenar produk atau perkhidmatan (Lohse & Spiller, n.d.). Menurut Boon & Shi (2014), tingkah laku pengguna dipengaruhi oleh empat faktor psikologi: kognisi, kepercayaan, motivasi dan sikap. Oleh itu, dengan memahami tingkah laku pengguna. menggalakkan Faktor di mana mereka membelibelah dalam talian akan dapat membantu peniaga yang menjalankan perniagaan dalam talian membangunkan strategi yang berkesan untuk meningkatkan lagi trafik pembelian di laman web mereka (Har & Eze, 2011). Oleh itu, terdapat pelbagai kemudahan dan kelebihan yang ditawarkan di atas talian. selain itu, ianya berjaya menarik perhatian masyarakat terutamanya dalam kalangan wanita Melayu yang terlibat dalam perniagaan ini samada secara kecil-kecilan dan besar-besaran. penglibatan warna dalam bidang perniagaan atas talian dan menyebabkan berlakunya peningkatan yang ketara. disamping itu, terdapat kewujudan pelbagai aplikasi dalam talian seperti Instagram, Facebook, blog, Telegram dan e-perniagaan Des, Temps, dan En (2009) untuk meningkatkan capaian urusan perniagaan dan sangat memudahkan urusan jual beli produk.

## 1.2. Persoalan Kajian

Persoalan kajian ini adalah:

- i) Adakah terdapat hubungan diantara faktor kepuasan pelanggan terhadap urusan pembelian atas talian?
- ii) Adakah terdapat hubungan diantara faktor kepercayaan pelanggan terhadap urusan pembelian atas talian?
- iii) Adakah terdapat hubungan diantara faktor kemudahan pengguna terhadap urusan pembelian atas talian?



## 1.2 Objektif Kajian

Objektif kajian pula adalah:

- I. Untuk menentukan hubungan diantara faktor kepuasaan pelanggan terhadap urusan pembelian atas talian.
- II. Untuk menentukan hubungan diantara faktor kepercayaan pelanggan terhadap urusan pembelian atas talian.
- III. Untuk menentukan hubungan diantara faktor kemudahan pengguna terhadap urusan pembelian atas talian.

# 2. Penyataan Masalah

Pembelian secara online merupakan salah satu proses perniagaan yang mudah dijalankan. Dengan adanya ICT pada masa ini sangat memberi pengaruh dalam perkembangan ekonomi. Sebelum wujudnya pembelian atas talian ini terdapat pelbagai cara yang dilakukan oleh penjual dan pembeli, kini dengan zaman yang semakin berkembang dan dunia teknologi yang semakin canggih serta dengan adanya norma hidup baharu lepas kewujudan pandemik Covid-19 yang melanda negara yang semakin merebak membuatkan semua perkara hanya dilakukan melalui internet. Dengan adanya sistem pembelian atas talian ini dapat memudahkan para pembeli untuk melakukan kerja harian.

Kajian terdahulu menunjukkan, beberapa tahun kebelakangan ini, industri perbankan di seluruh dunia telah mengalami transformasi yang pesat.Peningkatan teknologi maklumat telah memudahkan pengesanan dan pemenuhan komitmen yang lebih baik, pelbagai saluran penghantaran untuk pelanggan dalam talian dan penyelesaian isu yang lebih cepat (Al-Shafi & Weerakkody, 2010). Kemudahan ini sangat sesuai bagi golongan mahasiswa yang mempumyai masa yang terhad untuk keluar membeli-



belah. Walaubagaimanapun, ianya merupakan sifat semulajadi mereka yang inginkan sesuatu yang senang dan cepat berbanding pembelian secara konvensional yang memerlukan seseorang individu untuk hadir ke kedai bagi mendapatkan sesuatu barangan. Pembelian secara atas talian adlah lebih menjimatkan masa dan mudah kerana segala transaksi dilakukan secara maya. Yazid et al., (2016). Selain itu, faktor kepercayaan sangat penting untuk pengguna yang melakukan transaksi secara maya. Kajian terdahulu mengenai kepercayaan pembelian atas talian telah banyak digunakan sejak awal 1980-an (Chen, Zhang, Zhao, Lee, & Chong, 2016), tetapi kemudahan penggunaan, kualiti, estetika, daya tarikan dan nilai untuk wang mesti dipadankan atau melebihi dengan pelanggan jangkaan terhadap produk. Hal ini demikian, ianya hanya melalu perhubungan melalui perantara samada computer, telefon pintar atau tablet.

Walaubagaimanapun, jual beli secara atas talian ini lebih ringkas dan mudah, pengguna juga sangat mudah diperdaya dimana maklumat penting seperti kad kredit atau nombor akaunsangat mudah diakses dan dicuri oleh penjenayah siber Portal Polis Di Raja Malaysia, (2014). Selain itu, terdapat faktor kepuasan yang perlu diambilkira seperti barangbyang diterima agak berbeza (kualiti, saiz, warna) daripada yang diiklankan, barangan tidak sampai dengan selamat setelah pembayaran dibuat, banrangan yang sampai telah rosak dan sebagainya. Oleh sebab itu, kajian ini dijalankan bagi mengenalpasti persepsi masyarakat di Kawasan Kangar terhadap urusan pembelian atas talian yang mempengaruhi aktiviti harian seseorang.

Antara faktor kemudahan dalam urusan pembelian atasan talian adalah penggunaan teknologi yang boleh mempercepatkan atau memudahkan sesuatu urusan (Naszariah et al., 2021). Faktor kemudahan amat penting kerna pengguna pada masa kini lebih mementingkan saluran yang mudah untuk perkhidmatan atau membeli sesuatu produk. Situasi ini berlaku adalah kerana kesibukan mereka dalam pekerjaan seharian dan ditambah isu terkini iaitu isu pendemik yang menyebabkan peniaga terkesan seperti tidak dapat beroperasi secara normal dan pergerakan sangat terhad. Hasil kajian oleh Yeow et al., (2008) mendapati bahawa terdapat faktor kemudahan yang digunakan untuk memiliki hubungan positif yang signifikan terhadap penggunaan laman web e-pembelian. Antara faktor kemudahan yang digunakan telah lama dikenalpasti sebagai keperluan asas terhadap reka bentuk sesebuah system. (Chau, 1996).



## 3. Ulasan Karya

Perniagaan atas talian menjadi alternatif yang sangat penting dan pelengkap kepada perniagaan tradisional yang mana ianya tidak memerlukan kos sewaan tempat untuk memulakan perniagaan. Rezaei et al., (2014) Perniagaan dalam talian adalah satu perkembangan dalam bidang perniagaan yang akan disebabkan oleh perkembangan teknologi maklumat dan komunikasi (TMK) di dunia. Perniagaan berkonsepkan dalam talian yang menggunakan media sosial sebagai medium perniagaan utama merupakan proses keseluruhan penggunaannya yang melibatkan medium internet. Perkembangan perniagaan dalam talian adalah platform terbaik yang digunakan untuk menjalankan sesuatu aktiviti perniagaan dan pemasaran masa kini kerana ianya menawarkan pelbagai kemudahan kepada penggunanya. (Mohd Nawi et al., 2020)

### 3.1 Pembelian Atas Talian

Menurut Bobbitt, L.M. and Dabholkar, (2001), ada dua jenis perilaku pembelian online, pengguna yang menggunakan atau online untuk melakukan pembelian dan pengguna yang online hanya untuk mendapatkan informasi tentang apa yang ingin mereka beli. Yazid et al., (2016) juga menyatakan bahawa sebahagian besar pengguna pertama kali menggunakan internet untuk mencari informasi sebelum melakukan keputusan pembelian. Tujuan dari pencarian informasi ini adalah agar mereka memiliki pengalaman membeli yang positif dengan teman-teman mereka dengan berkongsi pengalaman dan memanfaatkan informasi yang tepat di internet. Keseluruhan proses penggunaannya melibatkan media internet yang dinamakan perniagaan berkonsepkan atas talian dengan media sosial sebagai medium perniagaan utama. Pertumbuhan perniagaan dalam talian adalah platform terbaik untuk menjalankan aktiviti perniagaan dan pemasaran hari ini kerana ia memberikan pelbagai kemudahan kepada penggunanya. Ini terbukti dengan pertambahan tahunan bilangan peniaga online yang terlibat dan pelbagai medium baru perniagaan dalam talian. Statistik terkini menunjukkan sehingga Julai 2017, Husin & Roslan, (2021). ).Membeli-belah dalam talian telah menjadi kaedah membeli-belah yang popular dan berkembang di dunia dalam beberapa tahun kebelakangan ini . Tambahan pula, Wahyuni & Rachmawati, (2018) menyatakan bahawa ia tercermin dalam peningkatan jumlah pengguna yang membeli dalam talian dan juga penjualan runcit dalam talian baru-baru ini.



## 3.2 Faktor Kepuasan Pelanggan.

Menilai kepuasan pelanggan telah menjadi sangat penting, terutamanya untuk produk dan perkhidmatan berteknologi tinggi.Secara umumnya, kepuasan pelanggan telah diukur menggunakan skala soal selidik. Kajian oleh Ankit, (2011) menyiasat kepuasan pelanggan dalam industri perkhidmatan menggunakan penggunaan fungsi kualiti (quality function deployment QFD). Mereka mempertimbangkan pengurusan perkhidmatan luaran dan dalaman isu dan inovasi perkhidmatan seterusnya berdasarkan rangka kerja QFD. Pada masa ini, imej jenama telah menjadi topik perbincangan yang menarik dalam literatur pemasaran seperti yang dinyatakan oleh beberapa pakar juga mengatakan bahawa imej jenama telah menjadi peranan penting dalam membezakan syarikat dan menggunakan media pemasaran yang baik. Menurut Rahi dan Ghani (2016), jenama adalah identiti produk dan imej yang menjelaskan sama ada jenama itu bernilai atau tidak.Imej jenama juga digambarkan sebagai pemahaman dan kepuasaan yang tertanam dalam ingatan klien sebagai cerminan persatuan yang wujud dalam fikiran klien Kotler & Keller, (2012). Menurut Rahi & Ghani, (2016) imej jenama sesebuah syarikat juga amat penting untuk produk atau perkhidmatan yang ditawarkan. Menghubungkan imej jenama dan kepuasan pelanggan, telah menunjukkan bahawa imej jenama adalah penentu kepuasan pelanggan; ia memberi kesan positif kepada kepuasan pelanggan. Oleh itu, hipotesis menunjukkan bahawa imej jenama mempunyai kesan yang signifikan terhadap kepuasan pelanggan.

## 3.3 Faktor Kepercayaan

Kepercayaan pengguna sangat penting dalam proses membuat pembelian dalam talian kerana ia melibatkan transaksi kewangan. Ini kerana setiap transaksi sedemikian adalah berisiko untuk pembeli, dan jual beli dalam talian sedemikian mendedahkan pengguna atau pelanggan kepada kemunculan dan ancaman risiko baharu Ankit, (2011) Takrifkan kepercayaan sebagai perasaan atau emosi setiap orang untuk mengurangkan atau mengelakkan sebarang komplikasi apabila berhadapan dengan peristiwa atau situasi berisiko. Selain itu, kepercayaan antara sikap pembeli dan peniaga adalah sangat penting dalam persekitaran perdagangan dalam talian di mana kepastian dan maklumat sedia ada tidak selari antara satu sama



lain Gefen, (2002). Penyelidik Astuti et al., (2010), juga menegaskan bahawa kepercayaan adalah penting. Konsepnya ialah sikap amanah dalam proses transaksi dalam talian dan dalam digunakan alat yang untuk menialankan transaksi.Kepercayaan juga ditakrifkan sebagai persepsi pengguna dalam talian mengenai peruncit dalam talian yang boleh dipercayai Fitra, (2015). Pembelian tradisional berbeza dengan pembelian dalam talian kerana terdapat ketidakpastian dan kesamaran semasa aktiviti pembelian dalam talian.Penjual dalam talian perlu membina kepercayaan pengguna dalam talian dan meyakinkan mereka bahawa membeli-belah dalam talian adalah lebih baik daripada membeli-belah di luar talian (Jalil et al., 2014).

## 3.4 Faktor Kemudahan Pengguna

Menurut kajian Nilsson & Wall, (2017) bahawa kemudahan penggunaan berkait dengan kepuasan. laitu masyarakat yang pembelian pakaian secara atas talian mengharagai laman web yang mereka diguna kerana kemudahaan pengguna untuk mencari maklumat adalah lebih senang dan tidak mempunyai masalah.Pelanggan yang menggunakan internet untuk membeli produk atau perkhidmatan berpendapat bahawa laman web itu mudah digunakan dan oleh itu ia akan menjadi salah satu

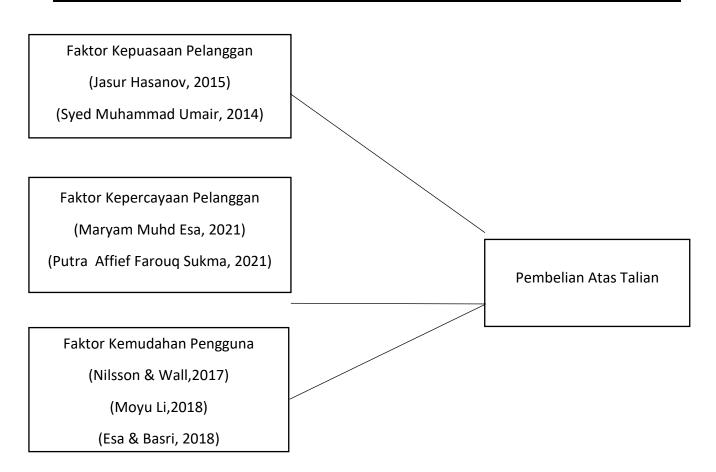
laman web yang paling kerap digunakan untuk membeli produk atau perkhidmatan.Mereka mendapati tapak tersebut mengurangkan usaha mereka untuk memahami maklumat yang disampaikan. lebih tinggi 13 pengguna merasakan kemudahan penggunaan, lebih aktif pandangan pengguna. Penyata ini dikaji oleh Li & A, (2018). Kemudahan menjadi daya tarik bermula dengan pilihan barangan, kemudahan dalam melakukan pembelian, kemudahan pembayaran dan juga kemudahan mendapatkan barangan tersebut. Duasa et al., (2019). Menurut kajian Husin & Roslan, (2021) pembelian sacara atas talian dipilih sebagai langak mudah untuk berbelanja bagi mendapatkan barang keperluan tanpa perlu beratur panjang di kaunter.

## 4. Rangka Kerja Kajian

Pembolehubah Tidak Bersandar

Pembolehubah Bersandar





## 5. Hipotesis

Terdapat Tiga (3) Hipotesis dalam kajian ini iaitu:

H1 : Terdapat hubungan diantara faktor kepuasaan pelanggan terhadap pembelian atas talian.

H2 : Terdapat hubungan diantara faktor kepercayaan pelanggan terhadap pembelian atas talian.

H3 : Terdapat hubungan diantara faktor kemudahan pengguna terhadap pembelian atas talian.

## 6. Kaedah Kajian / Metodologi



Kajian ini menggunakan kaedah Kajian Kuantitatif. Populasi kajian adalah masyarakat di kawasan Kangar, Perlis yang berjumlah 200 Sampel dipilih terdiri daripada masyarakat di kawasan Kangar. McNaughton & Cowell, (2018). Menggunakan kaedah Persampelan Bukan Rawak (Nonprobability Sampling) iaitu persampelan secara kesenangan (convenience) maka sampel kajian yang dipilih. Soal selidik digunakan dalam kajian ini, dimana soal selidik ini diadaptasikan dari Ankit, (2011). Soal selidik ini mengandungi 10 soalan yang dibahagikan kepada pembolehubah tidak bersandar. Pembolehubah pertama terdiri daripada faktor kepuasan pelanggan.Soalan diadaptasikan dari Ankit, (2011). Pembolehubah kedua terdiri daripada faktor kepercayaan. Soalan diadaptasikan dari. Pembolehunah ketiga terdiri daripada faktor kemudahan pengguna.Soalan diadaptasikan dari Tuan Pham dan Yazdani (2021). Analisis diskriptif digunakan dalam kajian ini. Kekerapan dan min digunakan menggunakan perisian SPSS.

Skor Min	Min Penarifan	Tahap
1.00 – 2.33	Rendah	Rendah
2.34 - 3.66	Sederhana	Sederhana
3.67 – 5.00	Tinggi	Tinggi



## 7. Dapatan Kajian

## 7.1 Demografi responden

Jadual 2: Profile Responden			
Ciri-Ciri	Kategori	Kekerapan	
Jantina	Lelaki	150	<u> </u>
	Perempuan	164	
	Jumlah	314	
Umur	18-29	210	
	30-39	80	
	40-49	14	
	50 Keatas	10	
	Jumlah	314	
Status	Bujang	226	
	Kahwin	66	
	Lain-Laim	2	
	Jumlah	314	
Kawasan	Kangar	314	
	Arau	-	
	Puah	-	
	Lain-Lain	-	
	Jumlah	314	
Bangsa	Melayu	212	
	Cina	57	
	India	45	
	Jumlah	314	

Jadual 2 di atas menunjukkan ciri-ciri demografi responden dimana 164 adalah lelali manakala 150 adalah perempuan. Umur diantara 18-19 tahun adalah yang paling banyak menjawab. Responden yang bujang adalah sejumlah 226 orang.



Jadual 3: Analisis Kebolehpercayaan			
PEMBOLEHUBAH	NILAI CRONBACH ALPHA		
PEMBELIAN ATAS TALIAN	0.917		
FAKTOR KEPUASAN PELANGGAN	0.934		
FAKTOR KEPERCAYAAN PELANGGAN	0.771		
FAKTOK KEMUDAHAN PENGGUNA	0.911		

Jadual 3 di atas menunjukkan nilai Cronbach Alpha yang diperolehi melalui kajian pilot yang dilakukan. Nilai melebihi 0.6 menunjukkan bahawa item boleh digunakan bagi mengukur pembolehubah yang dinyatakan.

## 7.1 Analisis Min

Jadual dibawah menunjukkan analisi min kajian

		Sisihan
Pembolehubah	Min	Piawaian
Pembelian Atas Talian		
1) Jika berpeluang, saya akan meramalkan semula laman web peruncit yang pernah saya guna di masa hadapan.	3.84	1.007
2) Saya berhasrat akan meneruskan membeli barangan secara maya dari laman web yang sering saya gunakan.	3.97	.817
3) Pada masa akan datang, saya berhasrat akan menggunakan laman web tersebut bila-bila masa saya perlukan.	4.03	.890
<ol> <li>Saya berniat untuk mencari maklumat tentang produk tertentu dari laman web belian secara maya yang sering saya gunakan.</li> </ol>	4.11	.826
5) Kecuali tanpa sebab-sebab munasabah, saya berniat untuk terus menggunakan laman web belian secara maya yang sering saya gunakan.	4.15	1.848
JUMLAH	4.02	1.078

### Jadual 4: Analisis Deskriptif



Pembolehubah	Min	Sisihan Piawaian
Faktor Kepuasan Pelanggan		Tawalan
1) Saya berpuas hati dengan pengalaman membeli-belah secara maya yang telah saya lakukan.	4.27	1.804
2) Saya rasa membeli-belah secara maya memudahkan apabila saya membeli-belah dalam laman web ini.	4.08	.853
3) Berbanding dengan tempat-tempat membeli-belah dalam laman web lain, saya berpuas hati dengan pengalaman membeli-belah secara maya yang telah saya lakukan.	4.10	.857
4) Saya berpuas hati dengan maklumat yang dipaparkan di laman web membeli secara maya.	4.09	.856
5) Saya berpuas hati dengan perkhidmatan tambahan (tempahan/hantaran barangan/pulangan belian) yang disediakan dalam laman web belian secara maya.	4.12	.903
JUMLAH	4.13	1.055
Pembolehubah	Min	Sisihan Piawaian
Faktor Kepercayaan Pelanggan		
1) Saya percaya segala maklumat yang disediakan di laman web adalah benar dan jujur.	4.07	.851
2) Intrastruktur laman web yang saya layari boleh dipercayai.	4.21	3.008
3) Saya percaya laman web akan buat yang terbaik demi kepentingan saya.	4.11	.798
4) Saya percaya pengurusan laman web akan menjaga maklumat peribadi saya dengan selamat.	4.06	.892
5) Saya rasa segala transaksi dengan laman web maya ini adalah selamat.	4.08	.874
		4 005

JUMLAH

4.11

1.285



Pembolehubah	Min	Sisihan Piawaian
Faktor Kemudahan Pengguna		
1) Laman web belian secara maya adalah mudah untuk dipelajari.	4.17	.854
2) Laman web belian secara maya tidak memerlukan penggunaan tenaga minda dengan banyak.	4.23	.801
3) Urus niaga secara maya adalah bebas dari sebarang gangguan.	4.22	.839
4) Laman web belian secara maya adalah mudah untuk diuruskan.	4.17	.870
5) Laman web belian secara maya adalah mudah untuk digunakan dan menjimatkan masa.	4.21	.855
JUMLAH	4.20	0.844

Jadual 4 di atas menunjukkan dapatan min bagi semua pembolehubah. Min tertinggi bagi pembolehubah pembelian atas talian ialah 4.15. Purata min ialah 4.02. Min tertinggi bagi pembolehubah kepuasan pelanggan ialah 4.27 dimana purata min ialah 4.13. Kepercayaan pelanggan pula mencatatkan purata 4.11 dengan min tertinggi ialah 4.21. Purata min tertinggi dicatatkan oleh pembolehubah kemudahan pengguna iaitu 4.20

### 7.1 Analisis Korelasi

#### Jadual 5: Analisis Deskriptif

PEMBOLEHUBAH	(PAT)	(FKP1)	(FKP2)	(FKP)
PEMBELIAN ATAS TALIAN	1			
(PAT)				
FAKTOR KEPUASAN PELANGGAN	.654**	1		
(FKP1)				
FAKTOR KEPERCAYAAN PELANGGAN	.538**	.627**	1	
(FKP2)				
FAKTOR KEMUDAHAN PENGGUNA	.565**	.602**	.572**	1
(FKP)				



Jadual 5 di atas menunjukkan terdapatnya hubungan diantara kepuasan pelanggan, kepercayaan pelanggan dan kemudahan pengguna terhadap pembelian atas talian.

# 8. Kesimpulan

Kesimpulan dari kajian ini menunjukkan bahawa responden berminat untuk terus membeli di atas talian bagi laman web yang sering digunakan. Responden juga berpuas hati selama dalam melakukan pembeliansecara atas talian. Ini mungin disebabkan laman laman web yang dilayari adalah laman-laman web yang boleh dipercayai dan ianya bebas dari gangguan dan tidak memerlukan tenaga yang banyak.

Dapatan kajian ini juga menunjukkan hubungan pembolehubah wujud diantara kepuasan pelanggan, kepercayaan pelanggan dan kemudahan pengguna terhadap pembelian atas talian. Ini bertepatan dengan kajian terdahulu seperti Har dan Eze (2011).

Kajian ini membuktikan bahawa bukan sahaja faktor mudah dan penjimatan masa yang menyebabkan pembeli tertarik untuk melakukan pembelian secara atas talian, malah situasi atau trend semasa juga menyebabkan mereka lebih berani mengambil risiko bagi membuat pembelian atas talian. Jadi, para pemasar dan peniaga perlulah lebih berhatihati dalam menyusun strategi demi meraih kepercayaan dan memberikan pengalaman yang positif kepada pengguna, di samping menyesuaikannya mengikut perubahan semasa. Pengalaman yang positif akan mendorong para pembeli untuk mengulangi pembelian dan pada masa yang sama berkongsi pengalaman tersebut dengan rakan-rakan yang lain.

# Rujukan

- Al-Shafi, S., & Weerakkody, V. (2010). Factors affecting e-government adoption in the state of Qatar. *European and Mediterranean Conference on Information System*, 2010, 1–23. Retrieved from http://bura.brunel.ac.uk/handle/2438/4395
- Ankit, S. (2011). Factors Influencing Online Banking Customer Satisfaction and Their Importance in Improving Overall Retention Levels : An Indian Banking Perspective.



Information and Knowledge Management, 1(1), 45–55.

- Boon, C. L., & Shi, Y. W. (2014). Factors Influencing Consumers 'Online Purchase Intention : A Study among University Students in Malaysia. *International Journal of Liberal Arts and Social Science*, *2*(8), 121–133.
- Chen, C., Zhang, K. Z. K., Zhao, S. J., Lee, M. K. O., & Chong, T. (2016). The Impact of Mere Exposure Effect on Smartphone Addiction The Impact of Mere Exposure Effect on Smartphone Addiction. *Hawaii International Conference On System Sciences*, (January), 1507–1514. https://doi.org/10.1109/HICSS.2016.190
- Des, L., Temps, E. A., & En, P. (2009). *Part Time Students ' Benefit Perception on Online Shopping in Malaysia*. *5*(4), 72–80.
- Esa, M. M., & Basri, R. M. (2018). Faktor-Faktor Yang Mempengaruhi Pengguna Dalam Factors Influencing Consumer in Making Decision on Online. *Journal of Business Innovation*, *3*(M), 36–46.
- Har, L. C., & Eze, U. C. (2011). Factors influence consumers' intention to repurchase online in Malaysia. *International Journal of Electronic Commerce Studies*, *2*(2), 157–164.
- Lohse, G. L., & Spiller, P. (n.d.). *Electronic Shopping. Communications of the ACM. 41*, 81–87. https://doi.org/http://dx.doi.org/10.1145/278476.278491
- McNaughton, D. B., & Cowell, J. M. (2018). Using methods of data collection. Advanced Public and Community Health Nursing Practice: Population Assessment, Program Planning and Evaluation, Second Edition, 38, 127–153. https://doi.org/10.1891/9780826138446.0006
- Naszariah, R., Naseri, N., Mohd Esa, M., Abas, N., Zamratul, N., Ahmad, A., ... Norazmi Bin Nordin, M. (2021). An Overview Of Online Purchase Intention Of Halal Cosmetic Product: A Perspective From Malaysia. *Turkish Journal of Computer and Mathematics Education*, 12(10), 7674–7681.
- Pallant, J. (2007). SPSS Survival Manual A step by step guide to data analysis (3rd ed.). Open University Press.
- Tuan Pham, A., & Yazdani, K. (2021). The Mediating Role of Customer Experience on the Relationship between Online Shopping Determinants and Customer Satisfaction in Vietnam. *International Journal of Social Science and Humanity*, *11*(1), 5–8. https://doi.org/10.18178/ijssh.2021.v11.1028



# FAKTOR MOTIVASI MEMPENGARUHI AMALAN HIJAU DI RESTORAN

Nur Hafiza Hani Binti Abdul Halim Shah<sup>1</sup>, Nur Faizatul Aziera Binti Jamaludin<sup>2</sup>, Nur Yasmin Izzati Binti Mohd Yazid<sup>3</sup>, Norzianis Binti Rezali@Abdul Sukor<sup>4</sup> <sup>1</sup> hafihalim@yahoo.com, <sup>2</sup> nurfaizatulaziera@gmail.com, <sup>3</sup> yasminizzati76@gmail.com, <sup>4</sup> norzianis@gmail.com

### Abstrak

Kajian ini meneroka amalan hijau di restoran yang menyumbang kepada pembangunan lestari. Pengurusan restoran amalan hijau adalah unik kerana ia mempengaruhi kesan ke atas alam sekitar. Kajian ini telah menganalisis dan menjelaskan setiap faktor motivasi secara terperinci daripada pelbagai sorotan kajian. Kajian ini bertujuan untuk mengenal pasti amalan hijau yang dilaksanakan di restoran makanan dan minuman. Dapatan kajian telah mengenalpasti ekologi imej, tingkah laku ekologi dan persepsi amalan hijau merupakan faktor motivasi dalam pengurusan restoran amalan hijau. Selain itu, ia turut menyumbang kepada pengetahuan sedia ada dalam faktor amalan hijau yang mempengaruhi pengurusan restoran.

Kata-kunci: Faktor Motivasi, Amalan Hijau, Pengurusan Restoran, Malaysia

### 1.0 Latar Belakang Kajian

Pada era globalisasi hari ini, dalam mengejar kemodenan negara dan peningkatan taraf hidup penduduk, kegiatan ekonomi dan projek pembangunan sering mengabaikan kepentingan alam sekitar. Isu tentang alam sekitar adalah masalah yang sentiasa dihadapi oleh masyarakat dengan bermula daripada masalah pencemaran alam sekitar, perubahan iklim dan kekurangan sumber semula jadi yang mengancam dunia (David Wesley et al., 2021). Selaras dengan arus pemodenan dunia yang ingin dicapai melalui revolusi 4.0, kemajuan pesat teknologi sains dan industri merupakan penyumbang utama kepada kemerosotan kualiti alam sekitar. Aktiviti seperti perindustrian, penggunaan enjin mesin dan kenderaan, pembakaran terbuka, ujian nuklear dan sebagainya telah menyumbang kepada peningkatan karbon dioksida di atmosfera. Lantaran itu, penekanan terhadap pengaplikasian "amalan hijau" dalam kehidupan adalah suatu cara



yang tepat dalam menangani masalah pemanasan global.(Kamis et al., 2018). Pada 2017, 90 daripada 140 sungai di Malaysia dikelaskan sebagai tercemar (Zhao et al., 2019). Ini jelas menunjukkan bahawa kesedaran diri kepada melindungi alam sekitar masih tidak berlaku. Usaha telah dilakukan untuk mengubah tingkah laku populasi ke arah amalan hijau melalui melalui cara konvensional iaitu pendidikan, media dan dasar kerajaan. Namun, usaha-usaha ini masih tidak berjaya (Hoegh-Guldberg, Ove; Jacob, Daniela; Taylor, 2018). Oleh itu, demi kemaslihatan semua pihak, meneroka faktor motivasi amalan hijau amat diperlukan dalam industri di Malaysia.

## 1.2 Penyataan Masalah

Ekonomi yang semakin meningkat menjadikan banyak premis perniagaan makanan dan minuman dibuka. Peningkatan ini, menjadi kesan negatif terhadap alam sekitar kerana industri makanan menjana sisa dalam kuantiti yang besar. Ia turut menyumbang bukan sisa makanan tetapi juga jenis bahan pembaziran yang lain. Melalui lambakan ini, kawasan perbandaran dan petempatan penduduk akan mula terjejas. Pada tahun 2016 terdapat 158 tapak pelupusan yang beroperasi di seluruh negara dan pada 2015 terdapat 14 tapak yang dikategorikan sebagai tapak pelupusan sanitari (Kementerian Perumahan dan Kerajaan Tempatan, 2017). Satu cabaran paling utama dalam amalan pengasingan sisa dan kitar semula ialah tindak tanduk masyarakat untuk menjadikan pengasingan dan kitar semula sebagai satu tabiat (Ghafar, 2017). Antara kesan daripada industri pemakanan dan minuman terhadap alam sekitar ialah pencemaran sungai. Pencemaran ini terjadi apabila perlepasan air bersama sisa kandungan minyak, lemak dan gris dari singki premis melalui sistem perparitan tanpa ada sebarang proses penapisan. Pembuangan minyak masak terpakai ke dalam sistem pembetungan akan menyebabkan saluran tersebut tersumbat dan menyebabkan pencemaran air. Ia turut memusnahkan kehidupan akuatik di laut disebabkan oleh lapisan minyak yang meliputi permukaan air dan menghalang oksigen larut (Kabir et al., 2017). Ini akan menyebabkan masalah kesihatan dan pencemaran terhadap alam sekitar. Oleh sebab itu, kajian mengenai motivasi amalan hijau di restoran adalah sangat penting bagi menyumbang kelestarian alam sekitar.



## 1.3 Objektif Kajian

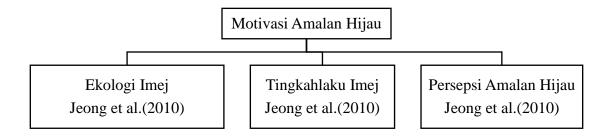
Berikut merupakan objektif utama untuk mngkaji faktor motivasi amalan hijau di restoran

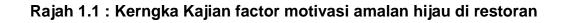
i) Untuk meneroka faktor-faktor motivasi amalan hijau di restoran.

# 1.4 Persoalan Kajian

- i) Apakah faktor motivasi amalan hijau di restoran?
- ii) Mengapakah amalan hijau dilaksanakan di restoran?

# 1.5 Kerangka Kajian





## 2.0 Kajian Literatur

Amalan hijau adalah aktiviti-aktiviti yang boleh dilakukan oleh sesebuah organisasi untuk mengurangkan kesan negatif yang dilakukan oleh pengusaha terhadap alam sekitar (Blackwell, Miniard, & Engel, 2004). Amalan hijau semakin meluas dipraktikan dalam bidang pelancongan, perhotelan dan perkhidmatan makanan. Ini memberi kesan kepada pelanggan dalam memilih perkhidmatan yang disediakan. Pada masa kini, kebanyakan



pelanggan yang datang makan di restoran mempunyai pendedahan dan pengetahuan tentang amalan hijau melalui pelbagai sumber. Selain itu juga, pelanggan di restoran percaya mereka mempunyai pengetahuan yang tinggi tentang amalan restoran hijau, memahami mengenai kepentingan tentang persekitaran dan kitar semula di restoran. (White, 2004)

Amalan hijau ini tidak hanya digunakan dalam perkhidmatan makanan, malah dilakukan juga dalam bidang perhotelan. Sebagai contoh aktiviti yang dilakukan oleh perhotelan adalah, hotel boleh menggunakan sumber tenaga lampu yang cekap dan jimat tenaga yang bertujuan menjimatkan bil elektrik dan menyumbang pengeluaran karbon dioksida yang berlebihan (Mekhilef et al., 2012). Selain itu, Perkhidmatan sewaan basikal di sekitar hotel juga boleh diperkenalkan bagi mengurangkan penggunaan kenderaan dan dapat mengurangkan pengeluaran asap yang berlebihan.

# 2.2.2 Tingkah laku ekologi

Tingkah laku ekologi adalah satu aktiviti dimana manusia sendiri melakukannya untuk menyelamatkan semula alam sekitar yang semakin tercemar. Selain itu, tingkah laku ekologi juga digambarkan sebagai tindakan yang menyumbang ke arah pemeliharaan dan pemuliharaan alam sekitar. Tindakan bertanggungjawab atau dikenali sebagai proalam sekitar yang memaparkan penilaian kelestarian alam sekitar, termasuk mengurangkan bahan buangan dan sumber kitar semula. Tingkah laku ini bertujuan untuk mengurangkan kesan buruk ke atas ekosistem yang disebabkan oleh aktiviti manusia dan menyumbang kepada tempat kerja yang mampan alam sekitar (Hut et al.,2010).

Tingkah laku ekologi juga ialah tingkah laku mesra alam secara khususnya di tempat kerja berbanding dengan tingkah laku individu yang merujuk kepada mengambil tindakan untuk mengurangkan kesan negatif terhadap alam sekitar atau memberi manfaat positif kepada perlindungan alam sekitar. Tingkah laku mesra alam ditakrifkan sebagai penglibatan pekerja dalam tingkah laku ekologi, termasuk tindakan pekerja dalam melaksanakan kerja mesra alam. Sebagai contoh, Pencegahan pencemaran dan pelepasan karbon yang berlebihan, penggunaan semula atau kitar semula, mengurangkan tenaga yang digunakan, dan mempengaruhi orang lain untuk menerima pakai inisiatif hijau adalah contoh tingkah laku ekologi dalam pelaksanaan pengurusan alam sekitar (Greaves et al. 2013).



# 2.2.3 Ekologi imej

Ekologi imej ialah impak yang ketara terhadap imej syarikat dalam industri makanan kerana ciri tidak ketara restoran tidak boleh dinilai sebelum pelanggan menjamu selera. Akibatnya, pelanggan sangat bergantung pada imej restoran yang dibuat oleh pengusaha (cth, nama jenama restoran atau atribut restoran). Ekologi imej juga penting terhadap aktiviti amalan hijau kerana ia juga sebahagian daripada alam sekitar. Imej hijau restoran boleh digambarkan sebagai imej kepercayaan pelanggan tentang imej ekologi restoran. (Bloemer & Ruyter, 1998; Ryu et al., 2008). Ekologi imej korporat dalam pemasaran juga menunjukkan bahawa fungsi amalan hijau merupakan komponen pembangunan imej restoran. Hasil daripada peningkatan sensitiviti sosial terhadap isu imej restoran boleh terjejas dengan ketara oleh kurangnya minat terhadapnya kebimbangan alam sekitar.

Imej syarikat adalah penting kerana ia mencerminkan restoran tersebut agar pelanggan berpuas hati dengan imej hijau yang dilakukan oleh pengusaha. Pelbagai kajian juga telah menunjukkan bahawa imej sesebuah organisasi dapat memainkan peranan yang penting terhadap persepsi pelanggan terhadap restoran (Ryu et al., 2008). Begitu juga, imej hijau restoran boleh digambarkan sebagai kepercayaan pelanggan terhadap imej ekologi restoran. Pengusaha harusnya lebih peka terhadap imej hijau yang semakin dikenali oleh masyarakat pada masa kini. Ekologi imej restoran juga harus lebih peka terhadap persekitaran semasa agar dapat menari minat pelanggan terhadap alam sekitar.

# 2.2.4 Persepsi amalan hijau

Persepsi amalan hijau adalah satu aktiviti di mana sesebuah organisasi mencipta produk baru bagi menggantikan produk lama yang mendatangkan kesan negatif terhadap alam sekitar. Produk baru yang dicipta adalah jauh lebih baik kerana tidak menjejaskan alam sekitar. . (Mohd Hamdan Adnan, JP Diana Demiyah Hamdan, 2018) Persepsi amalan hijau ini perlu diamalkan di premis perniagaan. Terutamanya dalam perindustrian makanan dan minuman. Hal ini kerana setiap produk baru yang dicipta semestinya mempunyai kelebihan tersendiri kepada alam sekitar. persepsi amalan hijau boleh dikaitkan dengan pelanggan restoran yang dipengaruhi oleh amalan mesra alam restoran yang penting penilaian tentang kehijauan restoran. Oleh itu, persepsi pelanggan mengenai prestasi amalan hijau di restoran akan mempengaruhi kepercayaan pelanggan mengenai kemesraan alam sekitar restoran.



Persepsi terhadap persekitaran hijau boleh mempengaruhi tingkah laku pengguna. Ia menguji sama ada tingkah laku pengguna bertindak balas terhadap perubahan persekitaran. Hubungan antara persepsi pelanggan terhadap amalan hijau dan imej yang dilihat oleh pengusaha restoran boleh dijelaskan bahawa pelanggan menitik beratkan amalan hijau yang diterapkan oleh pengusaha restoran. oleh itu, persepsi amalan hijau di restoran akan mempengaruhi apa yang pelanggan percaya mengenai isu-isu alam sekitar di restoran. Selain itu, amalan hijau yang mempengaruhi imej ekologi restoran yang dilihat oleh pelanggan hijau mungkin berbeza daripada pelanggan yang kurang gemar terhadap hijau (Martineau, 1958; Myers, 1968).

### 3.0 Methodologi

### 3.1 Reka Bentuk Kajian

Kajian ini menggunakan kaedah kualitatif. Kajian ini menggunakan satu kes kajian (*single kes study*). Kes kajian yang dipilih berdasarkan restoran tersebut mempunyai ISO 14000. Temubual dijalankan menggunakan soalan separa berstruktur. Analisis data yang digunakan adalah analisis tematik.

### 3.2 Responden

Responden dalam kajian ini adalah mereka yang bekerja di restoran yang telah berkhidmat melebihi 3 tahun. Sebanyak 3 orang respondent yang dipilih dalam kajian ini. Salah seorang daripada responden adalah pengusaha restoran tersebut. Manakala dua responden yang lain adalah pekerja di restoran tersebut. Responden pertama mempunyai pengetahuan dari faktor motivasi yang dinyatakan

## 4.0 Dapatan Kajian

Analisis faktor-faktor motivasi amalan hijau di restoran telah dikenalpasti melalui temuramah bersama tiga respondent pengamal amalan hijau. Dapatan kajian mengenai faktor-faktor motivasi amalan hijau adalah seperti berikut:



Pertama, respondent 1 menyatakan ekologi imej adalah merupakan faktor motivasi amlan hijau direstoran.

"(..)Okey dari segi interior kita boleh nampak, kita menggunakan lebih kurang 80% adalah kayu termasuklah frame kedai, ni semua ni ada kayu okey dari orang kata environment lah, ketika masak asap yang em asap yang dikeluarkan ketika masak ditapis menggunakan charcoal adalah aranglah supaya asap yang dikeluarkan adalah asap bersih dan minyak minyak tu terkumpul di charcoal tersebut. (Respondent 1)

Berdasarkan Jadual 1.1, majoriti respondent (3/3) menyatakan bahawa faktor motivasi amalan hijau di restoran adalah disebabkan oleh ekologi imej. Ini adalah disebabkan pelanggan akan mudah tertarik apabila reka bentuk dalaman restoran banyak mengutamakan konsep alam sekitar sebagai contoh, pengusaha banyak menggunakan kayu – kayu jati sebagai perabot dalaman restoran. Selain itu, asap yang dikeluarkan ketika masak akan ditapis supaya asap yang dibebaskan adalah asap yang bersih. Hal ini akan membuatkan pelanggan lebih tertarik untuk berkunjung ke restoran tersebut kerana merasakan memilih restoran yang mengamalkan hijau turut sama menyumbang kepada kelastarian.

Kedua, respondent 1 menyatakan tingkahlaku ekologi adalah merupakan faktor motivasi amalan hijau direstoran.

"(..)Aaa okey dari segi bahan mentah yang disupplier kepada agent agent saya mengetengahkan isu aaa refill. Aaa maksud dia setiap bahan mentah yang digunakan tidak perlulah kita menggunakan bahan plastik aa terlalu banyak, bermaksud sekali pakai habis, datang kedai refill. Aaa seperti itu. Untuk agent selalunya yang boleh di refill adalah sos takoyaki lah, kami sedaikan yang awal awal tu kami sediakan sebuah botol aa kepada agent aa supaya agent aa senang untuk buat refill lah kat kedai kami. Dari segi Takoyaki saya aaa menyarankan kepada agent menggunakan papper box supaya tidak menggunakan plastik box aa secara meluas.

(Responden 1)



Berdasarkan Jadual 1.1 majoriti respondent (3/3) menyatakan bahawa faktor motivasi amalan hijau di restoran adalah tingkahlaku ekologi. Tingkahlaku ekologi yang suka akan inisiatif hijau menyumbang kearah kelastarian. Ini selaras dengan yang menekankan bahawa amalan hijau mungkin tidak menjadi pilihan terbaik untuk industri. Terutama jika Inustri iitu tidak bersedia untuk mengaplikasi amalan hijau.

Akhir sekali, respondent 1 menyatakan persepsi amalan hijau adalah merupakan faktor motivasi amalan hijau direstoran.

(..)Aaa kita oleh lihat , apa yang boleh saya katakan, pelanggan kadang kadang dia tak cerita, aa tetapi dari lenggok dan dari kekerapan aaa freguency pelanggan ke sini aa kita boleh nampak aa pelanggan lebih kepada selesa dan tenang aa ketika berada di dalam kedailah okey aa dan bukan aa kita tidak boleh harapkan aircond untuk menenangkan pelanggan tapi aa sebenarnya dari segi orang kata penglihatan pun dapat menyejukkan seseorang itu dan kita boleh lihat daripada situ lenggok pelanggan amat selesa dengan amalan hijau diterapkan dalam kedai ini. suasana аа yang (Responden 1)

Berdasarkan Jadual 1.1, majoriti respondent (3/3) menyatakan persepsi amalan hijau terhadap restoran yang dikunjungi dapat meningkatkan kekerapan pelanggan ke restoran tersebut. Cabaran yang dihadapi melalui faktor ini ialah dimana bukan semua restoran dapat mengetengahkan persepsi tersebut. Masih banyak restoran yang belum mengamalkan persepsi amalan hijau terutamanya restoran yang baru memulakan perniagaan di dalam industri ini.

Faktor Motivasi	Responden 1	Responden 2	Responden 3	Jumlah
Ekologi imej	1	1	1	3/3
Tingkahlaku ekologi	1	1	/	3/3
Persepsi amalan hijau	1	1	1	3/3

Jadual 1.1: Faktor- Faktor motivasi amalan hijau di restoran



Berdasarkan Jadual 1.1, majoriti responden menyatakan bahawa faktor- faktor motivasi amalan hijau di restoran adalah ekologi imej, tingkah laku ekologi, dan persepsi amalan hijau. Ekologi ima

## 5.0 Kesimpulan dan Cadangan

### Cadangan

Pertama. berdasarkan implikasi amalan hijau dan kesedaran untuk menjaga alam sekitar, amalan hijau adalah dianggap sebagai satu aktiviti penting untuk diterapkan di dalam industri perhotelan pada masa kini. Industri perhotelan dicadangkan keran kekurangan kajian berkaitan amalan hijau di sektor perkhidmatan. Hal ini kerana industri perhotelan merupakan salah satu industri yang sector perkhidmatan. Kajian akan dating dicadangkan untuk melihat faktor motivasi amalan hijau.

Kedua, kajian seterusnya adalah dicadangkan dalam sector pelancongan merupakan industri yang berkembang pesat yang menyumbang secara positif kepada ekonomi pertumbuhan sesebuah negara. Disebabkan pelancongan melibatkan interaksi antara manusia dan alam sekitar, pertambahan kedatangan pelancong dan aktiviti pelancongan boleh memberikan kesan terhadap alam sekitar (Siti Nabiha et al., 2011). Industri ini juga mamapu dijadikan bahan penyelidikan kerana mempunyai banyak faktor motivasi. Faktor motivasi yang di maksudkan termasuklah ekologi imej, tingkah laku ekologi dan persepsi amalan hijau

## Kesimpulan

Amalan hijau adalah penting bagi semua industri kerana ia bukan sahaja memberi impak kepada alam sekitar tetapi kepada sosial dan ekonomi. Secara tidak langsung amalan hijau ini menyumbang kepada kelastarian. Kajian ini telah menemui tiga faktor motivasi iaitu ekologi imej, tingkahlaku ekologi dan persepsi amalan hijau. Faktor motivasi ini juga nerupakan secara tidak langsung dapat menyumbang kepada kelastarian.



### Sumber Rujukan

- David Wesley, S., Helena Maria André, B., & Clerici, M. T. P. S. (2021). Gluten-free rice & bean biscuit: characterization of a new food product. *Heliyon*, 7(1), 1–14. https://doi.org/10.1016/j.heliyon.2021.e05956
- Fordham, D. A., Jackson, S. T., Brown, S. C., Huntley, B., Brook, B. W., Dahl-Jensen, D., Thomas, M., Gilbert, P., Otto-Bliesner, B.L. Svensson, A., Theodoridis, S. Wilmshurst, J. M., Buettel, J. C., Canteri, E., McDowell, M., Orlando, L., Pilowsky, J., Rahbek, C., & Nogues-Bravo, D. (2020). Durham Research on-line. *Science*, 269(6507).
- Ghafar, S. W. A. (2017). Food Waste in Malaysia : Trends, Current Practices and Key Challenges. *FFTC Agcricultural Policy Articles*, *July*, 1–12. http://ap.fftc.agnet.org/ap\_db.php?id=774
- Hoegh-Guldberg, Ove; Jacob, Daniela; Taylor, M. (2018). Impacts of 1.5 C global warming on natural and human systems." Global warming of 1.5 C. An IPCC Special Report. American Journal of Epidemiology, 170(June), NP. http://www.ncbi.nlm.nih.gov/pubmed/19943627
- Kabir, S., Ahasanul, H., & Sarwar, A. (2017). Factors Affecting the Intention to Become an Entrepreneur : A Study from Bangladeshi Business Graduates Perspective To cite this version : HAL Id : hal-01580857 Factors Affecting the Intention to Become an Entrepreneur : A Study from Bangladeshi Business. *International Journal of Engineering and Information Systems(IJEAIS)*, 1(6), 10–19.
- Kamis, A., Mohammad Hussain, M. A., Che Kob, C. G., Nur Yunus, F. A., & Rahim, M.
  B. (2018). Validity and Reliability of Green Skills Instrument. *Sains Humanika*, *10*(3–3), 73–80. https://doi.org/10.11113/sh.v10n3-3.1518
- Lindsay, E. K., Young, S., Smyth, J. M., Brown, K. W., & Creswell, J. D. (2018). Acceptance lowers stress reactivity: Dismantling mindfulness training in a randomized controlled trial. *Psychoneuroendocrinology*, *87*(September 2017), 63– 73. https://doi.org/10.1016/j.psyneuen.2017.09.015
- Novacka, L., Pícha, K., Navratil, J., Topaloglu, C., & Švec, R. (2019). Adopting environmentally friendly mechanisms in the hotel industry: A perspective of hotel managers in Central and Eastern European countries. *International Journal of*



*Contemporary Hospitality Management*, 31(6), 2488–2508. https://doi.org/10.1108/IJCHM-04-2018-0284

- Salim, S. M., & Cheah, S. C. (2009). Wall y + Strategy for Dealing with Wall-bounded Turbulent Flows. *International MultiConference of Engineers and Computer Scientists (IMECS)*, *II*, 1–6.
- Yuriz, Y., Ismail, T. N. H. T., Mohamed, I., & Hassan, N. N. M. (2021). Characteristic properties of plastic wastes: Possibility of reinforcing material for soil. *Jurnal Teknologi*, 83(4), 127–136. https://doi.org/10.11113/jurnalteknologi.v83.14676
- Zhao, Y., Gao, W., Li, S., Williams, G. R., Mahadi, A. H., & Ma, D. (2019). Solar-versus Thermal-Driven Catalysis for Energy Conversion. *Joule*, *3*(4), 920–937. https://doi.org/10.1016/j.joule.2019.03.003



# MENGKAJI TAHAP KEPERCAYAAN, KESETIAAN DAN KEPUASAN PENGGUNA DALAM MEMBELI PRODUK ATAS TALIAN DI KAWASAN ARAU PERLIS

## NUR AMNI NATRAH BINTI RAMLEE, NURUL AISYAH BINTI SAMSUDIN, NUR AZLIN NATASHA BINTI ZAKARIA

nuramninatrah2021@gmail.com, aisyahsamsudin0910@gmail.com, azlinzakaria16@gmail.com

# ABSTRAK

Kajian yang dijalankan ini bertujuan untuk mengetahui faktor-faktor yang mempengaruhi pembelian produk di atas talian. Faktor yang mempengaruhi pembelian atas talian yang dikaji dalam kajian ini adalah kepercayaan, kesetiaan dan kepuasan. Kaedah pengumpulan data adalah secara pengedaran borang soal selidik kepada penduduk kawasan Arau yang mempunyai pengalaman tentang pembelian secara atas talian. Data dianalisis secara deskriptif dan korelasi. Dapatan kajian menunjukkan kepercayaan yang teguh memperkukuhkan bahawa banyak faedah yang diperoleh dalam pembelian atas talian. Diharapkan kajian ini dapat dijadikan rujukan oleh peniaga online dalam menambah baik kualiti perkhidmatan agar pengguna lebih percaya, setia dan puas membeli.

Kata kunci: pembelian atas talian, kepercayaan, kesetiaan, kepuasan

## 1.0 PENGENALAN

Malaysia pernah berkemampuan untuk menjadi sebuah bandar yang maju bagi mencapai target wawasan 2020 yang diungkapkan oleh Tun Dr Mahathir Mohamad semasa beliau menjadi Perdana Menteri. Walaupun kita tidak dapat mencapainya kita rakyat Malaysia

masih dikira dalam keadaan aman, sejahtera dan bebas (Astro Awani Disember 2019) serta dapat mengikuti beberapa teknologi negara maju yang dapat digunakan oleh rakyat malaysia bagi mempercepatkan ekonomi berkembang dengan pesat. Seperti yang sedia maklum, Malaysia dan seluruh negara telah dikejutkan dengan satu wabak penyakit iaitu Covid-19 yang membuatkan ekonomi seluruh negara lumpuh. Selain itu, ianya juga membuatkan peniaga tempatan dan global berada dalam keadaan kegawatan untuk mencari sumber kewangan dan bahan mentah. Bagi mengatasinya, pandemik ini



menyedarkan rakyat bertindak mengubah corak pembelanjaan supaya tidak berhadapan dengan masalah kewangan yang serius (Valasko et al.,2021).

Dengan isu yang diusulkan ini kaedah perniagaan yang digunakan adalah terus kepada penjual dan pembeli tanpa menggunakan orang tengah melalui medium yang semakin pesat membangun iaitu internet yang merupakan pembelian secara atas talian atau lebih dikenali sebagai 'online shopping' bagi pengguna abad ke-20. Dengan hanya dapat melewati platform perniagaan sesebuah syarikat tersebut, pengguna boleh melihat dan memilih produk atau perkhidmatan yang dikehendaki dengan hanya mengklik. (Nor Syahilia dan Faizatul Hafilah 2015). Pengguna bukan sahaja memberikan maklumat kepada pembekal tentang kualiti sesuatu produk melalui platform digital tetapi urusan jual beli turut dijalankan menggunakan perkara ini (Sima et al.,2020). Keadaan yang memaksa telah membuat orang ramai ingin mengambil tahu tentang platform yang banyak digunakan untuk memperkenalkan produk dan menjual tanpa bersemuka contohnya ialah website company, lazada, shopee, zalora dan sebagainya untuk langkah kepada pengguna mengetahui lebih lanjut.

## 1.1 LATAR BELAKANG KAJIAN

Pelbagai maklumat dihujung jari mudah dicari melalui rangkaian internet yang banyak digunakan dan menjadi rujukan serta dapat mencari maklumat tanpa had penggunaan

. Tidak terlepas juga pada usahawan dan peniaga bagi menggunakan platform seperti website, shopee dan lazada untuk memperluaskan rangkaian perniagaan. Sering diperkatakan bahawa komunikasi antara pelanggan dengan penjual dapat menarik minat untuk membeli tetapi ada sahaja pelanggan yang cenderung untuk membeli secara atas talian kerana mempunyai masalah dalam berkomunikasi terhadap orang asing.

Seterusnya adalah pemberitahuan dalam kalangan pelanggan atas talian ini mengenai harga yang dikenakan terhadap pembelian atas talian lebih murah dan berpatutan. Dibuktikan juga pengguna mudah tertarik dan berpasang niat untuk mengetahui produk secara lebih kepada arah positif. (Lim & Cham 2014). Seperti yang ditekankan semasa endemik berlaku masyarakat hanya berurusan dari rumah maka kita perlu tahu pada era ini peningkatan 'online shopping' adalah sangat memberangsangkan Silver (2008) menyatakan penggunaan perniagaan atas talian dapat menambahkan pendapatan mereka secara terus.



Walau bagaimanapun, setiap individu haruslah mengetahui risiko atau impak terhadap diri apabila terjebak dengan pembelian atas talian mahupun remaja atau dewasa. Apabila sesuatu perkara itu menjadi trend semasa, mereka akan terbiasa dan jarang membeli di kedai secara bersemuka dan menjadi satu tanggungan kepada peniaga juga kerana terlampau banyak pesaing di media massa dengan menggunakan platform pembelian atas talian. Pelbagai jenis perniagaan yang dijalankan adalah untuk menjana pendapatan ketika pengangguran dan pembuangan pekerja bersebab ketika Perintah Kawalan Pergerakan (PKP) bagi menyara hidup mereka. Satu kajian telah terbukti iaitu hasil daripada Mohammad Hossein et. Al (2012) berpendapat akan timbulnya faktor pembelian atas talian antara pengguna dan pembeli atas kesulitan tentang adakah barangan yang dibeli akan sampai ke pengguna.

### 1.2 PENYATAAN MASALAH

Kajian yang dibuat adalah tahap kepuasan pengguna dalam kalangan masyarakat ketika Perintah Kawalan Pergerakan (PKP) melanda di daerah hulu langat yang meningkat di kawasan bandar (Faradillah Iqmar Omar1, Khairunnisa Hanifah & Nor Azli Hassan 2021). Seperti sedia maklum, kajian ini mengkaji tentang kepuasan menyeluruh di kawasan Arau yang menjadi trend terkini pembelian atas talian. Peningkatan permintaan melalui e-dagang semakin meningkat sehingga kini menjadi pilihan utama pengguna untuk membeli produk secara atas talian (Isa et al., 2020). Seperti yang dimaklumkan, kajian yang dijalankan tahap pengguna antaranya kepercayaan, kesetiaan dan kepuasan pembelian atas talian. (Zainal Badar, 2016).

Kajian lepas hanya membincangkan tentang personaliti atau persepsi pengguna iaitu kemudahan, populariti dan keselamatan serta pengalaman (Taufan Hariyadi (2014), Cicilia Desy Widya Permatasari (2015) dan Pube Emma Naomi R.B (2016). Kajian yang mengadakan hubungan positif turut dibuat. Kelebihan yang membawa faedah yang menjadikan permintaan tinggi adalah internet menjadi keutamaan masyarakat tetapi ianya juga menjadikan sumber rezeki kepada penjual dan pembeli, impak yang terpaling kepada pengguna membuatkan mereka tidak gemar. Risiko yang terlibat dengan urus niaga dalam talian menjadi impak kepada pengguna trauma atas pembelian atas talian apabila transaksi jual beli dilakukan tapi tiada pulangan produk (Raihan et al., 2006).

Apabila Malaysia diperkuat kuasa dengan mengadakan Perintah Kawalan Pergerakan (PKP) yang tidak membenarkan semua rakyat diharamkan keluar rumah tanpa alasan yang munasabah. Dilaporkan bahawa Kedah dikenakan Perintah Kawalan Pergerakan Diperketatkan (PKPD) pada februari 2022 sedangkan negeri lain sudah dalam keadaan fasa endemik dan masih kekalkan SOP (Berita harian 2022). Permintaan kurier



meningkat sehingga mencatatkan 77,000 parcel dalam masa sehari untuk penghantaran dengan kekurangan pekerja akibat PKP. Selain itu mereka menyaksikan peningkatan yang singkat pengguna melakukan pembelian atas talian ini menjadikan lambakan barang dan mereka mengambil tindakan meningkatkan fasiliti kurier (Harian Metro 2021).

## 1.3 PERSOALAN KAJIAN

Dalam membuat penyelidikan, pasti ada persoalan yang timbul. Antara persoalan yang terdapat dalam kajian ini ialah:

1. Adakah terdapat hubungan faktor kepercayaan terhadap keinginan membeli secara atas talian?

2. Adakah terdapat hubungan faktor kesetiaan terhadap keinginan membeli secara atas talian?

3. Adakah terdapat hubungan faktor kepuasan pengguna terhadap keinginan membeli secara atas talian?

### 1.4 OBJEKTIF KAJIAN

Objektif kajian ini adalah untuk mengkaji tahap kepercayaan, kesetiaan dan kepuasan pengguna dalam membeli produk di atas talian. Berdasarkan persoalan kajian, tiga objektif penyelidikan dapat dibentuk. Antara objektif tersebut ialah:

1. Mengkaji hubungan faktor kepercayaan pembelian atas talian oleh penduduk di kawasan Arau.

2. Mengkaji hubungan faktor kesetiaan pembelian atas talian oleh penduduk di kawasan Arau.

3. Mengkaji hubungan faktor kepuasan pembelian atas talian oleh penduduk di kawasan Arau.

### 2.0 ULASAN KARYA

Sorotan penulisan bagi kajian ini memberi fokus kepada faktor-faktor yang mempengaruhi pengguna dalam membuat keputusan pembelian atas talian. Beberapa kajian lepas yang telah dijalankan berkaitan dengan tajuk kajian ini turut dibincangkan.



Huraian yang dibuat merujuk kepada pembolehubah bersandar iaitu pembelian secara atas talian dan tiga pembolehubah tidak bersandar iaitu kepercayaan, kepuasan dan kesetiaan pengguna.

#### 2.1 PENGENALAN

Trend pembelian secara atas talian telah menjadi kegemaran oleh para pembeli. Hal ini kerana, dengan melakukan transaksi secara atas talian dianggap alternatif lebih mudah dan menjimatkan masa berbanding pembelian secara bersemuka. Pelbagai jenis transaksi yang lebih pantas dapat dibuat jika menggunakan transaksi dalam talian. Sesuai dengan perubahan gaya hidup oleh masyarakat yang semakin sibuk seiring dengan kepesatan ekonomi, pembelian secara atas talian lebih diberi tumpuan dan pilihan oleh pengguna. Pengguna dapat memperoleh banyak manfaat hasil dari membeli secara *online*. Hanya dihujung jari, pengguna dapat membuat perbandingan barangan dalam pelbagai aspek sebelum membeli barangan tersebut. Semua ini hanya dibuat secara maya sahaja tanpa perlu keluar dari rumah. Di samping itu, ianya juga mudah digunakan dan dapat menjimatkan masa pengguna.

#### 2.2 Pembelian atas talian

Membeli-belah dalam talian ialah proses membeli barangan dan perkhidmatan daripada peniaga melalui internet. Berbelanja membawa maksud suatu perancangan untuk membeli barangan mahupun perkhidmatan tertentu (Pudji Utomo et al., 2011). Utomo, P., Lestariningsih, E., & Suhari Y 2011 mengkaji kepercayaan terhadap internet serta pengaruhnya pada pencarian maklumat dan keinginan membeli secara online. Kajian yang dijalankan menggunakan teknik pengambilan sampel yang digunakan adalah purposive accidental sampling. Teknik yang digunakan memerlukan penelitian responden yang mempunyai pengetahuan dan cara mengakses perniagaan yang melakukan jualan secara online.

Transaksi pembelian secara online boleh dibuat pada bila-bila masa tanpa perlu tahu kedudukan penjual dan pembeli ianya berbeza jika dibandingkan dengan pembelian secara bersemuka. Pembelian secara atas talian menjadi trend ikutan sejak dua dekad lalu dan juga menjadi sesuatu yang sah oleh para pengguna. Terdapat pengguna yang peka dan sedar tentang pentingnya membeli dalam talian. Sejajar dengan pembangunan ekonomi dan teknologi di Malaysia membolehkan pembeli membuat keputusan dan berbelanja secara atas talian. Pembangunan teknologi baru dan gelombang internet memberi kesan perubahan gelagat pengguna dalam kehidupan harian mereka (Bauerova & Klepek, 2018). Perkembangan teknologi internet memberi kesan terhadap



perniagaan dalam talian (e-dagang). Proses pembelian dan jualan yang dibuat melalui elektronik dikenali sebagai (e-dagang). Antara proses tersebut ialah membuat pesanan, penghantaran, pembayaran, pengiklanan dan perkhidmatan selepas jualan untuk perkhidmatan dan juga barangan. Menurut kajian Faradillah Iqmar Omar (2016), dalam kajiannya menjelaskan tentang teknologi baru yang memberi kesan besar terhadap kehidupan masyarakat terutamanya kepada generasi muda. Ini merangkumi aspek perniagaan, perkongsian maklumat, penerimaan berita serta pemasaran dan periklanan.

## 2.3 Faktor Kepercayaan

Kepercayaan merupakan faktor penting yang mendorong seseorang individu dalam membuat keputusan membeli barangan atau perkhidmatan di internet. Menurut Suhartini R.S (2011), kepercayaan juga mempengaruhi tahap spekulasi terhadap risiko dan penilaian yang dilakukan oleh pelanggan. Menurut kajian oleh Tractinsky, dan Vitale, (2000) mendapati faktor kepercayaan adalah menjadi kepentingan dalam hal yang melibatkan risiko dan pertukaran menerusi elektronik. Kajian yang dijalankan memperoleh kutipan data menggunakan borang soal selidik. Faktor kepercayaan oleh pengguna apabila menggunakan apa jenis aplikasi dalam laman sesawang amat diutamakan (Ahmad Syahrul Haniff Mohd Rawi et al., 2011). Ini bertujuan untuk mengenalpasti sama ada sesebuah laman web yang dikunjungi mengandungi unsur penipuan atau tidak untuk mengelakkan kerugian kepada pihak pembeli.

#### 2.4 Faktor Kepuasan

Pembeli yang berpuas hati dengan barang yang dibeli sudah pasti akan membuat ulang beli pada masa akan datang. Tindakan mengulangi belian dimaksudkan sebagai kesetiaan pelanggan pada peringkat mulanya (Cunningham, 1961; Tucker, 1964). Penyataan ini dikritik oleh beberapa sarjana terdahulu kerana tindakan mengulangi belian tidak semestinya menggambarkan keinginan pelanggan untuk setiap pelanggan untuk setia dengan premis perniagaan. Jika barangan yang dibeli sesuai dengan citarasa pembeli, akan timbul rasa setia oleh pembeli terhadap jenama dan barangan tersebut. Sebaliknya, beberapa pengkaji lain juga mengatakan komitmen berhubung rapat dengan kesetiaan kerana tanpanya, kesetiaan dianggap tidak nyata *(spurious loyalty).* Jadi, wujud kedua-dua perspektif sikap dan gelagat mendefinisikan kesetiaan. Oleh kerana itu, kesetiaan pelanggan untuk membuat belian di premis perniagaan, mengulangi belian, meningkatkan kekerapan belian dan juga mengesyorkan premis perniagaan kepada pengguna lain untuk membeli di situ (Song et al., 2021). Untuk memastikan pengulangan

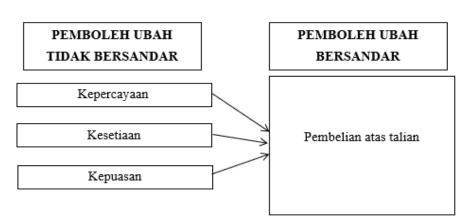


pembelian oleh pembeli di dalam talian, para peniaga perlu menitikberatkan fungsi, kualiti, harga, pempakejan dan jenama kerana ia mempengaruhi kesetiaan pelanggan.

### 2.5 Faktor Kesetiaan

Sikap umum terhadap layanan atau tindak balas emosi, antara jangkaan pelanggan dan apa yang diterima oleh mereka merujuk kepada kepuasan pelanggan. Kepuasan yang pengguna rasakan hasil dari membeli barangan secara atas talian juga menjadi faktor penting. Menurut kajian oleh Khalil (2014), lebih 55% responden menikmati pembelian dalam talian dan juga melayari internet untuk hiburan dan keseronokan. Pengguna mempunyai akses pilihan produk yang lebih luas, pelbagai jenis kedai dan pengalaman membeli-belah secara atas talian. Sebilangan besar responden menganggap bahawa pembelian dalam talian lebih mudah berbanding membeli-belah secara bersemuka. Hal ini disebabkan oleh pengguna tidak perlu mengerah tenaga untuk keluar dari rumah hanya untuk sampai ke sesebuah kedai mahupun pasaraya. Pengguna yang memilih untuk berbelanja secara dalam talian berpendapatan bahawa ianya lebih mudah dan jimat masa, serta dapat membuat perbandingan produk dan harga barangan mahupun perkhidmatan yang dimahukan.

#### 2.6 Kerangka Kajian



#### Rajah 1: Kerangka kajian

#### 3.0 METODOLOGI

Metodologi kajian ialah hal yang sangat penting dalam melakukan sesuatu penyelidikan. Metodologi yang diperolehi juga telah digunapakai dalam sebuah kajian. Data yang diperolehi juga menunjukkan kajian yang jelas supaya dapat mengelakkan daripada berlakunya kesilapan dalam membuat kesimpulan. Di samping itu, dalam bahagian ini



akan menjelaskan tentang medotologi, reka bentuk kajian, analisis data dan kajian rintis terhadap penduduk di Arau, Perlis.

### 3.1 Populasi / Saiz

Sampel Populasi kajian terdiri daripada orang awam yang berkedudukan di negeri Perlis di kawasan Arau. Seramai 384 saiz sampel (Jadual Krejcie and Morgan) responden telah terpilih secara persampelan kesenangan daripada anggaran populasi 97,322 penduduk kawasan Arau yang berkedudukan.

#### 3.2 Lokasi / Unit

Analisis Lokasi ini tertumpu kepada orang yang tinggal di kawasan Arau, Perlis.

## 3.4 Maklum balas

Sebanyak 323 borang soal selidik diedarkan, daripada jumlah itu sebanyak 364 dianalisa dan diguna pakai. Ini setelah ditolak borang soal selidik yang rosak dan pelbagai ralat.

#### 3.5 Instrumen kajian

Hasil adaptasi beberapa kajian berikut ialah kebolehpercayaan. Instrumen ini disahkan melalui ujian *reliability test* dengan dapatan Alpha Cronbach untuk faktor kepercayaan adalah 0.645, faktor kesetiaan 0.633 dan faktor kepuasan 0.702.

PEMBOLEHUBAH	NILAI CRONBACH ALPHA
	0.645
Kepercayaan Kesetiaan	0.633
Kepuasan	0.707
Pembelian online	0.809

Jadual 3.1 Nilai Cronbach Alpha dan Kebolehkepercayaan Kajian F	Rintis
(~ 202)	

#### 4.0 DAPATAN KAJIAN

Dapatan kajian ini berkaitan hasil kajian yang telah dianalisa daripada pengumpulan data penduduk. Data yang terkumpul hasil daripada pengedaran borang soal selidik. Maklumbalas responden dianalisis dengan menggunakan sistem program SPSS.



#### 4.1 Jantina

Jadual 4,1 menunjukkan jantina responden yang terlibat dalam kajian ini. Seramai 94 responden (27.2%) merupakan lelaki. Manakala, 229 responden (66.4%) lagi merupakan responden perempuan.

JANTINA	KEKERAPAN	PERCENT
Lelaki	94	27.2%
Perempuan	229	66.4%
Jumlah	323	100

#### Jadual 4.1 Jantina Responden

#### 4.2 Umur

Hasil dapatan dari kajian yang dibuat menunjukkan bahawa 34 responden (9.9%) terdiri daripada umur kurang 18 tahun yang membuat pembelian atas talian. Selain itu, hasil kajian menunjukkan bahawa 272 responden (78.8%) berumur 18 sehingga 24 tahun. Seterusnya 7 responden (2%) terdiri daripada umur 25-54 tahun dan 10 responden (2.9%) bagi umur 54 tahun ke atas.

#### Jadual 4.2 Umur Responden

	KEKERAPAN	PERCENT
Kurang dari 18 tahun	34	9.9 %
18-24 tahun	272	78.8 %
25-54 tahun	7	2.0 %
55tahun ke atas	10	2.9 %
JUMLAH	323	100



#### 4.3 BANGSA

Daripada kajian yang dikaji, jadual di bawah menunjukkan bahawa terdapat beberapa bangsa telah menjawab soal selidik ini. Antaranya, bangsa Melayu memperoleh sebanyak 79.1%, manakala bangsa Cina memperolehi sebanyak 11.3% dan bangsa India memperolehi sebanyak 2.6% dan yang lain-lain 0.6%.

	KEKERAPAN	PERCENT
Melayu	273	79.1%
Cina	39	11.3%
India	9	2.6%
Lain-lain	2	0.6%
Jumlah	323	100

#### Jadual 4.3 Bangsa Responden

#### 4.4 DAPATAN MEAN

Jadual 4.4 menunjukkan dapatan mean bagi pembelian dalam talian bagi faktor kepercayaan, kepuasan dan kesetiaan. Berdasarkan jadual tersebut, faktor kepercayaan menunjukkan nilai terendah iaitu 3.816. Manakala, bagi faktor kepuasan menunjukkan nilai mean sebanyak 3.984 dan faktor kesetiaan merupakan nilai mean tertinggi iaitu 3.998.

#### Jadual 4.4 : Dapatan Mean

	MEAN	
Kepercayaa n	3.816	
Kepuasan	3.984	
Kesetiaan	3.998	



#### 5.0 KESIMPULAN

Kesimpulannya, dalam pembelian dalam membeli barangan secara online faktor- faktor seperti kepercayaan, kesetiaan dan kepuasan mampu mempengaruhi pengguna dalam membuat belian. Pembelian atas talian dapat memberi banyak manfaat yang dapat diperoleh oleh setiap generasi, ianya bukan sahaja mudah malah menjimatkan banyak masa. Pengguna dapat membuat pilihan dengan pelbagai jenis barang di internet hanya di hujung jari. Pembelian atas talian juga menjimatkan kos kerana pembeli tidak perlu keluar rumah. Hal ini kerana, semenjak pandemik Covid-19 yang melanda negara, rata-rata rakyat Malaysia terpaksa membuat belian secara online untuk mengelakkan wabak merebak. Pada awal perintah yang dikeluarkan kerajaan membuatkan masyarakat sukar untuk keluar membeli barangan keperluan secara bersemuka. Kesimpulannya, produk yang ditawarkan melalui atas talian ini perlu mempunyai kriteria yang pengguna mahukan. Produk yang memenuhi citarasa dan melebihi jangkaan pengguna dapat menarik minat pengguna untuk membeli. Kriteria produk yang sering dipertimbangkan oleh pengguna ialah kualiti, saiz, warna, rasa, jenama, cara pembungkusan dan pelabelan.

#### 6.0 RUJUKAN

- Esa, M. M., & Basri, R. M. (2018). Faktor-Faktor Yang Mempengaruhi Pengguna Dalam Factors Influencing Consumer in Making Decision on Online. *Journal of Business Innovation*, *3*(M), 36–46.
- Klepek, M., & Aiolfi, S. (n.d.). *Technology Acceptance as a Determinant of Online Grocery Shopping Adoption*.
- Lim, Y. M., & Cham, T. H. (2015). A profile of the Internet shoppers: Evidence from nine countries. *Telematics and Informatics*, 32(2), 344–354. https://doi.org/10.1016/j.tele.2014.10.002
- Song, X., Cong, Y., Song, Y., Chen, Y., & Liang, P. (2021). A bearing fault diagnosis model based on CNN with wide convolution kernels. *Journal of Ambient Intelligence and Humanized Computing*. https://doi.org/10.1007/s12652-021-03177-x
- Yeong, D. J., Velasco-hernandez, G., Barry, J., & Walsh, J. (2021). Sensor and sensor fusion technology in autonomous vehicles: A review. *Sensors*, 21(6), 1– 37. https://doi.org/10.3390/s21062140



- Satryawati, E. (2018). Pengaruh Kepercayaan Dan Kepuasan Terhadap Loyalitas Pelanggan E- Commerce. *Jurnal Teknologi Informatika Dan Komputer*, *4*(1), 36–52. https://doi.org/10.37012/jtik.v4i1.284
- (Suhari, 2011)Suhari, Y. (2011). Kepercayaan Terhadap Internet Serta Pengaruhnya Pada Pencarian Informasi Dan Keinginan Membeli Secara Online. *Jurnal Dinamika Informatika*, *3*(1), 1–7.

Omar, F. I. (2016). Gen Y: a Study on Social Media Use and Outcomes. Journal of Management & Muamalah, 6(1), 22280 Fenomena Paylater di Tengah Menjamurnya Pinjo. http://dx.doi.org/10.1016/j.jplph.2009.07.006%0Ahttp://dx.doi.org/10.1016/j.nep s.2015.06.001%0Ahttps://www.abebooks.com/Trease-Evans-Pharmacognosy-13th-Edition-William/14174467122/bd

- (Jamaludin et al., 2015) Jamaludin, A., Arifin, Z., & Hidayat, K. (2015). Pengaruh Promosi Online Dan Persepsi Harga Terhadap Keputusan Pembelian (Survei Pada Pelanggan Aryka Shop Di Kota Malang). In *Jurnal Administrasi Bisnis* (*JAB*)/*Vol* (Vol. 21, Issue 1). www.antaranews.com
- Nurul Asyikin Ab Rahman, & Noor Aslinda Abu Seman. (2020). Hubungan antara Faktor Risiko dan Tingkah Laku Pengguna terhadap Pembelian Secara atas Talian. *Research in Management of Technology and Business*, 1(1), 968–983. http://penerbit.uthm.edu.my/periodicals/index.php/rmtb
- (Amri, 2020) Amri, A. (2020). Pengaruh periklanan melalui media sosial terhadap UMKM di Indonesia di masa pandemi. *Jurnal Brand*, 2(1), 123–130. https://www.academia.edu/42672824/Dampak\_Covid-19\_Terhadap\_UMKM\_di\_Indonesia
- Utomo, P., Lestariningsih, E., & Suhari, Y. (2011). Kepercayaan terhadap internet serta pengaruhnya pada pencarian informasi dan keinginan membeli secara online. *Jurnal Dinamika Informatika*, *3*.
- Mohamad, N., Ishak, M. S., & Rashid, S. M. (2017). pengaruh ciri-ciri produk kepada kesetiaan pelanggan : 5(2), 36–47.
- Ramli, M. W., Rohayah, S., & Dawood, S. (2021). *faktor golongan muda malaysia membeli dalam talian : satu tinjauan awal. 18*(5), 79–90.
- Komunikasi, J. (2012). Teknologi ICT kini telah banyak memberi kesan dalam aktiviti kehidupan seharian. 57, 105–127.



Technology, I., Jarvenpaa, S. L., & Vitale, M. R. (2000). Consumer trust in an Internet Store Consumer trust in an Internet store \*. April 2019. https://doi.org/10.1023/A

Arisah, Farhan Mat, Shamsul Azahari Zainal Badari, and Ahmad Hariza Hashim. "Amalan pembelian secara atas talian dan faktor-faktor mempengaruhi." *Malaysian Journal of Social Sciences and Humanities (MJSSH)* 1.3 (2016): 111-123.

- Baskara, I. P., & Hariyadi, G. T. (2012). Analisis Pengaruh Kepercayaan, Keamanan, Kualitas Pelayanan dan Persepsi akan Resiko Terhadap Keputusan Pembelian Melalui Situs Jejaring Sosial (Social Networking Websites) (Studi pada Mahasiswa di Kota Semarang). Udinus Repo, 2011, 1–15.
- Esa, M. M., & Basri, R. M. (2018). Faktor-Faktor Yang Mempengaruhi Pengguna Dalam Factors Influencing Consumer in Making Decision on Online. *Journal of Business Innovation*, *3*(M), 36–46.
- Pube Emma Naomi, R. B. (2016). Pengaruh Kepercayaan. *Kemudahan, Kualitas* Informasi dan Harga Terhadap Keputusan Pembelian Konsumen Dalam Memilih Berbelanja Secara Online, 12.

Nesha, A. U., Rashed, M. S., & Raihan, T. (2018). Identifying the factors that influence Online Shopping Intentions and practices: a case study on Chittagong Metropolitan City. *BUSINESS STUDIES*, 157.

- Chin, P. N., Isa, S. M., & Alodin, Y. (2020). The impact of endorser and brand credibility on consumers' purchase intention: the mediating effect of attitude towards brand and brand credibility. *Journal of Marketing Communications*, 26(8), 896-912
- https://unctad.org/news/covid-19-has-changed-online-shopping-forever-surveyshows
- Isa, Khairunesa. (2020). Malaysians' Popular Online Shopping Websites during Movement Control Order (MCO). International Journal of Advanced Trends in Computer Science and Engineering. 9. 2154-2158. 10.30534/ijatcse/2020/190922020.
- https://www.hmetro.com.my/mutakhir/2020/03/557138/covid-19-pembelian-onlinemelonjak



Gil-Sepulcre M, Lindner JO, Schindler D, Velasco L, Moonshiram D, Rüdiger O, DeBeer S, Stepanenko V, Solano E, Würthner F, Llobet A. Surface-Promoted Evolution of Ru-bda Coordination Oligomers Boosts the Efficiency of Water Oxidation Molecular Anodes. Journal of the American Chemical Society. 2021 Jul 22;143(30):11651-61



# THE DEVELOPMENT OF SMART LOCK CONTAINER GAME FOR SLOW LEARNER CHILDREN

N. A. Moktar, NM. Kamaruddin, Z. Mohamad, N. Roslan, A. A. A. Wahid

Department of Electrical Engineering, Polytechnic Sultan Salahuddin Abdul Aziz Shah, Selangor Malaysia

<sup>1</sup>norazlinaroslan@gmail.com, <sup>2</sup>nmsarah87@gmail.com, <sup>3</sup>zunuwanas@yahoo.co.uk, <sup>4</sup>nuruliman.ahmadmoktar89@gmail.com, <sup>5</sup>Amir40872@gmail.com

#### Abstract

A slow learner is someone who takes longer than the average person to understand things or someone who needs multiple explanations before grasping a concept. Due to the pandemic of Covid19, children are often getting distracted while learning something at home and because of the limits and lack of idea on how their parents can get their children to engage in learning at home. To overcome this problem, Smart Lock Container Games for Slow Learner Children is developed. This device can help slow learner children learn and have fun solving problems at home. The project involves a game that will be played by slow learner children while being supervised by a parent to open a locked container that consists of a processor such as Arduino Nano and HC-05 Bluetooth Module that has an interface for the game and the container. It is a new method that can help and encourage slow learner children to learn or gain interest in learning and also can boost their ability to think when solving the game to open the lock.

Keywords: Slow learner, Arduino Nano, HC-05 Bluetooth Module, Assistive Technology.

#### 1. Introduction

A slow learner is someone who takes longer than the average person to understand things or someone who needs multiple explanations before grasping a concept and is not eligible for special education [1]. These individuals make up approximately 14.1% of the population, larger than the group of children with learning disabilities, intellectual disabilities, and autism combined [12]. According to Yusha'u, a slow child's measured intelligence ranges from 75% to 90% of that of an average child, and their learning rate



is 4/5 to 9/10 of that of a normal child [1]. Slow learners' disabilities are not usually as visible as those of children who are blind, deaf, or physically disabled. Their inability to think and learn is tied to their impairment. As a result,

they are less capable than other children to meet the normal demands of education and modern life. As adults, many of them will be absorbed into the community's life and will contribute meaningfully without bringing undue attention to themselves.

#### 2. Literature Review

#### 2.1 Slow Learner Cildren

Slow learners do not have special needs but are classified as having learning disabilities (LD). They have mild cognitive problems and are unable to acquire something in the time allotted for it. Slow learners have a low intelligence quotient (IQ), limited cognitive capacity, information processing weaknesses, poor memory or short-term memory ability, lack of concentration with a short attention span, difficulty with abstract thinking leading to inability to express ideas, and attention problems [8].

#### 2.2 Assistive Technolgy (AT)

Assistive technology (AT) or assistive device is any item, piece of equipment, software application, or product system that is designed, made, or adapted used to help people with disabilities increase, maintain, or improve their functional abilities. Based on certain factors parents should choose suitable assistive devices for their child to use to aid in the process of learning [11].

Although AT does not cure or eliminate learning disabilities, it can help a child reach her full potential by allowing her to focus on her strengths while avoiding areas of difficulty. A student who struggles with reading but has excellent listening skills, for example, might benefit from listening to audiobooks. Assistive technology can be lowtech, mid-tech or high-tech, so teachers and parents should become familiar with assistive



technology and understand how it can be incorporated within their teaching to support an inclusive learning environment.

#### 2.3 Learning Styles

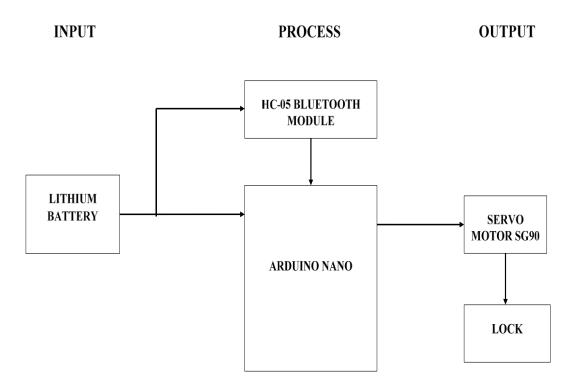
A learner's 'learning style' can be defined as the characteristics of that learner that influence how that person learns. Individual differences shape how people learn; some prefer reflection, while others need to see and practise their new skills. Understanding one's preferred learning style can help one's ability to absorb and retain new information.

#### 3. Methodology

#### 3.1 Block Diagram

The project design's block diagram, shown in Figure, consists of a microcontroller and a communication system. The central processor is an Arduino Nano, and the Bluetooth module is an HC-05. To control the Servo motor, the Bluetooth Module will act as a communicator between the game app and the Arduino Nano. Once the Bluetooth module is connected, the game app can control the motor to open or close the lock.





#### Figure 3: Block Diagram of Smart Lock Container Games

3.2 Software Implementation

This project was created with the Arduino Software (IDE), open-source software that allows users to easily write code and upload it to the board. This software is compatible with any Arduino board. There are two types of programming systems available: Arduino programming language (based on Wiring) and Arduino Software (IDE), which is based on Processing.



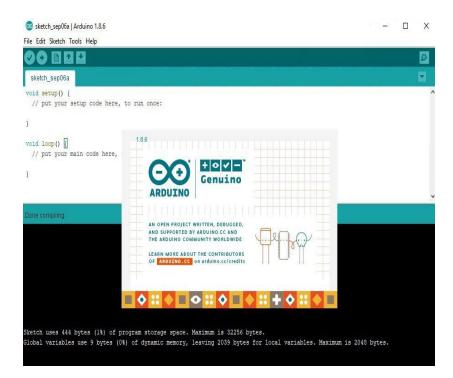


Figure 2: Arduino Software IDE

#### 4. Result & Discussion

4.1 Experiment on MIT App Inventor

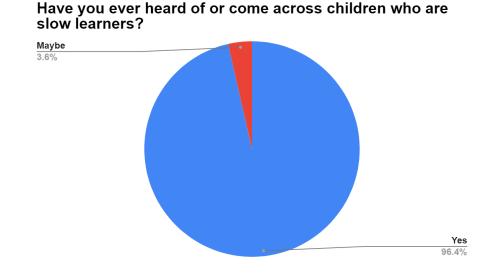
This section of the experiment shows how to create software or a game using the MIT App Inventor and how it will communicate with the Arduino via a Bluetooth module. MIT App Inventor is an open-source tool for people who want to create simple software or games using blocks as programming. The goal of this experiment is to ensure that the game visual is in the right location on the graphic smartphone and is linked to the programming and hardware and to make sure that the Bluetooth was connected successfully and the motor can be controlled.





Figure 3: Testing the visual of the game

4.2 Analysis of people that heard or come across slow learner children



# Figure 4: Pie chart percentage of people who ever heard or come across slow learner children



Figure 4 shows the analysis of people who ever heard or come across slow learner children. It shows that only one respondent is unsure if they have ever come across a slow learner child, but the majority of respondents have seen or heard of such.

#### 5. Conclusions

In the domain of adaptive technology behaviour, slow learners have no trouble making connections, establishing themselves, and socialising. Their main problem is a lack of educational development. Slow learners will require more attention and practice than their peers when it comes to learning new things. Audio-visual aids, graphics, displays, reference books, online material, and worksheets must be used to help children stay focused and process information faster, but they are not interactive enough for today's children.

#### References

1. Wan Ahmad, W. F., Md. Noordin, S., & Nor, N. S. (2013). Development of a multimedia courseware for slow learner children with reading difficulties: MyLINUS. Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 8237 LNCS, 371–382. https://doi.org/10.1007/978-3-319-02958-0\_34

2. Puckett, Kathleen (2005). An Assistive Technology Toolkit. Computers in the Schools, 22(3-4), 107–117. doi:10.1300/J025v22n03\_09

3. Tayade, A., Tayade, S., Chalak, A., & Srivastava, T. (2018). The impact of Video Assisted learning (VAL) on slow learners. International Journal of Biomedical and Advance Research, 9(1), 13–18.



4. Khan, A. (2018, August 28). Dealing with A Slow Learning Child - Challenges and Tips to Help. FirstCry Parenting. https://parenting.firstcry.com/articles/dealing-with-a-slow-learner-child-challenges-and-tips-to-help/

5. Bishara, Saied; Wubbena, Zane (2018). Active and traditional teaching, selfimage, and motivation in learning math among pupils with learning disabilities. Cogent Education, 5(1), –. doi:10.1080/2331186x.2018.1436123

6. Sanni, Shereefdeen & Olusuyi, Kehinde & MAhmud, Ismail. (2019). Design and Implementation of Home Appliance Energy Monitoring Device. 10.31258/ijeepse.2.2.1-6.

7. Ruhela, R. (2014). The Pain of the Slow Learners. Online International Interdisciplinary Research Journal, 4(4), 193–200.

8. Hassan, A., & Mahmud, M. (2015). Tablet technology and apps to enhance slow learners motivation in learning. Advanced Science Letters, 21(10), 3165–3169. https://doi.org/10.1166/asl.2015.6521

9. Robotic Solutions. (2015). HC-05 Bluetooth Module User's Manual V1. 0. User Manual.

10. Arduino. (2019). Arduino Nano. https://www.arduino.cc/

11. Samantha Hearn and Maeghaen-Kaytlyn Flora Dr . Delar K . Singh , Mentor , Department of Childhood , Elementary , and Special Education. (2009). 21(2006), 2006.

12. du Plessis, S. (2021, November 11). What Is a Slow Learner? - Edublox Online Tutor. Edublox Online Tutor | Development, Reading, Writing, and Math Solutions. https://www.edubloxtutor.com/slow-learner/



13. Langston, A. (2020, December 10). Assistive Technology in Special Education. ViewSonic Library. https://www.viewsonic.com/library/education/assistive-technology-in-special-education/#Why\_is\_Assistive\_Technology\_Important

14. Dimitra, Kirstavridou & Kousaris, Konstantinos & Zafeiriou, Christina & Tzafilkou, Katerina. (2020). Types of Game-Based Learning in Education: A brief state of the art and the implementation in Greece. 3. 10.31757/euer.324.

15.LearningWorks. (2020, November 20). Games and Activities That ImproveProcessingSpeed.LearningWorksforKids.https://learningworksforkids.com/2017/05/games-activities improve-processing-speed/

16. Hoffman, R. I. (1968). The Slow Learner— Changing His View of Math. NASSP Bulletin, 52(327), 86–97. https://doi.org/10.1177/019263656805232711



# AN IOT (INTERNET OF THINGS) BASED SURGICAL BOX STORAGE MONITORING SYSTEM

Nur Safiah Zawanah binti Mohamad Salim<sup>1</sup>, Pushpa a/p Jegannathan<sup>2</sup>

Department of Electrical Engineering, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Malaysia. <sup>1</sup>safiahsalim99@gmail.com <sup>2</sup>pushpajsu@hotmail.com

#### Abstract

Generally, the nature of operating rooms is hectic and the staff has a high workload as claimed. Due to this distraction, multitasking, and time pressure, staff who is handling the surgical kit can wrongly arrange or count the surgical items such as swabs or sponges. This could lead to serious problems such as unintended retention of foreign objects (URFOs) in a patient's body during surgery. To overcome these unwanted issues, we have developed an IOT-based surgical box storage monitoring system. This device consists of an ultrasonic sensor, Arduino, Wifi-NRF24L01, and the Blynk application. When the items are arranged in the surgical box they will be counted using an ultrasonic sensor and recorded to the system. After the surgery, the items that are rearranged in the surgical box and disposed into the bin will be counted by referring to the initial data and any error in the data will alert the healthcare personnel via an LCD and the application for immediate action. This is a cost-effective solution that could potentially mitigate any risks of unintended retention of foreign objects which could also improve the concentration among surgeons and staff members when surgery is taking place.

**Keywords:** Unintended retention of foreign object (URFO), ultrasonic sensor, Arduino, Blynk application.

#### 1. Introduction

In 2018, the most reported avoidable incident with 272 voluntary disclosures by health care providers was the unexpected retention of a foreign object (URFO) incident (Grant et al., 2020). In addition, about 132 incidents were reported to have involved the removal of unintended



retention of a foreign object (URFO) leftover from previous surgery, according to summary data of sentinel events reviewed by The Joint Commission (The Joint Commission, 2012). Surgical swabs were the most frequently retained foreign objects.

Despite their rarity, unintentional retained surgical swabs are dangerous to surgery patients because if the swabs are left in the body for too long and if the patient is not infected with any disease, the surgical swab will be classified as clinical waste, or they will be classified as infectious waste if there is a risk of contamination on the patient. It is also costly to hospitals because it requires an x-ray to detect the surgical swabs left inside the patient's body, as well as the inconvenience of opening the wound to potentially remove the swab (Lampe et al., 2004). This issue is currently being addressed by incorporating a thin thread into swabs, which can be seen in a post-surgery x-ray.

Unintended retained surgical items (URFO), most typically swabs or sponges, are errors that occur in surgically invasive environments and are harmful to patient safety. An URFO after surgery is the occurrence of unwanted object retention at any stage following surgery. Examples include retention of a swab, sponge, cannula tip, or guidewire. This knowledge is needed to design safer processes of care and improve patient safety ("Commonwealth of Massachusetts Board of Registration in Medicine Quality and Patient Safety Division Quality and Patient Safety Division, MA Board of Registration in Medicine Performance Data Guidelines," 2010).

Therefore, surgical box storage concept is a suitable solution for reducing the possibility of leaving a swab inside the body in the first place, as well as removing the annoyance of keeping track of the swabs used and also for reducing the probability of these unfavorable outcomes (Steelman et al., 2019). The proposed system employs an ultrasonic sensor as an input, while the number of waste is displayed on an LCD as an output, allowing the user to know the number of waste in the bin without checking it again.

#### 2. Methodology

This chapter will explain the methodology used in developing this project which consists primarily of hardware components, the project's construction, flowchart contents, drawing block diagram of the operating system. The data collection also has been done to analyze the usability of the wrist joint rehabilitation. These methods are used to achieve the objective of the project that accomplish a perfect result.



# 2.1 Project Design

The project is designed to fit on an operating room trolley and not be too high or too heavy to use. Figure 1 shows an overview of where the project will be used, i.e. placed on an operating room trolley. Figure 2 shows the top view of the trolley. Figure 3 is an overview of the kit part of this project that serves as a place to store swabs before use in surgery. Finally, Figure 4 shows an overview of the Bin section of this project. This Bin section serves as a place to dispose of clinical waste after a surgical session. Both parts are equipped with ultrasound sensors, NodeMCU V3 ESP8266, LCDs, and NRF24L01.

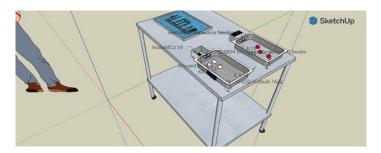


Figure 1: An overview of the project

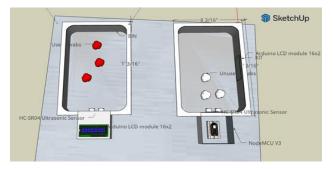


Figure 2: Top view of the project



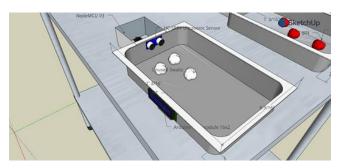


Figure 3: One of the part of the project design (Kit)

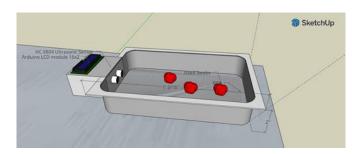


Figure 4: One of the part of the project design (Bin)

Figure 5 shows the circuit of the an IoT (Internet Of Things) Based Surgical Box Storage Monitoring System for both KIT and BIN. One ultrasonic was used to get the range of object detection. The Arduino is links with the NodeMCU as the microcontroller between the hardware and the smartphone. The input voltage fed into microcontroller which is Arduino Uno and NodeMCU then the board will supply the voltage to other components. All of the VCC component will connected to positive terminal, while all of the GND components will directly to negative terminal.

This circuit need one ultrasonic sensors as the input of the device. Then the pin of echo and trig ultrasonic will connect to Digital pin D4 until D5 of NODE MCU ESP8266. Then, the LCD pin of SCL and SDA will connect to Digital pin D2 and D1.

The NodeMCU will link with Blynk App, so for the circuit, we only need two components for NodeMCU which is ultrasonic sensor, and NRF24L01 module. The connection pretty simple, connect all the pin of the component to Digital pin NodeMCU we ready to go to the program then compile to microcontroller based on Figure 6.





Figure 5 shows the circuit of the an IoT (Internet Of Things) Based Surgical Box Storage Monitoring System for both KIT and BIN

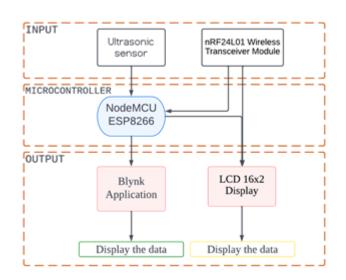


Figure 6 when the system is on

2.2 Block Diagram

The block diagram of the project design, shown in Figure 7, consists of two inputs and outputs, and one microcontroller. The main processor is nodeMCU. The ultrasonic sensor detects an obstacle in the storage container as the input. During the process, make sure the Wi-Fi connection is on and in stable condition for the NRF24L01 ready to start in real-time through a mobile application processing and transmitting the data. As for the output, the LCD, to give a little information. Also, for the part of the IoT application, the Blynk apps will display the data and send a notification to users.



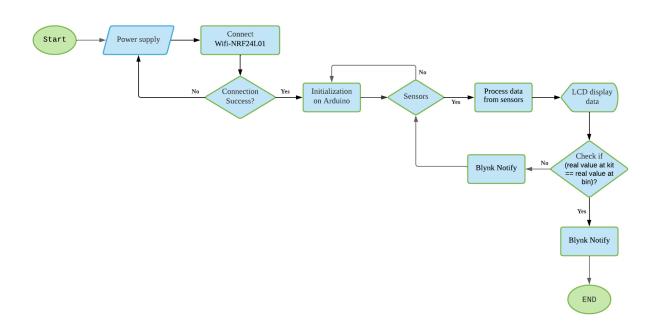


# Figure 7: Electronic Components in the an IoT (Internet Of Things) Based Surgical Box Storage Monitoring System

#### 2.3 Flowchart

Figure 8 shows the process that will be implemented in the kit and bin of the an IoT (Internet Of Things) Based Surgical Box Storage Monitoring System. Both kit and the bin will start by turning on the power supply connect with Wi-Fi NRF24L01. If the connection is successful, it will initialize on NodeMCU. If the connection is not successful, you need to start again with the power supply. Next, the process data will begin and the LCD will display the data as the output. the Blynk application will be function as a notification to notify the user if the data on the bin is the same as the data on the kit. If it is successful, it will end the process.





**Figure 8: Flowchart Function Project** 

#### 2.4 Data collection method

Data collection is the process of gathering, measuring, and evaluating correct insights for study following defined, accepted techniques. Three methods are used to acquire data. We have created a series of questionnaires, a project experiment, and procedures for conducting the experiment on the subject. The data collecting flowchart is shown in Figure 9.

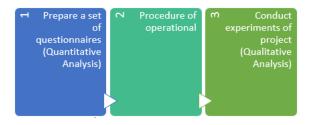


Figure 9 Flowchart of data collection



#### 2.4.1 Questionnaire

We created a questionnaire to collect data and responses from Google Forms. Because of the COVID-19 pandemic and the lockdown, we only have a few options for obtaining this result. As a result, we created a Google Form questionnaire as one of the ways to interact with the public. We successfully received 25 responses to this survey. It is divided into two sections: pre-survey and post-survey.

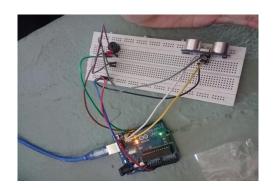


Figure 10 Overview of questionnaire

2.4.2 Experimental of Ultrasonic Sensor

In this step, the ultrasonic sensor was tested to make sure it works as planned and to find out how much different the measured value is from the actual value. The sketch is simple, and it uses the Serial Monitor to show the distance measured in centimetres. The performance of the sensor was measured by slowly changing the distance between the transducer and the object being looked at from 1 cm to 21 cm. Figure 11 shows how the NodeMCU and ultrasonic sensor are hooked up and ready to test for each distance thought about.





# Figure 11 Testing the Ultrasonic sensor

#### 3. Result and Discussion

#### 3.1 Experiments of Project

This research looks into how an ultrasonic sensor works. The information gathered is summarised in Table 1. The result of the ultrasonic sensor, the real distance value between the measured distance value, is shown in table 1.

	Average Measured value (cm), x	
Actual Distance (cm), y	Ultrasonic Sensor 1 [Kit (Cm)]	Ultrasonic Sensor 2 [Bin (Cm)]
2	1.9	2.0
4	3.8	4.0
6	6.0	6.1
8	8.1	8.0
10	10.1	9.9
12	12.2	12.1
14	13.9	13.9
16	16.0	16.0
18	18.0	17.9
20	20.1	20.2

# Table 1: Analysis of Ultrasonic Sensor: Measured Distance(cm) VS ActualDistance(cm).



Table 1 displays the ultrasonic sensor analysis, which is the difference between the actual and measurement values. The following conclusion can be drawn from the analysis of the experimental results: to develop an accurate obstacle detection system capable of integrating sensors. In the case of Table 1, the closer the sensor is to the object, the more accurate the measured value. In this regard, the relative error of the ultrasonic sensor did not exceed 5.8 percent, which is the value appropriate for use in this project. As expected, the output of the ultrasonic sensor is highly dependent on the accuracy of the calculated distance. In a nutshell, the ultrasonic sensor is the best sensor to use for this project.

#### 4. Conclusions

The outcome for this project is the users e.g. surgeons and staff members can focus on doing surgery operations without any problems. It is also cost-effective and a highly reliable system as it has additional services such as the Surgical Box Storage Monitoring System Based on IoT are interfaced with an android application to keep track of the history of the medical swabs used in every operation and a notification will be sent to the surgeons or staff members when the LCDs display does not show the same number on both part (the surgical kit and the bin). This product also acts as a one-stop unique solution to reduce the risk of URFOs (Unintended Retained Foreign Objects) and can improve patient safety in the facility's perioperative department (Operating Room). By defining this project well on the background, problem statement, objectives, scope, and significance of the project in proper structure without letting out any highlighted issue. Also, electronic devices are known as complex things to human beings. We as a user can make it better and positive to their life by following the requirements and purposes.

#### 5. Acknowledgment

We would like to express my sincere thanks and gratitude to my supervisor, Madam Pushpa, for letting me work on this project. We are very grateful to her and all the lecturers from the Electrical Department for their support and guidance in completing this project. We are also thankful to my parents as well, because we were able to successfully complete this project with the help of their guidance and support. Finally, I want to thank all my dear friends as well. It helps me a lot in finishing the project.



#### 6. References

(2021). In R. G. Beran & V. L. Raposo (Eds.), *Medical Liability in Asia and Australasia*. Springer Singapore.

Commonwealth of Massachusetts Board of Registration in Medicine Quality and Patient Safety Division Quality and Patient Safety Division, MA Board of Registration in Medicine Performance Data Guidelines. (2010).

Grant, E. K., Gattamorta, K. A., & Foronda, C. L. (2020). Reducing the risk of unintended retained surgical sponges: A quality improvement project. *Perioperative Care and Operating Room Management*, *21*(March), 100099. 10.1016/j.pcorm.2020.100099

Lampe, M., Zurich, E., Schoch, T. M., Floerkemeier, C., & Schoch, T. (2004, January). *The Smart Box Concept for Ubiquitous Computing Environments*. ResearchGate. https://www.researchgate.net/publication/2950654

Mahbub, M. (2019, September). Design and Implementation of Multipurpose Radio Controller Unit Using nRF24L01 Wireless Transceiver Module and Arduino as MCU. *International Journal of Digital Information and Wireless Communications*, 9(2), 61-72. 10.17781/p002598

Rao, A. (n.d.). IoT-based Smart Medicine Kit.

Steelman, V. M., & Cullen, J. J. (2011, August). Designing a Safer Process to Prevent Retained Surgical Sponges: A Healthcare Failure Mode and Effect Analysis. *AORN Journal*, *94*(2), 132-141. http://dx.doi.org/10.1016/j.aorn.2010.09.034

Steelman, V. M., Shaw, C., Shine, L., & Hardy-Fairbanks, A. J. (2019). Unintentionally Retained Foreign Objects: A Descriptive Study of 308 Sentinel Events and Contributing Factors. *Joint Commission Journal on Quality and Patient Safety*, *45*(4), 249-258. 10.1016/j.jcjq.2018.09.001

The Joint Commission. (2012). Summary Data of Sentinel Events Reviewed by The Joint Commission 1995 through 2Q 2012. 2021. http://www.jointcommission.org/assets/1/18/Summary\_2Q\_2012.pdf



# THE DEVELOPMENT OF DETECTION WALKING POSTURE ABNORMALITIES PATIENT IN HUMAN GAIT USING PRESSURE SENSOR

Seri Hafsah Binti Ab Razak<sup>1</sup>, Pushpa A/P Jegannathan<sup>2</sup>

Electrical Engineering Department, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor <sup>1</sup>serihafsah631@gmail.com <sup>2</sup> pushpa@psa.edu.my

#### Abstract

Nowdays, physiotherapy assistant needs to gain data and determine the rehabilitation process of every patient with a walking problem. This is because healthcare assistants don't have any tools that can come out with the precise data collecting. In order for gait rehabilitation treatments to be effective, a precise data analysis of a patient's gait is necessary. Supination, pronation, instability in the left foot, and instability in the right foot can all be detected through gait analysis. These abnormalities should be noticed immediately to correct our walking posture and avoid injury. However, the existing technology that has been applied to healthcare assistants only uses observation by perception without data for a user walking. Healthcare assistants could not get the exact data and analysis for the treatment progress besides hard to find in the market. Those techniques are still quite expensive for the consumer market due to technical reasons and the complicated instrument for measuring body movement. For this product, we've developed a home-based gait analysis shoe system. This paper aims to develop, record, and analyse the walking performance of users by collecting data from pressure sensors to determine whether the walking pattern is normal or abnormal. Families and healthcare assistants can keep a close eye on the person wearing the device by uploading and viewing an app-generated summary of their gait data. It is possible to monitor the wearer's gait by integrating sensors, wireless technology, and social ability with computer software.

**Keywords:** gait analysis, pressure sensor, abnormalities, shoe's insole, health monitoring, walking posture



#### 1. Introduction

In daily life, walking always seems to be an essential activity. It's not something you usually think about, as the body will coordinate and manage the steps without controlling them. However, normal walking might be more challenging for persons who have trouble walking. When a person can't walk normally, it's called abnormal gait or walking abnormalities (Nmss, 2006). Walking fundamental trait will allow humans to go about their daily lives and contribute to society. The gait is a characteristic of walking. An average person's gait, also known as the normal gait, is the optimal gait pattern in terms of power and gait velocity for a human to walk comfortably for a long time. According to the research, this abnormal walking behaviour will lead to many worst diseases either in the long term or short-term period such as leg pain, back pain, ankle problem and other serious bone injury (Sunarya et al., 2020). This device is developed for medical assistants in the healthcare sector for gaining the data analytic from patients. The main function is to detect the abnormal posture and gait which is opposite to the normal behaviour of human walking. The device that can gain the data by pressure sensor act by human while walking will be processed and transferred with interface application (Baker, 2018). This application will run the algorithm that will finalise either that human walk in normal or abnormal posture. The data gained will been monitor and utilized by healthcare assistant at hospitals nor patient itself at home as the product based on user friendly concept.

Nowadays, an increasing number of people suffer from gait disorders, and due to the diversity of patients' symptoms and causes, the treatment is performed manually and logically based on biomechanical, musculoskeletal, and neuromotor principles (Bae & Tomizuka, 2011). According to American Family Physician, gait disorders were detected in approximately 25 percent of persons 70 to 74 years of age, and nearly 60 percent of those 80 to 84 years of age (Salzman, 2011). According to the American Community Survey, about half of Americans ages 75 and older (49.8%) reported living with a disability in 2015, as did about a quarter (25.4%) of those 65 to 74. es with walking or independent living (Nilpanapan & Kerdcharoen, 2016). More than 20 million people ages 18 and older reported having serious difficulty walking in 2015, representing 7.1% of the civilian non-institutionalized population(Raknim & Lan, 2016).

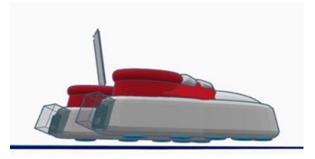


#### 2. Methodology

Designing and developing the mechanical part of the detection of walking posture abnormalities in patients in human gait using a pressure sensor, a block diagram of the operating system, and developing a flowchartof the operation device are all the stages of this research. The method is used to achieve the objective of the project that accomplishes a perfect result.

# 2.1 Designing the mechanical part of the detection walking posture abnormalities patient in human gait using pressure sensor

The detection of walking posture abnormalities in figure 1, has five points of detection and each point has five resistive pressure sensors. The components of the device in this research are, one (1) ESP 32 WI-FI module, one (1) power supply 6V, and five (5) resistive sensors.



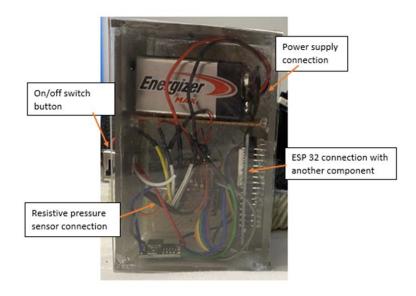
#### Figure 1: Mechanical Design Of The Detection Walking Posture Abnormalities Patient In Human Gait Using Pressure Sensor Using Tinkercad

The walking postures are detected by the resistive pressure sensor that has been placed at the insole which is when the patient starts walking the sensor will detect the abnormalities during the rehabilitation session. The device is a wearable device that comes with an on-off button so that the patient can save the device's power. The detection walking posture will detect the pressure of up to five-point during the human gait cycle as in the figure that shows the side view of the detection walking posture abnormalities device.



## 2.2 Developing The Hardware and IoT Implementation Of The Detection Walking Posture Abnormalities Patient In Human Gait Using Pressure Sensor

The figure 2 shows the system of circuit installation for the detection walking posture abnormalities in the patient in human gait using a pressure sensor. ESP32 Wi-Fi module works as a device controller which programs can be loaded onto it from the predefined Arduino IDE programming. The USB cable connection is used to upload the verified coding from the Arduino IDE to the circuit of the device.



# Figure 2: circuit installation of the Development of Detection Walking Posture Abnormalities Patient In Human Gait Using Pressure Sensor

Figure 3 shows the development of electronic and mechanical parts the wrist joint rehabilitation. The design of this data shoe is based on a home application that detects the wearer's gait behaviour in real-time. FSRs, or force-sensitive resistor sensors, are embedded in the shoe's insole to monitor gait. Five FSRs are embedded in four areas of the shoe: the bottom of the toes, the pad of the foot, the outer arch, and the heel of the foot, which is enough to collect gait pattern data. In addition, for the developer's convenience, the wireless data transfer device is installed in a small pocket at the anklebone.





# Figure 3: Development of electronic and mechanical part of The Detection Walking Posture Abnormalities Patient In Human Gait Using Pressure Sensor

Referring to Figure 4, the interface of IoT implementation using Blynk application for the live data pressure when patient walking and to give notification that the patient is in the abnormal condition and using Thingspeak application for the display and save the progress of the patient while using the device. The Blynk and Thingspeak applications are easy to download on the user's IOS system and android system which can make them easy to detect and see the progress of the abnormal pressure by walking even if the therapist is not around. Based on Table 1, shows the function of each button of the Blynk and Thingspeak application during using the device.



2<sup>nd</sup> National Conference on TVET Undergraduate Students (NCTS) Politeknik Tuanku Syed Sirajuddin 19-20 July 2022

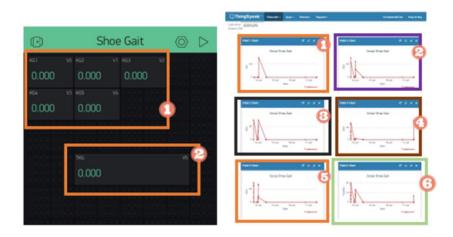


Figure 4: Interface of IoT implementation using Blynk and Thingspeak application for detecting the pressure of resistive pressure sensor

#### Table 1: function of the button of Blynk application

	BUTTON
NO.	BLYNK APPLICATION
1.	DETECT THE LIVE DATA OF FIVE PLACEMENT
	SENSOR
2.	THE AVERAGE AMOUNT FOR TO FIVE SENSORS

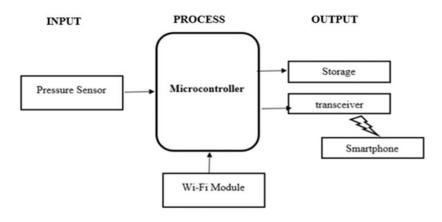
#### Table 2: function of the button of Thingspeak application

	BUTTON
NO.	THINGSPEAK APPLICATION
1.	THE DATA OF SENSOR 1
2.	THE DATA OF SENSOR 2
3.	THE DATA OF SENSOR 3
4.	THE DATA OF SENSOR 4
5.	THE DATA OF SENSOR 5
6.	THE AMOUNT OF AVERAGE OF FIVE SENSOR



#### 2.3 Block Diagram of the Operating System

Block has a specific purpose, and the block diagram illustrates in Figure 5 shows how each process is connected. The information on the device is sensors such as a resistive pressure sensor to detect the pressure of the ground contact surface while the patient is walking. NedeMCU ESP32 microcontroller act to process the data gain while transmitter and receiver being a part in transmitting/receiving process than display by monitoring systems. The application will notify users in certain conditions whenever the data gain is out of the normal walking pattern range. The data has also been stored in a cloud data server for data references. Lastly, the user's walking pattern data will be displayed on the smartphone.

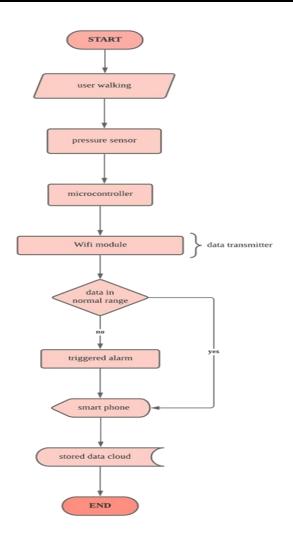


# FIGURE 5: BLOCK DIAGRAM OF THE DETECTION WALKING POSTURE ABNORMALITIES

#### 2.4 Flow Chart of the Operation Device

Figure 6 below shows a flowchart of the whole process of the system within the data collecting, transferring data, and monitoring system. First, the patient walks, and the pressure sensor at the insole will count every pressure in the gait walking phase. Next, the data collected transfer will be processed and transmitted for the monitoring process. This process will become out into two possible outcomes, either in the normal range or abnormal gait analysis. If the data is in an abnormal range, the application will notify the users about their walking gait pattern. Lastly, the data will be sent to the user's smartphoneand stored in the cloud storage.





# FIGURE 6: Flowchart of The Whole Process of System Within Data Collecting, Transferring Data and Monitoring System

#### 2.5 Data analysis method

Testing of the hardware and software was done to examine the usefulness of Detection Walking Posture Abnormalities Patient In Human Gait Employed Pressure Sensor undergo the by following the gait phase that has been used by the patient. As indicated in Figure 9, the gadget has been tested by the subject. The assessed data are crucial in assessing the usefulness of the Detection Walking Posture Abnormalities Patient In Human Gait Employed Pressure Sensor by observing the gait phase that has been used by the patient and collecting comments from experts and the public.





Figure 7: Testing of the hardware and software of the device

## 3. Result And Discussion

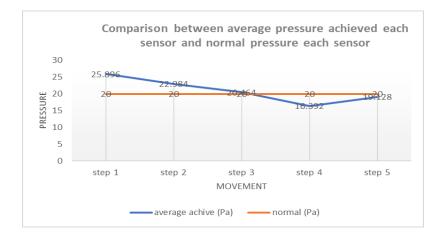
This device must be able to detect the abnormalities of pressure when patients walk. By comparing the average pressure achieved by each sensor of the device and the normal pressure of each sensor, it can figure out the usability of the detection walking posture abnormalities patient in human gait using a pressure sensor by observing the gait phase that has been using by the patient

Movement	Average Achieved (Pa)	Normal (Pa)	Comparison (%)
step 1	25.896	20	-5.896
Step 2	22.984	20	-2.984
Step 3	20.464	20	-0.464
Step 4	16.392	20	3.608
Step 5	19.128	20	0.872

# Table 3 : Comparison between average pressure achieved each sensor andnormal pressure each sensor.



As shown in Table 3, the range of the average achieved each pressure of every movement of the device comfortably exceeds the normal range pressure of each sensor. All the human normal pressure is completely different due to the size, sex, weight, and height of every single patient that wears the shoes. As we can see here the difference of movement between the step 1 average achieved and normal pressure is about -5.896% which means the patient has exceeded the normal walking range. These modifications represent the replacement of the resistive sensor and the condition patient while using the device. The design of the prototype has proven to be sensible and comprised based on the normal range pressure for each sensor according to patients' conditions. Referring to the figure shows the Comparison between the average pressure achieved by each sensor and the normal pressure of each sensor.



# Figure 8: Comparison between average pressure achieved each sensor and normal pressure each sensor.

#### 4. Acknowledgment

We would like to show my thanks to electronic engineering falculty, supervisor fyp ,parents and all researchers for all the technical papers that they have uploaded on the internet. It helps me a lot in the completion of the tasks.

## 5. Conclusion

The Detection Walking Posture Abnormalities Patient in Human Gait Using Pressure Sensor was designed and developed according to the patient foot size. To drive the



resistive pressure sensor to function and detect the abnormal pressure range when patient walking may be altered according to the patient's demand in Arduino IDE program (UNO program) (UNO program). IoT is successfully applied to the device by utilizing the Blynk and Thingspeak application so that the patient may perform the walking therapy by themselves at home cause the application will alert when the walking is in the abnormal range. Next, this project aids irregular walking patterns patients to conduct the treatment session at home without supervision from the therapist at the facility.

#### References

- Bae, J., & Tomizuka, M. (2011). Gait phase analysis based on a Hidden Markov Model. *Mechatronics*, 21(6), 961–970. https://doi.org/10.1016/j.mechatronics.2011.03.003
- Baker, J. M. (2018). Gait Disorders. *American Journal of Medicine*, 131(6), 602–607. https://doi.org/10.1016/j.amjmed.2017.11.051
- Nilpanapan, T., & Kerdcharoen, T. (2016). Social data shoes for gait monitoring of elderly people in smart home BT 9th Biomedical Engineering International Conference, BMEiCON 2016, December 7, 2016 December 9, 2016. The 2016 Biomedical Engineering International Conference (BMEiCON-2016) Social. http://dx.doi.org/10.1109/BMEiCON.2016.7859611
- Nmss. (2006). *Gait or walking problems the basic facts. 2006*(May 23), 1–9. http://www.nmss.org/Brochures-On Gait.asp.
- Raknim, P., & Lan, K. C. (2016). Gait Monitoring for Early Neurological Disorder Detection
   Using Sensors in a Smartphone: Validation and a Case Study of Parkinsonism.
   *Telemedicine and E-Health*, 22(1), 75–81. https://doi.org/10.1089/tmj.2015.0005
- Salzman, B. (2011). Gait and balance disorders in older adults. *American Family Physician*, *82*(1), 61–68.
- Sunarya, U., Hariyani, Y. S., Cho, T., Roh, J., Hyeong, J., Sohn, I., Kim, S., & Park, C. (2020). Feature analysis of smart shoe sensors for classification of gait patterns. *Sensors (Switzerland)*, 20(21), 1–22. https://doi.org/10.3390/s20216253



# THE DEVELOPMENT OF MOTORIZED REHABILITATION BIKE FOR STROKE PATIENT

Khairunnisa Izzati binti Mohd Azhar<sup>1</sup>, Pushpa A/p Jegannathan<sup>2</sup>

Department of Electrical Engineering, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor, Malaysia khairunisaizzati14@gmail.com, pushpa@psa.edu.my

#### Abstract

Globally, stroke is still one of the major causes of death and disability and it may be quite difficult to live with. Stroke can occur at any age, but it is significantly more common in older people than in younger people. However, the existing equipment is mostly operated manually, with more focus on the legs. Furthermore, every patient who needs physiotherapy in the hospital needs an alternative way to do their therapy at home or a rehabilitation centre. To address these issues, we have developed a motorized rehabilitation bike for stroke patients. This product is an automatic, motor driven pedal system for both the hands and the legs that will be more effective for the treatment of the user while being able to keep up a healthy lifestyle while doing therapy at home or facility. This device consists of a digital infrared sensor, microcontroller, ESP32, and a Thingspeak application that can record the data automatically. This device can be operated by using an application that can display the patient's data namely the speed of the pedal and the number of cycles, which can be recorded to the cloud system that could then be accessed by physiotherapists and users. This product will benefit patients suffering from a stroke while simultaneously saving both time and money.

Keywords: Stroke, Manual, Automatic, Digital Infrared sensor, ThingSpeak.



#### 1. Introduction

In the majority of countries, a stroke is either the second or third most common cause of death, and it is also one of the primary causes of acquired adult impairment. Stroke is a leading cause of long-term disabilities, such as hemiparesis, inability to walk without assistance, and dependence of others in the activities of daily living (Barbosa et al., 2015). Besides, in Malaysia, stroke has become a significant public health issue (Ganasegeran et al., 2020). The purpose of stroke rehabilitation is to assist you in relearning abilities that were lost when a stroke impacted a part of your brain. The cycling provides the mechanical coupling between the two legs helps the stroke patients to pedal cyclically so that a steady pattern of excitation emerge in the affected limb (Khichadiya & Kanase, 2017). Rehabilitation assists people who have had a stroke in relearning abilities that are unexpectedly lost when a part of the brain is injured.

Stationary cycling exercise utilized with numerous different interventions in the clinical (Raza et al., 2021). Everyone heals differently after a stroke, and the duration of your recovery will be determined by a variety of factors. Besides, the patient is required to visit the rehabilitation center at least twice a week, which is inconvenient for the patient and the guardian. Thus, it becomes imperative to have a method to monitor and quantitatively assess in-home rehabilitation exercises (Lee et al., 2019). Currently there are many motorized single rider stationary exercise bikes that are commercially available and that can provide a preprogrammed speed for the rider (Romero-laiseca et al., 2019). Nowadays, technologies with these characteristics are becoming more attractive for motor rehabilitation at home, thus respecting the social distancing that is required at this time of the COVID-19 pandemic, which presents a high risk to the elderly and can cause severe neural diseases (Cardoso et al., 2021).

This project will design and innovate a bicycle rehabilitation device from manual to automatic mode. This device will detect the fingers and foot when it starts to approach both paddles by using a digital infrared sensor and the paddle will start to move. We also use a rechargeable battery as a source since it is portable. This is a stationary bike development for rehabilitation that uses an existing bike with the ability to adjust the speed of both paddle and a step counter so that patients can observe their cycles. A stroke patient with upper and lower limb paralysis will benefit from this device. This bike also allows the patient to do therapy anywhere and at any time.



# 2. Methodology

For this chapter, it consists of block diagram, flowchart, estimation cost of project, design of project and circuit diagram. This section contains the flowchart used in constructing The Development of Motorized Rehabilitation Bike for Stroke Patient, as well as the procedure and application of this project.

# 2.1 Mechanical design of Motorized Rehabilitation Bike for Stroke Patient

The rehabilitation bike in Figure 1 has automatic mode and both pedal has their own sensor and DC motor. This is the left view of mechanical design of the Motorized Rehabilitation Bike using Tinkercad.



Figure 1: Mechanical Design of the Motorized Rehabilitation Bike

# **2.2 Developing the hardware and Internet of Thing (IoT) implementation of the Motorized Rehabilitation Bike.**

Figure 2 shows the system of circuit installation of the rehabilitation bike. There is an ESP32 connection, a motor driver connection and a microcontroller connection which is a PCF8574 connection. The ESP32 NodeMCU works as a device controller, so Arduino software can be used to load programs onto it.



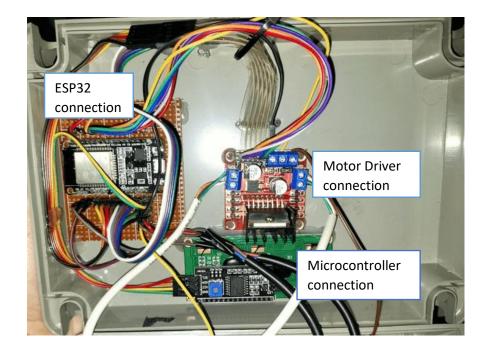


Figure 2 : Circuit installation of the Motorzed Rehabilitation Bike

The development of the electronic and mechanical components of the rehabilitation bike is visualized in Fig 3. Each arm and leg pedal has its own sensor and DC motor to move forward when the patient selects a forward speed. Through the keypad, the patient's desired speed may be selected. Since the ESP32 has been powered on, the DC motor will begin to rotate automatically once the desired speed has been selected. In addition, Figure 4 illustrates the device's keypad for controlling the speed of both pedals. The upper keypad controls the leg pedal, while the bottom keypad controls the arm pedal.



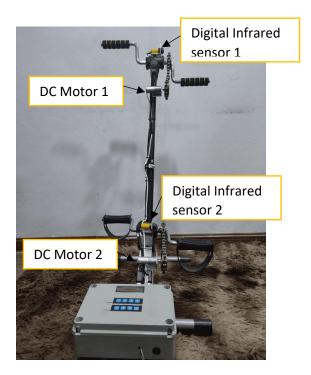


Figure 3: The Development of Motorized Rehabilitation Bike for Stroke Patient



Figure 4: Keypad to control the speed



This is the interface of the Internet of Things (IoT) implementation utilizing the Thingspeak application for showing the number of cycles and evaluating the data. Referring to Figure 5 shows the graphical representation. Any device, even a smartphone, is capable of opening the ThingSpeak program provided it is hosted on a web server. The program known as ThingSpeak is a real-time data stream that runs on the cloud server.

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Figure 5: Interface of Implementation using ThingSpeak application

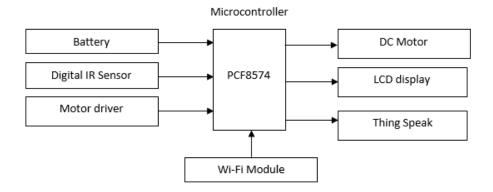
## Table 1: Function of the Thingspeak application

NO.	FUNCTION
1	Number of cycles for leg pedal in the shape of graph
2	The number of cycles on leg pedal
3	The number of cycles on arm pedal
4	Number of cycles arm pedal in the shape of graph



## 2.3 Block Diagram

Figure 6 demonstrates the methodology in further detail. The block diagram illustrates the component of the system, which consists of three major parts: input, process, and output. The input process of the project's block diagram consists of the battery, digital infrared sensor, and motor driver. A digital infrared sensor is responsible for detecting and transmitting a signal as the input sensor. In this project's programming, the PCF8574 serves as the microcontroller. Then, the DC motor serves as the output, while the LCDs the pedal's speed. The ESP32 is utilized to transmit the input data to the server through a Wi-Fi connection. ThingSpeak is a cloud-based IoT analytics platform service that enables the collection, visualization, and analysis of live data streams. The server's application, which is the ThingSpeak application, will display the number of cycles on a smartphone or other device.



# Figure 6: Block Diagram of the Development of Motorized Rehabilitation Bike for Stroke Patient

## 2.4 Flow Chart of the Operation Device.

Figure 7 is a flowchart depicting the operation of the rehabilitation bike. To activate the device, patients must position a chair in front of the pedal and place both their hands and feet on it. Then, activate the battery to begin. Connect the equipment to a mobile device for the data to be stored in the Thingspeak application. After that, if the sensor senses



motion on the pedal, it will flash. The patient can then select the desired speed to regulate the pedal's speed, at which point the DC motor will begin to rotate. The number of cycles will then be displayed on the Thingspeak application, and the user and patient will be able to record the data. The session will conclude following the prepared program.

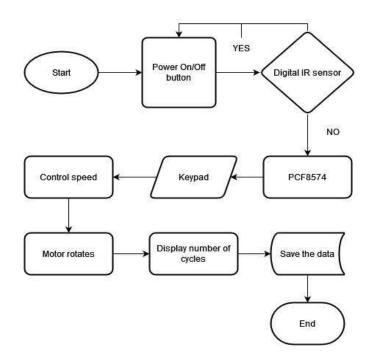


Figure 7: Flow Chart of the project

## 2.5 Data Analysis Method

After the completion of the final prototype, the results from testing the functionality of the device are collected and analyzed. Testing of both the hardware and the software was carried out to evaluate the suitability of the device for use by stroke patients in the course of their rehabilitation therapy. As can be seen in Figure 8, the subject has examined the device that is being tested.



2<sup>nd</sup> National Conference on TVET Undergraduate Students (NCTS) Politeknik Tuanku Syed Sirajuddin 19-20 July 2022



## Figure 8: Testing of the hardware on the subject

#### 3. Result and Discussion

There are manual and automated modes on this device for patients who have had strokes. Three people of varying ages are shown in Table 2 using a motorized rehabilitation bike. All three participants were closely monitored for 10 to 20 minutes to get the optimal result.

	SUBJECT 1 (AGE 56)	SUBJECT 2 (AGE 32)	SUBJECT 3 (AGE 23)
SPEED (ARM)	Number of cycles		
2	17	22	35
4	22	69	93
SPEED (LEG)	Number of cycles		
2	34	74	113
4	48	92	186

#### Table 2: Result of the subject based on different ages



Figure 9 illustrates a graph based on the speed of each of the three subjects tested. These three individuals were put through their tests using the fastest and slowest pedal speeds available. The plot in Figure 9 demonstrates that older persons may have difficulties pedaling the pedal since it is automated. Pedaling is much simpler for younger folks.

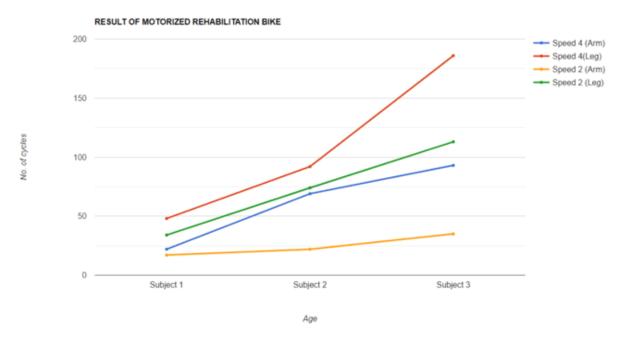


Figure 9: Graph shows the result of motorized rehabilitation bike

## 4. Acknowledgement

A particular gratitude goes out to my supervisor, Madam Puhshpa A/p Jegannathan, and the other lecturers of Polytechnic Sultan Salahuddin Abdul Aziz Shah. We would like to extend our appreciation to those researchers who have posted technical papers to the Internet. It is of great assistance to me in completing the job.



# 5. Conclusion

The purpose of the project is to design a stroke-friendly, user-friendly rehabilitation cycling system. Moreover, upgrading the current manual rehabilitation bicycle into an automated model can aid stroke patients' recovery. In addition, the potential to develop an intelligent gadget that aids in muscle recovery and allows the patient to do therapy anywhere dependent on the distance between their house and the rehabilitation center. Moreover, to enhance an innovative rehabilitation bike by storing patient data in a Thinspeak application. In order to properly organize this project, it is important to define the project's background, problem description, objectives, scope and relevance. By adhering to the specifications and goals, we as users can improve it and make it more beneficial to their lives.

#### 6. References

- Barbosa, D., Santos, C. P., & Martins, M. (2015). The application of cycling and cycling combined with feedback in the rehabilitation of stroke patients: A review. *Journal of Stroke and Cerebrovascular Diseases*, 24(2), 253–273. https://doi.org/10.1016/j.jstrokecerebrovasdis.2014.09.006
- Cardoso, V. F., Delisle-Rodriguez, D., Romero-Laiseca, M. A., Loterio, F. A., Gurve, D., Floriano, A., Valadão, C., Silva, L., Krishnan, S., Frizera-Neto, A., & Bastos-Filho, T. F. (2021). Effect of a brain–computer interface based on pedaling motor imagery on cortical excitability and connectivity. *Sensors*, *21*(6), 1–13. https://doi.org/10.3390/s21062020
- Ganasegeran, K., Ch'ng, A. S. H., Aziz, Z. A., & Looi, I. (2020). Population's health information-seeking behaviors and geographic variations of stroke in Malaysia: an ecological correlation and time series study. *Scientific Reports*, *10*(1), 1–13. https://doi.org/10.1038/s41598-020-68335-1
- Khichadiya, P. M., & Kanase, S. B. (2017). *Indian Journal of Physiotherapy and Occupational Therapy.* 11(2).
- Lee, M. H., Siewiorek, D. P., Smailagic, A., Bernadino, A., & Bermúdez I Badia, S. (2019). Learning to assess the quality of stroke rehabilitation exercises. *International Conference on Intelligent User Interfaces, Proceedings IUI, Part*



F1476, 218–228. https://doi.org/10.1145/3301275.3302273

- Raza, M. A., Waris, M., Murtaza, F., Waris, S., Noor, R., & Bashir, S. (2021). Effects of Treadmill Training and Stationary Cycling Training to Improve Ambulatory Function and Cardiovascular Fitness. *Pakistan Journal of Medical and Health Sciences*, 15(9), 2171–2174. https://doi.org/10.53350/pjmhs211592171
- Romero-laiseca, M. A., Cardoso, V., Pomer-escher, A., Longo, B., Nascimento, S. S.
   G., Lima, J. P. S., Loterio, F. A., & Frizera-neto, A. (2019). *Towards a Lower-Limb Rehabilitation System Based on Motor Imagery and Motorized Pedal for Stroke Patients. March.*



# THE DEVELOPMENT OF IOT BASED PORTABLE MONITORING DEVICE FOR COVID-19 PATIENT

Aina Syafiqah Muhamad Rosli<sup>1</sup>, Pushpa Jegannathan<sup>2</sup> Department Of Electrical Engineering, Politeknik Premier Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor, Malaysia. <sup>1</sup>ainasyafiqahhh17@gmail.com, <sup>2</sup>pushpa@psa.edu.my

#### Abstract

COVID-19 has posed a significant threat to public health across the world, including Malaysia. A COVID-19 patient needs to be monitored regularly and self-isolated if under home quarantined without caretakers. The unbearable number of cases has truly affected the healthcare system in managing them. To address this issue, we have developed an IOT based portable monitoring device for COVID-19 patients which is capable of measuring and recording the heart rate, oxygen saturation and electrical activity of the heart. The device comprises of a heart rate sensor, an oxygen saturation sensor (SPO2), an ECG sensor, Arduino Uno as microcontroller and an IoT server to enable the system to record the data and send it to the application which will be monitored by the end user remotely. The patient's data such as heart rate, oxygen saturation and electrical activity of the heart, all of which represent indicators of the COVID-19 virus will be measured and any abnormal readings gives the immediate alert to the end user to attend to the patient. This low-cost portable device can improve the flexibility of managing and protecting the health and safety of patients or healthcare workers while also preventing COVID-19 outbreaks.

**Keywords**: COVID-19 Monitoring Device, Internet of Things (IoT), Arduino UNO, ECG, Oxygen Saturation, Heart Rate.



#### 1. Introduction

Following a December 2019 outbreak in China, the World Health Organization (WHO) identified COVID-19 as a new type of coronavirus in early 2020. Unfortunately, the virus has quickly spread throughout the world. As in Malaysia, there were two waves of COVID-19 cases and over 20,000 Malaysians have died as a result of the ongoing COVID-19 pandemic (A. Elengoe, 2020). In the middle of a pandemic, WHO issued strict guidelines to the whole world, which included staying at home, wearing a mask, washing hands frequently, social distancing, avoiding gatherings and self-isolating if develop symptoms. Thus, the Ministry of Health (MOH) distributed the national guidelines in Malaysia, as declared by the WHO, with the goal of helping front liners in every phase of COVID-19 case management (J. H. Hashim, 2021).

However, hospitals are severely affected because patients are not operated in a timely and proper manner. It can be difficult for hospitals to monitor the conditions of COVID-19 patients on a regular basis. It becomes more difficult to monitor patients' health and even healthcare worker's safety due to a lack of supplies and the time it takes for test results (T. A. S. C. O. Post., 2020). Aside from that, due to strictly social distancing from infected people, patients who must be quarantined at home may not have caretakers who can monitor their condition. During quarantine, they can only look up to themselves before being transported to the hospital for further treatment.

Thus, the objectives of this project is to design a portable medical kit for COVID-19 patient that consists of an ECG, heart rate and SpO2 sensor. Other than that, to develop a portable medical kit that can monitor and record the condition of COVID-19 patient at home or hospital. Last but not least, to analyze the effectiveness of the portable medical kit that can integrate ECG, heart rate and oxygen saturation levels during monitoring the patient's condition.

## 2. Methodology

# 2.1 Designing the mechanical part of the Portable Monitoring Device For Covid-19 Patient

Figure 1 shows the sketch design of the Portable Monitoring Device for COVID-19 Patients using TinkerCAD. The components of the device in this project are the Arduino Uno, NodeMCU Wi-Fi, ECG electrodes, Heart Rate SpO2 Sensor, ECG sensor, and

OLED. All the components are implemented into the storage box, which serves as a casing.





Figure 1: Design of Portable Monitoring Device For Covid-19 Patient

# 2.2 Developing the hardware and software implementation of the Portable Monitoring Device For Covid-19 Patient

Figure 2 illustrates the circuit installation of the Portable Monitoring Device for COVID-19 Patients. It simply depicts the assembly of all the components in the casing. The Arduino Uno and NodeMCU microcontroller programmes are loaded onto it from the Arduino IDE programming. The NodeMCU works as a development kit for prototyping and developing Internet of Things (IoT) products. In this case, IoT product used in this project is Blynk application as shown in the Figure 4. The sensors such as the MAX30100 and AD8232 are capable of recording the conditions of the user such as ECG, heart rate, and oxygen saturation (SpO2) levels, which in turn are forwarded to the microcontroller. There is also an OLED, which allows for an emissive display with high image quality. Aside from that, the circuits are connected with the jumpers to make sure that the circuits are working properly.

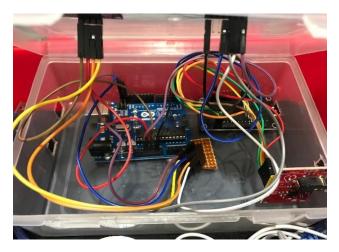


Figure 2: The circuit of the Portable Monitoring Device for Covid-19 Patient



Figure 3 shows the development of the mechanical part of Portable Monitoring Device for COVID-19 Patient. The system basically involves the collection of physiological data from the user using dedicated sensors. The system works as a whole right from the start, where the sensors record data, all the way to the very end, where the data can be seen in the specified application. To obtain the heart rate and oxygen saturation data, the patient need to attach their finger on the heart rate SpO2 sensor when the screen displayed an instruction. For ECG data, the patient just have to follow the instruction given by the manuals.

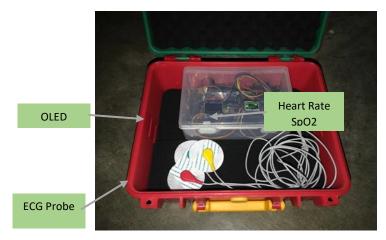


Figure 3: Portable Monitoring Device for COVID-19 Patient

Referring on Figure 4, it is an interface of an IoT implementation which known as Blynk app, shows the ECG monitoring section for a user. Users can simply download the Blynk application from the Playstore, or even access it from the Blynk website, and simply monitor their physiological condition. Overall, this device will help doctors and healthcare workers remotely monitor the condition of COVID-19 patients in real time.



Figure 4: Interface of Blynk application



#### 2.3 Block Diagram

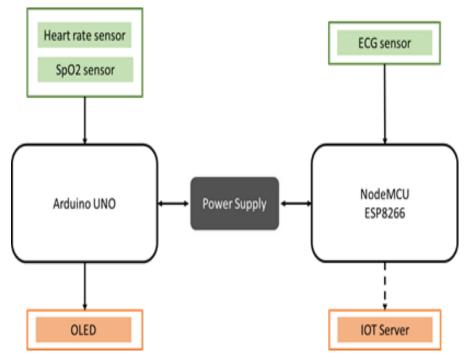


Figure 5: Block Diagram of Project

From the Figure 5 above, the block diagram shows two major roles of system's components, such as the processor, input and output. The sensor that will be used as an input is an ECG sensor, which measures the electrical activity of the heart, as well as a heart rate SpO2 sensor, which measures the beats per minute (bpm) and an oxygen saturation levels (%). The OLED display and ESP8266 Wi-Fi will be used as an output hardware. The corresponding data will be sent directly to the OLED display as well as through the computer or mobile phone.



#### 2.4 Flow chart

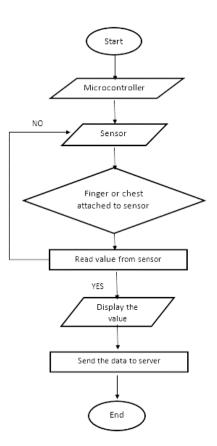


Figure 6: Flowchart of Project

Figure 6 shows the flowchart of the standard operation of the project. The Arduino will initialize the input and output positions once the system is turned on. The sensor will get its reading from the tip of a finger or from the chest. As a result, the value can be obtained when the patient places their finger or chest to a sensor, whether it is a heart rate SpO2 sensor or an ECG sensor. When the sensor detects a reading, it starts measuring the oxygen saturation and heart rate values, as well as an ECG reading. Then, the oxygen saturation and heart rate readings are displayed on the OLED, and the ECG readings are then sent to the IoT server.



#### 2.5 Data Analysis Method

The system is made up of two parts which is hardware and software. Both components are necessary for the system, and users can obtain results from both. The analysis of the results is important in determining the effectiveness of the device during monitoring the patient's condition. Therefore, the results of testing the device's performance are collected after the final hardware prototype is completed. The device was tested to ensure that it functions properly and that the data from COVID-19 patients is accurate. Figure 7 shows the corresponding sensor attached and ready to test. The sensor performance was measured by taking readings on a few subjects. After examining the system separately, it was observed that all sensors worked satisfactorily.

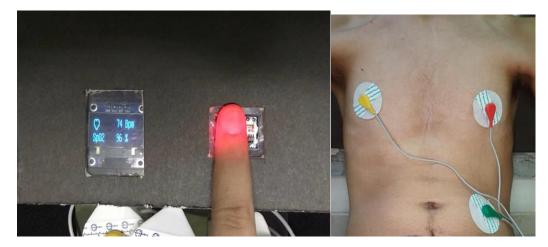


Figure 7: Testing the Heart Rate SpO2 sensor and ECG sensor



## 3. Result and Discussion

Referring on Figure 7, it shows the user experience of measuring the values of heart rate and SpO2 levels in which the user can see the displayed value on the OLED, and also shows the user experience of recording the ECG signal. The system passes the data to a mobile application, which then shows the result of the measured ECG signal of the user. With this device, users can get the results they need by looking at a screen or by using mobile apps.

The device was evaluated on a few subjects of different ages in different conditions. In the test cases, for heart rate and oxygen saturation levels, we recorded the actual value and observed value from the device. We then calculated the error rate from the data to demonstrate the device's effectiveness. As there is no alternative way to analyze the ECG signals, we simply display the subject's data from the Blynk application. Table 1 and 2 shows the actual and observed value with error rates for oxygen saturation levels and heart rate respectively.

Subject	Age	Actual value (%)	Observed value	Error rate (%)
			(%)	
Person 1	23	96	97	1.04
Person 2	24	90	93	3.33
Person 3	20	92	96	4.34
Person 4	25	93	99	6.45
Person 5	21	88	92	4.54

Table 23: SpO2 data collected by machine (actual) and device (observed)

Table 24: Heart rate data collected by machine (actu	Jai) and device (observed)
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Subject	Age	Actual value (Bpm)	Observed value (Bpm)	Error rate (%)
Person 1	23	70	73	4.28
Person 2	24	65	68	4.61
Person 3	20	73	72	1.36
Person 4	25	69	74	7.24
Person 5	21	64	69	7.81



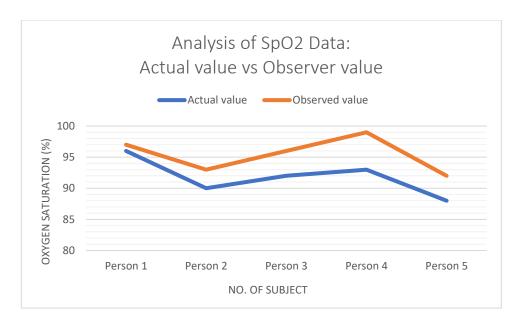


Figure 8: The result of SpO2 sensor

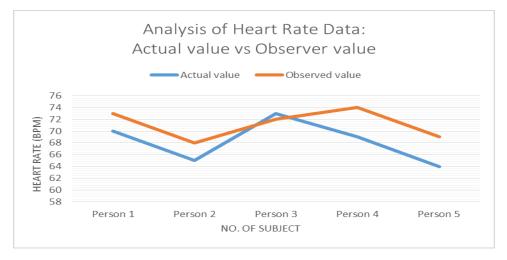


Figure 9: The result of Heart Rate sensor

The results of heart rate SpO2 sensor testing are shown in Figure 8 and Figure 9. It displays the difference between the actual value and observed value of the heart rate and oxygen saturation levels. According to the graph in Figure 8, most people's SpO2 levels were close to their actual values. For the graph in Figure 9, the heart rate values for the different subjects were comparable between actual and observed values. It was also discovered that the measured physiological data for the test subjects were different. As a result, the heart rate SpO2 sensor is relevant for use in this project. Hence, we can



conclude that the system worked perfectly. On the other hand, Figure 10 illustrate the corresponding ECG data from five different subject shown in Blynk application.



Figure 10: The result of ECG sensor

# 4. Conclusions

In a nutshell, the project was developed to make life easier for people who have health conditions and need to visit the hospital. From the beginning, we wanted to design a well-organized, application-based device that could be used in the current pandemic. Even though the tests are performed outside of the hospital, healthcare workers can view and track the data in real time. The system can also help nurses and doctors in pandemic situations because raw medical data can be analysed quickly. The system is also costeffective and versatile, making it possible to diagnose patients' conditions no matter where they are.



## 5. Aknowledgement

The author would like to express the gratitude to all lecturers of JKE for their guidance and encouragement in carrying out this project. Also thanks to Puan Pushpa as a supervisor, for giving the opportunity to do this project successfully and providing invaluable guidance throughout this research.

# 6. References

- T. A. S. C. O. Post. (2020). Hospitals report challenges in responding to the COVID-19 pandemic, The ASCO Post.
- A. Elengoe. (2020). Covid-19 outbreak in Malaysia, Osong Public Health and Research Perspectives, vol. 11, no. 3, pp. 93–100,
- J. H. Hashim, M. A. Adman, Z. Hashim, M. F. Mohd Radi, and S. C. Kwan. (2021). Covid-19 Epidemic in Malaysia: Epidemic progression, challenges, and response, Frontiers in Public Health, vol. 9.
- M. Nasajpour, S. Pouriyeh, R. M. Parizi, M. Dorodchi, M. Valero, and H. R. Arabnia. (2020). Internet of things for current covid-19 and future pandemics: An exploratory study, *Journal of Healthcare Informatics Research*, vol. 4, no. 4, pp. 325–364.
- M. M. Islam, A. Rahaman, and M. R. Islam. (2020). Development of Smart Healthcare Monitoring System in IOT environment, SN Computer Science, vol. 1, no. 3.
- Bikash Pradhan, Saugat Bhattacharyya, Kunal Pal. (2021). IoT-Based Applications in Healthcare Devices, *Journal of Healthcare Engineering*, vol. 2021.
- A. Saadon Al-Ogaili Ameer Alhasan, A. Ramasamy, M. Binti Marsadek, T. Juhana Tengku Hashim, A. Al-Sharaa, M. Binti Aadam, and L. Audah. (2021). IOT technologies for tackling COVID-19 in Malaysia and worldwide: Challenges, recommendations, and proposed framework, *Computers, Materials & amp; Continua*, vol. 66, no. 2, pp. 2141– 2164,
- Mohammad Monirujjaman Khan, Safia Mehnaz, Antu Shaha, Mohammed Nayem, Sami Bourouis (2021). IoT-Based Smart Health Monitoring System for COVID-19 Patients", *Computational and Mathematical Methods in Medicine*, vol. 2021.
- O. Taiwo and A. E. Ezugwu. (2020). Smart Healthcare support for remote patient monitoring during covid-19 Quarantine, Informatics in Medicine Unlocked.
- A. Rahaman, M. M. Islam, M. R. Islam, M. S. Sadi, and S. Nooruddin. (2019). Developing IOT based Smart Health Monitoring Systems: A Review.



# OPTIMIZING THE PRODUCTION PROCESS OF BRACKET EXHAUST SENSORBY IMPROVING THE TOOLING

Abdullah Afifi bin Abd. Rahman<sup>1</sup>, Izwan bin Hamid<sup>2</sup>

<sup>1,2</sup> Department of Mechanical Engineering,Polytechnic Sultan Azlan Shah, 35950 Behrang, Perak Rahmanafifi28@gmail.com<sup>1</sup>, izwanh@edu.com.my<sup>2</sup>

#### Abstract

Aim of this article is to present the process of new production on Bracket Exhaust Sensor. In thearticle, the concept of line balancing is discussed to proving the efficiency of the process. The overall process for bracket exhaust sensor is 8 stamping process, while inhouse stamping machine only have 6 machine. Double die concept is used to optimize the uses of machine that can improve from 51% to 60% efficiency.

Keywords: line balancing, production process, stamping, tooling, efficiency

1. Introduction

Company A's functions primarily as the assembler and accessory fitting expert for T's vehicles inboth the local and international markets, its perfoms there services in one of the largest and mostmodern motor assembly plan in Malaysia. Through a team of highly trained specialists, who are passionate about delivering top-quality products to their customers, ASSB assembles up to 100,000 vehicles each year, making it one of the most efficient facilities within the global T's network.

Original Equipment Manufacturer Supplier Parts Tracking Team (OEM SPTT). The team mainly responsible to works closely with quality and logistics department on new project development. Other than that, this team also responsible to manage T's vehicle major functional parts specifically on interior, exterior parts and wire harness components. It is more to analyze the partchanges and new improvement plan from T's Japan. It also needs to define requirements and provide timeline to the local parts supplier based on the



new changes. This team also need to collaborate with quality department and supplier to establish inspection procedures to ensure dimensional measurement, part functionality and accuracy requirements that fulfilled according to drawing from development team. To make sure the project work with schedule we have 5 majorSPTT meeting with supplier. It call as Kick off, SPTT 1, SPTT 2, SPTT 3, and SPTT 4.

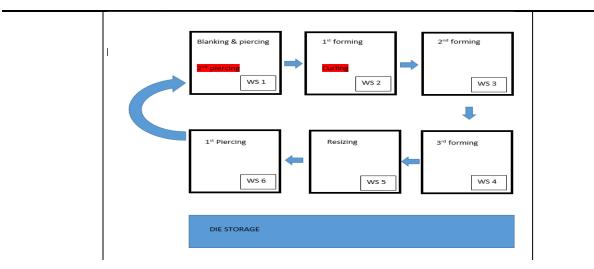
This research have done at one of T's supplier that is company W. Research was focused on improvement of the bracket exhaust sensor development process. Beside, the project also aims on production line and fabricate tooling to improve talk time in production. Furthermore, this study is to avoid waste time in production that need buffer the uncomplete stock that waiting for replacetooling at machine.

This study takes place at the production line and frabrication tooling department. The purpose of the new die system can reduce the use of machines. The scope of this study is the production line with 6 stamping machine that need to go with 8 process of stamping. Besides, the concept oftooling die is double die and use line balancing to distribute the task evenly over the work stations that idle time to man of machine can be minimize.

## **1.2 Problem Statement**

Production Process Confirmation Sheet (PPCS) need to declare overall process and control system. For this Bracket Exhoust Sensor need 8 process that means this part have 8 die to makeit Finish Good (FG). Come with the problem in production line only have 6 stamping machine that mean in one time is only can do 6 process, this make a buffer of uncomplete part to continue 2 more process.







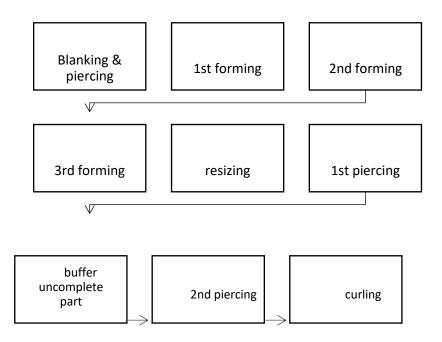


Figure 2: Precedence Diagram

Figure 1 & 2 shown the production layout with process originally. The process starts from the blanking process, 1st 2nd and 3rd forming .Then next process is resizing then last process for this cycle is 1st piercing. For this cycle, W's run for 6 hour 30 minute then have to take turn (30 minutes) for change die at 1st & 2nd machine to next process that 2nd piercing and curling.



2. Literature review

#### 2.1 Finished Good (FG)

A good purchased as a "raw material" goes into the manufacture of a product. A good only partially completed during the manufacturing process is called "work in process". When the good is completed as to manufacturing but not yet sold or distributed to the end-user, it is called a "finishedgood" (Gill. Suveera, 2009)



#### 2.2 Production Layout

In manufacturing engineering, a product layout refers to a production system where the work stations and equipment are located along the line of production, as with assembly lines. Usually, work units are moved along line (not necessarily a geometric line, but a set of interconnected work stations) by a conveyor. Work is done in small amounts at each of the work stations on theline. To use the product layout, the total work to be performed must be dividable into small tasksthat can be assigned to each of the workstations.

Because the work stations each do small amounts of work, the stations utilize specific techniquesand equipment tailored to the individual job they are assigned. This can lead to a higher rate of production (Mikell P. Groover, 2007)

#### 2.3 Stamping Process

It is believed that the first coins were struck by the Lydians in what is modern-day Turkey in the seventh century B.C. Until 1550, the hammering method of coins remained the primary method of coin-making. Marx Schwab in Germany developed a new process for stamping that involved

as many as 12 men turning a large wheel to press metal into coins. In the 1880s, the stamping process was further innovated (Hounshell, 1984).

Several automobile manufacturers adopted stamping of parts. Henry Ford resisted the recommendations of his engineers to use stamped parts, but when his company could not satisfydemand with die forged parts, Ford was forced to use stamping (Hounshell, 1984).



#### 3. Methodology

The overview on the overall research methodology and operation steps as shown in Figure 3 are required in achieving the objectives of this project.

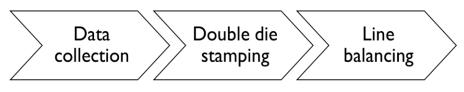


Figure 3: Methodology Chart

#### 3.1 Data collection

#### 3.1.1 Die size

To modify original die to the double die stamping, data size of die must be taken. Data must taken 3-axis, X-axis, Y-axis and Z-axis. Data only take a lower die because the upper die is opponentwith lower die and this measure use a metal ruler.

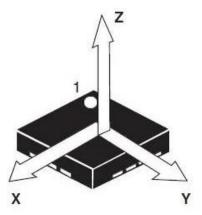






Figure 4 shown the axis that should be measure for this size die data.

#### 3.1.2 Cycle time

Cycle time is the actual time spent working on producing an item or providing a service, measuredfrom the start of the first task to the end of the last task. In this study, cycle time of all process willtaken 3 time per process before and after line balancing for comparison. Time will taken using stop watch.



3.2 Double die Stamping

Figure 5: Double die stamping

Figure 5 shown Double die stamping is idea that combine two different die, die must be modify to exact size with the second die. When two die combine and attach with one machine can reduce uses of the machine and eliminate the waiting time for changing tooling.

#### 3.3 Line balancing

Line balancing is a production strategy that involves balancing operator and machine time to match the production rate to the takt time. Takt time is the rate at which parts or products mustbe produced in order to meet customer demand.



Line balancing will start with identify the higher cycle time in all process, analysis cyble time, twsand number of work station. Make precedence diagram and precedence table to identify the flow of the process. From this data, it can calculate the efficiency of the production process.

#### 4. Result and discussion

#### 4.1 Data collection

#### 4.1.1 Die size

No. Die	X-axis	Y-axis	Z-axis
1	20.3	20.3	15
2	21.1	21.1	16
3	21.1	21.1	16
4	21.3	21.3	14
5	20.8	20.8	15
6	21.2	21.2	14
7	21.3	21.3	14
8	21.1	21.1	15

#### Table 1: Measurement lower die

From the table 1, 2<sup>nd</sup> and 3<sup>rd</sup> die is axactly same diamention with mean can be combine to make a double die stamping. While, 6<sup>th</sup> and 7<sup>th</sup> die is slightly different but can be modify to make it doble die stamping.

4.1.2 Cycle time



no	process cycle				
110	proceed	time			
		trial 1	trial 2	trial 3	averag
					е
1	Blanking &	15	14	14	13.3
	piercing				
2	1st forming	11	11	12	11.6
3	2nd forming	15	17	17	17
4	3rd forming	15	14	14	14.6
5	resizing	6	8	7	6.6
6	1st piercing	6	6	7	6
				total	69.1
	bufer unfinish FG ste	ock - 30 I	minute fo	or chang	e tooling
7	2nd piercing	7	7	6	6.3
8	curling	24	23	24	23.3
		-		total	29.6

## Table 2: Cycle time before line balancing

From the table 2, state the bufer for unfinish FG is effect the cycle time.

## 4.1.3 Efficiency

ttotal cycle time

*efficien* × 100 *cy* =

total number workstation × large cycle time



efficiency = 51%



4.2 Double Die stamping

Figure 6 & 7: 2<sup>nd</sup> & 3<sup>rd</sup> die



Figure 8: 6<sup>th</sup> & 7<sup>th</sup> die

Figure 6, 7, and 8 show that die that selected for double die stamping.

## 4.3 Line balancing

#### 4.3.1 cycle time



		Cycle time (s)			
No	Process	Trial 1	Trial 2	Trial 3	Average
1	BLANKING &PIERCING	14	14	14	14
2	1 <sup>ST</sup> & 2 <sup>nd</sup> FORMING	16	15	15	15.3
3	3 <sup>RD</sup> FORMING	14	14	13	13.6
4	RESIZING	6	7	6	6.3
5	1 <sup>ST</sup> & 2 <sup>ND</sup> PIERCING	9	8	8	8.3
6	CURLING	22	23	22	22.3
					total= 79.8 sec

## Table 3: cycle time after line balancing

4.3.2 Efficiency

efficien	ttotal cycle time	× 100%
<i>cy</i> =		

total number workstation  ${\sf \times}$  large cycle time

 $efficiency = \frac{9.8}{\times 100}$ 

6 × 22

efficiency = 60%



### 4.0 Conclusions

As the conclusion, the improvement can improve production plan layout with no take turn production. By having this condition, this created balance workstation proved by efficiency from 51% to 60%. Also this Increase the productivity of the finished good that achieve daily requirement from T's.

### 4. Reference

- Sivasankaran, P., & Shahabudeen, P. (2014). Literature review of assembly line balancing problems. *The International Journal of Advanced Manufacturing Technology*, *73*(9), 1665-1694.
- Tor, S. B., Britton, G. A., & Zhang, W. Y. (2005). A knowledge-based blackboard framework for stamping process planning in progressive die design. *The International Journal of Advanced Manufacturing Technology*, *26*(7), 774-783.
- Adnan, A. N., Arbaai, N. A., & Ismail, A. (2016). Improvement of overall efficiency of production line by using line balancing. *ARPN Journal of Engineering and Applied Sciences*, *11*(2), 7752-7758.
- Koc, A., Sabuncuoglu, I., & Erel, E. (2009). Two exact formulations for disassembly line balancing problems with task precedence diagram construction using an AND/OR graph. *lie Transactions*, *41*(10), 866-881.



## THE DEVELOPMENT OF ASSISTIVE SPOON STABILIZER FOR HAND TREMORS PATIENTS

N. Roslan<sup>1</sup>, NM. Kamaruddin<sup>2</sup>, Z. Mohamad <sup>3</sup>, N. A. Moktar<sup>4</sup>, A. A. A. Wahid<sup>5</sup>

Department of Electrical Engineering, Polytechnic Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor, Malaysia <sup>1</sup>norazlinaroslan@gmail.com, <sup>2</sup>nmsarah87@gmail.com, <sup>3</sup>zunuwanas@yahoo.co.uk, <sup>4</sup>nuruliman.ahmadmoktar89@gmail.com, <sup>5</sup>Amir40872@gmail.com

### Abstract

Tremor is the most common movement condition, characterized as a rhythmic and involuntary movement of the any-body component. People or individuals who suffer from tremors need an assistive device for them to live a normal life. However, the individuals with tremors will not benefit from the normal spoon because it does not respond besides the existing assistive spoon device is too expensive and not affordable to be bought by the patient. To overcome this limitation, we proposed a new assistive spoon stabilizer that can be responding to be used by patients with hand tremors. The assistive spoon can contribute to the hand tremor society because by having this product, the patient who suffers from hand tremors can eat with a spoon without having difficulties. The project involves a processor of Arduino Nano as it combines with a gyro sensor to identify the angularity of the spoon. It also consists of two servo motors to stabilizer device can help the community to be more independent because this product is affordable to be bought by the patients compared to the existing assistive spoon in the market which is expensive.

**Keywords:** Assistive Spoon, Hand Tremor, Movement Disorder, Arduino Nano, Gyro Sensor.

## 1. Introduction

Tremor is the most common movement condition, characterized as a rhythmic and involuntary movement of any of body components. Because all individuals have variable degrees of physiological tremor, it's critical to distinguish between normal and pathological tremors. Tremor is not inherently harmful, but it can significantly limit one's capacity to



function at home and at work (Elias & Shah, 2014). Rest and activity tremors are the two types of tremors. When the injured body portion is totally supported against gravity, a rest tremor ensues. Postural, isometric, and kinetic tremors are all types of action tremors that are caused by voluntary muscular contraction (Smaga, 2003). An individual may have postural tremors without rest tremors, as well as other characteristic Parkinson's disease symptoms. The degree of Parkinson's tremor varies and rises with mental exertion. The tremor normally develops bilateral some years after the commencement of the disease; the limbs do not shake in unison, suggesting when they're under the control of separate tremor generating (Bötzel et al., 2014)(Raethjen et al., 2000). There have been reports of tremor control weakening in time, necessitating repeated resetting (Bhidayasiri, 2005). As results, writing and other fine motor activities are injuries sustained, but rough actions such as drinking from a cup or glass are also adversely affected, resulting in significant difficulties in daily life. It may be difficult for patients with essential tremors to eat.

### 2. Literature Review

#### 2.1 Hand Tremor

Rest tremor, postural tremor, and intention tremor are the three different types of tremors. The basic disorders that trigger any of these kinds of tremors are varied. Whenever the arm is placed down or at rest, a rest tremor develops. This tremor is typical of Parkinson's disease, which is characterized by unilateral tremors initially. One or more fingers, the hand, the foot, or the chin might all show signs of rest tremors. As a result, when the patient maintains his arms outstretched, a postural tremor frequently occurs. Then there's the finger-to-nose test, which displays an intention tremor as the finger approaches the target, like the nose. Cerebellar dysfunction causes intentional tremors, which can be unilateral or bilateral (Bötzel et al., 2014).



# Figure 1: Types of Tremor (a) rest tremor, (b) postural tremor, (c) intention tremor

Source: Bötzel, K., Tronnier, V., & Gasser, T. (Deutsches Arzteblatt International 2014)



A hand tremor is a tremor that travels from one hand to the other (Jankovic, 2008). The degree of Parkinson's tremor varies and rises with mental exertion (Bötzel et al., 2014)(Raethjen et al., 2000). There are two increases in the frequency of essential tremor between the ages of 10 and 20 and 50 and 60 (Louis & Dogu, 2008). Cerebellar dysfunction causes intentional tremors, multiple sclerosis is the most prevalent cause (Schniepp et al., 2013). Intensification physiological tremor can develop as a symptom of several medications or in the context of a metabolic illness (Louis & Dogu, 2008). Early signs of Parkinson's disease include diminished arm swings and stooped posture. Brain imaging shows a decline in serotonin function before movement symptoms appear (Chou, 2004). Essential tremor is a tremor of the index finger around the nose in the finger- to-nose test. Dysarthrophonia and swaying, broad-based stride are common symptoms of cerebellar illness in afflicted patients (Bötzel et al., 2014).

#### 2.2 Assistive Technologies

"Any device or system that allows an individual to execute a task that they would otherwise be unable to complete" is what an assistive device is defined as. From a simple walking frame or crutches to prosthetic limbs, an assistive device can help. Assistive Technology (AT) refers to an assistive device that goes a step further and employs technology to help the user (Cunningham et al., 2009). Various alternate ways of reducing hand tremors were proposed. Several innovative gadgets with direct or indirect control, which may be classified as stationary or portable, have been demonstrated. Fixed devices are normally placed on the ground, a table, or a wheelchair, and are meant to assist individuals with hand tremors in doing certain tasks such as writing, eating, and so on (Abbasi & Afsharfard, 2018).

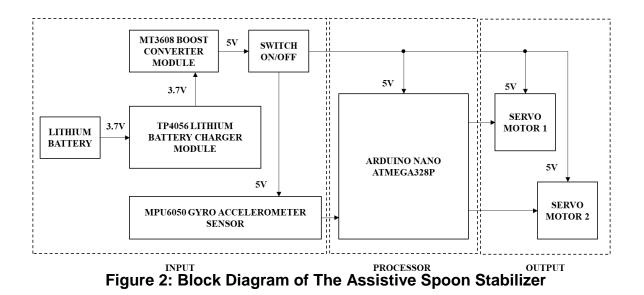
## 3. Methodology

#### 3.1 Block Diagram

Based on Figure 2, the block diagram consists of a processor, input, and output. From the input, the device has a sensor which is an MPU6050 Gyro Accelerometer Sensor that can receive input from the patient hand three-axis. The output will reset the angle of the axis to 00. The power supply is from a lithium battery to activate the device. The device is connected by power supply, it's made with battery lithium 18650 3.7V and connected to a TP4056 lithium battery charger module so the device can be used as rechargeable. Then is it connected to the MT3608 boost converter module so the output voltage will come out as 5V. Push-button is used to control the voltage to supply the circuit and activate the device. The power 5V is supplied to the MPU6050 gyro accelerometer sensor, Arduino Nano, and MG90S servo motors. The Arduino Nano is



then connected with a power supply, input from MPU6050 and output to two MG90S servo motors.



#### 3.2 Flowchart

Figure 3 shows the flowchart of the assistive spoon stabilizer. The flowchart shows the standard of procedure of the project. Below is the procedure shows the step on how to operate the device and how it works:

- 1. Turn ON the power button.
- 2. Read the angle from the x-axis (horizontal).
  - a. If the degree is more than 0°, motor 1 will rotate clockwise
  - b. If the degree is less than 0°, motor 1 will rotate counter-clockwise.
- 3. Read the angle from the y-axis (vertical).
  - a. If the degree is more than 0°, motor 2 will rotate clockwise
  - b. If the degree is less than 0°, motor 2 will rotate counter-clockwise.
- 4. If the power button is OFF, it will end the process.



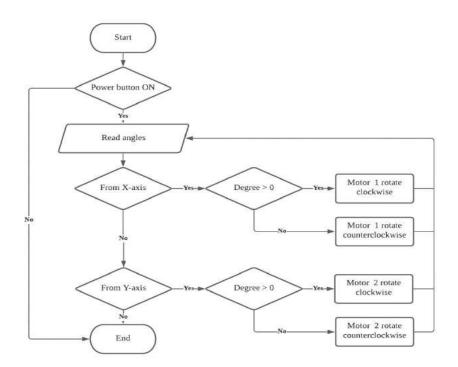


Figure 3: Flowchart of the Assistive Spoon Stabilizer

## 3.3 Circuit Installation

The straight female header connector is soldered on the prototype board aligned such as in the breadboard to form a connection of the circuit using jumpers. The Arduino Nano Atmega328 and MPU6050 Gyro Accelerometer Sensor are connected on the soldered prototype board. Figure 4 show the wiring connection of the circuit fit perfectly inside the casing of the Assistive Spoon Stabilizer.

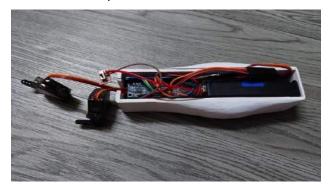


Figure 4: Wiring Connection inside The Assistive Spoon Stabilizer



### 3.3 Programming Installation

Because Arduino Nano has an old bootloader, it could not be burned using the normal method. Therefore, for burning programming into Arduino Nano, we need to use another Arduino board as a bootloader. In this case, I am using Arduino Uno as a bootloader to burn the programming into Arduino Nano. Below are the steps to burn programming into Arduino ISP Software on Figure 5.



Figure 5: Arduino ISP Software

1. ArduinoISP programming can be found in the example of Arduino Software. Set programmer as "AVRISP mkII" and upload ArduinoISP programming into Arduino Uno board.

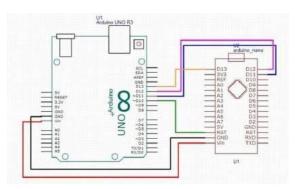


Figure 6: Bootloader Circuit



- 2. After uploading ArduinoISP programming into the Arduino Uno board, Arduino Nano is connected as Figure 6.
- Then, open the Assistive Spoon Stabilizer programming and set programmer to "Arduino as ISP" meanwhile port from Arduino Uno and burn Assistive Spoon Stabilizer programming into Arduino Nano.

## 4. Result & Dicussion

4.1 Comparison Between Assistive Spoon Stabilizer and Normal Spoon

Based on Figure 7, the Assistive Spoon Stabilizer can be stabilized to approximately 0° from the x-axis and y-axis. Meanwhile, a normal spoon does not have the ability to stabilize the spoon and hand binder which can suppress the hand of the patient and help the stabilizing itself.



Assistive Spoon Stabilizer

Normal Spoon

# Figure 7: Comparison Between Assistive Spoon Stabilizer and Normal Spoon

## 4.2 Data Analysis

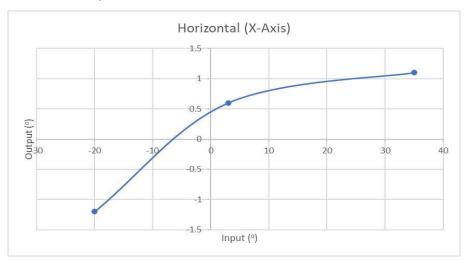
The results of Controlling the Assistive Spoon Stabilizer have taken from different angle in degree and the analysis showed in Table 1.



Axis	Input (°)	Output (°)	Output Average (°)
	3°	0.6°	0.6° + 1.1° + (-1.2°)
Horizontal			
(X-Axis)	35°	1.1°	3
	-20°	-1.2°	= 0.17°
	-0.4°	-0.2°	(-0.2°) + (-0.8°) + (-4.5°)
Vertical			
(Y-Axis)	-26.5°	-0.8°	3
	44.2°	-4.5°	= 1.83°

## Table 1: Results of Controlling the Assistive Spoon Stabilizer

Figure 8 shows the graph of input versus output in degree (°) from the results of controlling the Assistive Spoon Stabilizer from the horizontal axis.



## Figure 8: Graph Input Versus Output from Horizontal Axis



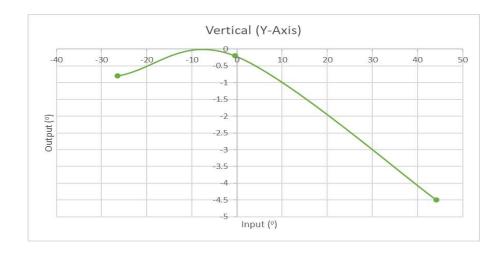


Figure 9 shows the graph of input versus output in degree (°) from the results of controlling the Assistive Spoon Stabilizer from the vertical axis.

## Figure 9: Graph Input Versus Output from Vertical Axis

#### 5 Conclusions

At the end of this project, with the development of the prototype Assistive Spoon Stabilizer, it can be stabilized by a gyro accelerometer sensor that can receive input from the patient hand from the horizontal and vertical axis and the output will reset the angle to the axis approximately of 00. The power supply is made from a lithium battery so the device can be rechargeable and activated the device. In addition, the device is consisting of a handgrip and hand binder to suppress the patient hand to prevent it falls from the hand of the patient while eating. The switch ON/OFF can be switched to enable or disable the sensor and then control the angle of the servo motor for the patient to eat thfood with the spoon

#### References

Abbasi, M., & Afsharfard, A. (2018). Modeling and experimental study of a hand tremor suppression system. *Mechanism and Machine Theory*, 126, 189–200. https://doi.org/10.1016/j.mechmachtheory.2018.04.009



- Bhidayasiri, R. (2005). Differential diagnosis of common tremor syndromes. *Postgraduate Medical Journal*, 81(962), 756–762. https://doi.org/10.1136/pgmj.2005.032979
- Bötzel, K., Tronnier, V., & Gasser, T. (2014). Differenzialdiagnose und therapie des tremors. *Deutsches Arzteblatt International*, *111*(13), 225–235. https://doi.org/10.3238/arztebl.2014.0225
- Chou, K. L. (2004). Diagnosis and management of the patient with tremor. In *Medicine and health, Rhode Island* (Vol. 87, Issue 5, pp. 135–138).
- Cunningham, L. M., Nugent, C. D., Finlay, D. D., Moore, G., & Craig, D. (2009). A review of assistive technologies for people with Parkinson's disease. *Technology and Health Care*, *17*(3), 269–279. https://doi.org/10.3233/THC-2009-0547
- Elias, W. J., & Shah, B. B. (2014). Tremor. JAMA Journal of the American Medical Association, 311(9), 948–954. https://doi.org/10.1001/jama.2014.1397
- Jankovic, J. (2008). Parkinson's disease: Clinical features and diagnosis. *Journal of Neurology, Neurosurgery and Psychiatry, 79*(4), 368–376. https://doi.org/10.1136/jnnp.2007.131045
- Louis, E. D., & Dogu, O. (2008). Does age of onset in essential tremor have a bimodal distribution? Data from a tertiary referral setting and a population-based study. *Neuroepidemiology*, 29(3–4), 208–212. https://doi.org/10.1159/000111584
- Raethjen, J., Lindemann, M., Schmaljohann, H., Wenzelburger, R., Pfister, G., & Deuschl, G. (2000). Multiple oscillators are causing parkinsonian and essential tremor. *Movement Disorders*, 15(1), 84–94. https://doi.org/10.1002/1531-8257(200001)15:1<84::AID- MDS1014>3.0.CO;2-K
- Schniepp, R., Jakl, V., Wuehr, M., Havla, J., Kümpfel, T., Dieterich, M., Strupp, M., & Jahn, K. (2013). Treatment with 4-aminopyridine improves upper limb tremor of apatient with multiple sclerosis: A video case report. *Multiple Sclerosis Journal*, *19*(4), 506–508. https://doi.org/10.1177/1352458512461394

Smaga, S. (2003). Tremor. American Family Physician, 68(8), 1545–1553.



## A PILOT STUDY OF NUTRITIVE PROFILE AND CONSUMER'S ACCEPTABILITY OF MUSA CAVENDISH

Muhammad Adam Norman Bin Nadzri<sup>1</sup>, Bustamam Bin Bonari<sup>2</sup>, Muhammad Fakhrulfahmi Bin Faisal<sup>3</sup> Wan Fawwaz Aiman Bin Wan Nazdi<sup>4</sup>, Siti Khatijah Binti Che Hassan<sup>5</sup>, Nur Hafizah Binti Mohamad Nasir<sup>6</sup>, Nur Maisara Binti Wazi<sup>7</sup>

> Tourism & Hospitality Department, Politeknik Tuanku Syed Siarjuddin, Arau, Perlis bustamam@ptss.edu.my

## Abstract

Musa Cavendish is an innovative product based on banana skin and used as a health food product, namely energy bars. It is suitable for consumption by consumers such as athletes, students and all walks of life. The name BARnana means a combination of banana peel and energy bar. BARnana has three layers starting with the bottom of a mixture of cereals, honey and dates. Then the second layer is banana peel that has been ground and mixed with melted chocolate. The Barnana energy bar is combination with a layer of nuts, almonds, cauliflower and pumpkin seeds. In addition, food waste is the cause of the idea to innovate BARnana products. The Innovation Idea Development Template method is used to produce BARnana innovation products. As a result of the questionnaire on BARnana innovation products, showed positive feedback. Results from 30 respondents stated that as many as 80% agreed this product is a health food. Improvements on innovative products will be improved in terms of taste, shape according to taste and consumer market in the future.

Keyword: BARnana, Banana Peel, Innovation Idea Development Template.

#### 1. Introduction

The word 'banana' refers to the fruit of evergreen, giant herb, and exclusively subtropical belonging to the genus Musa from the family of Musaceae (Lassoudière, 2007). Banana



is an elongated tropical fruit with a creamy texture, pleasing aroma, and sweet taste (Ploetz, Kepler, Daniells, & Nelson, 2007). Banana is considered the leading food in many countries (Singh, et al. (2016); Nelson, Ploetz & Kepler, 2006). Since this fruit is highly demanded, it was ranked as the fourth most essential food globally after other foods, namely rice, wheat, and maize. It is also consumed as the primary food resource and an alternative to rice and corn (Reginio Ketnawa & Ogawa, 2020). However, banana has a short life span (Ferreira & Freitas, 2019) that needed further investigation to prolong the shelf life for food security due to weather uncertainty like El Nino. Bananas have been widely grown and inexpensive in over 130 countries in Southeast Asia, including Malaysia, and it has an excellent potential to be exported abroad (Reginio, Ketnawa & Ogawa, 2020). There are approximately 300 types of bananas grown worldwide (Singh et al., 2016). An edible banana was grouped based on the chromosome sets existent and the proportion of genomes of M. acuminata (A) and M. balbisiana (B). The hybridization of M. acuminata and M. balbisiana will produce a plantain, a banana used for cooking (Hapsari & Lestari, 2016; Singh et al., 2016). The characteristic of banana and plantain are almost identical, depending on the amount of starch and sugar in the fruits (Hapsari & Lestari, 2016; Singh et al., 2016). Although their purpose is different (Singh et al., 2016), both are called bananas (Hapsari & Lestari, 2016).

Moreover, banana peel are considered food waste because many people usually only eat the banana pulp and throw away the banana skin / banana peel, banana peel are edible and contain many type of nutritions, moreover, (Szalay, 2021). Therefore, they can also be a good way to get magnesium and vitamins C and B6."Bananas are known to reduce swelling, protect against developing Type 2 diabetes, aid in weight loss, strengthen the nervous system and help with production of white blood cells, all due to the high level of vitamin B6 that bananas contain,Bananas are high in antioxidants, which can provide protection from free radicals, which we come into contact with every day, from the sunlight to the lotion you put on your skin, Bananas are also good for your heart. Furthermore, they are packed with potassium, a mineral and electrolyte, which carries a small electric charge. As such, potassium sends an electric signal to nerve cells that then fire to keep the heart beating and muscles contracting; it also helps to keep a healthy balance of water in your cells (Szalay, 2021). This shows that banana peels contain so many vitamins and nutritions.

There are many type of healthy process food product in the market, but to get the process healthy food that contain added protein, carbohydrates, dietary fiber and other nutrient is Energy bar, according to (Gill&Singh,2020) Energy bars are supplemental bars containing cereals, micronutrients, and flavor ingredients intended to supply quick food energy. Because most energy bars contain added protein, carbohydrates, dietary fiber, and other nutrients, they may be marketed as functional foods (Gill & Singh, 2020). Energy bar can



be consumed by athlete or people who care about healthy lifestyle and clean eating because according to (Noakes, Foster, et al ,2004) Energy bars may be used as an energy source during athletic events such as marathons, triathlons and other activities which require a high energy expenditure for long periods of time. They are also commonly used as meal replacements in weight-loss programs. (Noakes, Foster et. al ,2004). This shows that energy bar are good at supplying energy and nutrients to the consumer and its also easy to consumed anywhere and anytime.

In additional, food waste has always become the ugly cultures among malaysian, food wastage among malaysian has increased rapidly especially when during Ramadan and during food festival, according to (Reserve, 2022) Malaysia throws away 17,000 tonnes of food daily, there is an urgent need for Malaysia to look into curbing food waste in the country, as up to 17,000 tonnes of food waste are recorded on a daily basis. (Reserve, 2022). So to decrease the amount of food waste, we decided to make some food innovation, which is to combine energy bars and Banana peels.

Moreover, banana peel are considered food waste because many people usually only eat the banana pulp and throw away the banana skin / banana peel, banana peel are edible and contain many type of nutritions, moreover, (Szalay, 2021) Bananas are high in potassium and pectin, a form of fiber, said Laura Flores, a San Diego-based nutritionist. Therefore, they can also be a good way to get magnesium and vitamins C and B6."Bananas are known to reduce swelling, protect against developing Type 2 diabetes, aid in weight loss, strengthen the nervous system and help with production of white blood cells, all due to the high level of vitamin B6 that bananas contain,Bananas are high in antioxidants, which can provide protection from free radicals, which we come into contact with every day, from the sunlight to the lotion you put on your skin, Bananas are also good for your heart. Furthermore, they are packed with potassium, a mineral and electrolyte, which carries a small electric charge. As such, potassium sends an electric signal to nerve cells that then fire to keep the heart beating and muscles contracting; it also helps to keep



a healthy balance of water in your cells (Szalay, 2021). This shows that banana peels contain so many vitamins and nutritions.

Nowadays, food wastage has become a global issue and no stranger to the world especially during the month of Ramadan, people always throw away excess food waste due to reckless spending. According to Utusan Online (2018), every year there will definitely be an increase in the rate of food waste. The problem of food waste is very worrying because the disposal of food should be done in the right way or the other way is to reuse food waste to make a product so that the ecosystem is not affected and reduce the amount of food waste disposal Utusan Online (2018). Therefore, food premises also needed to introduce anti food wastage awareness and advise their customers not to waste their food unnecessarily. It is important to create awareness about food wastage as there are tens of thousands of poor families who do not get enough food every day. The excessive food could be distributed to those in need, like the poor families who have to live from hand to mouth. One of the methods to insure to resolve the problem is to create new food from food wastage New Straits Time (2018). Moreover, there are solutions to overcome the current issue such as creating a new product based on food wastage such as banana skin. Banana is a fruit grown mainly in tropical countries of the world. After harvest, almost 60% of banana biomass is left as waste. Worldwide, about 114.08 million metric tons of banana waste-loss are produced, leading to environmental problems such as the excessive emission of greenhouse gasses (Alzate, 2021) Many protein bars also contain high amounts of added sugar and use unhealthy sweeteners like high fructose corn syrup, which adds excess fructose to daily diet and increase risk of fatty liver, obesity and dia betes when consumed in high amount (Esther, 2019).

Most studies focused on processed bananas such as juice, puree, flour, and chips (Ranjha, Irfan, Nadeem, & Mahmood, 2020; Singh et al., 2016). However, based on the previous literature, there is a limited study on the commercial processing of bananas (Elkhalifa, Hassan, & Zei, 2014). Therefore, this study aims to evaluate Banana energy bar nutritional profile and acceptability from the species. This Barnana can be commercialised and, at the same time, tackle food security since it has a long shelf life when properly stored and used. Nevertheless, it also provides the nutrients needed by the body to grow. Because of that reason, there is a need to preserve bananas for later consumption and to face food security in the long run.



### 2.0 LITERATURE REVIEW

#### 2.1 The History of Banana and Species

However, a banana peel, called banana skin in British English, is the outer covering of the banana fruit. Banana peels are used as food for animals, an ingredient in cooking, in water purification, for manufacturing of several biochemical products as well as for jokes and comical situations. Besides that, bananas are a popular fruit consumed worldwide with a yearly production of over 165 million tones in 2011. Once the peel is removed, the fruit can be eaten raw or cooked and the peel is generally discarded. Because of this removal of the banana peel, a significant amount of organic waste is generated , FAO (1992). Moreover, the nutritional value of banana peel depends on the stage of maturity and the cultivar; for example plantain peels contain less fiber than dessert banana peels, and lignin content increases with ripening (from 7 to 15% dry matter). On average, banana peels contain 6-9% dry matter of protein and 20-30% fibre (measured as NDF). Green plantain peels contain 40% starch that is transformed into sugars after ripening.

Banana peels provide vitamin B6, vitamin B12, magnesium, potassium, fiber and protein. Banana peels may offer different health benefits depending on their level ripeness. Underripe, green bananas may be more effective in treating digestive issues, while riper, blackened bananas have been shown to help white blood cells fight off disease and infection. Then, rolled oats and Nestum can provide oats that are incredibly nutritious, whole oats are rich in antioxidants, oats contain a powerful soluble fiber called betaglucan, can lower cholesterol levels and protect LDL cholesterol from damage, and oats can improve blood sugar control. After that, honey contains a variety of nutrients, rich in antioxidants, better for blood sugar levels than regular sugar, may improve heart health, and is easy to add to daily diet. While the dry cranberry may lower risk of cardiovascular diseases, improves renal function and reduces comorbidly factors. Then, the function of nuts can make weight loss diabetes control, folic acids, magnesium, potassium, calcium and phosphorus. The last one, dates use because they are high in fiber, high in Disease – Fighting Antioxidants, promote brain health, promote Natural Labor, excellent natural sweetener and easy to add to daily diet.



### 2.2 The usage of Banana

The indigenous germplasm cultivated banana was located at the Malaysian Agricultural Research and Development Institute (MARDI). Uniquely, bananas are considered an exceptional crop due to the usage of their whole plant (Kennedy, 2009). Banana is a significant food source for humans (Sarma, Govila, & Yadav, 2020) and animals (Cronauer & Krikorian, 2012). Besides the creamy texture, soft and sweet, everything from the banana and its plant can be utilized (Mohapatra, Mishra & Sutar, 2010). Banana can be eaten as it is when ripe, can be mashed, and also can be used in many types of cooking such as cook, boil, steam, deep-fried, and bake traditional food. Banana steam is normally used to cook *Kerabu Umbut Pisang, Kari Batang Pisang*, and the unripe banana is used to cook *Gulai Pisang Putik* that popular in Northern part of Malaysia – in Kedah, Penang, and Perlis. Meanwhile, the banana skin can be used as fertilizers for other plants, and the banana flower can be used in soup and Kerabu Jantung Pisang. Furthermore, banana leaves are commonly used to wrap food. The banana leaves give a unique aroma to the food, especially Nasi Lemak (a rich and creamy dish in Malay Culture).

### 2.3 Aceptability

Acceptability could be a subjective degree based on hedonics (delight). It may, in turn, is impacted by the tactile properties of the nourishment, past introduction to it and ensuing desires, relevant components, an individual's culture, physiological status (i.e., starvation, thirst and presence/absence of ailment), and numerous other factors. Food acceptability is influenced by numerous variables; which may be related to the person, the nourishment, or the environment in which the food is devoured. The estimation of food acceptance is exceedingly complex and depends on psychometric (scales) and/or behavioural models (food choice models) (Murray & Baxter, 2003). How much somebody likes a foodstuff ought to be critically calculated in affecting the choice and utilization of foodstuff or eating habits. These critical impacts of buyer's convictions and desires on items discernment have been illustrated for absolutely tangible measurements of nourishment. They have been appeared to have collective effects on behaviour, e.g., utilization (Caballero, Trugo & Finglas, 2003). The product's color, texture, taste, and flavour is vital for the new product development. For most consumers, foodstuff flavour appears to be the foremost critical acceptability criterion before appearance and texture (Kumar, Singh & Pathak, 2020; Baixauli et al., 2002).

Based on this banana powerbar is a good sports nutritions product, like powerbar, that is developed to be easily digestible throughout any form of exercise. They come ready to eat or can be prepared with minimum effort and of course need to be consumed. This makes it much easier for athletes to take in the optimum combination of nutrients in the



right quantity, at the right time and in the best quality. According to (A R Priatama, 2019) . This banana powerbar is also good to be consumed for diabetics people that want to take care of their healthy life.

## 3.0 METHODOLOGY

This quantitative study was used an individual as a unit of analysis. Data was collected from the population of staff and students at Polytechnic Tuanku Syed Sirajuddin, Perlis. Respondent rate for this study or questionnaire as a whole is 30 respondent and chooses by simple random sampling method respondents and the number of respondent 100% has been determined .

Hedonic liking tests are carried out by consumer panels and usually ask questions of overall acceptability and comments about its characteristics, which consumers like or dislike. After the Barnana was made, therefore, it is ready to be tested by consumers. The Barnan was cut into smaller pieces and was tested by the consumers. The convenient sampling has opted for this study. The participants were recruited based on their voluntarism in Arau, Perlis. The acceptability attributes for the assessment were then clarified. Overall, only 30 consumers have participated in a pilot study. The chosen participants are similar to the consumers who consumed the product, as suggested by Watts, Ylimaki, Jeffery, and Elias (1989). Then, the assessment for the acceptability attributes such as texture, quality, taste, colour, and flavour was distributed. The 5-point Likert scales were used; 1=dislike extremely, 2=dislike slightly, 3=neutral, 4=like slightly, and 5=like extremely (Watts et al., 1989). All these attributes were analyzed by using descriptive analysis.

#### 4.0 RESULTS AND FINDING

#### 4.1 The demographic profile

Based on the results obtain, female was the highest respondents in this study with 30% followed by male was 70%. Next for the ages, 18-20 was the highest respondents in this study with 46.7%, followed by 21-22 is 30% and the lowest respondents in this study is 23-above is 23.3%.



Majority of responden (80%) agree that BARnana is a healthy food , healthy consumed and have a good potential in the market. Meanwhile out of 40% agree that BARnana have a good taste , flavor , taste and appearance. Despite others 60% respondent agree that BARnana have a good packaging and nutritive information. Therefore, the product's color plays a crucial factor in influencing the consumers' acceptance of dried food. It is related to the food product's acceptability and essential physical characteristics (Baixauli et al., 2002)

## Table 4.1.1 Gender of Respondent

## 4.1 Respondent demographic

Table 4.1 Respondent's Profile by	Gender (N= 30)
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Gender	Frequency	Percent (%)
Male	21	70.0
Female	9	3
Total	30	100.0

## 4.2 Nutritive Analysis

Mean while ,the result of the nutritional profile of BARnana energy bar and the method used is presented in table 4.21 . The calorie of BARnana energy bar is 366 kcal per 100 g which is higher than the raw banana that is only 148.8g. The total carbohydrates for Barnana energy bar are 54.5 g for every 100 g, which is slightly higher g than a banana (35.24 g). However, the fat of frozen banana is higher, which 13.9 as compared to raw banana that is only 0.08. Based on the result, the frozen banana contains more calories and fat

Test parameter	Unit	Method used	Result Per 100g
Calories	Kcal	Method of analysis for nutrition	366
		Labeling ,Chapter1 ,1993	
Protein	g	AOAC 976.05	5.8

Table 4.2.1	Nutritional	Analysis
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2 <sup>nd</sup> National Conference on TVET Undergraduate Students (NCTS)
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19-20 July 2022

Total Carbohydrate	g	Method of analysis for nutrition Labeling ,Chapter1 ,1993	54.5
Total Fatt	g	In house method Based on pearson Chemical Analysis of Food ,8 <sup>th</sup> Ed ,1990	13.9

## 5.0 Conclusion

The BARnana energy bar seeks to convey to the consumer a straightforward, hassle-free, and nutrient-rich notion of this product and to implement packaging that is user-friendly with the consumer to produce a good usability and excellent experience as a buyer of BARnana energy bar. Banana Powerbar, like Powerbar, is a superb sports nutrition product that is made to be easily digestible throughout any sort of exercise. Naturally, they must be consumed. They can be easily made or come ready to eat. This makes it much simpler for athletes to consume the ideal combination of nutrients in the highest quality, amount, and timing. As stated by (A R Priatama, 2019). As a result, it is proposed that a qualitative method or a quantitative method with a high sample size be used to extend and gather more data. Future studies should include more rigorous data analysis employing a structural equation model and improvise the product innovation.

#### References

Baixauli, R., Salvador, A., Fiszman, S. M., & Calvo, C. (2002). Effect of the addition of cornflour and colourants on the colour of fried, battered squid rings. European Food Research and Technology, 215(6), 457-461

Elkhalifa, A. E. O., Hassan, A. M., & Zei, M. E. A. (2014). Analytical quality and acceptability of baked and fried banana chips. Journal of Human Nutrition and Food Science, 2(6), 1052

FAOSTAT (2014). Statistical Database of the Food and Agriculture Organization of the United Nations. <u>http://faostat.fao.org</u>

Ferreira, T. H., & Freitas, M. L. (2019). Production, physical, chemical and sensory evaluation of dried banana (Musa Cavendish). Emirates Journal of Food and Agriculture



Hapsari, L., & Lestari, D. A. (2016). Fruit characteristic and nutrient values of four Indonesian banana cultivars (Musa spp.) at different genomic groups. AGRIVITA, Journal of Agricultural Science, 38(3), 303-311.

Kumar, B., Singh, V. P., & Pathak, V. (2020). Quality Characteristics of Banana based Milk Smoothies Developed from Milk of Hariana, Sahiwal and Cross Breed Cows. Asian Journal of Dairy & Food Research, 39(1).

Lassoudière, A. (2007). Bananier et sa culture (le) (p. 383). Versailles CEDEX, France: Editions Quae

Murray, J. M., & Baxter, I. A. (2003). Sensory Evaluation Food Acceptability and Sensory Evaluation.

Mohapatra, D., Mishra, S., & Sutar, N. (2010). Banana and its by-product utilisation: an overview.

Noakes. (2004). Meal Replacement Are as Effective as Structured Weight-Loss Diets for Treating Obesity in Adults with Features of Metabolic Syndrome. *The Journal Of Nutrition*.

Nelson, S. C., Ploetz, R. C., & Kepler, A. K. (2006). Musa species (banana and plantain). Species profiles for Pacific Island agroforestry, 15(2), 251-259.

Pandey, A. K., Ravi, N., & Chauhan, O. P. (2020). Quality attributes of vacuum fried fruits and vegetables: a review. Journal of Food Measurement and Characterization, 1-14.

Price, N. S. (1995). The origin and development of banana and plantain cultivation. In Bananas and plantains (pp. 1-13). Springer, Dordrecht.



Reginio, F. C., Ketnawa, S., & Ogawa, Y. (2020). In vitro examination of starch digestibility of Saba banana [Musa 'saba'(Musa acuminata× Musa balbisiana)]: impact of maturity and physical properties of digesta. Scientific Reports, 10(1), 1-10.

Sarma, U., Govila, V. K., & Yadav, A. (2020). The traditional and therapeutic use of banana and its plant-based delicacies in ethnic Assamese cuisine and religious rituals from Northeast India. Journal of Ethnic Foods, 7(1), 1-7.

Singh, B., Singh, J. P., Kaur, A., & Singh, N. (2016). Bioactive compounds in banana and their associated health benefits–A review. Food Chemistry, 206, 1-11.

Watts, B. M., Ylimaki, G. L., Jeffery, L. E., & Elias, L. G. (1989). Basic sensory methods for food evaluation. IDRC, Ottawa, ON, CA



## MICROSLEEP DETECT AND ALERT SYSTEM FOR DRIVER

Aniss Rais Nabila Abd Razak, Dr Siti Anizah Muhamed

Faculty of Electrical Department, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor. anissrais05@gmail.com

#### Abstract

The Road Safety Department of Malaysia logged a total of 535000 road accidents that occurred in 2018 and an increment of 19000 cases in 2019 with fatal accidents totalling 5764 cases in the same year. Statistically, Malaysia is one of the ASEAN countries with the highest road fatalities based on the overall population. In 2020 Human behaviour was listed as the highest-ranking cause of Road Accidents in Malaysia, with drowsiness caused by microsleep and fatigue conditions among the sub-factors. A sudden temporary episode or drowsiness which lasts up to several seconds is defined as microsleep (MS). Microsleep signs can be detected by using a human heartbeat pulse which is used in this system design. Taking the simple concept of other road users honking to alert a wanderoff driver, this system combines IoT technology with an applicable device that analyzes data of microsleep signs, alert the drivers by automatically turning on a neck massager and at the same time notify interested parties such as other people in the car or family at home. The system has proven able to detect the microsleep of the subject by using a heart rate sensor. The system is also used to study the heartbeat pulse patterns when sleepiness occurs and the effects of a sudden stimulus on the pattern. The heart rate that has been detected will notify the Blynk app and can be seen by the user.

**Keywords:** Microsleep Detect, Analysis of Road Accident, The cause of microsleep are fatigue and microsleep.



#### 1. Introduction

Road accidents that lead to death may cause many people to experience the loss of a family member or close friend(Mahat et al., 2020) [1]. One of the reasons that lead to road accidents is the drowsy driver. Microsleep (MS) and crashes are the two important consequences

of sleepiness during driving (Golz et al., 2011). There are several gadgets on the market to prevent microsleep during driving. For example, the Samsung smartwatch can track health, activity, fitness, and sleep. However, most of these solutions focus on detecting microsleeps without any prevention action. There is a need for the development of a device that can detect microsleep and refresh the driver to avoid MSE whilst driving. Still, microsleeps may reoccur even after a refreshing episode. This is why the related parties such as other people in the same vehicle or family at home should be notified about the possible microsleep incidents during the ride.

Road accidents case which involving cars and heavy vehicles such as buses and lorries are one of the major causes of injuries in Malaysia. The total number of road accidents was 265,175 with fatalities of 5230, seriously injured 6942, and slightly injured 30,684 in the year 2001. (Abdul, 2003). Microsleep and fatigue condition is one of the main factors that contribute to road accidents. Driving in this condition will lead to an accident since it affects the driver's concentration. Rest up before driving, take caffeine or pull over for a rest when the signs of microsleep and fatigue appears could avoid falling asleep on the wheel. However, some drivers cannot take this action to refresh themselves from fatigue and continue driving. Therefore, detecting a microsleep is one of the important steps to preventing road accidents. This project proposed to detect the sign of microsleep using a pulse beat sensor and also to alert and refresh the driver using a neck massager.

#### 2. Literature Review



## 2.1 THE INCREASING OF ROAD ACCIDENTS ARE A MENACE TO SOCIETY

Many people had experienced a road accident in their life, which is an extremely traumatic incident. Road accident which involves cars, lorries and motorcycles will affect our physical whether the minor injury or major injury. Based on an article by Abdul Kareem, K. Abdul, according to the Ministry of Health Malaysia, during the year 1997-98, road accident was the third main cause of hospitalization in hospitals and accident was the fourth main cause of death behind heart diseases, septicaemia and cerebrovascular accident (Mahat et al., 2020). He summarized that accident fatality in Malaysia should be reduced thus saving millions of Ringgits in terms of productivity loss, property damage, medical cost, and others (Abdul, 2003). Based on an official portal website of the Ministry of Transport Malaysia, in terms of tracking road accidents and road fatalities, there are two types of crash data collection method which is authorised by the Royal Malaysian Police (RMP) and research conducted by the Malaysian Institute of Road Safety Research (MIROS) (Abdul, 2003).

#### 2.2 CAUSE OF ROAD ACCIDENT

Microsleep is an involuntary sleep episode that lasts for 15 seconds or less 7 seconds rather than minutes or hours. Based on a website article, medically reviewed by Dr Anis Rehman, M.D, microsleep referred to as behavioural microsleep can be identified by a person's lapses in attention or briefly closing their eyes. Microsleep becomes risky

because it could make a person less responsive for a brief time. Measuring brain activity or a person's face and body could be one of the ways to detect microsleeps [3]. Electroencephalogram (EEG) measures brain waves during a microsleep episode. To show the differences in brain activity between microsleep and regular sleep, functional magnetic resonance imaging (fMRI) is used [3].

#### 2.3 NORMAL RESTING HEART RATE RANGE FOR ADULTS



Based on an official website of Mayo Clinic, there are common ways to determine a human heartbeat, which is placing your index and third fingers on the side of your throat on your neck or putting two fingers between the bone and the tendon over your radial artery, which is located on the thumb side of your wrist, to check your pulse. Multiply the count number of beats in 15 seconds, to calculate beats per minute [6]. Resting heart rate is when your body is a complete rest in a condition such as sleeping, sitting or relaxing. Our heart is pumping the lowest amount of blood to supply oxygen for our body when we are at rest. Peter Santucci, MD, professor of cardiology at Loyola University Medical Centre in Maywood, Illinois said that the normal rate can be from 40 to 100 beats per minute [7]. Since the body unwinds so profoundly during rest, the dozing pulse ought to be marginally lower than the ordinary resting pulse while conscious. The heart rate begins to slow as a person begins to fall asleep, and studies suggest that this process can begin as soon as a person realises, he is preparing for sleep [8]. Core body temperature can drop and metabolism, as well as heart rate usually will slow down, as the body relaxes into a deep sleep state [8].

An article from the British Heart Foundation state that between 60 and 100 beats per minute (bpm), is a normal heart rate whilst resting. But it will vary depending on what you were doing and when it will be measured before the reading is taken [9]. However, many factors can influence our heart rate, such as age, body size, medication, body fitness and activity level also health condition of a person. The category for a normal target of

	Age	Target HR Zone 50-85%	Average Maximum Heart Rate, 100%
	20 years	100-170 beats per minute (bpm)	200 bpm
	30 vears	95-162 hnm	190 hnm
Age	Group		Normal Resting Heart Rate (bpm)
1 mo	nth old or le	SS	70-190
1-11 months			80-160
1-2 years			80-130
3-4 years			80-120
5-6 years			75-115
7-9 y	ears		70-110

#### FIGURE 1: Normal target and average maximum heart



heart rates and the average maximum heart rate is based on age [10]. According to the American Heart Association, 60-100 beats per minute is the reasonable resting heart rate for most people barring any underlying medical conditions and it should be closer scores to 60bpm rather than 100bpm. Based on data from the National Institutes of health, there is a typical list of sleeping heart rates by different ages [11].

## 3. Methodology

## 3.1 BLOCK DIAGRAM

The figure below shows the main components which are NodeMCU, pulse sensor and vibration. For input, we connect a pulse rate sensor to detect the heartbeat of the user. The power supply with NodeMCU ESP8266 is connected to NodeMCU. For the output,

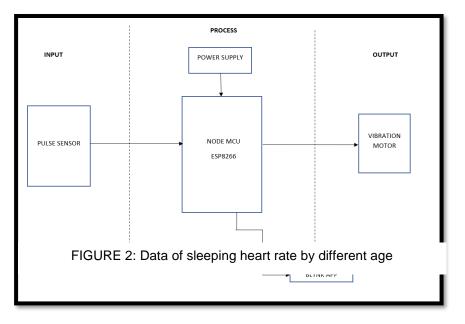


FIGURE 8: Block diagram

we have a vibration motor that will automatically activate when a heartbeat below 60-100 bpm is detected. Also, the data will be displayed on the IoT application, the Blynk app.



## 4. Result & Discussion

## 4.1 DEVELOPMENT OF PROJECT

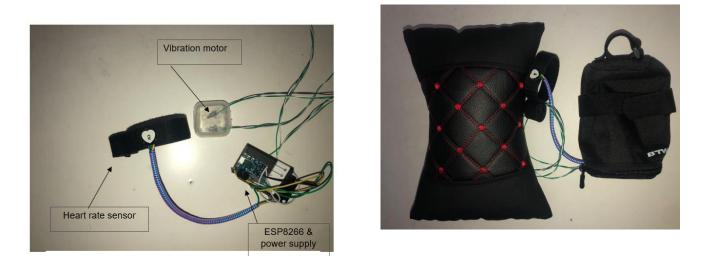


FIGURE 15: The result of microsleep detect and alert system for driver project prototype

Figure 15 above shows the prototype with a full casing. The micro motor vibration is put in the headrest to able to put at the driver's seat in the car. It is to be adjusting the micro motor vibration at the neck of the driver while their driving. The heart rate pulse sensor is designed to be put at the driver's wrist to detect the heartbeat of the user. Lastly, the NodeMCU, rechargeable battery and a power switch that connects with motor microvibration and heart rate pulse sensor are put in the casing, so the user is comfortable wearing them on their arm.

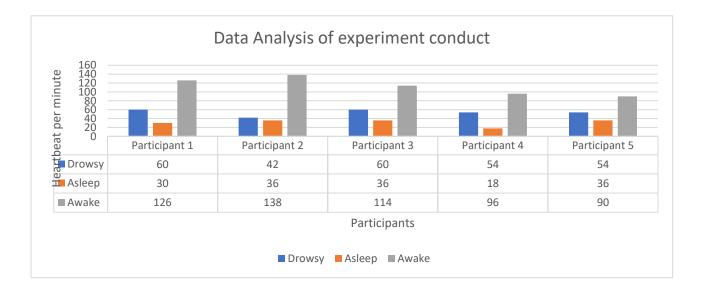


## 4.2 Result Analysis

Participants Heart rate when Time taken for Heart rate when Hear						
	drowsy (bpm)	the device to	asleep (bpm)	sudden awake		
		operate (s)		(bpm)		
1	60	3	30	126		
2	42	2	36	138		
3	60	2	36	114		
4	54	2	18	96		
5	54	3	36	90		
6	60	3	26	108		
7	60	2	54	136		
8	48	2	43	126		
9	60	2	50	90		
10	65	3	54	102		

#### Table 25: Data Collection

### Graph 1: Data Collection





This experiment cannot be conducted on drivers in the car because of the possibility that would harm the driver. So, the experiment was conducted on the subject at different places and times. Ten subjects were involved in these experiments to test the ability of the device that was developed. From the table, we can see the results of heart rate when the subjects are drowsy, sleeping and sudden awake. The participant's heart rate was recorded between 60bpm and below in a drowsy state, the heart rate for the asleep state is also at the lowest number of bpm and the heart rate going spikes when the participants are in a sudden awake state, which is 100bpm and above. We also recorded the time taken for the device to operate when the heart rate of the subject in a drowsy state was detected. The Blynk app notifies the third party when the microsleep is detected, and the vibration motor will immediately turn on. As we can see from the table, it takes between 2-3 seconds for the vibration motor to activate. The device can detect the drowsy heart rate which falls below 60-100bpm beat per minute. This is shown in Graph 1 of the heart rate in bpm against time.

#### 4. Conclusions

The Microsleep Detect & Alert System for Drivers can work well for drivers on the road. Furthermore, the device can alert and refresh the driver that shows coming microsleep signs by using an automatic neck massager. Moreover, it is packaged with an application that alerts passengers and related parties when the driver shows microsleep signs. It also can be used to analyse heartbeat pulse patterns when sleepiness occurs and the effects of a sudden stimulus on the pattern. By characterizing this pattern, a better design can be implemented for future improvement.



#### References

- Stipdonk, H., Bijleveld, F., van Norden, Y., & Commandeur, J. (2013). Analysing the development of road safety using demographic data. *Accident Analysis & Prevention*, 60, 435–444. https://doi.org/10.1016/j.aap.2012.08.005
- Abdul, K. (2003). Review of Global Menace of Road Accidents With Special Reference To Malaysia- a Social Perspective. Malaysian Journal of Medical Sciences, 10(2), 31–39.
- Road Accidents and Fatalities in Malaysia. (2021, November 14). MINISTRY OF TRANSPORT MALAYSIA. https://www.mot.gov.my/en/land/safety/road-accidentand-facilities
- Summer, J. (2021, August 26). Microsleep: What Is It, What Causes It, and Is It Safe? Sleep Foundation. https://www.sleepfoundation.org/how-sleep-works/microsleep
- WAKE: A Behind-the-ear Wearable System for Microsleep Detection. (2020, June). [Slides]. PowerPoint. http://mnslab.org/nhatpham/files/MobiSys2020\_WAKE\_Presentation.pdf
- Defining Microsleep. (2021, March 12). Sleep.Org. https://www.sleep.org/what-ismicrosleep/
- Heart rate: What's normal? (2020, October 2). Mayo Clinic. https://www.mayoclinic.org/healthy-lifestyle/fitness/expert-answers/heart-rate/faq-20057979
- Iliades, C. (2021, February 25). How to Know If Your Sleeping Heart Rate Is Normal. LIVESTRONG.COM. https://www.livestrong.com/article/105256-normal-heartrate-sleeping/



- What is Considered a Normal Sleeping Heart Rate? (2021, February 6). The Health Board. https://www.thehealthboard.com/what-is-considered-a-normal-sleepingheart-rate.htm
- American Heart Association editorial staff. (n.d.). Target Heart Rates Chart. Www.Heart.Org. Retrieved March 9, 2021, from https://www.heart.org/en/healthyliving/fitness/fitness-basics/target-heart-rates
- Target Heart Rates Chart. (n.d.). Www.Heart.Org. Retrieved March 9, 2021, from https://www.heart.org/en/healthy-living/fitness/fitness-basics/target-heart-rates
- Cralle, T. (2020, October 8). Average Sleeping Heart Rate by Age: Why it Matters? Terry Cralle from https://www.terrycralle.com/average-sleeping-heart-rate-byage/#:%7E:text=By%20age%2010%2C%20most%20kids%20will%20have%20a n,of%20their%20life%2C%20provided%20they%20remain%20relatively%20heal thy.
- Agarwal, T. (2020, April 22). *Heart Beat Sensor How to Measure Heart Beat: Working and Application*. ElProCus - Electronic Projects for Engineering Students. https://www.elprocus.com/heartbeat-sensor-working-application/
- Aqeel, A. (2021, December 13). Introduction to Arduino Nano. The Engineering Projects. https://www.theengineeringprojects.com/2018/06/introduction-toarduinonano.html#:%7E:text=Arduino%20Nano%20Programming%20%26%20Commu nication%201%20The%20Nano,the%20board%20and%20the%20computer.%2 0More%20items. . .%20
- A. (2020, November 16). Introduction to L298N Motor Driver | How it's work. ElectroDuino. https://www.electroduino.com/introduction-to-l298n-motor-driverhow-its-work/



## REAL-TIME FALL DETECTION AND VITAL SIGNS MONITORING SYSTEM FOR ELDERLY LIVING ALONE USING WEARABLE SENSOR

#### Wan Nur Safiah Hanis Wan Mamat Zukunain, Dr. Siti Anizah Muhamed

Faculty of Electrical Department, Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Selangor. Safiahhanis123@gmail.com

### Abstract

Malaysia will become an ageing country by 2030. Data show that number of elders aged above 60 is increasing, while the percentage of young people aged 14 and below declined over the years. The rising number of elders results in socioeconomic issues including healthcare costs and social support from family members, community, and policymakers in terms of living arrangements. Especially for elders living alone, falling is a serious health problem, and it can lead to serious injuries such as hip fractures. When a person is immobilised due to an injury or unconsciousness, they are unable to aid themselves. Not being found for hours after a fall is fairly prevalent among the elderly who live alone, which dramatically raises the severity of fall-related injuries. Wearable fall detection systems have gotten a lot of interest in academia and business. Some monitoring gadgets, however, are difficult for older persons to wear or singularly only detect falls without monitoring vital signs. This project combines real-time vital signs monitoring system with a fall detection alert function by using wearable sensors and IoT technology. The system has proven able to detect all falls in FIVE (5) varieties of common falling patterns among the elderly.

# Keywords: fall detection; variable sensor; elderly people; prevention; automatic; wireless.

## 1. Introduction

According to Malaysia's demographic age structure, the percentage of people in their golden years (60 years and up) is growing. The percentage of people aged 60 and more has risen from 4.6 per cent in 1991 to 5.3 per cent in 2005, and it is anticipated to rise to 8.0 per cent by 2020. Around 7% of Malaysia's 1.4 million people aged 60 and over live alone, according to census data from 2000. Data from a subsample of the study on



Mental Health and Quality of Life of Older Malaysians were referred to in this paper. Around 10% of the original sample, or 299 seniors aged 60 and over, were living alone[1].

A variety of causes can induce falls in the elderly. "Accidental" or "environmental" is the most often mentioned cause of falls among older persons living in a variety of settings, according to one of the largest retrospective studies of falls among older adults living in a variety of settings, accounting for 30–50 per cent of most series. The gaits of older people are stiffer, less coordinated, and potentially harmful than those of younger people. With age, posture control, body-orienting reflexes, muscular strength and tone, and step height all deteriorate, making it more difficult to prevent falling following an abrupt trip or slide. After a slip, the "method" for maintaining balance goes from the rapid-correcting "hip strategy" (fall avoidance via weight shifts at the hip) to the "step strategy" (fall avoidance via a rapid step) to absolute lack of ability to correct in time to prevent a fall as people get older. Vision, hearing, and memory problems are all common in people as they get older. Trips and stumbles are more likely as a result of this [2]. Many falls attributed to accidents, on the other hand, are the result of a combination of identified environmental dangers and increased human vulnerability to hazards as a result of age and sickness. The hazardousness escalated if the fall happens when the elderly are alone. A simple and wearable sensor that can detect falls and inform third party real-time is a needed solution.

#### 2. Literature Review

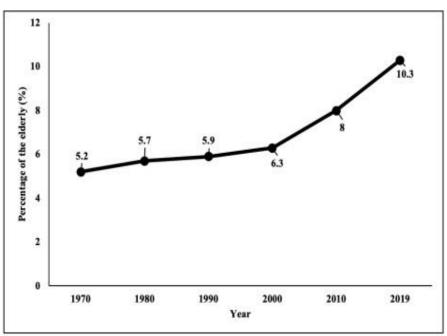
# 2.1 MALAYSIAN AS AN AGEING COUNTRY

Malaysia will become an ageing country by 2030. Data show that number of elders aged above 60 is increasing, while the percentage of young people aged 14 and below declined over the years. The number of elderly people in Malaysia from 1970 to 2019 is depicted in Figure 1, however, the 2019 figure is simply an estimate. According to Figure 1, there were 3.4 million seniors in 2019 compared to 546,000 annually in 1970, which is the period covered by the graph. In contrast, just 5.2 per cent of the population was over the age of 65 in 1970, but by 2019, that number had risen to 10.3 per cent. In terms of Malaysian states, the Department of Statistics (2019a) said that Perak attained the "old" classification when the proportion of residents aged 60 and above reached 15.3 per cent in the state in 2020. (MyMetro, 31 October 2019).

According to statistics, Malaysians' life expectancy rises as their socioeconomic condition and access to medical care improve. Because of advancements in healthcare, the death rate has decreased over time for all age groups. By 2020, the Malaysian population's life expectancy is anticipated to reach 80. Birth in 2018 was anticipated to



live, on average, 75 years until 2093, per the Department of Statistics Malaysia (2018). In addition, it is anticipated that Malaysian men and women would live an additional 15.0 and 17.2 years, respectively, after they turn 65. Malaysia's growing geriatric population is a result of the country's declining fertility rate.



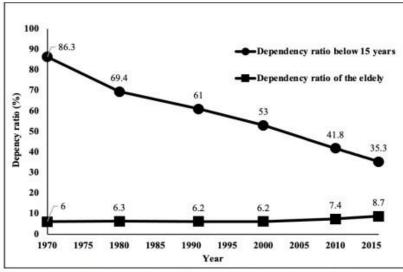
Source: Department of Statistics Malaysia (2019a)

Figure 2.1: Percentage of the Elders in Malaysia, 1970-2019

Additionally, the dependence ratio of the population aged 65 and above is impacted by the rise in the elderly population. This demonstrates the current and predicted future burden of caring for the elderly on the working class. The number of dependents per 100 persons in the working-age group is known as the dependency ratio. The juvenile dependency ratio (those under 15) and the old-age dependency ratio (those 65 and beyond) make up the overall dependency ratio (Department of Statistics Malaysia, 2017). In 1970, there were 92.3 dependents per 100 working persons (15-64 years old), but by 2015, that number had dropped to 44.0. To 43.0 per cent, the reliance ratio dropped. From 86.3 per 100 working persons (15-64 years old) in 1970 to 35.3 per 100 working people in 2010, there was a 32.6 per cent fall in the ratio of young dependents aged 0 to 14. Due to Malaysia's dropping birth rate, there are fewer persons in this age group, which results in a decrease in the youth dependence ratio. Unlike the old-age dependence ratio, which went from 6.0 per 100 working persons (15-64 years old) in 1970 to 8.7 per 100 working people in 2016, this ratio increased, showing a gain of 8.0 per cent throughout the period (1970-2016).



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Source: Department of Statistics Malaysia (1975; 1984; 1995; 2001; 2011; 2017).

Figure 2.2: Dependency Ratio of the Population n Malaysia, 1970-2015

Low reproductive rates can either lengthen or shorten a person's lifetime. As a result, there are population ageing challenges that need to be addressed to manage the senior population's needs for healthcare, housing, general care, and family assistance. The neighbourhood should be ready to accept the increasing number of older residents and act to solve this problem, especially for elderly men. The longevity of a person might be increased or decreased by low fertility rates. This is due to an increase in the number of older men who struggle to govern alone, particularly after the death of their wives. However, more senior citizens are now aware of these self-care difficulties, and some have turned into contributing members of society. One worry is that since children do not want to live with their parents, the elderly are left to live alone without any assistance from the family, especially when it comes to their nutritional and medical needs. The reality of elderly individuals living longer makes this issue more obvious in both developed and developing nations. In major cities, being alone has become the norm.

# 2.2 SOCIODEMOGRAPHIC FACTORS AS A RISK OF FALLING

After the age of 60, the risk of falling rises, and multiple studies have found that age, as well as past falls, is a major predictor of falling. It is commonly known that 30 per cent of the community's residents over the age of 65 die each year (48 per cent). Over 40 per cent of individuals over 75 years old and nearly one in every two persons are affected. Those above the age of 80 will fall at least once a year. [7]



The number of injuries caused by falls rises dramatically as people get older. Falls appear to be a sign of frailty, poor mobility, and acute or chronic health problems. The sheer fact that you've fallen before tells you very nothing about what caused it.

The relationship between falls and gender is not well understood, according to community sample studies. Some writers claim that women are more prone than males to fall whereas others claim that there are no differences in the incidence of falling between men and women. Other research skips gender analysis since their samples are largely or exclusively female.[8]

# 2.4 FALL DETECTION

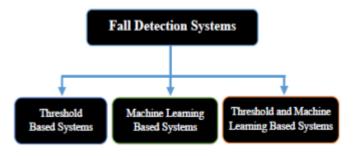


Figure 2.4: Fall Detection System Classifications

Based on the algorithms employed to distinguish between a fall and a no-fall scenario, we may divide fall detection systems into three categories. Figure 2 is a simple illustration of the classification. The numerous smartphone sensors are used to collect human motion data. Accelerometer, gyroscope, and magnetometer are all examples of sensors. The sensor data is then compared to specific predetermined values. Specific sensor values or variations between sensor readings can be used as pre-set values[10]. Specific sensor values, or disparities between sensor readings, are examples of pre-set values. A decision is made depending on whether or not the sensor values fulfil the system's required requirements. When a fall is observed, emergency services and mediators are usually notified via notification services[10].



# 3. METHODOLOGY

# 3.1 BLOCK DIAGRAM

Based on the **Figure 3.1**, below as stated in the Block Diagram, the input of the system is LI-ON Battery, ADXL335, DS18B20 and MAX30100. All the sensors will give input to the NODEMCU to begin the process notification. The gyrometer will alert the fall detection and the other sensors is used to send the vital signals.

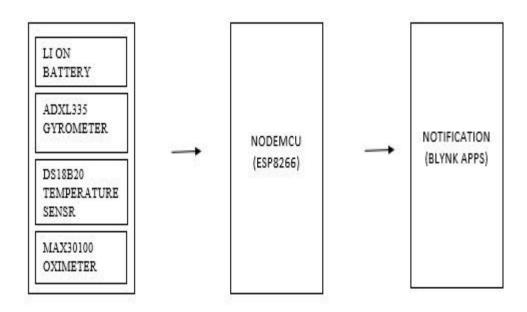


Figure 3.1: Block Diagram of The Project

# 3.3 FLOWCHART

After one of the algorithms detects a fall, the fall detection programmes proceed through what is known as the post-fall process. The process flowchart may be seen here. All falls recognised by the if gyro gets the trigger and the value we set is below 450 "possible falls" in this process, guardians will be notified through Blynks App along with real-time reading vital signs as shown in Figure 3.3. If the gyro does not get gets triggered by user action, the process will repeat.



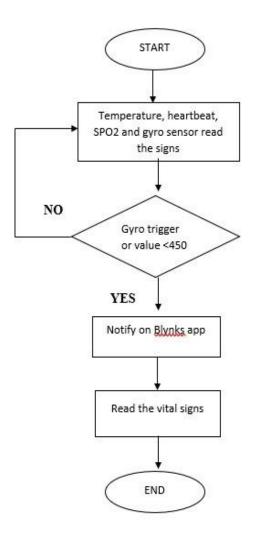


Figure 3.4: Flowchart of The Project

4. Result & Discussion

# 4.1 DEVELOPMENT OF PROJECT

This section shows the hardware and software of the real-time fall detection and vital signs monitoring system for the elderly living alone using a wearable sensor that can be used by the guardian.



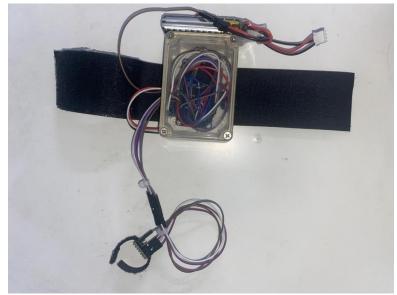


Figure 4.1: The prototype of The Project

# 4.2 Result Analysis

The results of 4 participants doing commonly elderly falls. As shown in the table, the result is accompanied by reading vital signs.

PARTICIPANTS	TEMPERATURE (°C)	HEART BEAT (bpm)	SPO2 (%)	GYRO Revolutions per seconds (RPS)
1	33.25	72	95	586
2	32.75	71	95	602
3	32.94	70	95	400
4	35.83	90	93	439

 Table 4.2: Result Analysis of Commonly Elderly Falls



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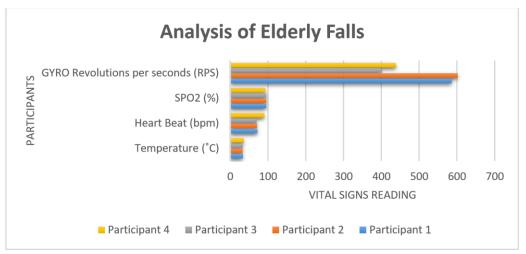


Figure 4.2: Analysis of Elderly Falls

4. Conclusions

In conclusion, based on existing policies and activities, Malaysia is equipped to deal with the issue of an ageing population or the status of an "old" nation. The wearable sensor is a system that can detect falls in the elderly. Furthermore, the system also will alert the guardian of the elderly if they fall unnoticed. Besides that, it can periodically update the health vital signs of the elderly by utilizing IoT Technology thus a real-time monitoring system. This system can be improved into a sophisticated system that can save a lot of lives and ease the worries of guardians that are forced to leave elderlies at home alone.

#### References

- F. Wu, H. Zhao, Y. Zhao, and H. Zhong, "Development of a Wearable-Sensor-Based Fall Detection System," vol. 2015, 2015.
- C. R. Assessment, "Falls in older people : epidemiology , risk factors," pp. 37–41, 2006, doi: 10.1093/ageing/afl084.



- W. C. Graafmans, M. E. Ooms, H. M. A. Hofstee, P. D. Bezemer, L. M. Bouter, and P. Lips, "Falls in the elderly: A prospective study of risk factors and risk profiles," *Am. J. Epidemiol.*, vol. 143, no. 11, pp. 1129–1136, 1996, doi: 10.1093/oxfordjournals.aje.a008690.
- M. Rantz *et al.*, "Automated in-home fall risk assessment and detection sensor system for elders," *Gerontologist*, vol. 55, pp. S78–S87, 2015, doi: 10.1093/geront/gnv044.
- M. E. Tinetti and C. S. Williams, "The effect of falls and fall injuries on functioning in community- dwelling older persons," *Journals Gerontol. - Ser. A Biol. Sci. Med. Sci.*, vol. 53, no. 2, pp. 112–119, 1998, doi: 10.1093/gerona/53A.2.M112.
- L. M. Yee, L. C. Chin, C. Y. Fook, M. B. Dali, S. N. Basah, and L. S. Chee, "Internet of Things (IoT) Fall Detection using Wearable Sensor," *J. Phys. Conf. Ser.*, vol. 1372, no. 1, 2019, doi: 10.1088/1742-6596/1372/1/012048.
- A. Masood, T. Younas, and A. R. Khalid, "Design of Wearable Prototype Smart Wristband for Remote Health Monitoring Using Internet of Things Design of Wearable Prototype Smart Wristband for Remote Health Monitoring Using Internet of Things," no. May, 2020, doi: 10.1007/978-981-15-5232-8.
- A. Bergland, "Fall risk factors in community-dwelling elderly people," vol. 22, no. 2, pp. 1–14, 2012.
- N. El-bendary, M. Transport, Q. Tan, and F. Pivot, "FALL DETECTION AND PREVENTION FOR THE ELDERLY:," no. June 2013, 2017, doi: 10.21307/ijssis-2017-588.
- M. M. Islam, N. H. Neom, M. S. Imtiaz, S. Nooruddin, M. R. Islam, and M. R. Islam, "A review on fall detection systems using data from smartphone sensors," *Ing. des Syst. d'Information*, vol. 24, no. 6, pp. 569–576, 2019, doi: 10.18280/isi.240602.



- V. GAY and P. LEIJDEKKERS, "A Health Monitoring System Using Smart Phones and Wearable Sensors," *Int. J. ARM*, vol. 8, no. 2, pp. 29–36, 2007.
- N. El-bendary, M. Transport, Q. Tan, and F. Pivot, "FALL DETECTION AND PREVENTION FOR THE ELDERLY:," no. June 2013, 2017, doi: 10.21307/ijssis-2017-588.
- M. M. Islam, N. H. Neom, M. S. Imtiaz, S. Nooruddin, M. R. Islam, and M. R. Islam, "A review on fall detection systems using data from smartphone sensors," *Ing. des Syst. d'Information*, vol. 24, no. 6, pp. 569–576, 2019, doi: 10.18280/isi.240602.
- V. GAY and P. LEIJDEKKERS, "A Health Monitoring System Using Smart Phones and Wearable Sensors," *Int. J. ARM*, vol. 8, no. 2, pp. 29–36, 2007



# WORK TRACKING SYSTEM

Ts.Dr Azuin Binti Ramli<sup>1</sup>, Ahmad Taufiq Aiman Bin Mohd Hanizan<sup>2</sup>

Civil Engineering Department, Politeknik Ungku Omar, Ipoh, Perak http://www.puo.edu.my

#### Abstract

The construction industry is in a perfect storm and contractors and subcontractors alike from any field have many good reasons to adopt construction technology. The construction sector has always been sluggish to accept new technology. Additionally, digitization in the construction sector has advantages for increased company innovation capacity, profitability, and productivity. In the construction of earthworks, for a company it is important in Tracking Work Progress conventionally is to update the form manually (WhatsApp) by the site engineer and needs to be updated daily. While new technologies are coming every year, digital adoption is slowing in the construction sector. The present study explores the effectiveness of work progress tracking system that can monitor and minimise communication in construction site. The solution enables project managers and engineers to obtain information regarding daily planning and progress via a mobile app from anywhere and at any time. This application is also appropriate for the company's numerous tasks. The idea of this system is user-friendly, as it can access information from anywhere and at any time through a mobile application. The effectiveness attributes was tested empirically through a survey on 30 construction players. Quantitative data were statistically examined using descriptive analysis (mean, standard deviation) and paired T-test. Respondent preferred using WTS (Mean = 4.90, SD = 0.305) compare with existing method (Mean= 2.86, SD = 0.730). A paired sample t-test found this difference to be significant, t = -11.70; p=0.250, p < 0.05. The results presented here may facilitate improvements in the different digital construction contexts to achieve various in construction industry.

**Keywords:** Work Tracking System, Mobile Application, Sustainable Construction, UserFriendly



# **1. INTRODUCTION**

Project management is defined as the overall planning, control, and coordination of a project from inception to completion to meet customer needs and ensure that the project is prepared on time, within budget, and works as expected by the customer. The difference between project management and "management" is that project management has a defined result and timeline, whereas management is a continual activity. As a result, a project professional requires a diverse set of abilities, including frequent technical expertise, as well as people management and commercial acumen. The effectiveness of project management consists of several components, such as quality, to ensure that the project is managed in accordance with the specifications and quality expected to meet the needs of customers. In addition, the cost to ensure that the total cost at the end of the project does not exceed the original allocation. Finally, the time that ensures that a project is completed within a minimum period of time or a predetermined time frame (Ramli, 2021).

According to Ramli, 2021), The building sector is crucial to the economic development of the country. Construction is a significant and productive sector in Malaysia, contributing to economic growth and enhancing Malaysians' quality of life and living standards. According to the Malaysian Department of Statistics, the value of construction works increased by 8.1 percent in the first quarter of 2021, with civil engineering works being the most prevalent type of activity, followed by nonresidential buildings, residential buildings, and finally special trade activities.

Malaysia, on the other hand, has issues in the construction business, including poor on-time and budget performance, construction waste, low productivity, and an overreliance on foreign labour (Mayuran., 2015). Despite these obstacles, project delay is a significant component of the construction management process and has become a critical factor in determining a project's success. According to Patnaik (2013), the most common cause of conflict in any company is a 'lack of or ineffective communication.' Communication breakdown is the root cause of most confrontations, whether at work or elsewhere. Effective communication is a valuable talent that can never be mastered and is often undervalued. Project managers and teams frequently miss deadlines or are unable to deliver on certain communication issues.



In order to address the issue, a fourth industrial revolution, dubbed Industry 4.0, has evolved in recent years to address it. With the aid of connection through the Internet of Things (IoT), access to real-time data, and the introduction of cyber physical systems, Industry 4.0 has elevated the emphasis on digital technology from the previous decade to a new level. The Fourth Industrial Revolution (Industry 4.0) offers a more complete, linked, and comprehensive approach to manufacturing. It links the physical and digital worlds together, enabling improved cooperation and access across departments, partners, and vendors as well as between goods, services and people.

#### 2. Literature Review

#### 2.1 Project Management

Project management is a critical practice that applies the knowledge of process, skills, tools, deliverables, and techniques to project activities to ensure the project meets its stated goals and requirements. In simple terms, project management is the process of leading a team to hit goals or complete deliverables within a set timeframe. It is the responsibility of project managers to ensure that work is completed effectively while adhering to strict schedule, scope, and budget limitations. Project management includes the documentation, planning, tracking, and communication of projects.

#### 2.2 Construction Project Management

Construction management is the process of overseeing the execution of building projects. However, when comparing the management of a construction project to the management of other kinds of projects, the primary contrast is that construction is mission-based. This signifies that the project's organisation comes to an end with the completion of the project's construction. While project management is commonly described as the management of resources throughout the life cycle of a project via different tools and processes to regulate scope, cost, time, quality, and other factors when working in the construction business, your perspective must be wider.



#### 2.3 Progress Report

The building phase, the contract administrator prepares frequent (typically monthly) construction status reports, which are then sent to the customer on a timely basis. They will typically be a synopsis of the reports that have been received and the discussions that have taken place during construction progress meetings. This report may be a mix of minutes from construction progress meetings and reports received at such meetings, with the most important concerns emphasised in an accompanying cover letter. Alternatively, they might be a rewritten version of the material that has been tailored precisely to the client's needs.

#### 3. Methodology

#### 3.1 Research Design

Research design is very important for planning and observation. The implementation steps should be monitored to identify problems that will arise during implementation. Changes need to be made when there is a critical problem that is a major cause of job implementation failure. Control measures must be taken to maintain a constant flow. Figure 3.1 show the details of data analysis methodology are illustrated.



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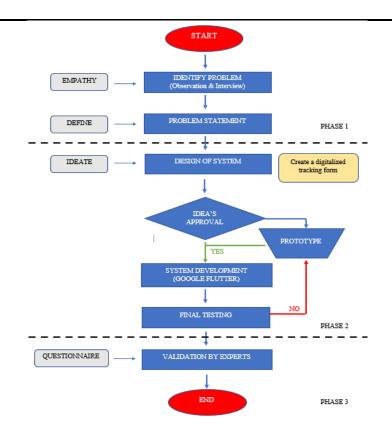
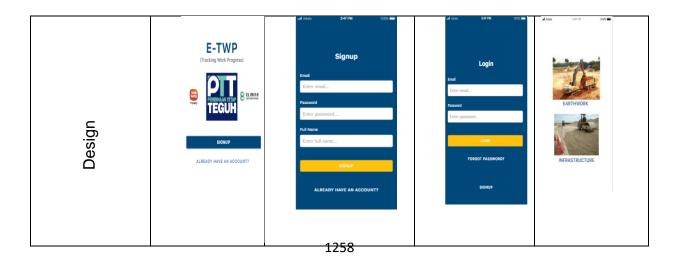


Figure 3.1: Development of Research

# 3.2 Prototype Design

Prototype provides visualization solutions. Various methods are involved, such as sketches, quickprototypes and more. Whichever method you choose, the main goal of this phase remains thesame: to come up with a draft solution to decide whether it will be beneficial to the problem.





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Description	Step 1: Main Page	Step 2: Registe r	Step 3: Login	Step 4: Interface	
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#### 3.3 Test/Feedback

Table 3 shows respondant level of usability toward using existing method whereby analysis shows for all variables tested the mean score were less than 3.00 meaning that the usability level of existing method were medium and low. Whilst Table 4 shows respondant level of usability toward using Working Tracking System whereby analysis shows for all variables tested the mean score were more than 4.00 meaning that the usage of Working Tracking System much more easier compare with the existing method.

Varaibles	Mean	Interpretation
Perceived Ease of Use	2.7	Medium
Perceived Usefulness	2.6	Medium
Attitude Towards Using	2.6	Medium
Technology		
Behavioral Intention to	2.5	Low
Use		

Varaibles	Mean	Interpretation
Perceived Ease of Use	4.6	Very High
Perceived Usefulness	4.5	Very High
Attitude Towards Using	4.5	Very High
Technology		
Behavioral Intention to	4.4	Very High
Use		

Pair	<u>Paired</u> <u>Differences</u> Mean	t	Sig. (2- tailed)
Existing Method – Work	-1.0	- 11.70	<.001



Tracking		
System		

In order to evaluate the effectiveness of WTS in the project, a paired sample t test was performed. Results as shown in Table , respondent preferred using WTS (Mean = 4.90, SD = 0.305) compare with existing method (Mean= 2.86, SD = 0.730). A paired sample t-test found this difference to be significant, t = -11.70; p=0.250, p < 0.05. Together this suggests that using WTS was much easier and resourceful compared with existing method. This mean that WTS was more effective compare with the existing method.

#### 4. Conclusions

In conclusion, the main goal of the research is to track the progress of work in construction more easily, as well as the challenges that arise in the lack of communication can be reduced. According to the results of the analytical questionnaire, the majority of respondents have trouble tracking work progress, especially when using traditional methods to track work progress using social media (WhatsApp), and staff dislike it because it is less appropriate and unsystematic. Based on the first objective, to identify the details information in daily planning and progress in construction work, it is clear that it showed the objective had achieved. After the problem has been clearly described, the study's second objective emerges, which is to innovate an "Work Tracking System" (WTS) using mobile apps. In order to assess feedback on the system's efficiency during task tracking, expect validation surveys to be delivered as part of the final aim. The results show that respondents firmly feel that Kota Elmina's monitoring progress can be managed

very well by using the Work Tracking System for Construction (WTS). WTS helps provide on-site progress monitoring for daily updates and can reduce communication breakdowns. Since users are happy with how simple it is to use for tracking work, WTS has been suggested for use at the Kota Elmina site.

#### References

Ater, T. (2017). Building Progressive Web Apps: Bringing the Power of Native to the Browser.

United States of America: O'Reilly Media, 1005 Gravenstein Highway, Sebastopol,



Blake, E. (2019, FEBRUARY 13). What is a Construction? Retrieved from

Tenderfield.com:https://news.tenderfield.com/what-is-a-construction-request-for-information-

Android Studio. (2016). Android Studio. Android Studio : The Official IDE for Android.

https://doi.org/10.1109/GLOCOM.2009.5426221

Ademilde Aboginije, C. (August 2019). The Application Of Green Technology

In Modern Day Construction Project. Sustainable Human Settlement and Construction Research Centre.

Pembinaan Tetap Teguh Sdn Bhd (PTTSB). (2018). PTTSB. Retrieved from Pembinaan Tetap Teguh Sdn Bhd web site: <u>https://www.ptt.com.my/</u>

Management, D. T. (2017, September 21). 9 Best Mobile Construction Management Apps. pp. <u>https://blog.capterra.com/top-mobile-construction-management-apps/</u>.

Arif, M. I. (2020, 12 2). The Use of Robotics Technology in the Production of Industrial Building System (IBS) Components Towards Industrial Revolution 4.0 in the Construction Sector. Retrieved from Research in Technology Management and Business: <u>https://publisher.uthm.edu.my/periodicals/index.php/rmtb/index</u>



# STUDY OF PART SUPPLY FOR ASSEMBLY LINE (SUNVISOR)

Khairul Nizad Panior<sup>1</sup>, Safwanah Shaffie<sup>2</sup>

<sup>1,2</sup> Ungku Omar Polytechnic Ipoh, Perak safwanahshaffie@ gmail.com

#### Abstract

The warehousing operation is an important part of the overall supply chain process. The warehouse needs to supply the material and goods to the production to continue the process. The operation goalis to ensure that resources and items are maintained in good condition and are ready for the next process. In a way to make sure the distribution process smooth without having any problem, the element that need to be take into consideration to make sure the efficiency of the warehousing stable are space, labor, and equipment. The goal is to optimize the stock accuracy and minimize the buffer stock at assembly line. These factors will reflect the cost of warehouses operation. The effective and efficient methods and procedures utilized throughout the warehouse operation are based on the stock accuracy for every material and goods. The part supply needs to be prepared effectively to avoid from bottleneck at the assembly line to achieve their outcome. There is no system in tracking the material and goods at the warehouse. Therefore, the purpose of this project is to supply part to assembly line efficiently by using QR code system and provide the suitable schedule for reference. The project is focus on convert the manual system at the warehouse into automatic system. The QR code system is highly recommended to be used in control the stock the easier way. The effectiveness of this system was evaluated using questionnaire studies among warehouse team members by answering the survey of the need of a system use by the warehouse. The results show the good feedback from the team member regarding stock accuracy for each item.

Keywords: Part supply, Warehouse method, Stock Accuracy, QR code.

#### 1. Introduction

Warehouse is a planned space for the efficient storage and handling of goods and materials. Material from supplier or finished good from manufacturer come into



warehouse, the informationmust be available to say where these goods must go, and they then get passed down the distribution chain to customer. However, there are still some

problems faced by the planner also the PIC of warehouse. There was stock accuracy problem that can influence the ordering time since there is no triggering system on critical item.

From the previous study, the ordering form is difficult to write by the operator because there isso much item with different back number. So, they decide to not follow the rule that has beenset by the warehouse. For this project we are trying to upgrade the ordering form or a system by using Microsoft Excel by providing the table that contain the supply trip based on time and quantity provide by PIC from PPC department. Based on the study, the manpower plays big role in the warehouse (store), also the layout and space give the big impact to this project. By implement the best solution, the cost can be reduced, and the inventory of the goods can be control.

#### 1.1 Problem statement

Part supply for assembly line is very important thing to do before started any process involving assembly line. This project is focusing on how to control item intake in store and make store as one of strictly place that nobody can enter without permission from storekeeper. By implement the suitable method, it can make the recording system be easier and the inventory cost and space is optimized.

The problem started when the stock accuracy is low. Stock accuracy mean the quantity in and out need to exactly same as in the system. Since in this company they only use excel as their recording and references, so there is no triggering system on critical stock. So, the planner will never know unless they need to keep count the item to make sure the quantity is same as in therecord then they can open order. The reasons why this thing happen is because there is no fix time for child part shopping by the assembly. So, since there is no accuracy on the stock the order will not follow as it plans.



# 1.2 Objective

The objective of this project is to:

- i. Study the method to supply part at assembly line efficiently.
- ii.
- iii. Optimize stock accuracy in order to improve storage space at warehouse.
- iv. Minimize buffer stock at sun visor assembly line.

# 1.3 Scope

The scope of this project is to:

- i. Target line: Sun visor assembly line
- ii. Related to production planning control department
- iii. All schedule plan for store and assembly line

# 2. Literature Review

2.1 Manpower and method warehouse improvement

The manpower plays big role at warehouse. By not having enough manpower, the problem will keep coming since the other people job scope need to cover by one person. The target manpower for certain stations. For example, the main problem for supervisor was the cages that were filled with bags and boxes tagged by unloading supervisor, but it was not properly stacked in racks or cages<sup>1</sup>. A study done for the placing of the cages when truck to be unloaded and truck stand in front of the docks. Data was collected that was truck number, truck weight, total tonnage inside the truck, manpower used by supervisor and start time of unloading the truck (clock time). The calculation below shows the manpower that are required at certain area.

- i. Target manpower for each station
- ii. Requirement for fast, on-demand resourcing
- iii. Continuously improve



	Box cages (data collection for 5 days)	Bag cages (data collection for 5 days)			
Total cages	390	390			
Average cages	390 / 5 = 78	390 / 5 = 78			
Average time per cage	17	6			
Manpower	2	1			
Man min for per cage	17 * 2 = 34	6 * 1 = 6			
Shifting time per day	78 * 34 = 2652 min	78 * 6 = 468			
Total shifting time	2652 + 468 = 3120				
Manpower required for Stacking area	3120 / 450 (working time) = 6.93 = 7 manpower				

#### Table 1: The manpower required for certain area

#### 2.2 Warehouse performance

Routing techniques for line sequencing in order picking batches have been well researched, documented, and applied in today's Warehouse Management Systems (WMS). The LSO's sequences, on the other hand, may look odd to the picker, demanding

a qualitative assessment to uncover sequence patterns<sup>2</sup>. Automation for order picking operations is only employed to a limited extent in warehouses. The order picking function

of a warehouse management system is described as the process of removing products from storage in response to a specific customer request (WMS). Vendors of warehouse management systems are seeking to integrate features in order to increase productivity and order picking efficiency. Routing techniques are crucial because they have a direct influence on the amount of time it takes to finish an order picking batch. The performance of the warehouse can be developed by the warehouse management system software. By referring the system, the performance can be monitor and can be improve.



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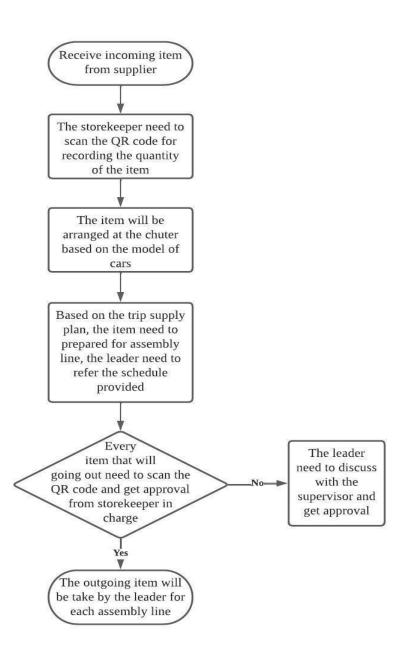


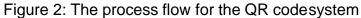
Figure 1: The example of warehouse management systemsoftware



#### 3. Methodology

#### 3.1 Flow process







#### 3.2 Tools used

## Table 2: The tools use for the project

Tools	Description
Device for QR code	Use to scan the QR code for recording incoming and outgoing item.
Google drive	Act as a cloud system which use to store the data come from the scanning QR code.
Microsoft Excel	Use to plan the trip and triggering system to prepare part supply for assembly line.
Stock control card	Act as recording system to make sure the data is accurate.

#### 4. Result

**4.1** To study the method to supply part at assembly line efficiently

The study shows on how the method can be used to supply part efficiently. Based on the study those three things need to be taken as consideration to make sure the objective can be achieved.

Method	Manpower	Space utilization	Smart warehouse
Description	For the unloading and loading area there was increased in total time. There is frequently disorder among employees and managersthat cause the time for unloading being lost. The idea for using all area from loading to unloading	The space utilization is link with the material handling. The use of vehicle number is to determine the truck size and provide precise solution for labor. The stacking area use to track the area that packwith their packing style. Two manpower use for stacking	The impact of the lean manufacturing approach, KANBAN TOOL, on enhancing the warehouse management system. It enables warehouse managers to improve strategic planning and reduce excessive output. Inventory levels are determined ahead of time to ensure that production waste is kept to a minimum.



Problem statement	Current enough requireme			The limited space to store the child part, WIPetc since they not following the plan provided by Production Planning Control department.	get involve in recording the item.
Solution	(da           Total cages           Average time per cage           Maranis for per cage           Man min for per cage           Shifting time per day           Total shifting time           Manpower required for Stacking area	Box cages ta collection for 5 days)           390         5           390         5           17         2           17* 2         34           78* 34         2652 + 46           3120 / 450 (working tim	(x)		<ol> <li>Thinp         <ul> <li>Using the decisions such as 1470 out starters</li> <li>Maters and Solid out and short physical dynamic and solid out and short physical dynamic and solid out and soli</li></ul></li></ol>

4.2 To optimize stock accuracy in order to improve storage space at warehouse

The stock accuracy is important to make sure there is no disruption at the warehouse. Since there is limited storage space at warehouse, the need to use the system (QR code) is a must so that the movement of the item can be trace. The QR code below can be use for recording purpose in order to optimize the stock accuracy.

ARM RH	FOAM PAD	PVC M (D63D)	
ARM LH	FOAM RECESS	PVC T REAR (D63D)	
BRACKET RH	WIRE FRAME RH	PVC Y (D63D)	
BRACKET	WIRE FRAME LH	PVC U	
MIRROR HOLDER	PVC V (D63D)	PVC T FRONT	
KNOB	PVC W (D63D)	PVC T REAR	

Figure 3: The QR code for the childpart of sunvisor



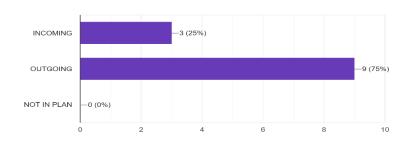
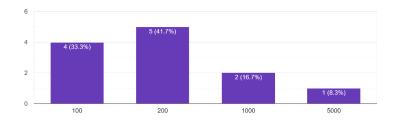
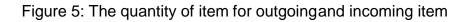


Figure 4: The percentage for incoming andoutgoing item per day.





4.3 To minimize buffer stock at sun visor assembly line

The buffer stock is important to guarantee the rate of difference between the stock supply in packaging and the consumption of stock. In other circumstances, the buffer stock serves as a safety zone, to help against any failures that may occur earlier in the process flow. In a way to help in minimize buffer stock is by plan a trip support of sembly line.

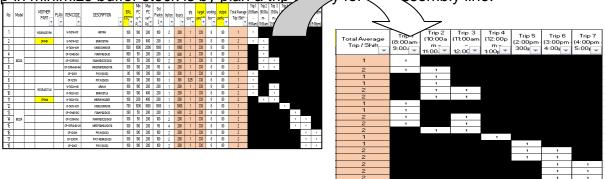


Figure 6: The trip supply for different model of carand the number of trips



Based on the trip supply, the leader can refer the plan every morning before start shopping the item required. The number of trip can be refer at the schedule provided at the warehouse to acknowledge person in charge for each trip.

	SIP	RO PLAS			S SDN	BHD				
Morning break Lunch		- 10:15 AM 1 - 2:00 PM								
break	_	_				_	_	_	_	
	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10
On Duty	(8am-	(10am-	(11am-	(12pm-	(2pm-	(3pm-	(4pm-	(5pm-	(6pm-	(7pm-
	9am)	11am)	12pm)	1pm)	3pm)	4pm)	Spm)	6pm)	7pm)	8pm)
Fariz										
Adzmin										
Wani										
				•	•					
	Trip 11	Trip 12	Trip 13	Trip 14	Trip 15	Trip 16	Trip 17	Trip 18	Trip 19	Trip 20
On Duty	(8pm-	(10pm-	(11pm-	(12am-	(2am-	(3am-	(4am-	(Sam-	(6am-	(7am-
	9pm)	11pm)	12am)	1am)	3am)	4am)	Sam)	6am)	7am)	8am)
Aiman										
Zul										

Figure 7: The daily schedule for warehouse tripsupply

For non-plan trip, the leader are required to fill In the requisition form to order the item neededand need to approve by the head of department for assembly.

MODEL	MOTHER PART	ITEM CODE	DESCRIPTION	Std Packin	Locatio n	8:00- 9:00	9:00- 10:00	10:00- 11:00	11:00- 12:00	12:00- 1:00	2:00- 3:00	3:00- 4:00	4:00- 5:00	
		W-74310-05-D55L	MIRROR HOLDER (D55L)	100	W1									
ISLAND 2		CP-1331N-AX-RH	REINFORCEMENT RH D87A	100	C6									
		CP-1331N-AX-LH	REINFORCEMENT LH D87A	100	C6									
		CP-13FR4-AX-RH	WIRE FRAME RH D87A	50	R5									
		CP-13FR4-AX-LH	WIRE FRAME LH D87A	50	R5									
		CP-1394D-AX	FOAM PAD D87A	200	C6									
		CP-13355-AX	FOAM RECESS D87A	100	C6									
		CP-22016	D/SIDED TAPE (TISSUE TAPE) 30	9	R8									
		CP-1331N-A	REINFORCEMENT	100	C6									
		CP-1394D-A	FOAM PAD	100	C6									
		CP-13355-A	FOAM RECESS	100	C6									
		CP-13FR4-A-RH	WIREFRAME RH	100	R5									
		CP-13FR4-A -LH	WIREFRAME LH D46T	100	R5									
		CP-1394D-D63	FOAM PAD D63D	200	C5									
		CP-13355-D63	FOAM RECESS D63D	100	C6									
		CP-HMG01	HOT MELT GLUE	160	R4									
		W-74310-03M	KNOB SUNVISOR	2000	W1									
		W-74310-03-D55L	KNOB SUNVISOR (D55L)	1000	W1									
		CP-1394D-D55	CORRUGATED BOARD D55L	100	С3									
		CP-13355-D55A	FOAM PAD D55L	200	C3									
		CP-13355-D55B	FOAM RECESS D55L	100	C3									
		CP-13FR4-SV-LH	WIRE FRAME LH D55L	50	R3									
		CP-13FR4-SV-RH	WIRE FRAME RH D55L	50	R3									
								F	REQUEST	ED BY	ISSUED BY	r	APPROVED	) BY

Figure 8: The requisition form for non plan trip



#### 5. Conclusion and Recommendation

#### 5.1 Discussion

QR code is new system applied at warehouse in a way to trace the stock accuracy. The system did not require high cost but having too much problem. During implement the system, there area few problems occur, that is:

- 1) Unstable internet connection.
- 2) The device ability.
- 3) Some operators do not want to follow the rule by the warehouse.

The problem however solved after discussion with the person in charge to ensure the problem will not happen again in order to make sure that there is no disruption to achieve the outcome for assembly line.

#### 5.2 SWOT analysis

Strengths, weaknesses, opportunities, and threats are listed together in the SWOT analysis. The main goal of a SWOT analysis is to fully understand all the aspects that go into decision-making theproject.

Strength	Weakness	Opportunities	Threats			
The stock accuracy easy to monitor. The QR code system is easy to understand and did not require specific cloud.	internet connection.	The QR code can be improved to be better system. Make the system link with the stock ageing.	during work.			

Table 3: SWOT	analysis
---------------	----------

#### 5.3 Conclusion



To conclude this project, stock accuracy is important to control the inventory at warehouse. The current situation at warehouse is so bad since the stock control card is not up to date. This stock control card very important to trace the incoming and outgoing of the child part. The objective to optimize the stock accuracy can be achieve by provide the system which is QR code, and the buffer stock can be minimize at the assembly line by provide the schedule for the assembly line as reference. From the survey result, it can be said that the use of QR code can contribute to the accuracy of stock status. This project

help to manage inventory and make the stock accuracy at warehouse more accurate and efficient.

#### 5.4 Recommendation

*i.* Improve current system into RFID to move along the industrial revolution 4.0

The IoT is the thing that need to apply at the company. This thing is very important in a way to moving forward into the revolution industry 4.0. The IoT thing can be improve into better system from QR code into RFID system which even better than current project. The initial cost may be higher but can give a better outcome to the company. The system not only can help the process become smooth but also give back the higher income toward company.

# *ii.* Improve layout based on the requirements for manpower in order to make the systembetter

The layout for the warehouse needs to be improve such as the racking system can be upgrade to the higher one. The company need to invest for lift truck that can pick up and place the item. By improving the layout, the problem regarding manpower can be solve and more work in process, child part etc can be store at the warehouse neatly.



#### Reference

- 1. Tonape, S., Patil, K., & Karandikar, V. (2016). Manpower Optimization and MethodImprovement for a Warehouse.
- 2. Žunić, E., Delalić, S., Hodžić, K., Beširević, A., & Hindija, H. (2018, November). Smart warehouse management system concept with implementation. In *2018 14th Symposiumon Neural Networks and Applications (NEUREL)* (pp. 1-5). IEEE.



# "DEVELOPMENT OF A MOBILE PRODUCTIVITY CALCULATOR APPLICATION FOR SUNWAY BELFIELD CONSTRUCTION PROJECT" PRODUCTIVITY CALCULATOR FOR ARCHITECHTURE PROGESS (PCAP)

Mohd Amir Fakhri<sup>1</sup> And Dr. Rufaizal<sup>2</sup> Department of Civil Engineering, Politeknik Ungku Omar, Ipoh, Perak http://www.puo.edu.my

#### Abstract

In the modern era of construction industry, scheduling and planning is important. It is necessary to know the best way in planning in order to address any potential concern difficulties as soon as it occurs. Furthermore, construction productivity must be identified and monitored in order to determine daily productivity. The use of modern technology software can help with progress monitoring and determining the real worth of productivity in building. Sunway Belfield Project uses just the most basic technologies to track productivity on the construction site. As a response, an application titled 'Progress Calculator for Architecture Productivity (PCAP)' can help to ease the architecture productivity monitoring. It will also enable to determine the real value of productivity. The study's objective is to identify the architecture productivity, and lastly evaluate the effectiveness of the application. According to survey results, respondents highly believe that using the PCAP application is helpful in determining the architecture productivity and can help with the planning. The PCAP application is useful for monitoring of architecture work and ensuring that it is completed on time.

**Keywords:** Productivity Calculator For Architechture Progess, Application and Technology



#### 1.0 Introduction

Productivity is defined as the amount of output created per unit of input. Productivity may be defined as the quantity of economic output per input unit as well as per worker. Productivity is critical to a country's wealth and well-being, and efforts to boost productivity are undertaken at all levels of society. Productivity is a useful metric for comparing the quantity of construction work done vs the amount of capital invested. The cost and time it takes to perform a mission are directly influenced by the productivity of the crew. By evaluating and forecasting efficiency, project managers may be more successful in tracking and projecting project time and cost during execution before completion (Dolman, 2007).

Low productivity may result from inefficient management of construction resources. It is therefore critical that contractors and construction managers are acquainted with the techniques that lead to the evaluation of the productivity of equipment and staff in various crafts. It is necessary to have good control over the productivity factors that contribute to the integrated output composition, such as labour, equipment, cash flow, to achieve the income required from any construction project in general. No standardized definition of productivity has been developed in the construction sector. A standard productivity measure is difficult to define since firms have their own processes that are not standardized. Association clearly indicates the efficiency between an output and an input (Mathew, 2011).

#### 1.1. Problem Statement

Planning the construction cycle is essential in management-related employment, as for a project planner, in order to ensure that the project is completed on schedule. However, the planning should take into account the conditions at the building site and the number of employees who will be allocated among the various tasks. At the Sunway Belfield construction project site, a few difficulties have been identified. One of the issue is that the productivity of architecture work does not follow the planned work schedule. This is due to the manpower constraint, the condition of the work place, and the weather factor. As a result, planning must be done in accordance with the circumstances at the building site. Additionally, it is crucial to know how much manpower is required to complete the certain work in order to follow the scheduled plan. The solution to this issue is to have a system in place to constantly update what is happening while also keeping track of the actual condition on the worksite. Implementing a mobile application is a useful strategy.



This is due to the fact that mobile phones are a highly common item among day to day life. Anyone can report on every development at the construction site from there (Abdul Rahman, H., 2011).

## 1.2. Objective

- i. To identify the architecture productivity at the project site
- ii. To develop an application to monitor the architecture productivity
- iii. To evaluate the effectiveness of the application in term of functionality

# 1.3. Scope Of The Study

The location of the study is in the area of the office and construction site of Sunway Belfield, Jalan Belfield, Kuala Lumpur. The area is restricted to workers from various positions, such as project manager, construction manager, engineer, site manager, site supervisor and office admin. This study is focussed on using to make a planning on project progress which is cycle time of the project and the actual progress on site. Users are required to register to ensure that all updated information is visible from time to time. This application is also suitable for various projects to be implemented by other project

# 2.0. Literature Review

Construction is one of the industries that contributes to a country's growth and influences its development. Furthermore, considerable study has been fuelled by the fact that the economy would increase as a result of the building sector's participation. In accomplishing Malaysia's 2020 goal of moving forward from the development framework that includes the building sector. More and more innovative technologies are becoming an economic force in Malaysia, making the country more advanced than it has ever been. According to a poll of over 600 construction sector workers, mobile technology is a top priority for 80% of respondents. App developers who are well-known collaborate closely with real estate firms to generate unique business solutions. As a result, it's clear that it all boils down to mobile applications and their widespread adoption throughout the sector. It may also be accessible from anywhere via technologies such as programmes or systems, making daily tasks easier with only a few clicks (Mehul, 2019).



# 2.1 Definiton of Productivity

Productivity, success factor, output rate, person-hour unit (p-h), and other terminology are used in the construction business. Productivity has traditionally been defined as the ratio of input to output. For example, the ratio of an associated resource's input to actual production in economic growth is commonly, but not always, expressed in (p-hs). The

two most important measures of labour productivity are the productivity in which labour is engaged during the construction phase. Aside from that, relative productivity of labour performing what needs to be done at a given time and place (Sickles, 2019).

# 2.2 Brickwork Productivity

Brickwork is one of the oldest construction materials that still competitively used on par with other modern construction materials. Good loadbearing characteristics of masonry has been indisputably utilised in the structures as structural walls since historical times including majority of the modern buildings. Subsequently better determination of compressive strength characteristics of masonry in existing masonry structures and for new building design have been the prime research trends in the past few decades (Dhanasekar, M., 2020).

# 2.3 Plaster Productivity

Plaster is a <u>building material</u> used for the protective or decorative coating of walls and ceilings and for moulding and casting decorative elements. The most common types of plaster mainly contain <u>gypsum</u>, <u>lime</u>, or <u>cement</u>, but all work in a similar way. The plaster is manufactured as a dry powder and is mixed with water to form a stiff but workable paste immediately before it is applied to the surface. The reaction with water liberates heat through <u>crystallization</u> and the hydrated plaster then hardens (McKee, 2017).

# 2.4 Skimcoat Productivity

In most surfaces, such walls are finished with <u>paint</u> or <u>wallpaper</u>. Skim coat walls are usually similarly decorated, but unpainted skim coat can also serve as a finish. Because bare skim coat can be appealing to the touch, and paint would add an additional layer,



some <u>decorators</u> opt to leave exposed skim coat in some or all of surfaces, as a creative choice. In such cases, if the skim coat's natural colour is not desired, tints can be added as part of the mixing process, or can be introduced unevenly for artistic colour effects (Decker, 2017).

# 2.5 Labour Productivity

This work aims on labor efficiency in the building industry, as construction is a laborintensive industry. The existing state-of-the-art problems are considered important to this topic by this report. It covers the concepts of construction labor productivity, aspects, metrics, factors that influence it, various methods used to calculate it, and techniques for modeling. The primary outcome of literature It is because there is no traditional definition of efficiency. This research offers a guide to the necessary steps taken to increase the efficiency of construction labor and, ultimately, the performance of the project (Bhavsar, 2017).

# 2.3. Cycle Time In Construction

Cycle time during a trenchless project can be defined as the time needed to complete an operation from beginning to end. This time is fixed between the contractor and the owner on the basis of the form of project being carried out and the present working conditions. Delay in cycle time can lead to financial losses when a job is performed long before the planned cycle time can lead to compromised work quality. Trenchless construction processes require multiple equipment and manpower that must be incorporated into an efficient plan for time management to ensure that the project is completed within the planned cycle time (Fat, 2017).

# 2.4 Construction Sector Application Apps

ICT has previously been developed as a way of enhancing performance and efficiency. Apps are widely available, thanks to software delivery networks, that began in 2008. The majority of applications qualify, while some must be acknowledged. They're generally downloaded from a shop to a target device like an Apple and Android. IT applications have become more popular in construction as a relatively new technology, yet proper management of IT is getting more difficult due to several well-documented limitations.



The most recent rise in the application of IT in the construction sector has been in the sector of internal or external communication systems for information exchange (Mbachu, 2018).

# 2.5 Device Efficiency and Apps

Individuals have declared the term "sustainable" to be the most common. However, in addition to building forms, sustainable construction is essential to guarantee that the benefit can be fulfilled without the disadvantage. Sustainable practises are now integrated ecofriendly intentions in all sectors, from nourishment to automotive construction and engineering institutional arrangements, among almost all of around us. Moreover, sustainable construction is widely understood to imply that the construction sector is obligated for the sustainable use of resources while reducing the negative ecosystem impact (Banerjee, 2017).

# 2.6 Working to develop Android

The Android mobile application software programme that runs on smartphones that are powered by the Android platform. Android Development is one of the top work opportunities. The development of Android mobile applications is increasing by sector, with new mobile apps and goods arriving every day. An Android app is a piece of mobile software designed to run on Google's Android operating system. Industry-wide, Android mobile app development is ongoing, with new apps and products being produced on a daily basis. We used to have no choice except to write an application from start for each level. With the constant advancement of technology, it is now possible to efficiently and rapidly build your own Android mobile application utilising a variety of Android Development Tools (Tang, 2018).

# 2.7 Conclusion

In the construction sector, implementing technology to increase performance and to save time would indeed be advantageous. It can also be accessible from everywhere employing methods like as programmes or frameworks, allowing necessary tasks smoother with just a simple tap. The project manager, engineer, and site supervisor must keep an eye on things like work progress, project cycle, and the plan baseline for construction project progress. As a consequence, everyone can focus on the next phase, ensuring that the process runs successfully and the project is finished on schedule.



#### 3.0 Methadology

In this chapter will explore on the approach and how the system was built. This chapter also will discuss on the techniques used to identify the problem and will use the applicable system from the beginning to the end of the project. This method is used to guarantee that the project's objectives are archive and ensure a flawless final product outcome. The implementation will review the apps' efficiency while working on a task. In this chapter, you'll see how to model designs as well. The viability of using primary and secondary source studies to add value to the project was studied in order to provide value to the project. The primary source was studied through a survey and observation. While the data selection and evaluation comes from secondary sources. In addition, the methods to be used will be thoroughly detailed based on the problems available, as well as the selection of applicable systems for use within the site. This is based on all available information, including current references like documents, interviews, meetings, and other circumstances. Thereafter, the project's procedural direction will be included to this chapter and expanded to integrate the work environment on site.

# 3.2 Design Research

This method is crucial for planning observational work. From implementation to identifying problems that may arise during implementation, steps should be tracked. If a serious issue is a significant source of job execution failure, improvements must be done and in order to maintain a steady flow, control methods must be utilised.

# 3.3 Development Research

The development of research was shown as a research framework in this study. Figure 3.2 show the research development of this study. The diagram show the flow of research development starting from literature review, identifying problem statement, ideating the innovation, creating the system or product, testing and evaluating the effectiveness of the product.



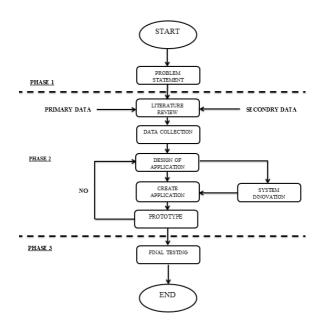


Figure 3.1 : Flow of Research Framework

This framework was used as a guide line to execute the project accordingly. The process in this study is divided into several phases as show in diagram. This development research is a process of starting up to the end of the Productivity Calculator of Architecture Progress (PCAP) application. In this process to develop the flow chart of this system to ensure that the project run smoothly as planned.

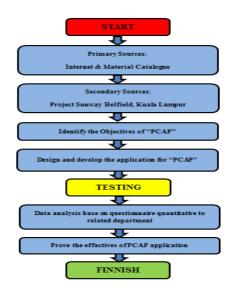


Figure 3.2 : The Details of Research Development



#### 3.4 System Design

The system design is explaining the about the website and overall the system function on it. This part is important for user and researcher to understanding the function of website. Besides, it is also explained about the every function of button that contain inside it. The website can be user-friendly for worker to use in future. Systems design is the process of defining elements of a system like modules, architecture, components and their interfaces and data for a system based on the specified requirements. It is the process of defining, developing and designing systems which satisfies the specific needs and requirements of a business or organization. The system design outlines how the application and the entire program operate. This section is necessary for users to understand the application's functionality (Corato, 2022).

#### 3.5 Research Method

The research conducted a questionnaire as a research study in this study. It was essential to collect data using this approach during an open interview or face-to-face interview. The questionnaire is the best way of gathering data after researchers understand what the evaluation required. Surveys can also be used for public research, and the number of responses can help people get a clear picture of the information needed for the questionnaire based on existing data. Also, this approach is used because of:

- i. Data collected will be processed
- ii. Data collection work is encouraged by questionnaires
- iii. Respondents will be asked the same question following a predetermined sequence.

#### 3.6 Conclusion

The chapter's conclude and discuses on collected data and information methods for analysis in an effective way. The data collected will be reviewed to come up with conclusions. This chapter also covers the location, respondents, research methodology, data analysis, and the stage of work completed during the review process. Furthermore, the methods to be utilized will be clearly described based on the issues at hand, and also the selection of relevant systems for usage inside the site. Following that, the project's process direction is related to this chapter and will be prolonged to the work situation even when on site.



#### 4.0 Data and Analysis

In this chapter, the researcher have forecast on the expected outcome of the project will be. It is also one of the planning procedures before the project is carried out, and researcher thought to carefully evaluate what data will be created during the project's execution. The researcher wants to be sure that the data collected will help to achieve the objectives. The following objectives are expected to be achieved by using the Productivity Calculator for Architecture Progress (PCAP) application:

- I. To identify the architecture productivity at the project site
- II. To develop an application to monitor the architecture productivity
- III. To evaluate the effectiveness of the application

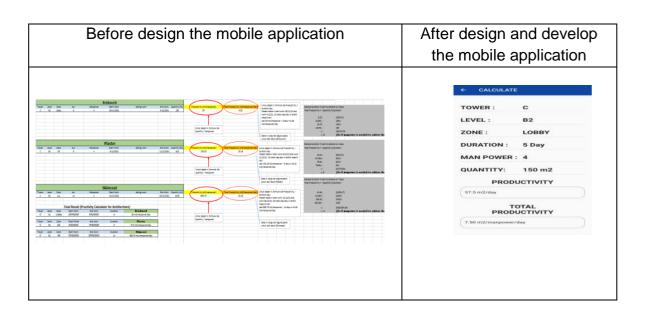
# 4.1 Investigate the Architecture Productivity at the Site Project

The architecture productivity is divided into three components. Three of these productivity categories are brickwork, plaster and skimcoat. Usually this productivity is monitor through the completion period of each job. After completion the data will be gathered in Excel to calculate how much productivity value for each job. In addition, when get the actual of each work productivity it will be easier to planning ahead. Figure 4.1 show the types of how researcher refer and identify the architecture productivity.

# 4.2 Develop an Application to Monitor the Architecture Progress of Construction Productivity

Progress for Productivity Calculator for Architecture Progress (PCAP) mobile application has been constructed by using Android Studio. This mobile application is suitable for employee or any user to calculate the architecture productivity. To develop the mobile application, researcher need to list down the actual productivity on site in order to calculate the productivity rate in excel by using proper formula so it will easier to update into Android Studio.







# 4.3 Evaluate the effectiveness of the system of the application

Figure 4.1 shows in order to evaluate the effectiveness of the PCAP application in the project, a paired sample t test was performed. Result as shown in table 4.8, respondent preferred using PCAP application (Mean= 4.00, SD = 0.26) compare with existing method (Mean= 3.60, SD = 0.33). A paired sample t-test found that this difference to be significant, t (11) = 3.55; p=0.00457, p < 0.05. Together, this suggests that using PCAP application was much easier and more resourceful compared with existing method. This means that PCAP application was more effective compare to the existing methods.

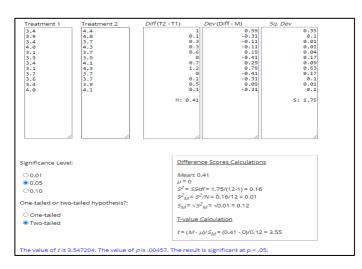


Figure 4.1 : Statical Index in Effectiveness (T-Test)



Overall, questionnaire results between using existing method and PCAP implementation can be seen a positive impact. As a result, researcher compared side to side whether the PCAP implementation can improve the calculation of the architecture productivity at the Sunway Belfield project site. Figure 4.2 shows the respondents' comparison base on the questionnaire that has been distributed between by using the existing method and Productivity Calculator for Architecture Progress (PCAP) application implementation. In table 4.1 shows the result of respondents' questionaire.

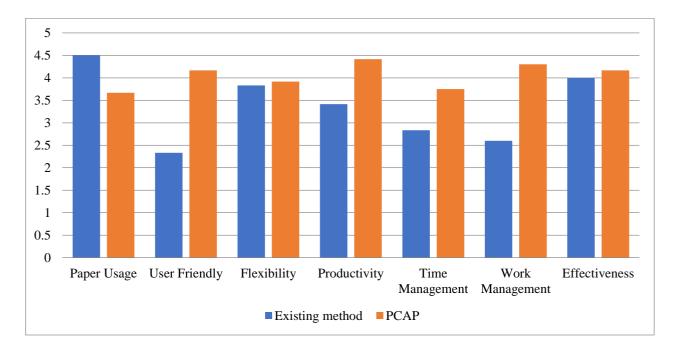


Figure 4.2 : Result of Respondents' Questionaire

# 4.4 Conclusion

In leading the day-to-day technology system that makes everyday life easier, anyone can put the effort developing something. Furthermore, this technology can be employed in a variety of fields, including building. Indeed, in this field, technology is required in terms of work that can save time and provide reliable information. Today, the best option to calculate and monitor architecture productivity at Sunway Belfield, Kuala Lumpur is to use technology to create an application that can help address the problem. Develop an application that can assess the PCAP Application effectiveness when used on this site.



#### 5.0 Conclusion and Recomendation

This part summarises the results, conclusions, and recommendations based on the data reviewed in the previous topic. The effectiveness of implementing the Productivity Calculator for Architecture Progress (PCAP) to monitor and calculate architecture productivity at the Sunway Belfield Project was tested by evaluating at how effectively some of the study's objectives were achieved. The data of the observations and questionnaires indicate that the Sunway Belfield Project team has difficulties with monitoring and estimating productivity. All of the difficulties that occur at the project site have an impact on the respondents' work. The PCAP application has been suggested to be used at Sunway Belfield because of its efficiency of use in monitoring and estimating architecture productivity. According to the findings from the respondents, this application has its own beneficial feedbacks.

# 5.2 Advantages of Using Productivity Calculator for Architecture Progress

According to the findings from the respondents' questionnaire result, PCAP application has its own beneficial output. By implementing this application, users can help to save time in calculating the architecture productivity. Previously, the researcher observed that the employees at Sunway Belfield project site having trouble in calculating the productivity rate on site as it required conventional stationary material such pen, paper and calculator. By using PCAP, users only required a mobile phone to calculate the architecture productivity. As result, user or employee can save their time as the application can calculate instantly the architecture productivity rate. Furthermore, PCAP application can assist user to forecast for the planning the next sequence as its capability of generate productivity rate. By this, user can know whether the work program is on schedule or in a delay.

By implementing PCAP application at the project site, user can easily save or reduce paper usage. As before, researcher observed that employees Sunway Belfield project site use paper to calculate and monitor the architecture productivity. This method is conventional a method and have been use since the beginning of the project. By using PCAP application, it will eliminate the paper usage in calculating the architecture productivity. This application only needs to be installed in android mobile phones and can be use right after that



# 5.3 Recommendations for the Improvement of PCAP Application

Findings from the result above, researcher would like to suggest some suggestions that can be used as a guide or follow up action for the improvement of the Productivity Calculator for Architecture Progress (PCAP) application. Firstly, PCAP only can calculate productivity of 3 architecture elements which is brickwork, plaster and skimcoat. In further study, researcher suggested that to add more than this trade such as tiles, ceiling, painting and others in order improve PCAP capability to calculate more 3 this architecture elements. Next, PCAP does not have the capability to save the collected data. As by this, researcher suggest that further study can be done on upgrading the features in the application such as enabling the application to save data in Portable Document Format (PDF) and also be able the data to be printable. Furthermore, researcher suggested that PCAP application to be published in Google Play where users can download the application themselves. Finally, PCAP application was created base on Android Studio platform where researcher find a few difficulties when constructing it. Nevertheless, researcher suggested that to construct PCAP application base on other software or platform so that further study can avoid the difficulties that faced by the researcher in making the PCAP application.

# References

Abdullah, A. A., Harun, Z., & Abdul Rahman, H. (2011). Planning process of development project in the Malaysian context: a crucial brief overview. International Journal of Applied Science and Technology, 1(2):

http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1089.3604&rep=rep1&type=pdf

Ben Dolman, D. P. (2007, October 5). SSRN. Retrieved from Productivity Commission Staff Working Paper:

https://papers.ssrn.com/sol3/papers.cfm?abstract\_id=1018881

Sunwaybelfield.com.(2022):

https://www.sunwaybelfield.com/assets/images/upload/location-map/location-map-en.png



Evans, Jon. (2017, February 19) "Why Is Android Studio Still Such a Gruesome Embarrassment?" TechCrunch:

http://www.techcrunch.com/2017/02/19/why-is-android-studio-still-such-a- gruesome-embarrassment/.

Wikimedia Foundation, (2019, Nov 21) Wikipedia Contributors. "Flutter (Software)." Wikipedia: en.wikipedia.org/wiki/Flutter\_(software).

Flutter.dev, (2019) Flutter. "Flutter - Beautiful Native Apps in Record Time.": https://flutter.dev/

Android Developers, (2019) "Create App Icons with Image Asset Studio, Android Developers.",:

developer.android.com/studio/write/image-asset-studio.

Mathew, T. &. (2011, December). Science Direct. Retrieved from Towards improving construction labor productivity and projects' performance: https://www.sciencedirect.com/science/article/pii/S1110016812000142

Abdillah, L. (2019, December). An overview of Indonesian fintech application. In The First International Conference on Communication, Information Technology and Youth Study (I-CITYS2019), Bayview Hotel Melaka, Melaka (Malacca), Malaysia.

https://papers.ssrn.com/sol3/papers.cfm?abstract\_id=3516455

Mahmud, S. H., Assan, L., & Islam, R. (2018). Potentials of internet of things (IoT) in Malaysian construction industry. Annals of Emerging Technologies in Computing (AETiC), Print ISSN, 2516-0281.:

https://papers.ssrn.com/sol3/papers.cfm?abstract\_id=3524922

Shinde, V. J., & Hedaoo, M. N. (2017). A review on productivity improvement in construction industry. International Research Journal of Engineering and Technology, 4(11), 210-215:

https://www.academia.edu/download/55203354/IRJET-V4I1136.pdf

Saurav, D., Amit, K. P., Satya, N. M., & Sanjeev, B. (2017). A study of enabling factors affecting construction productivity: Indian scenario. Int J Civ Eng Tech, 8(6), 741-758.:



https://www.researchgate.net/profile/Saurav-Dixit/publication/318582183\_A\_study\_of\_enabling\_

factors\_affecting\_construction\_productivity\_Indian\_scnerio/links/59956289a6fdccaded 25496d/A-study-of-enabling-factors-affecting-construction-productivity-Indian-scnerio.pdf

Sickles, R. C., & Zelenyuk, V. (2019). Measurement of productivity and efficiency Cambridge University Press:

https://books.google.com/books?hl=en&lr=&id=mXuIDwAAQBAJ&oi=fnd&pg=PR17&d q=Sickles,+R.+C.,+%26+Zelenyuk,+V.+(2019).+Measurement+of+productivity+and+eff iciency.+%09Cambridge+University+Press.&ots=R0x

0M6kiZy&sig=YaSNr8sKPUAf3CBzed4qJnsueWc

SessionLab, (2019, Mar 19). "20 Useful Online Tools for Design Thinking.":

http://www.sessionlab.com/blog/design-thinking-online-tools/.

Corato, V., Vorpahl, C., Sedlak, K., Anvar, V. A., Bennet, J., Biancolini, M. E., & Zappatore, A. (2022). The DEMO magnet system–status and future challenges. Fusion engineering and design, 174, 112971.:

https://www.sciencedirect.com/science/article/pii/S0920379621007468

Thamboo, J., & Dhanasekar, M. (2020). Assessment of the characteristics of lime mortar bonded brickwork wallettes under monotonic and cyclic compression. Construction and BuildingMaterials, 261, 120003.:

https://www.sciencedirect.com/science/article/pii/S0950061820320080

Fiala, J., & Mikolas, M. (2019, November). Special brick products and their application. In IOP Conference Series: Earth and Environmental Science (Vol.362,No.1,p.012165).IOP Publishing.:

https://iopscience.iop.org/article/10.1088/1755-1315/362/1/012165/meta

McKee, Harvey J. (2017). An Introduction to Early American Masonry, Stone, Brick, Mortarand Plaster. Springfield, IL.:



https://books.google.com/books/about/Introduction\_to\_Early\_American\_Masonry\_S.ht ml?id=2PPWAAAAMAAJ

Singh, Lakhmir; Kaur, Manjit (2019). Science for Class 10 Part-2 Chemistry. S. Chand.:

https://books.google.com/books/about/Science\_for\_Tenth\_Class\_Part\_2\_Chemistry.ht ml?id=p2stDAAAQBAJ

Szostakowski, B.; Smitham, P.; Khan, W.S. (2017-04-17). "Plaster of Paris–Short History of Casting and Injured Limb Immobilization". The Open Orthopaedics Journal.:

https://openorthopaedicsjournal.com/VOLUME/11/PAGE/291/FULLTEXT/

Glass, D. M. (2018). Dark Roads Always Lead Home (Doctoral dissertation, Cleveland State University).:

https://graduate-studies.csuohio.edu/current-students/thesis-dissertation

Vila, B. (2022, July 9). All about skim coat plastering. Bob Vila:

https://www.bobvila.com/articles/1169-skim-coat-plastering/

Bob Vila. 2022. Blueboard and Veneer Plaster Offer Old-Style Look .:

https://www.bobvila.com/articles/361-blueboard-and-veneer-plaster-offer-old-style-look/

Black & Decker (2017). The complete guide to finishing walls & ceilings: includesplaster, skim-coating, and texture ceiling finishes. Chanhassen, Minn: Creative Publishing International.:

https://www.coursehero.com/file/154974042/The-Complete-Guide-to-Finishing-Walls-Ceilings-Includes-Plaster-Skim-coating-and-Texture-Ceiling/

Patel, B., Bhavsar, P. J., & Pitroda, J. (2017). A critical literature review of labour productivity in building construction. Int. J. Constr. Res. Civ. Eng, 3(4), 76-80:

https://www.researchgate.net/profile/Dr-Jayeshkumar

Hamza, M., Shahid, S., Bin Hainin, M. R., & Nashwan, M. S.(2019). Construction labour productivity:review of factors identified. International Journal of Construction Management 1-13.:



https://www.tandfonline.com/doi/abs/10.1080/15623599.2019.1627503

Fat, S. (2017, December 9). Trenchless. Retrieved from Cycle Time:

https://www.researchgate.net/publication/268592127\_Life\_CycleCost\_Comparison\_of\_ Trenchless\_and\_Conventional\_Open\_Cut\_Pipeline\_ Construction\_Projects

Mbachu, J. (2018, October). researchgate. Retrieved from Benefits and barriers in uptake of mobile apps in New Zealand construction industry: What top and middle management perceive:

https://www.emerald.com/insight/content/doi/10.1108/F-08-2017-0078/full/html

Banerjee, A., & Roychoudhury, A. (2017, May). Future of mobile software for smartphones and drones: Energy and performance. In 2017 IEEE/ACM 4th International Conference on Mobile Software Engineering and Systems (MOBILESoft) (pp. 1-12). IEEE.:

https://ieeexplore.ieee.org/abstract/document/7889026

Leiringer, R. (2020). Sustainable construction through industry self-regulation: the development and role of building environmental assessment methods in achieving green building. Sustainability, 12(21), 8853.:

https://www.mdpi.com/2071-1050/12/21/8853

Deng, C., Tang, W., Liu, L., Chen, B., Li, M., & Wang, Z. L. (2018). Self-powered insole plantar pressure mapping system. Advanced Functional Materials, 28(29), 1801606.:

https://onlinelibrary.wiley.com/doi/abs/10.1002/adfm.201801606

Kanjjilal, J. (2021, January 27). developer.com. Retrieved from Android Studio : An Introduction:

https://www.developer.com/ws/android/android-studio-tutorial-an-

introduction.html#:~:text=

The%20Android%20platform%20allows%20developers,targeted%20at%20the%20And roid%20platform.



Hagos, T. (2018). Android studio. In Learn Android Studio 3 (pp. 5-17). Apress, Berkeley, CA:.

https://link.springer.com/chapter/10.1007/978-1-4842-3156-2\_2

Tashildar, A., Shah, N., Gala, R., Giri, T., & Chavhan, P. (2020). Application development using flutter. International Research Journal of Modernization in Engineering Technology and Science, 2(8),1262-1266.:

https://www.irjmets.com/uploadedfiles/paper/volume2/issue\_8\_august\_2020/3180/162 8083124

Kernbach, S., & Nabergoj, A. S. (2018, July). Visual design thinking: Understanding the role of knowledge visualization in the design thinking process. In 2018 22nd International Conference Information Visualisation (IV) (pp. 362-367). IEEE.:

https://ieeexplore.ieee.org/abstract/document/8564186/

Ottoboni, S., Price, C. J., Steven, C., Meehan, E., Barton, A., Firth, P., ... & Tahir, F. (2019). Development of a novel continuous filtration unit for Pharmaceutical process development and manufacturing. Journal of Pharmaceutical Sciences, 108(1), 372-381.:

https://www.sciencedirect.com/science/article/pii/S0022354918304052

Torabi, N. (2020, March 13). Neemz. Retrieved from Design Thinking - brainstorming through the 'Ideation' phase:

https://neemz.medium.com/design-thinking-brainstorming-through-the-ideation-phase-4612b3cf723a

Dam, R. F., & Siang, T. Y. (2020). Design thinking: A quick overview. https://apo.org.au/node/306478

Stevens, E. (2019, January 14). Career Foundry. Retrieved from How To Define A Problem Statement: Your Guide To The Second Step In The Design Thinking Process:

https://careerfoundry.com/en/blog/ux-design/stage-two-design-thinking- define-the-problem/



Zhao, W., Tian, S., Huang, L., Liu, K., Dong, L., & Guo, J. (2020). A smartphonebased biomedical sensory system. Analyst, 145(8), 2873-2891.:

https://pubs.rsc.org/en/content/articlehtml/2020/an/c9an02294e

De Cremer, P., Desmet, N., Madou, M., & De Sutter, B. (2020). Sensei: Enforcing secure coding guidelines in the integrated development environment. Software: Practice and Experience, 50(9),1682-1718.:

https://onlinelibrary.wiley.com/doi/abs/10.1002/spe.2844



# IMPLEMENTATION OF PP PLATE IN A GLOVE PRODUCTION LINE

Divashiniletchumy<sup>1</sup>, Nurul Zaidi<sup>2</sup> and Lee Kok Teong<sup>3</sup> <sup>1, 2</sup>Mechanical Engineering Department, Politeknik Ungku Omar, Ipoh, Perak

> <sup>1</sup>divashini2410@gmail.com <sup>2</sup>nurulzaidikasbolah@puo.edu. my

<sup>3</sup>Top Glove Sdn Bhd. Setia Alam, Shah Alam 40170 Selangor <sup>3</sup>leekt@topglove.com.my

#### Abstract

The main project idea stars from the existing plate which is S Plate. S Plate is a stainless steel plate. The main function of S Plate is to smoothen the assembly line of the former robots during immersion into the tank in a S letter shaped. The S Plate is made up of stainless steel is because the whole assembly line ways is made of stainless steel. Stainless steel has a good quality and physical strength. There are a few reasons why S Plate had to be protected although this particular plate is strong by its own physical strength and properties. There are a few objectives had been decided after identifying our problem statement. The main aspect which is very much particular during the design of our project is on the material of the product being used and most probably the comparison in between the existed product which is in market and the decided product which is going to be our project and every material comes with advantages and disadvantages as well. Generally, 'PP Plate' project involves few mechanical process. In addition, the measurement process is important and sensitive in the production of the components and materials for the project as well. All of these processes have continuity and connection between each other. Therefore, the working mechanism involves the design, install, modify, test and confirmation after testing the results.

Keywords: Stainless steel, Design, Assembly line



#### 1. Introduction

S Plate is a type of Plate that is made up of stainless steel. S Plate is used to assist the movement of the former holder between tanks from vertical position to horizontal position or vice versa. S plate is used by most of the factories in production line. This Plate is installed at 4 different locations in the production line that are Acid Tanks, Alkaline Tanks, Chlorine Tanksand Water Rinse Tanks.

The main function of S Plate is to smoothen the assembly line of the former robots during immersion into the tank in a S letter shaped. The S Plate is made up of stainless steel is because the whole assembly line ways is made of stainless steel. Stainless steel has a goodquality and physical strength.

The term stainless steel is used to describe a family of about 200 alloys of steel with remarkable heat and corrosion resistance properties. The carbon percentage can range from

0.03% to 1.2%. Its distinguishing characteristic is the high amount of chromium. Stainless steelcontains a minimum of 10.5% of chromium that improves its corrosion resistance and strength. The chromium in the alloy creates a passive layer on oxidation when exposed to air. This layer acts as a shield against further corrosion essentially making the alloy rustproof. This mechanism allows for retaining a spotless appearance for long periods under normal workingconditions.

1.1 Problem Statement

There are a few reasons why S Plate had to be protected although this particular plate isstrong by its own physical strength and properties.

- a) Excess of Polypropylene raw material in our production.
- b) S Plate undergoes corrosion and abrasion due to acid and alkaline immersion.
- c) Forming a Polypropylene Plate is expensive.

Therefore, the objective had been decided after identifying the problem statement.

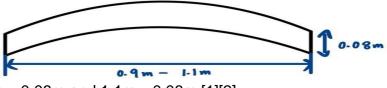
- a) To utilize the Polypropylene raw material to form the Pp plate.
- b) To form a Pp Plate to cover the S Plate to prevent from corrosion.
- c) To process the Pp plate economically by our workshop method.



# 2. Literature Review

The main aspect which is very much particular during the design of our project is on the material of the product being used and most probably the comparison in between the existedproduct which is in market and the decided product which is going to be our project and everymaterial comes with advantages and disadvantages as well. In order to design the PP plate there are many researches and study on other existing projects from abroad that we had reviewed to plan our PP plate project. There are many journals that had been reviewed throughout the study [1][4].

Throughout this design study we identified and come to a that there are 2 different techniques on how to form the PP Plate that are Hot Press and Cold Press Machine and Plastic Injection Moulding Machine. Different factories and area using different S plate dimension. Need to fabricate based on line design. The most common are 0.9m



x 0.08m, 0.97m x 0.08m and 1.1m x 0.08m [1][2].

Figure 1: Dimension Range of PP Plate

The mould to produce a PP plate size of 1000MM X 300MM is designed and as shown. Themould is made up of three main parts. They are mould cover, mould frame and mould base.

The mould cover and base are made up of 2.5MM stainless steel (SS) sheet metal whereas the mould frame is made up of 2.5MM mild steel (MS) Plate.

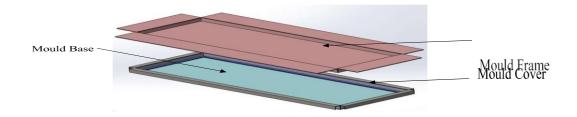


Figure 2: Mould Design of PP Plate



Stainless steel (SS) is used to make mould cover and mould base because stainless steel is anti-sticking, anti-corrosion, anti-rusting, and has shiny as well as smooth surface. This is crucial to produce a smooth and clean surface PP plate, and to prevent sticking during the retrieval of PP plate from the mould.

#### 3. Methodology

Methodology in this study, formulating the overall design of our project. In addition, we also discuss and the processes and workings of which it aims to complete the whole project we systematically and in accordance with a predetermined time. PP Plate project involves few mechanical process. In addition, the measurement process is important and sensitive in the production of the components and materials for the project as well. All of these processes have continuity and connection between each other. Therefore, the working mechanism involves the design, install, modify, test and confirmation after testing the results.

#### 3.1 Injection Moulding

Plastic injection moulding and cold press machines are introduced by melting the crushed PPin the screw extruder then transfer the required amount of molten PP to cold press machine for cold pressing process to produce an even thickness PP plate. The function of the plastic injection moulding machine is to melt the crushed PP by heat and pressure in the screw extruder. This method promotes a shorter melting duration if compared to hot press machinedue to high pressure and temperature. In addition, plastic injection moulding machine can ensure all the crushed PP to be fully melted. On the other hand, the function of cold press machine is to provide cold pressing to the molten PP. The process starts by filling the crushedPP into the feed hopper of the plastic injection moulding machine. Next, with the aid of high pressure and temperature, the crushed PP is melted into molten PP then injected out from thenozzle. A worker is required to collect the molten PP using a bucket for 4 to 6 shots. Then, themolten PP is loaded to obtain the required amount and pour into the mould. The mould is then transferred to cold press machine for cold pressing process. The process is the continued by retrieval of PP Plate using manpower and cutting process to produce the final PP S-Plate



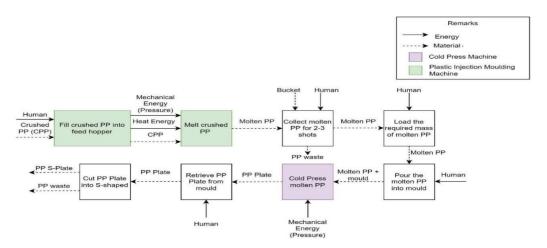


Figure 3: Plastic Injection Moulding Process

#### 3.2 Hot Press and Cold Press Machine

The function of the hot press machine is to supply heat directly to the mould via conduction to melt the PP waste. This promotes more efficient and effective heat transfer which shorten themelting duration. In addition, melting process with the aid of pressing function helps in producing a uniform thickness of PP plate. On top of that, the function of the cold press machine is to create pressing mechanism during the cooling process of molten PP. This is crucial because this pressing mechanism can aid air bubbles removal from the molten PP bycreating material overflowing. With this, the PP plate produced is much compact and wear resistant. Besides, the pressing mechanism restrains warpage and rippling of PP plate duringits solidification process. Hereby, the PP plate produced is even in thickness and specified inshape according to the mould dimension even thickness PP Plate. Next, the cold PP Plate is produced from the mould and proceed with cutting process to produce PP S-Plate. PP waste is produced during the spreading of RPP and cutting process.

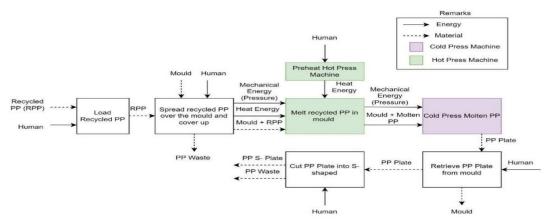


Figure 4: Hot Press and Cold Press Machine Process



#### 4. Result and Discussion

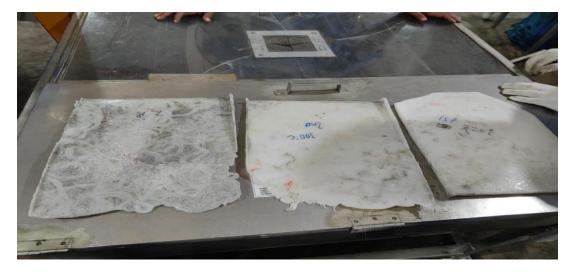


Figure 5: Appearance of PP Plate Formation

After Comparing and contrasting all the trial run formation, we project team selected 3 best PP Plate. The selection of the best 3 Plate is from the process of Hot Press and Cold Press Process. The PP Plates that formed at 220 degrees Celsius has a better viscosity compares to the 2nd and 3rd PP Plate. Hence the appearance of the 1st PP Plate is more suitable Plateto be chosen for our production. Besides there are few modifications are needed to be done. This is because although the 1st PP Plate has a good viscosity and flexible, there are a few improvements had to be done to make sure the PP Plate product to be even and thick enoughto support the S Plate in Glove Production Line.

QA INSPECTION	PP plate	S Plate
Density, g/cm <sup>3</sup>	0.910	7.93 to 8.0
Tensile modulus of elasticity, MPa	1600	515
Yield stress, MPa	31	202
Elongation at yield, %	8	40 - 60
Notched impact strength Charpy, kJ/m²	15	0.5 – 40
Temperature range, °C	0 to +100	0 to 1200
Thermal Decomposition, °C	300	1200
Melting point, °C	160	1450

Table 1: Comparison of PP Plate and S Plate Specification
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After producing the PP Plate our QA department had carry out several tests such as weight, density, elastic pulling test, temperature test and so on. All these test are important for us to rectify the differences before and after improvement. The PP Plate

Figure 6: PP Plate Ready for Installation

density is low where it is more suitable to fix on the S Plate and does not affect the load of the production line in anyway. Furthermore, the elasticity of the material has a good tensile strength. The PP Plate can be stretched up to 1600 MPa. Thus the melting point is low where the PP can easily melt if the temperature of the surroundings has exceeded to 100 Celsius.



Figure 7: S Plate before PP Plate Installation

The 3mm PP plate is cut to Closed Loop Control System for Modulating Hot Press and ColdPress Machine. The shape of S plate had been mounted on the stainless steel S plate inside of the respective tanks. The PP Input (SV)plate is fastened using rivet pin on the S plate.



Installation of PP Plate in Production Line



Figure 8: S Plate before PP Plate Insta

Stainless steel S plate mounted with PP plate is better than the current stainless steel S plate without PP plate mounted which is projected to have longer lifespan and able to reduce downtime losses to replace worn out S plate. The total cost of investment is also affordable for the production to form PP Plate from the excessive PP raw material in Factory.

#### 5. Conclusion

The project has successfully completed, and it is continuing to work on by the team to also carry out any process to know how well does the PP project progress. The analysis had alsoproved that the Hot Press Technique gives a better and a flexible PP product compared to Plastic Injection Moulding Process. This particular project had been also done many trial run in order to make a decision on which project are supposed to be implemented and executed on this PP Project.

Hence, it could be also concluded that:

1. The Polypropylene raw material has a tendency to form a PP Plate product to coat the S Plate in the glove production.

2. The Pp Plate is proven an anti-corrosion, heat tolerance and high tensile strength material that is suitable to be utilized in a glove production line.

3. The Pp plate that is formed by hot and cold pressed machine is considered an economical workshop method to be implemented by the Hot Press and the Cold PressMachine

# 6. References

Williams Berlin (2016) 12<sup>th</sup> edition Plastics Europe Industry and Processed in Production



Harley (2017) Plastic Pollution Coalition. New Global study on the production and fate of all plastics ever made 217 - 263.

Reubold, T. (2016). 8 maps show plastic's impact on the world's oceans and what's beingdone about it.

Statista (April 2018) Global plastic production (https://www.statista.com/statistics/28)

National Society of Professional Engineers (2019). National Society of Professional Engineers.

Bachrach, M. (2018). A Locally Producible Plastic Plate Press for Bottom-Up Recycling inLow-Resource Settings. PDF. pp.38–112.