Lecture Notes in Networks and Systems 925

Bahaaeddin Alareeni
Allam Hamdan *Editors*

Technology: Toward Business Sustainability

Proceedings of the International Conference on Business and Technology (ICBT2023), Volume 3

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Bahaaeddin Alareeni · Allam Hamdan
Editors

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Preface

In an age defined by rapid technological advancements and a growing awareness of environmental and societal challenges, the convergence of technology and business sustainability emerges as a pivotal theme. This book, aptly titled "Technology: Toward Business Sustainability," endeavors to unravel the intricate relationship between technology and the pursuit of sustainable business practices.

The genesis of this book lies in the recognition that technology, when harnessed judiciously, has the potential to act as a catalyst for fostering sustainability across diverse industries. From renewable energy solutions and eco-friendly manufacturing processes to the integration of artificial intelligence for more efficient resource management, the possibilities are vast and transformative.

As we embark on this exploration, the contributors to this volume, a diverse assembly of thought leaders and experts, present a collection of insights, analyses, and case studies that illuminate the intersection of technology and business sustainability. The goal is not only to comprehend the current landscape but also to envision the future trajectory of businesses operating in harmony with the principles of environmental and social responsibility.

The book welcomes a range of perspectives, from theoretical frameworks that underpin the conceptual foundations to practical applications that demonstrate the tangible impact of technology on sustainable business practices. Whether you are an academic seeking a deeper understanding, a business professional navigating the complexities of sustainability, or a policymaker shaping the agenda for responsible business practices, the content within these pages aims to provide valuable insights and provoke thoughtful consideration.

The chapters within this book traverse a broad spectrum of industries and technologies, reflecting the diverse ways in which innovation can contribute to a more sustainable future. By delving into topics such as circular economy models, green technology adoption, and the role of big data in sustainability initiatives, the contributors contribute to a holistic understanding of the multifaceted challenges and opportunities at the intersection of technology and business sustainability.

May this book serve as a source of inspiration for those seeking to integrate technology seamlessly into their sustainability efforts. It is our hope that the collective wisdom contained herein will not only enhance awareness but also catalyze action, encouraging businesses to embark on a path of sustainable practices driven by the transformative power of technology.

Bahaaeddin Alareeni
Allam Hamdan

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EuroMid Academy of Business & Technology (EMABT)

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There is an ever-increasing need for high-quality research in most if not all aspects of twenty-first-century society. Universities are the primary providers of quality research education. Quality research education requires the participation of both established faculty, newly appointed staff, and research students. There is also the requirement for the academic to reach out to the general society as comprehensively as possible. As the university sector becomes increasingly focused on research excellence, there is a need to provide more fora, primarily in the form of peer-reviewed conferences, for academics to exchange ideas, questions, problems, and achievements concerning their personal research activities. These fora provide opportunities to exchange ideas, experience critiques, and obtain some recognition for individuals' progress toward research excellence. The more international the fora the more effective it is. Although publishing in highly rated indexed academic journals is still the most prized form of academic communication, the conference has become a significant outlet for research findings as well as an important facilitator to achieving this goal.

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Details of this event are contained on our website at http://www.embta.com/.

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The International Conference on Business and Technology (ICBT2023)

Overview

The 4th International Conference on Business and Technology (ICBT'2023) is organized by EuroMid Academy of Business and Technology, Istanbul, turkey. It will be held on November 01-02, 2023 at Hilton Istanbul Bomonti Hotel, Turkey.

The main objective of the ICBT'2023 Conference is to gather leading academicians, scholars, and researchers to share their knowledge and new ideas as well as to discuss current development in the fields of business, education, society, and technology.

The ICBT'2023 aims to achieve other objectives as the following:

- Highlighting business and technology problems that are faced by institutions in a scientific way, in addition to finding the possible practical solutions for them.
- Encouraging scientific research in business and technology areas which may contribute to sustainable improvements to it.
- The conference also offers opportunities for academicians and industry experts to meet and interact with local and international participants.
- Enable the researchers to publish their contributions in high-ranked journals and indexed proceedings by Scopus.

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Measuring Usage of Haraj Using the Technology Acceptance Model: Evidence from Saudi Arabia

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Abstract. With billions of users worldwide, mobile apps have become indispensable in the twenty-first century. The shifting dynamics of these apps' usage need research on how customers accept and utilize them. The Technological Acceptance Model (TAM) is a common paradigm for investigating customer acceptance of new technologies like mobile apps. In this study, TAM was employed to evaluate the success of the Haraj mobile app in Saudi Arabia, a popular marketplace for buying and selling things. The study examined users' assessments of the application's value and usability, as well as their attitude and desire to adopt it. Conducted in Saudi Arabia, the study targeted users of the Haraj application, offering everyone using it the opportunity to participate. Following the selection criteria and agreement to participate, 103 individuals completed a survey. Data analysis was performed using statistical software SPSS and Smart-PLS. The study findings revealed that attitudes toward the adoption of the Haraj application, perceived simplicity of use, and perceived usability are major factors influencing individuals' intentions to adopt the mobile application. The findings also emphasize the importance of making mobile apps easy to use and usable to enhance adoption rates. According to the results, Attitude toward Adoption had a strong positive association with both reported ease of use and perceived usability. Furthermore, perceived ease of use and perceived usability both had a substantial positive link with the intention to adopt the application, indicating that when mobile users regard applications as simple to use, they are more inclined to adopt them.

Keywords: Perceived Ease of Use · Perceive Usefulness · Attitude · Beahvior · TAM · Haraj · Saudi Arabia

1 Background of the Study

Technological advancements constantly pose challenges for traditional business models while simultaneously creating new chances for providing different services. Top companies try to leverage new technologies to benefit them (Bala and Verma 2018). As a result, researchers have been studying how quickly consumers embrace new technologies as their growth accelerates (Tew et al. 2022). Factors influencing how fast people accept these technologies include availability, convenience, need, and security.

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Haraj app (similar technology) is a case in point for the uptake of technology based on need, convenience, and accessibility, which have been identified as major determinants of technology acceptance. Haraj is a popular mobile app in Saudi Arabia that allows users to buy and sell second-hand items. The app was launched in 2011 by Mohammed Al-Athel, a Saudi entrepreneur, and quickly gained popularity among users looking for a platform to sell their used items. The Haraj mobile application has received positive evaluations for its simple and user-friendly interface, as well as its focus on creating a safe and secure platform for buyers and sellers (Atalawy, 2018). Notably, its popularity was catapulted when its available on Google's play store, enhancing its availability and, therefore, accessibility.

In 2014, the Haraj mobile app received a significant investment from Saudi Aramco Entrepreneurship Ventures (Wa'ed 2014), which helped the company expand its operations and reach a wider audience. Statistics have shown that as of 2021, the app had over 10 million downloads and was one of the most popular e-commerce platforms in the region. In addition to its core buy-and-sell functionality, Haraj has also introduced features such as auctions, in-app messaging, and the ability to pay via the app (Atalawy, 2018). The company has also launched a premium subscription service that allows sellers to highlight their listings and access other premium features.

This study aims to summarize the Technology Acceptance Model (TAM) leading to the adoption of the Haraj mobile app in Saudi Arabia. The Technology Acceptance Model is a framework developed to help explain why people accept or reject technology. It is based on the idea that a user's attitude toward technology can be determined by two primary factors: Perceived Ease of Use and Perceived Usefulness (Milly et al. 2020). TAM has been used to study various topics, such as the acceptance of mobile phones, social media usage, and the acceptance of digital payment systems (Vahdat, 2021; Granić, and Marangunić, 2019; Moslehpour 2018; Ajibade 2018). Furthermore, it has also been used to develop and refine models for predicting user behaviour and acceptance. Notably, various studies have been done to assess the levels of uptake, development, and usage of mobile apps in Saudi Arabia. However, these studies have not delved into the reasons behind the popularity of the Haraj app. Therefore, this study aims to investigate the dynamics behind the successful usage of the Haraj mobile application using the Technology Acceptance Model (TAM).

The findings of this study could have consequences for future research and practices concerning the adoption, usage, and design of mobile apps. The results of this study could inspire future research into the design and deployment of mobile apps that better align with are more suited to user preferences and requirements. Furthermore, the research outcomes could offer suggestions on how to increase consumer acceptability and adoption of mobile apps, especially those related to e-commerce. By enhancing the user experience, developers would be able to produce more effective mobile apps.

The rest of the paper is organized as follows: the next section will discuss the motivation of the study, followed by review of the theoretical framework and hypotheses development. This is then followed by research methodology, analysis, and results. The study concludes with findings, conclusions, implications and limitations, and directions for future research.

1.1 Motivation of the Study

Mobile apps have become essential in the 21st century, with billions of users worldwide. The changing dynamics surrounding the usage of these applications necessitate research into how consumers accept and adopt these apps. There is extensive research on the role of mobile applications and the determinants of adoption and usage on a global scale. This includes research on serval applications and their usage in Saudi Arabia. However, little has been done to investigate the dynamics behind the usage of the Haraj application, despite its increasing uptake in Saudi Arabia. The Technological Acceptance Model (TAM) is a popular paradigm for studying consumer acceptability of new technologies, such as mobile apps (Venkatesh and Bala 2015). Thus, the current study aims to contribute to a better understanding of user acceptance and adoption of mobile technologies by shedding light on the mechanisms underlying the success of the Haraj application.

2 Literature Review

2.1 Theoretical Background and Hypotheses Development

Mobile apps have become an indispensable part of contemporary life, offering a diverse variety of services and advantages to users. The capacity of mobile applications to facilitate transactions, exchanges, and other sorts of communication between users, companies, and organizations is one of its most important features. The Haraj app is one of the most popular mobile applications in the Middle East, thanks to its unique features that enable users to buy and sell items, s as well as participate in other forms of transactions. The Technology Acceptance Model (TAM) has been used as a theoretical framework in this research to examine the aspects that contribute to the success of the Haraj app.

2.2 Perceived Usefulness (PV) and Attitude Towards Haraj Mobile App

The perceived usefulness of an information system had the most substantial effect on usage, as found by Khoa (2020). Davis and Riksson also found that users had a much stronger relationship with usage than ease of use. Many existing studies have authenticated the effect of perceived usefulness on attitude (Kasilingam 2020). It is suggested that people's attitude toward using a new information system is based on their evaluation of how valuable they perceive it to be, and that this attitude is a significant factor in determining how much they use it. In the case of the Haraj mobile application, its perceived usefulness has had a significant impact on users' attitude.

H1*: Perceived usefulness has an effect on Attitude to use the Haraj application*

2.3 Perceived Ease of Use (PEOU) and Attitude Towards Haraj Mobile App

Researchers such as Fishbein and Ajzen propose that a user's attitude towards utilizing a system is determined by their expectation of how simple it is to use. This has sparked much debate among psychologists, especially concerning the recommendation to use self-reported evaluation terms. TAM suggests that a person's Perceived Ease of Use of a system has a direct, positive effect on users (Malik and Hadi 2019). However, the system's complexity can be a deterrent to its adoption. The evidence indicates that how easy an application is to use is a significant factor in how people view it (Chawla and Joshi 2019). People will be concerned with how much exertion it takes to use the system and its complexity. The process of discovering information and completing tasks must be perceived as effortless to create a positive experience. It is believed that PEOU (Perceived Ease of Use) has a significant influence on attitude. In contrast, users may be less likely to use the app if it is perceived as difficult or complex. Thus we propose that:

***H2**: Perceived ease of use is positively related to the Haraj users' Attitude*

2.4 Attitude Towards Haraj Mobile App and Behavioral Intention to Use Haraj Mobile App for Purchase

Attitude is an essential factor that affect the behavioural intention to use. Attitude is defined as an individual's evaluation of an object or situation. Positive attitudes lead to higher behavioural intention to use, while negative attitudes lead to lower levels (Lee et al. 2020). Attitude is crucial in determining whether or not an individual will act on their intentions. If an individual has a positive attitude towards a product or service, they are more likely to be willing to use it.

Conversely, if an individual has a negative attitude, they are less likely to use it. Attitude can be shaped by various dynamics, such as previous experiences, personal morals, and beliefs (Flavián et al. 2020; Kane 2019; Hameed et al. 2023; Hadi and Aslam, 2023). Therefore, it is vital to identify the factors that influence an individual's attitude to effectively influence their behavioural intention to use. A negative attitude towards the Haraj mobile app has negatively affected the user's behavioural intention to use the app. Negative attitudes can lead to feelings of doubt, skepticism, and frustration, which can prevent a user from using the app (Tang 2019). Furthermore, a depraved attitude can cause a user to be less likely to explore the app, leading to less usage. The user might uninstall the app or choose not to download it in the first place. Thus, the following hypotheses can be proposed:

***H3**: Haraj users' Attitude is highly related to behavioural intention to use Haraj mobile app*

***H4**: Attitudes of Haraj users mediate the relationship between perceived usefulness, perceived ease of use, and the intention to use Haraj mobile app*

The conceptual model is shown in Fig. 1.

3 Methodology

3.1 Scope of the Study

This scope of the study is limited to the adoption of the Haraj mobile App in Saudi Arabia. The study seeks answers to Attitude and behavioural intention, perceived ease of use, and perceived usefulness with respect to the Adoption of the Haraj mobile app in Saudi Arabia. The target population of this study included users of the Haraj mobile application in Saudi Arabia. Individuals who used the Haraj mobile application given a chance to

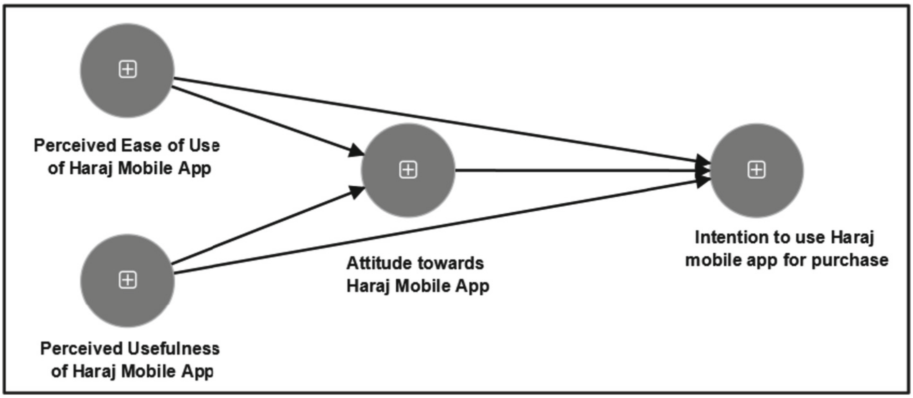
Perceived Ease of Use of Haraj Mobile App
Perceived Usefulness of Haraj Mobile App
Attitude towards Haraj Mobile App
Intention to use Haraj mobile app for purchase

Fig. 1. Conceptual framework

participate in the study. The selection was, therefore, not random and respondents were prompted to indicate whether they had interacted with the Haraj application before being asked to fill out the surveys. The study took place in Saudi Arabia, focusing on both citizens and residents who were Haraj users. A total of 103 respondents participated in the survey after meeting the selection criteria.

Data collected from the survey were coded, entered, and analyzed using structural equation modeling to investigate the relationship between attitudes towards the adoption of the Haraj app (AT), intention to adopt (IA), perceived ease of use (PEU), and perceived usefulness (PU) of the Haraj mobile app.

4 Analysis and Results

4.1 Convergent Validity

An analysis was conducted to measure the construct validity of Attitude Towards Adoption, Intention to Adoption, Perceived ease of use, and Perceived usability based on item loadings, composite reliability, and reliability (alpha values). As suggested by Hadi (2022), all constructs are reflective in nature. As the items are closely interchangeable. Results revealed that Attitude towards Adoption (AT1, AT2, AT3, and AT4) had loadings ranging from .886 to .796, and a AVE value of 0.771 indicating that the three items perfectly converge on its construct. Similarly, the results of CR (composite reliability) 0.931 and reliability coefficient 0.930 are considerable, indicating good internal consistency. Intention to Adoption consisted of two items (IA1 and IA2), with loadings of .796 and 0.801, IA had an alpha of .721, indicating good internal consistency reliability. The construct's composite reliability (CR) is .868, which also indicates good internal consistency. Similarly, Perceived ease of use (PEU1, PEU2, and PEU3), had loadings of .865 and .881, and 0.865, with an alpha value of 0.88 and CR = .91, indicating good internal consistency. The construct's average variance extracted (AVE) was .68, which is above the recommended threshold of .5, demonstrating good convergent validity. On the other hand, Perceived usefulness consisted of three indicators (PU1, PU2, and PU3), with loadings ranging from .669 to .876. PU had an alpha of .706 and a CR of .838, indicating good internal consistency. The construct's AVE was .638, which was also above the recommended threshold of .5 (Hadi et al., 2016a). The findings have been summarized in Table 1 below.

Table 1. Outer Loading, Examination of measurement models

LVs and items	S, loadings	alpha	CR	AVE
Attitude Towards Adoption				
AT1	,886	,90	,93	,771
AT2	,888			
AT3	,837			
AT4	,796			
Intention to Adoption				
IA1	,946	,72	,86	,768
IA2	,801			
Perceived ease of use				
PEU1	,865	,88	,91	,68
PEU2	,881			
PEU3	,865			
Perceived usefulness				
PU1	,831	,706	,83	,638
PU2	,876			
PU3	,669			

Source: own survey results

4.2 Discriminant Validity

A discriminant validity analysis was conducted on Attitude toward technology (AT), intention to adopt (IA), perceived ease of use (PEU), and perceived usefulness (PU). According to Table 2, the average variance extracted for AT was 0.878, indicating a capture index of 87.8% for the variance in AT, while the value of 0.877 for IA indicated a capture index of 87.7% for the variance in IA. PEU had an AVE of 0.822, revealing a capture index of 82.2% for the variance in PEU, and the value of 0.797 for PU indicated a 79.7% capture index for the variance in PU. These findings imply that the variables used in the study were distinct, and there is no problem of cross-loadings.

Statistical software SmartPLS was used to test the hypothesized relationships between perceived ease of use, perceived usability, Attitude towards Adoption, and intention to Adoption, as illustrated in Fig. 2. The analysis pointed out that 29% of the variance in IA is explained by PEU, PU, and AT. Nonetheless, the p-values for all

Table 2. Discriminant validity results

	AT	*IA*	*PEU*	*PU*
AT	*0.878*	---		
IA	***0.538***	*0.877*	**---**	
PEU	***0.632***	***0.415***	*0.822*	**---**
PU	***0.752***	***0.533***	***0.532***	*0.797*

Source: Own survey results

relationships are less than 0.05, providing enough grounds for the acceptance of all hypotheses. Please see Fig. 2 for detail.

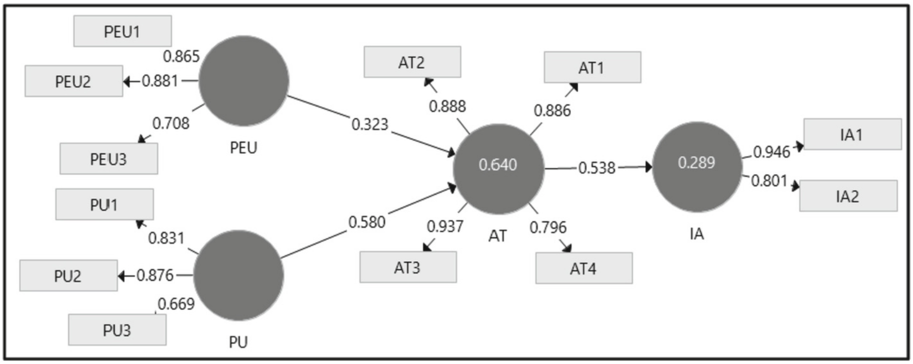

Fig. 2. Structural Model with path coefficients

These findings revealed that changes in perceived ease of use, perceived usability, and Attitude towards the use of the Haraj application could indeed be used as predictors of changes in the intention to adopt of the application. The relationships were defined by β, and t values. Based on these indexes, all direct effects were supported, which reveals the strength of the independent variables as a predictor of their criterion variable, i.e., Attitude towards Haraj application and Adoption of The Haraj application for their purchase. This finding is further supported by probability statistics, which revealed that all p-values are less than 0.05. A path coefficient analysis was also carried out to examine the indirect effects of PU → AT → IA and PEU → AT → IA Results of the study revealed that both indirect effects have a considerable relationship in the context of Haraj in Saudi Arabia ($\beta = 0.312$, $p < 0.01$and $\beta = 0.174$, $p < 0.01$). These findings indicate that Haraj users' attitudes play a key role in using Haraj for their purchase decision in Saudi Arabia. Refer to Table 3 for details.

Table 3. Direct and Indirect effect

Paths	β	Standard Error	t statistics	P values
AT → IA	,538	,092	5.8	,001
PEU → AT	,323	,076	4.2	,001
PU → AT	,580	,074	2.8	,001
Specific Indirect effect with a mediator				
PU → AT → IA	,312	,073	4.61	,001
PEU → AT → IA	,174	,048	3.62	,001

Source: Own survey results.

5 Discussion on Findings

The study investigated the relationship between attitudes towards the Adoption of the Haraj application (AT), intention to adopt (IA), perceived ease of use (PEU), and perceived usability (PU) of the mobile application. The researchers collected data from a sample of 103 Haraj application users in Saudi Arabia using an online survey.

The results of the study indicated that the participants had a positive attitude towards the Adoption of the Haraj application, with an average score of 4.30 out of 5. The intention to adopt the application was also high, with an average score of 4.24 out of 5. The perceived ease of use (PEU) and perceived usefulness (PU) of the app were also rated highly, with average scores of 4.27 and 4.25 out of 5, respectively. The research used statistical modeling using bootstrapping to examine the relationship between the variables. The results showed a positive and significant relationship between AT and IA ($\beta = 0.538$, $p < 0.01$), indicating that individuals who have a positive attitude towards the Adoption of the application are more likely to have a higher intention to adopt it. These findings were reiterated in a study by Venkatesh et al. (2003), who concluded that perceived ease of use was a key determinant of technology adoption. Similarly, Lin et al. (2011) found that perceived ease of use significantly predicts user acceptance of mobile commerce services.

The analysis also revealed a positive and significant relationship between PEU and AT ($\beta = 0.323$, $p < 0.01$), indicating that individuals who perceive the application to be easy to use have a positive attitude towards the Haraj application. Additionally, there was a positive and significant relationship between PU and AT ($\beta = 0.580$, $p < 0.01$), indicating that individuals who perceive the application as useful are more likely to have a higher intention to adopt it. This coincided with previous research findings that individuals' attitudes toward technology can influence their intention to adopt it (Ajzen 1991; Davis et al., 1989). Another study by Agarwal and Prasad (1998) found that perceived ease of use has a direct and positive impact on user intention to adopt e-commerce. Similarly, the results of indirect effects PU → AT → IA and PEU → AT → IA are also significant ($\beta = 0.312$, $p < 0.01$and $\beta = 0.174$, $p < 0.01$), demonstrating that Haraj users' attitudes play a key role in using Haraj for their purchase decision. This finding is consistent with the core concept of the TAM model. Furthermore, to examine the predictive power of the variables, the results showed that AT, PEU, and PU significantly predicted IA (F (3, 376) = 142.14, $p < 0.01$), with the three variables accounting for 53% of the variance in IA. This finding is in line with previous corroborated research that has shown that attitudes toward Adoption and perceived ease of use are significant predictors of technology adoption (Venkatesh et al., 2003; Davis et al. 1989; Moon and Kim 2001).

6 Conclusion

In summary the findings from this study suggest that Attitude towards the Adoption of the Haraj application, perceived ease of use, and perceived usability are important factors that influence individuals' intention to adopt the mobile application. The study's results also emphasize the significance of ensuring that mobile apps are perceived to be easy to use and usable to increase adoption rates. The results revealed that Attitude towards Adoption had a significant positive relationship with both perceived ease of use and perceived usability. Additionally, both perceived ease of use and perceived usability had a significant positive relationship with the intention to adopt the application, implying that when mobile users perceive applications as easy to use, they are more likely to adopt these applications.

6.1 Implications of the Study for Theory and Research

The findings from this study have significant implications for both theory and practice. In terms of theory, the study highlights the importance of considering individuals' attitudes towards the Adoption of technology, as well as their perceptions of the ease of use and usability of technology, when predicting their intention to adopt it. The study's findings are consistent with previous research, which has shown that attitudes toward technology and perceived ease of use are important predictors of technology adoption. By focusing on the Haraj application, the study's results provide valuable insights into the factors that influence the Adoption of mobile applications in Saudi Arabia. The study's results could potentially lead to higher adoption rates for the Haraj Mobile Application, given its increasing adaptability since its addition to the play store.

For practice, the study's findings have several implications for organizations seeking to develop and promote mobile applications in Saudi Arabia. Companies should focus on developing applications that are perceived as easy to use and highly usable, as these factors are positively associated with individuals' intention to adopt them. Therefore, investing in usability testing and user-centered design is crucial to ensure that their applications are intuitive and user-friendly. Secondly, companies should work to promote positive Attitudes towards their applications. This could be achieved through targeted marketing campaigns that highlight the benefits of using the application. Additionally, organizations might need to take into account cultural factors that could influence the Adoption of mobile applications in Saudi Arabia, such as the importance of social norms and the role of religion and Arabic culture in shaping mobile application adoption and use.

6.2 Limitations

While the study provides valuable insights into the usage of the Haraj mobile application using the technology acceptance model, there are several limitations that could have influenced the results. The study was conducted using a self-administered online survey, which may limit the generalizability of the findings. The sample was also relatively small, consisting of only 103 Haraj application users in Saudi Arabia, which may not be representative of the wider population. A larger sample would have been more appropriate to obtain data that could be generalizable to the entire population of Haraj application users across Saudi Arabia. Secondly, the study relied solely on self-reported data, which may be subject to social desirability bias. Participants may have provided socially desirable responses instead of their actual opinions or behaviours, which could have influenced the study's findings. However, the researcher requested the respondents to be as honest as possible in responding to the surveys to enhance the reliability of theprovided data. Thirdly, the study focused exclusively on the Haraj application, which may limit its applicability to other mobile applications. Other applications may have different features, user interfaces, and user experiences that could affect user attitudes and intentions. The study did not also account for external factors that could affect Adoption, such as the availability of alternative applications, the cost of using the application, or the influence of social norms.

6.3 Future Directions

Based on the findings of this study, there are several areas that could benefit from further research. Firstly, it would be valuable to explore the relationship between attitudes toward the Adoption of mobile applications and other factors that may influence Adoption, such as age, gender, income, and education level. This would provide a more nuanced understanding of the factors that contribute to the Adoption of mobile applications and could inform strategies to increase adoption rates among different demographic groups. Secondly, future research could focus on the impact of social influence on the Adoption of mobile applications. This could include examining the role of social networks, such as family, friends, and colleagues, in influencing attitudes towards Adoption and actual adoption behaviour. Additionally, investigating the effect of marketing and promotional activities on adoption rates could shed light on effective strategies for promoting mobile applications.

Finally, it would be useful to investigate the impact of mobile application adoption on user behaviour and outcomes. For example, researchers could examine the relationship between the Adoption of the Haraj application and user satisfaction, engagement, and purchase behaviour. Such research could provide valuable insights into the benefits and limitations of mobile applications for consumers and inform the design and development of future applications.

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Youth Acceptance Towards Food Security Practices in Campus: Application of Food Bank

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Abstract. Food security is given a high emphasis in today's culture, and campuses have a big impact on young people's attitudes and behaviours. This study explores how young people, primarily college students, feel about campus food security practises. By utilising a methodology that involves surveys, interviews, and observational data, we hope to better understand the factors that influence young people's acceptance of campus-based food security initiatives. This study offers insightful information about how college settings may encourage youth interest in and understanding of food security concerns. Policies and programs that better address food insecurity on college campuses and promote student initiative can be developed by utilizing the research findings as a guide. Ultimately, creating an environment that is more sustainable and food secure requires cultivating adolescent acceptance and engagement. Our understanding of how college environments might encourage young people's involvement in, and awareness of food security has been greatly advanced by this study. All the direct connections were found to be confirmed by the data when we used partial least square structural equation modelling (PLS-SEM) to analyse the data. The study's conclusions can be used to create programmes and policies that better address food insecurity on college campuses and encourage kids to get involved in problem-solving. The key to creating a future that is more sustainable and food secure is to support young people's acceptance and engagement.

Keywords: Food Security · Food Bank · Youth Acceptance · PLS · In-Campus

1 Introduction

Food security has recently grown to be a crucial issue that cuts across social and geographic divisions. Although the fundamental human right to adequate, secure, and nourishing food is included in food security, its importance goes beyond considerations of international policy. It reaches the core of educational institutions, where the future

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welfare of our children is at risk [11]. The expanding amount of young people pursuing higher education faces the difficult challenge of food insecurity. This complex issue highlights the need to investigate how young people adopt food safety practices, particularly in the peculiar environment of colleges and universities [14]. Colleges and universities are environments where students can grow personally and academically, but they are also the site of several problems, with food insecurity being one of the most common. The change to college life might be exhilarating, but it frequently entails greater financial difficulties due to rising tuition prices, housing costs, and the never-ending load of educational costs [6]. In this setting, eating consistently and healthily can become a daily challenge for a substantial majority of students.

Numerous educational institutions have launched proactive programs to address food insecurity on their campuses in response to this escalating challenge. The establishment of campus food pantries, meal assistance programs, and collaborations with nearby food banks are a few examples of these initiatives [29]. The acceptance and dedication of the young people who benefit from these food security practices, a component that is frequently disregarded, is essential to the success of these programs.

The idea of a food bank (FB) is well-known around the world and is the foundation of public social aid. FBs serve as crucial middlemen, collecting extra food provided by manufacturers, farmers, and merchants and guaranteeing its distribution to people who cannot afford it. Foodbank is crucial for addressing the widespread problems of food loss and waste and meeting the nutritional needs of individuals who are less fortunate and facing financial difficulties in addition to providing urgent aid. Notably, a thorough analysis of the world's food bank landscape by [25] reveals that the Global Food Bank Network, which includes more than 500 of these organizations, operates in more than 30 nations. Due to the fact that these initiatives have together impacted more than 20 million people, they have a large worldwide impact.

In Malaysia, as of December 2019, a total of 531,567 household members have benefited from the Food Bank program which started in August 2018. This Food Bank initiative aims to channel surplus food assistance to consumers in need and at the same time help ease the burden of living costs. Among the programs that have been successfully carried out is the Student Food Bank Program which is a collaboration initiative between the Ministry of Domestic Trade and Consumer Affairs (KPDNHEP), Food Bank Malaysia Foundation (YFBM), Strategic Partners, Institute of Higher Learning (IPT), contributors and mobilizers of student volunteers to ensure the implementation of the program runs smoothly and more systematically. Following the success of the Student Bank Food Program at 123 Public Institutes of Higher Learning (IPTA) last year, the Ministry of State Domestic Trade and Consumer Affairs (KPDNHEP) through Yayasan Food Bank Malaysia (YFBM) will expand this initiative to 123 IPTs, namely Institutions of Higher Learning Private (IPTS), Polytechnic and Institute of Teacher Education (IPG) to help more students from the B40 family. Indirectly, the program has also managed to save 2,120 metric tons of surplus food. As for the Student Bank Food program, a total of 12,251 students have benefited from this program which has been conducted in 21 Universities.

Nowadays, the concept of the food bank (FB) has spread around the globe. FB acts as a social welfare agency that gathers and distributes surplus food donated by manufacturers, farmers or retailers and distribute them to people which cannot afford to purchase it. FB makes a major contribution to the resolution of food loss problems, the availability of food for low-income people and environmental degradation due to food waste. The Food Bank program held at several public universities has helped students from the low-income (B40) group or poor families to have access to food. The initiative is very helpful to those with financial difficulties. For students that faced financial problems, it is also difficult to obtain food supply. Collage meal plans for students are often too expensive, especially for low-income students. To overcome this problem, food banks are the best way to help university student food insecurity. Universities are opening food banks to help ease student hunger.

We seek to obtain a thorough understanding of how youth perceive, apply, and participate in food safety programs in academia by looking at the underlying reasons that cause food insecurity among students and looking at initiatives implemented by educational institutions. This investigation is crucial because it contains the key to creating and putting into practice initiatives that are effective and catered to the needs and perspectives of students, thereby enhancing food security on campuses and the wellbeing of our young people.

2 Literature Review

Food security, which is essential to welfare, is still a major global issue. Food insecurity is the limited access to healthy and nutritious food. It refers to the insufficiency and unaffordability of an adequate quantity of food [28]. Young people, especially those enrolled in educational institutions, are one of the significant demographic groups who are becoming more aware of food security issues. The complicated environment of youth adoption of food security practices on campuses is explored in this review of the literature. It looks at the numerous causes of food insecurity among students as well as the steps educational institutions have taken to address the issue. To create effective intervention and support systems, it is crucial to comprehend the dynamics of young people's adoption and engagement in food security practices in academic settings. In recent years, food insecurity among college students has escalated in importance. Numerous studies have emphasized the severity of the issue and the susceptibility of young people who pursue higher education. Moreover 50% of the students questioned in [14] study experienced food insecurity at some point during their time in college. Rising tuition, housing prices, and the frequently disregarded but significant issue of textbook costs are all factors that contribute to food insecurity [6].

A comprehensive solution is needed to address the complex issue of food security for students. While efforts at the university level have made tremendous progress in addressing this problem, their success still depends on youth acceptance and participation. These activities should include tactics to reduce stigma, raise awareness, and encourage peer support. Research demonstrates that many factors must be carefully considered when developing and implementing programs to increase youth acceptance of food safety practices on campus. Student engagement is greatly influenced by their knowledge of and access to food safety programs. When these resources are widely accessible and strategically located, students are more likely to accept and use them [7].

Thus, awareness and accessibility towards the program should be noticed by the student on campuses. Peer influence and social networks impact how young people are accepted the program also should be enhanced. Students are more likely to adopt food security programs if they believe their classmates are doing so [10].

Many colleges and universities have put in place food security programs to address the growing concerns that students have regarding food insecurity. These programs use a range of tactics to lessen the difficulties pupils have with their diets. Campus food pantries, meal assistance programs, and collaborations with regional food banks are examples of such projects. Campus food pantries are now an important part of efforts to ensure food security in educational institutions. These food banks give students a casual and convenient way to get nourishing meals. The study by [29] highlights the beneficial effects of such programs to fight food insecurity and enhance students' overall wellbeing. Furthermore, some institutions have created meal aid programs to give students access to restaurants, stipends, or meal vouchers. These initiatives aid in lowering the cost of buying food [24]. A Collaboration with neighborhood food banks also has been successful in locating and distributing food to students in need. To promote campus food security initiatives, these partnerships make use of local resources [19]. The effectiveness of these projects depends on identifying the elements that influence youth acceptability and participation in food security activities on campus. Thus, numerous studies must be conducted to investigate how students feel about these programs.

3 Theory and Methodology

3.1 Theory of Planned Behavior

One of the most important and widely used frameworks for understanding and predicting human behavior is the theory of planned behavior (TPB), first proposed by [4]. And then improved. According to the TPB framework, behavioral prediction is based on three key factors: behavioral attitudes, subjective norms, and perceived behavioral control [21]. These factors, highlighted by [34], serve as a channel connecting a person's attitudes and beliefs to specific behaviors. According to [2], behavioral beliefs are what an individual believes will happen if they perform a certain behavior and effectively influence their behavioral attitudes. On the other hand, the establishment of subjective norms is influenced by normative beliefs, including perceptions of social pressure and expectations [4]. According to [3], control beliefs also influence perceived behavioral control, which reflects an individual's evaluation of the external elements that help or hinder the execution of the desired behavior. These elements work together to create behavioral goals, often known as immediate behavioral antecedents [3]. TPB is a well-liked and essential instrument in the field because of its capacity to illuminate the intricate relationships between human ideas, attitudes, and behaviors, as highlighted by its cognitive precursor study and behavior prediction [26].

3.2 Research Methodology

In this study, students from public universities in Malaysia served as the unit of analysis and research design using convenience sampling to select participants, in line with the ideas proposed by [22]. Convenience sampling, as explained by [20] and [27], is particularly relevant for considering theoretical implications based on the conceptual framework. Because it is convenient to reach the target audience of public university students, this method is very suitable for the research context. Data collection was conducted using an online survey format, leveraging digital platforms to reach a broader pool of potential respondents. To increase the response rate, an innovative online outreach strategy was used, recruiting public university students to help distribute the questionnaire, thereby promoting community engagement.

In an effort to minimize potential common method (CMV) biases, several procedural solutions were thoughtfully implemented. This included providing a full description of the project in the questionnaire, stating the purpose and significance of the research, an approach suggested by [23]. Respondents were also reassured that their responses and personal information would be treated with the utmost confidentiality. Their participation was completely voluntary, and they were encouraged to give candid answers because the questions in the questionnaire did not involve any right or wrong answers. To facilitate nuanced data collection, a five-point Likert scale with different anchor points was used, as recommended by [15]. We use food bank initiatives as one of the food security program as our case study context.

Before data collection, considerate analysis based on [15] table was performed to determine the minimum sample size needed to achieve sufficient statistical power to model the relationships in the study. Study, as recommended by [16]. This analysis revealed that, with a mean effect size of 0.15 and a power level of 0.05, a minimum sample size of 76 was needed for all three predictors. Impressively, the study gathered 331 responses, far exceeding the required threshold. This high response rate ensures the reliability and robustness of the model, thus reinforcing the methodological rigor of the study.

4 Results and Discussion

4.1 Respondent Profile

The demographic profile of the study respondents, comprising a total of 331 university students representing local universities across Malaysia, is presented in Table 1. The participant pool reflects the composition diverse, with 49 (14.7%) male students and 282 (85.2%) female students. Student. Students, showing a notable gender distribution. Additionally, a sizeable majority of respondents, 68% of the sample, came from low-income households with monthly incomes of less than RM3,000. The study's complex nature, which involved numerous undergraduate students from various socioeconomic origins, is typified by the demographic variety. Table 1 shows the demographic profile of the respondents.

The study made use of SmartPLS software version 3.2.8, which is renowned for its capacity to manage intricate models containing latent variables, to carry out thorough data analysis. This programme was selected as an analytical tool because it is excellent at illuminating underlying structures and their intricate relationships. Notably, SmartPLS is particularly adept at handling data that deviates from a normal distribution, a feature that proved essential in this analysis.

Table 1. Demographic profile

	Demographic		Frequency	Percent
1	Gender	Male	49	14.7
		Female	282	85.2
2	Student Status	Have Parents	272	82.2
		Have Only Mother/Father	58	17.5
		Orphan	0	0
3	Family Income	Below RM1000	113	34.1
		RM1001-RM2000	113	34.1
		RM2001-RM3000	47	14.2
		RM3001-RM4000	19	5.7
		RM4001-RM5000	12	3.6
		RM5000 and above	27	8.2

As advised by [16], a normality test was meticulously performed before embarking on testing the measurement model. Additionally, Web-Power software was used to calculate multivariate skewness and kurtosis, providing valuable information. The results unveiled significant deviations from normality, as indicated by Mardia's multivariate skewness ($\beta = 10.308$, $p < 0.01$) and multivariate kurtosis ($\beta = 97.402$, $p < 0.01$). These findings underscored the presence of non-normality within the dataset, which holds considerable implications, particularly in the context of regression analysis facilitated by SmartPLS.

Given that this analysis involved the simultaneous collection of dependent and independent variables from the same individuals, the potential for common method variance (CMV) emerged as a concern, in line with [23] perspective. To address this issue rigorously, a statistical approach was employed. Drawing on the insights of [31], CMV becomes problematic if a significant proportion of the explained variation is concentrated in a single latent factor. Additionally, [12] suggested that CMV becomes a concern when more than 50% of the total variance is due to the first factor. To assess the extent of this bias, Harman's single-factor test, used by [16], was executed. The results of the unrotated factor analysis showed that only 27.33% of the variance was due to the first factor, thus confirming that CMV did not emerge as a significant problem in this study.

4.2 Assessment of the Measurement Model

In this study, the parsimonious analysis method known as the two-step method introduced by [5] played a central role in evaluating the measurement model and the structural model. This method entails methodically assessing the intricate connections between variables at two separate stages, each fulfilling a particular function. Above all, much consideration has been given to the measuring model. The relationship between specific items and the underlying concept they are meant to measure is the focus at this point. This stage makes sure the measurement model is reliable, precise, and able to accurately capture the latent variables it claims to represent. One of the key criteria used to assess a measurement model is convergent validity, which emphasizes the degree of agreement between numerous items measuring the same concept. Each component in the measuring model is unique from the others, and the requirements for discriminant validity were extensively validated. The analysis that followed was built on these critical evaluations.

The structural model is covered in more detail in the second stage of the two-step method. The investigation of the link between independent and dependent constructions is the primary objective here. This step delves deeper into fundamental presumptions and offers perception into the causal relationships between variables, illuminating the current research topics.

It must be emphasized that to guarantee the validity and reliability of subsequent studies, compliance with the measurement model's convergent and discriminant validity requirements is crucial. In conclusion, this two-step technique thoroughly assesses the study model, considering both its structural and measurement features, and so offers a firm foundation for making relevant inferences. Table 2 offers a thorough depiction of the constructs and their interactions in the study, as well as a visual representation of the measuring model.

Table 2. Convergent Validity

Construct	Items	Loading	AVE	CR
Attitude	A1 A2 A3 A4	0.881 0.884 0.859 0.664	0.684	0.895
Subjective norm	B1 B2 B3	0.838 0.870 0.826	0.507	0.804
	B4	0.858		
	B5	0.845		
Perceived behavioral control	C1 C2 C3	0.689 0.672 0.717	0.719	0.927
	C4	0.767		
On-Campus food bank program	FB1 FB2 FB3 FB4	0.720 0.822 0.796 0.588	0.543	0.824

Note: KTL3, KTL5, FB5 were deleted due to low loading

The study carefully analyzed the convergent validity and discriminant validity of the measurement model to thoroughly evaluate the validity. Convergent validity, an important element of structural validity, is used to assess how well different items measuring the same underlying construct fit together. To verify the convergent validity of each construct in the measurement model, multidimensional assessment was performed. This includes careful examination of loading values, composite reliability (CR), and average variance (AVE) for each construct.

Following the instructions outlined by [16], the study sought to achieve specific threshold values to ensure the presence of convergent validity. According to these criteria, loading and AVE values should exceed 0.5, indicating a significant degree of uniformity between building components. Additionally, the CR value must reach a minimum threshold of 0.7, emphasizing the internal consistency and reliability of the concept. Notably, as shown in Table 2, the loading, AVE, and CR values consistently exceeded these recommended benchmarks, reaffirming the robustness of convergent validity in each model. Recorded loading values ranged from 0.588 to 0.844, AVE values ranged from 0.507 to 0.719, and CR values ranged from 0.804 to 0.927. These results collectively highlight the achievement of convergent validity, that is, a high level of agreement between items measuring each construct.

Then, after satisfactorily meeting the criteria for convergent validity, the study diligently assessed discriminant validity. This review aims to verify whether each concept in the established model is clearly distinct from the others, confirming the uniqueness of each concept's contribution. Testing for discriminant validity was performed through the application of a correlation criterion known as the heterotrait-monotrait ratio (HTMT), a methodological approach proposed by [17], The results of this analysis convincingly demonstrate that each concept in the model retains its distinctness and does not overlap conceptually with other constructs. The HTMT score, as advised by [18], consistently fell below the threshold value of 0.90, as shown in Table 3. This compelling evidence supports meeting the specified criteria for discriminant validity, confirming robustness and distinctiveness of all constructs in the analytical framework. Ultimately, rigorous assessments of convergent and discriminant validity enhanced the reliability and trustworthiness of the model, thereby highlighting its suitability for the research objectives.

Table 3. Discriminant Validity

	Attitude	On-Campus Food Bank Program	Perceived Behavioral Control	Subjective Norm
Attitude				
On-Campus Food Bank Program	0.634			
Perceived Behavioral Control	0.216	0.412		
Subjective Norm	0.62	0.698	0.124	

Before delving into examining the structural model, the study conducted collinearity analysis to verify the absence of collinearity problems in the research model. Collinearity problems, according to [16], can significantly affect the reliability and interpretability of structural model results. Therefore, a careful assessment of collinearity was performed by examining the variance inflation factor (VIF) values for all independent variables in the research model.

Following the guidelines set forth by [16], the VIF values were thoroughly tested, with a predetermined threshold of 3.3 serving as a benchmark. VIF values beyond this threshold are suggestive of potential collinearity issues amongst predictor variables, which may impair model accuracy, according to [9]. It is positive that all VIF values for each variable in the research model fell below the set cutoff of 3.3, as revealed by the analysis's findings. This strong support for the absence of collinearity issues among the predictor variables improved the model's robustness and the accuracy of its structural assessments.

In conclusion, this collinearity study offers crucial reassurance regarding the validity and dependability of the structural model, assuring that a subsequent analysis of the connections and model assumptions would result in Without collinearity's deceptive effects, the data is correct and relevant.

4.3 Assessment of the Structural Model

After carefully evaluating the measurement model to ensure its validity and reliability, the study conducted path analysis, a fundamental step in evaluating the three hypotheses proposed. Path analysis involves a comprehensive examination of several key statistical indicators, including the direction of beta values, significance assessed by t and p values, and determination of confidence levels below (LL) and above (LL). UL). Time period, following the global approach proposed by [16].

To rigorously evaluate the direct effect postulated in the hypotheses, the study used a bootstrapping procedure consisting of 5,000 replications. Results are shown in Table 4. First, regarding H1, which posited that attitudes have a positive influence on campus food bank program adoption, the analysis produced convincing results. Specifically, the results indicate a significant relationship characterized by a positive beta value ($b = 0.228$), a t value of 4.094, and a narrow confidence interval ($LL = 0.114$, $UL = 0.334$), all of which reached a highly statistically significant level ($p < 0.001$). Therefore, H1 is strongly supported and accepted, confirming the positive impact of attitude on program implementation.

Turning to H2, which proposed that perceived behavioral control (PBC) positively influences campus food bank program adoption, path analysis showed promising results. The beta coefficient shows a positive trend ($b = 0.223$) and reaches a high level of statistical significance, evidenced by the t value of 4.972. Additionally, the confidence interval ($LL = 0.139$, $UL = 0.317$) further strengthens the significance of this relationship, with all indices strongly supporting the acceptance of H2 ($p < 0.001$). Finally, the analysis focuses on H3, which posits that subjective norms have a positive influence on campus food bank program adoption. The results yielded a surprising and statistically significant positive relationship ($b = 0.426$) supported by a t-value of 7.502. The LL and UL of the confidence interval ($LL = 0.314$, $UL = 0.526$) further highlight the strength and significance of this relationship, unequivocally supporting the acceptance of H3 ($p < 0.001$).

Essentially, the overall path analysis not only confirms the hypotheses but also illuminates the nature and strength of the relationships between key concepts, thereby providing valuable insight into the Factors influencing campus food bank program adoption.

Table 4. Hypothesis Testing

	Relationship	Std Beta	Std error	t value	p values	CI		VIF	Decision
						LL	UL		
H1	Attitude → FB	0.228	0.057	4.094	0.000	0.114	0.334	0.1.441	Supported
H2	Perceived Behavioral Control →FB	0.223	0.045	4.972	0.000	0.139	0.317	1.024	Supported
H3	Subjective Norm →FB	0.426	0.054	7.502	0.000	0.314	0.526	1.433	Supported

Note: LL=Lower Level, UP=upper level, FB=food bank program

As part of a comprehensive evaluation of the research model's performance, the study looked at two key aspects: coefficient of determination (R^2) and level of influence (f^2). These figures provide essential information about the explanatory power of the independent variables relative to the dependent variable, highlighting the variance revealed by the model and the magnitude of the relationships.

Importantly, the R^2 value is an important indicator of how much variation in the dependent variable, in this case food bank program adoption, can be explained by the independent variables. Including attitudes and subjective norms. And perceived behavioral control. As explained in Table 5, the R^2 value was determined to be 0.427. This value means that about 42.7% of the variation in endogenous variables can be due to the influence of independent variables in the research model. It highlights how crucial attitudes, arbitrary standards, and perceived behavioral control are in influencing how food bank programs are adopted.

In addition, the magnitude of the effect, denoted f^2, plays a central role in assessing the practical significance of the relationship between the independent and dependent variables. Following [8] guidelines, effect sizes were characterized as small if the f^2 value was 0.02, medium as 0.15, and large as 0.35. In the context of this study, attitude shows a small effect size with an f^2 of 0.063, perceived behavioral control (PBC) also shows a small effect size with an f^2 of 0.084, while Personality norms Subjectivity emerged as the most influential factor, with the average being effective. With f^2, the effect size was 0.221. These results emphasize the practical significance of these ideas in influencing the adoption of food bank programs and offer insightful information about each idea's individual contributions. In addition to these evaluations, the study also applied the headband technique, a statistical technique intended to examine the model's predictability and dependability. This method of [16], specifically applied to endogenous structures, evaluated the model's capability to correctly anticipate outcomes. The results of this blind analysis, presented in Table 5, demonstrate the predictive ability of the model. Notably, the Q^2 values of attitude (0.063), perceived behavioral control (0.084) and subjective norms (0.221) all exceeded the threshold of 0, confirming the model's suitability for predicting employment. Apply for food bank programs. This reinforces the value of the model and highlights its practical usefulness in predicting outcomes. In summary, the combination of R^2, effect size (f^2), and banding techniques not only provides a comprehensive assessment of the performance of the research model but also highlights the practical and predictive importance of It. Predict key concepts in the research context.

Table 5. Coefficient of determination (R^2), and effect size (f^2), and predictive relevance (Q^2)

Hypo	Relationship	R^2	f^2	Q^2
H1	Attitude ➜ FB	0.427	0.063 (small)	0.063
H2	Perceived Behavioral Control ➜ FB	0.427	0.084 (small)	0.084
H3	Subjective Norm ➜ FB	0.427	0.221 (medium)	0.221

5 Conclusion and Recommendation

Examining the underlying variables of attitudes, subjective norms, and perceived behavioral control connected to college students' adoption of food security programs was the major goal of this study. The study tries to add fresh perspectives and actual data to the discussion surrounding the implementation of food security programs, particularly when the Theory of Planned Behavior (TPB) is used as a guiding theoretical framework. The study's main objective was to clarify the interplay between attitudes, subjective standards, and perceived behavioral control in determining college students' propensity to use food security programs. The study's findings have the potential to add critical new dimensions to our knowledge of this crucial area.

The results of the study demonstrate a strong and positive relationship between the attitudes of college students and their use of food security programs. This supports the results of previous research and highlights the importance of encouraging positive attitudes toward food security initiatives. This point of view is corroborated by [1], which highlights the importance of having a positive outlook. The results of this study corroborate those of [30], who discovered that food insecurity can hinder learning and have a detrimental effect on academic achievement. These findings demonstrate the importance of developing a positive attitude toward food security initiatives since these initiatives are essential in meeting the dietary needs of college students. The study also discovered a significant and positive relationship between program uptake for food security and perceived behavioral control. This result supports the research by [33], which also affirmed the significance of food banks in relation to effective food management. Moreover, [32] demonstrates that this has a significant impact on the application of appropriate food management techniques, such as the availability of food banks on college campuses. These findings highlight the critical role that students' sense of behavioral control plays in enabling the adoption of food security initiatives. Essentially, the data indicates that students are more likely to participate in these programs when they believe they have influence over whether to use food banks.

This study contributes to the theoretical framework by relating predictions derived from the Theory of Planned Behavior (TPB) and emphasizing the importance of attitudes, subjective norms, and cognitions. By incorporating these variables into a multi-component model, this study emphasizes the importance of these factors in influencing students' decisions to participate in food security programs. We now have a better understanding of TPB's function within the framework of food security processes, which will be helpful for future studies in this area.

Apart from its theoretical implications, this research provides valuable insights that can guide efforts aimed at tackling food insecurity among college students. These results unequivocally demonstrate that campus food banks must engage in programs to fight student hunger. This highlights how important it is to consider both the larger social context and subjective norms when putting such programs into place, as social effects play a big role in influencing students' choices. The results highlight the significance of encouraging positive attitudes and elevating perceptions of behavioral control, as these elements foster student acceptance and active involvement in campus food bank initiatives. These programs, which are characterized by continuous and persistent labor, have the potential to significantly lessen the problems brought on by rising living standards and the financial constraints that students must overcome. To sum up, this research adds to our understanding of TPB in a theoretical and practical way for the creation of university student food security initiatives. Notwithstanding its limitations, this study offers a strong foundation for additional research on this crucial subject and acts as a spur for the creation of practical solutions to address food insecurity and enhance students' overall wellness on college campuses across the world. Additionally, it promotes more research on the topic of food security, particularly that which focuses on program effectiveness and the long-term effects of students' lives on food security practices.

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The Contribution of Work Passion in Work Intentions - An Exploratory Study of the Opinions of a Sample of Lecturers from the Departments of Engineering Faculties at Mosul University

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Abstract. objectives: The study's idea was chosen in order to evaluate the relationship between work passion and work intentions, its motives and consequences.

Methods: The study method is the survey method; the study tool is the questionnaire. Statistical processing was done through the use of statistical analysis program SPSS and Amos and the processor and measurement tools that were used are descriptive statistical analyzes, inferential statistical analyzes. The five-way Likert method was adopted in formulating the questionnaire questions.

Duration: from June 22 to July 1,2023, The contribution of work passion in work intentions questionnaire in order to explore the opinions of a sample of lecturers from the departments of engineering faculties at Mosul University.

Hypotheses: The H0 Hypothesis for this study was (work passion didn't effect on work intention), H1 Hypothesis was (The effect of work passion on work intentions).

Results: The null hypothesis is incorrect, and therefore the alternative hypothesis must be correct. Which means that there is a strong direct relationship between work passion and work intentions.

Keywords: work passion · work intentions · personal characteristics · job characteristics · organizational characteristics · job behavior · organizational behavior · career decision

1 Introduction

Recent studies on work passion have predominantly focused on its types and its relationship with external factors surrounding individuals. However, there has been limited exploration of work passion from an internal perspective. In light of this gap, we conducted an exploratory study to investigate the internal motives underlying work intentions. Drawing from appraisal theory, we evaluated the relationship between work

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passion and work intentions. The study employed a model that was applied practically to gather opinions from a random sample of lecturers at the engineering faculties of Mosel University. The findings of this study serve as a guiding framework for future research on work passion in the field of scientific research.

The paper consists of several sections. The introduction provides background information and research objectives. The theory and hypotheses section introduces the research hypotheses, discusses work passion, and its motives and consequences. The materials and methods section outlines the materials used and describes the data collection and analysis methods. The results section presents the study's findings, including demographic analysis, confirmatory factor analysis, simple linear correlation analysis, and simple linear regression analysis. The discussion section interprets the results, explores their theoretical implications, highlights practical contributions, acknowledges limitations, and suggests future research directions. The conclusion section summarizes the main findings, and the supplements section includes additional materials. Finally, the references section lists the cited sources.

2 Theory and Hypotheses

According to the previous studies there is an internal feeling that causes an external reaction. From this point of view, we have searched more about the work passion through this systematic, non-directed, and procedural study with the aim of identifying the passion for work and its relationship with work intentions. Recently, Drea Zigarmi, Fred J. Galloway, Taylor Peyton Roberts examined work passion literature through the lens of appraisal theory, then they adopted Zigarmi model.(Zigarmi, D., Nimon, K., Houson, D., Witt, D., and Diehl, J. 2009) in their study, they created The (EWPA) model " employee Work Passion Appraisal model", which confirms that the work passion depends on the evaluation of employees cognitively and emotionally, in addition to test work experience and its relationship to job well-being, and job intentions that result from that evaluation. The EWPA " employee Work Passion Appraisal model" model also lists environmental antecedents like organizational or job characteristics and personal antecedents e.g., employee beliefs, values, interests, or traits as a basis for understanding the formation of work passion. (Drea Zigarmi, Fred J. Galloway and Peyton Roberts Taylor 2016).

The Contribution of Work Passion in Work Intentions Model (CWPWI) as illustrated (see Fig. 1). it emphasizes how work passion contributes in forming work intentions.

There are two phases to the appraisal process. In the first phase, work passion as an independent variable, in the second phase work intention as a dependent variable. At the beginning this study assesses the motives for creating work passion, discussing personal characteristics, organizational characteristics and job characteristics. After that, this study assesses the consequences of work passion, discussing organizational behaviors (positive or negative), job behaviors (positive or negative), career decisions (leave, shift career, waiting for retirement, staying employed with burnout, continue). Hypothesis (see Fig. 2).

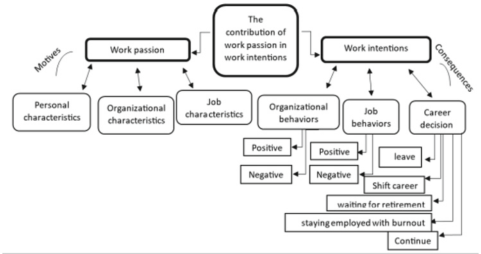
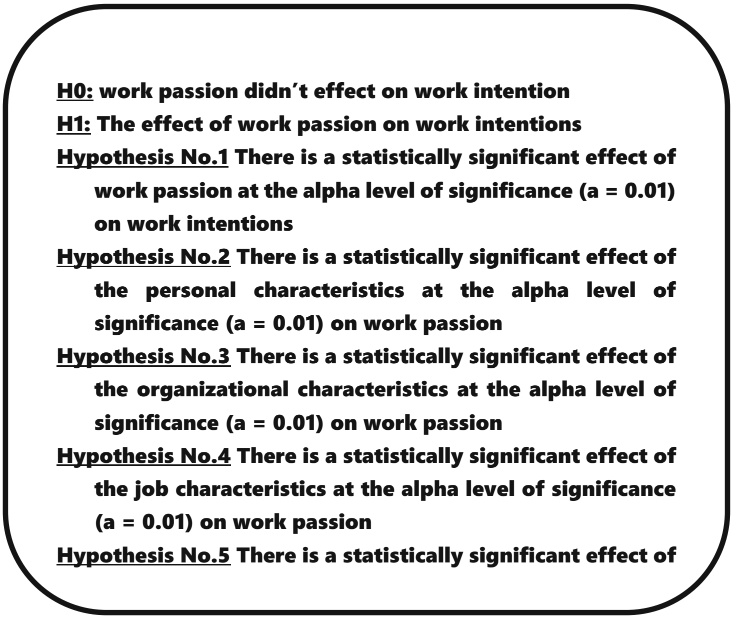

The contribution of work passion in work intentions
Work passion
Work intentions
Motives
Consequences
Personal characteristics
Organizational characteristics
Job characteristics
Organizational behaviors
Job behaviors
Career decision
Positive
Negative
Positive
Negative
leave
Shift career
waiting for retirement
staying employed with burnout
Continue

Fig. 1. The Contribution of Work Passion in Work Intentions Model (CWPWI)



H0: **work passion didn't effect on work intention**

H1: **The effect of work passion on work intentions**

Hypothesis No.1 **There is a statistically significant effect of work passion at the alpha level of significance (a = 0.01) on work intentions**

Hypothesis No.2 **There is a statistically significant effect of the personal characteristics at the alpha level of significance (a = 0.01) on work passion**

Hypothesis No.3 **There is a statistically significant effect of the organizational characteristics at the alpha level of significance (a = 0.01) on work passion**

Hypothesis No.4 **There is a statistically significant effect of the job characteristics at the alpha level of significance (a = 0.01) on work passion**

Hypothesis No.5 **There is a statistically significant effect of**

Fig. 2. The Hypothesis

3 Overview of Work Passion

Researchers have reached multiple scientific currents in explaining and clarifying what passion is. Jeffrey M. Pollack had classified passion into three categories 1) One-dimensional passion: General passion, which represents positive feelings towards one's work, like " I love my work". 2)Two-dimensional passion: Dualistic model, which divide passion into two inclinations, A: harmonious, like " "My work reflects the qualities I like about myself." B: obsessively, like "I have almost an obsessive feeling for my work.". 3)three-dimensional passion: Role-based passion, passion depends on the entrepreneurial role, which divide passion into three inclinations, A: developing passion.

B: founding passion. C: inventing passion. Like, “seeking for new service’s ideas.” (Jeffrey M. Pollack, Ernest H. O’Boyle. and Bradley L. Kirkman, Violet T. Ho. 2020.p.2,3). Hypothesis No. 1.

Work passion motives and consequences: (CWPWI) model divides the work passion motives into three categories, each category will be highlighted separately in the following lines.

3.1 Personal Characteristics

The researcher Zigarmi conducted a procedural study on 2,645 study samples. During this study, he reached the following results: After explaining, Zigarmi confirmed that there is a close correlation between the personal characteristics and motivational factors of the individual at work in terms of work passion as well as job intentions as shown in The Employee Work Passion Appraisal Model. (see Fig. 3), it proves there are two shapes of personal antecedents internal and external locus of control, which affected by controller and autonomous regulation and motivation, passion is affected by all of that, the result is two kinds of passion, it may be harmonious or obsessive, to show the relation between work passion and work intentions, the scientists mentioned five shapes of work intentions “ Intent to Use Discretionary Effort, Intent to Perform, Intent to Endorse, Intent to Stay and Intent to use OCB”. Thus, this The Employee Work Passion Appraisal Model proves that, there is a greater statistical significance in this model between the harmonious work passion emotionally and the five work intentions, greater than that between the obsessive work passion and the five work intentions. (Drea Zigarmi, Fred J. Galloway and Peyton Roberts Taylor 2016). Hypothesis No. 2.

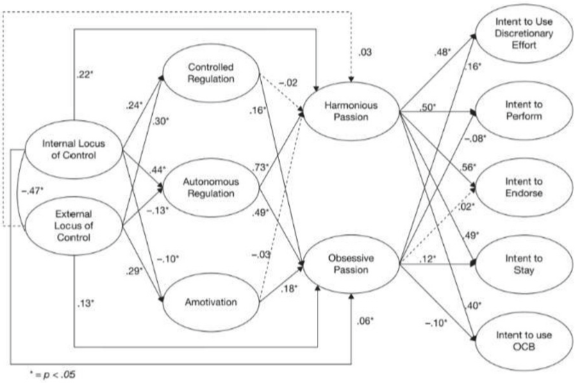

Intent to Use Discretionary Effort
Intent to Perform
Intent to Endorse
Intent to Stay
Intent to use OCB
Controlled Regulation
Autonomous Regulation
Amotivation
Internal Locus of Control
External Locus of Control
Harmonious Passion
Obsessive Passion
.22*
.03
.48*
.16*
−.02
.24*
.30*
.16*
.50*
−.08*
.44*
.73*
.56*
−.47*
−.13*
.49*
.02*
.49*
−.10*
−.03
.12*
.29*
.18*
.13*
.40*
.06*
−.10*
* = p < .05

Fig. 3. TEWPA Model “Results from the 2016 test of the employee work passion appraisal model, published in the Journal of Happiness Studien.2018”. N = 2,654

3.2 Organizational Characteristics

The organizational behavior of any organization is the main reason for its success (Oyewobi et al. 2016). The researchers confirm that organizations always seek to create a good work environment through organized positive action, which is based on setting a clear organizational vision with specific goals and tasks (Pook et al. 2017). The organizational characteristics of the organization such as the reward and promotion system, and etc. (Muhammad Farhan B. et al. 2022). The organizational characteristics: culture, organizational structure, reward and incentive and senior management support. (Abd Rahman Saida. et al. 2013).

Culture:

The organizational culture plays a crucial role in organizational performance (Hahn et al. 2013). It facilitates knowledge exchange and cooperation among employees (Eid and Nuhu, 2011), leading to improved outcomes. The CVF model. (See Fig. 4), depicted in Fig. 4, presents a framework that explores organizational culture from four dimensions: group culture, developmental culture, rational culture, and hierarchical culture (Eid and Nuhu, 2011).

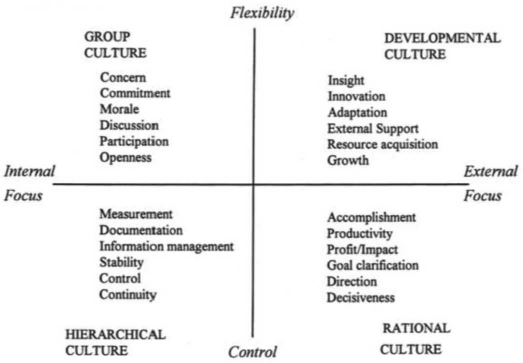

Flexibility
GROUP CULTURE
Concern
Commitment
Morale
Discussion
Participation
Openness
DEVELOPMENTAL CULTURE
Insight
Innovation
Adaptation
External Support
Resource acquisition
Growth
Internal Focus
External Focus
Measurement
Documentation
Information management
Stability
Control
Continuity
Accomplishment
Productivity
Profit/Impact
Goal clarification
Direction
Decisiveness
HIERARCHICAL CULTURE
Control
RATIONAL CULTURE

Fig. 4. The Organizational Culture Model) CVF. Model adapted from (Denison and Spreitzer 1991)

The model dealt with culture through two dimensions: the first dimension, flexibility and stability in cultural change, and the second dimension, an internal dimension within the institution itself or external outside the institution. (Denison D. R. et.al. 1991).

Organizational Structure:

KROM (see Fig. 5), Organizational Model developed the organizational structure of the organization, in which the model was divided into three sections. The first section is concerned with the framework of the organization. The second section deals with competencies and experience management. As for the third section, it is concerned with identifying the elements through which a description is made. The model links the three sections in order to achieve its objectives, when the company put its organizational structure in the best way including all these categories and elements, it would be better to the employee to like to work harder and to motivate the employee increasing his work passion. (Julian Gurdon, et al. 2015).

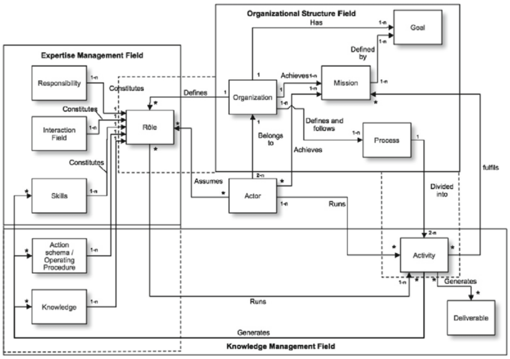

Organizational Structure Field
Has
Goal
Defined by
Achieves
Mission
Organization
Defines
Defines and follows
Belongs to
Achieves
Process
Expertise Management Field
Responsibility
Constitutes
Interaction Field
Rôle
Constitutes
Skills
Assumes
Actor
Runs
Divided into
fulfils
Action schema / Operating Procedure
Activity
Generates
Knowledge
Runs
Deliverable
Generates
Knowledge Management Field

Fig. 5. Organizational KROM-Based Model adapted from Julian Gurdon, et al. 2015

Reward and Incentive:
Incentives and rewards are a very important factor in working within any organization. (Wood et al. 1998). Both types have a very significant impact on the performance of the organization's work (Yu, Kim and Kim 2004).

Senior Management Support:
The researchers emphasized that the support of senior management (see Fig. 6), supports organizational knowledge and maintains the culture of knowledge in the organization in a positive way (Line 2007). In this regard, the following model is based on the support of senior management in order to be able to continue to provide support. The model explains the relationship between the four variables: It is a close interrelationship. (Albert Boonstra. 2013) working under successful senior management support motivates the employee to work comfortably. Hypothesis No. 3.

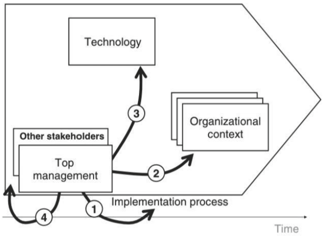

Technology
3
Organizational context
Other stakeholders
Top management
2
4
1
Implementation process
Time

Fig. 6. Senior Management Support Model adapted from Albert Boonstra 2013

3.3 Job Characteristics

The researchers developed a job characteristics model (see Fig. 7) that depends primarily on the human factor in order to preserve, maintain and develop it in the work organization. According to the model, workers feel job satisfaction and passion for work, and their effectiveness and internal motivation to work increases if they know that their work is useful or if they have knowledge of the results of their work. According to the model the test of personal reward and positive reinforcement is done when the employees are aware of the good performance in their task through knowledge of the results, and thus the employee feels the responsibility that he bears and it is a responsibility with worthwhile experience and these paths are reinforced through many job characteristics such as diversity of skills and feedback and independence and identity of the task and its importance. From what was previously mentioned in the model, we concluded that there are strong positive relationships between job characteristics (independent variables), job satisfaction, and internal motives (dependent variables). The internal motivation for work and general job satisfaction works, and the model confirmed that the relationship between these variables is a strong interactive correlation relationship. (Billy Boonzaier 2001).

Hypothesis No. 4 & Hypothesis No. 5.

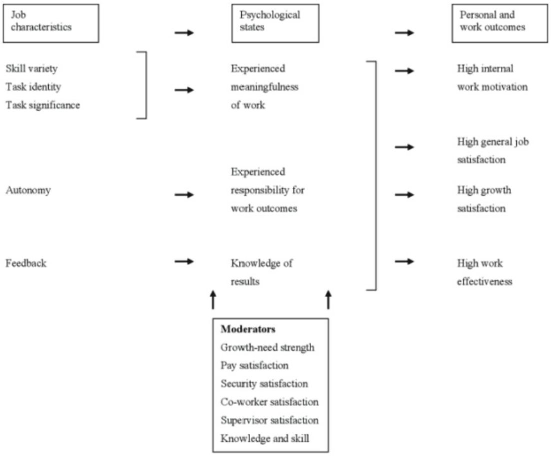

Job characteristics
Psychological states
Personal and work outcomes
Skill variety
Task identity
Task significance
Experienced meaningfulness of work
High internal work motivation
High general job satisfaction
Autonomy
Experienced responsibility for work outcomes
High growth satisfaction
Feedback
Knowledge of results
High work effectiveness
Moderators
Growth-need strength
Pay satisfaction
Security satisfaction
Co-worker satisfaction
Supervisor satisfaction
Knowledge and skill

Fig. 7. Job characteristics model adapted from (Billy Boonzaier 2001)

4 Materials and Methods

After determining the variables of the study, which is the independent variable work passion and the dependent variable work intentions, and determining the hypotheses of the study that have been mentioned above, the study population and the sample have been determined, provided that the field of study is a side of higher education institutions and the study community is some colleges of the Mosul University and the research sample will be a group of professors of engineering colleges in all its departments and the choice was random in order to maintain neutrality and impartiality, The reasons for choosing the sample are the importance of the university professors segment in terms of their work passion for career development and its relationship to their work intentions.

The study method is the survey method to access data through a survey of opinions in order to analyze, interpret and circulate them to benefit from them in the future for scientific purposes, the study tool is the questionnaire in order to collect data and analyze the results of the sample answers and access to the results and popularize them in order to achieve benefit from them in taking actions and recommendations. Statistical processing was done through the use of statistical analysis program SPSS and Amos and the processor and measurement tools that were used are descriptive statistical analyzes such as (frequencies, percentages, mean and standard deviation), inferential statistical analyzes such as (linear correlation and Simple linear regression). The five-way Likert method was adopted in formulating the questionnaire questions and an estimated balance was adopted according to the five-way Likert division scale, (mean 1:1.79 = public attitude strongly disagrees, mean 1.80:2.59 = public attitude disagrees, mean 2.60:3.39 = public attitude neutral, mean 3.40:4.19 = public attitude agrees, mean 4.20:5 = public attitude strongly agree).

The questionnaire was divided into five axes, the first axis (from v1:v5) is concerned with the demographic characteristics of the sample, while the second axis (from v6:v12) is concerned with the motives of work passion, the third axis (from v13:v16) is concerned with measuring work passion, the fourth axis (v17 and v18) is concerned with measuring the consequences of work passion, while the fifth and last axis (from v19:v21) is concerned with measuring job intentions and their relationship to work passion, the reliability statistics alpha = 94%, it means the questionnaire is honest and reliable.

Lecturers from the department of engineering faculties at Mosul University, participated in this exploratory study. Participants were recruited via an invitation to an online survey platform. A total of 45 lecturers (N = 45) completed the survey and were included in our final analysis. It was voluntary. Also, it was emphasized at the beginning of the questionnaire that we adhere to the ethical and professional provisions in not disclosing any private of confidential information. And that the questionnaire is for the purpose of scientific research only.

5 Measures

5.1 Work Passion Motives Measurements

We used 7-questions to measure the motivates of work passion, the 7-questions were rated on 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree) including, personality effects on work scale (Cronbach's Alpha = .92), organizational characteristics effect on work passion scale (Cronbach's Alpha = .95), job characteristics effects on work passion scale (Cronbach's Alpha = .97), work corresponds to practical inclinations scale (Cronbach's Alpha = .97), work in faculty effects on work passion scale (Cronbach's Alpha = .98), work enriches experiences scale (Cronbach's Alpha = .97), work reflects qualities scale (Cronbach's Alpha = .93).

5.2 Work Passion Measurements

We used 4-questions to measure work passion, the 4-questions were rated on 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree) including, can't control impulse to do work scale (Cronbach's Alpha = .98), work dominates mind most of the time scale (Cronbach's Alpha = .95), work increases enthusiasm scale (Cronbach's Alpha = .98), have passion for work scale (Cronbach's Alpha = .95).

5.3 Work Passion Consequences Measurements

We used 2-questions to measure the consequences of work passion, the 2-questions were rated on 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree) including, Work Passion affects positively on organizational behavior at work scale (Cronbach's Alpha = .97), Work Passion affects positively on job behavior at work scale (Cronbach's Alpha = .98).

5.4 Work Intentions Measurements

We used 3-questions to measure work intention, 2-questions were rated on 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree) including, the career decision scale comprises 5 dimensions (1 = leave, 2 = shift career, 3 = waiting for retirement, 4 = staying employed with burnout and 5 = continue), work in faculty effects on work intentions scale (Cronbach's Alpha = .99), work passion effects on work intentions scale (Cronbach's Alpha = .98), career decision scale (Cronbach's Alpha = .48).

6 Data Analysis

We used descriptive statistical analyzes such as frequencies, percentages, mean and standard deviation for analyzing the demographic axis, then we used the last statistical analyzes mentioned in addition to the analysis of average for mean and analyzed it to definite the public attitude to all the questions of the questionnaire. About inferential statistical analyzes we used the simple linear correlation to analyze the five hypotheses of the study, then we used the simple linear regression to analyze the first and main hypotheses of the study, then we used Amos program to analyze the relation between work passion and work intention.

7 Results

7.1 The Demographic Axis

Of the participants, 34(75.6%) were men (Cumulative Percent = 75.6%), 11(24.4%) were women (Cumulative Percent = 100.0%).

About age, 0(0,0%) were between 20–30 (Cumulative Percent = 0.0), 8(17.8%) were between 31–40 (Cumulative Percent = 17.8%), 21(46.7%) were between 41–50 (Cumulative Percent = 64.4%), 16(35.6%) were 51 and above (Cumulative Percent = 100.0%).

About department of the College of Engineering, 4(8.9%) were from Department of Civil Engineering (Cumulative Percent = 8.9%), 1(2.2%) were from Department of Electrical Engineering (Cumulative Percent = 11.1%), 14(31.1%) were from Department of Mechanical Engineering (Cumulative Percent = 42.2%), 2(4.4%) were from Department of Dams and Water Resources Engineering (Cumulative Percent = 46.7%), 10(22.2%) were from Department of Architecture Engineering (Cumulative Percent =

68.9%), 6(13.3%) were from Department of Computer Engineering (Cumulative Percent = 82.8%), 7(15.6%) were from Department of Mechatronics Engineering (Cumulative Percent = 97.8%), 1(2.2%) were from Department of Environmental Engineering (Cumulative Percent = 100.0%).

About academic degree, 9 (20.0%) were Assistant Lecturer (Cumulative Percent = 20.0%), 22 (48.9%) were Lecturer (Cumulative Percent = 68.9%), 12 (26.7%) were Assistant Professor (Cumulative Percent = 95.6%), 2 (4.4%) were Professor (Cumulative Percent = 100.0%).

About years of work experience, 3(6.7%) were between 0–5 (Cumulative Percent = 6.7%), 1(2.2%) were between 6–10 (Cumulative Percent = 8.9%), 4(8.9%) were between 11–15 (Cumulative Percent = 17.8%), 16(35.6%) were between 16–20 (Cumulative Percent = 53.3%), 10(22.2%) were between 21–25 (Cumulative Percent = 75.6%), 11(24.4%) were 26 and above (Cumulative Percent = 100.0%).

By extrapolating (Table 1), it is clear that the answers' mean of all questions of the axes (the motivates of passion) was between (3.9:4.1), the mean of the public attitude for the motivates of work passion = 4.041269841, which corresponds to the attitude (agree) in the estimated balance of the Likert five-point scale. The answers' mean of all questions of the axes (work passion) was between (3.9:4.1), the mean of the public attitude for work passion = 4.05, which corresponds to the attitude (agree) in the estimated balance of the Likert five-point scale. The answers' mean of all questions of the axes (consequences of work passion) was between (3.9:4.0), the mean of the public attitude for the consequences of work passion = 4, which corresponds to the attitude (agree) in the estimated balance of the Likert five-point scale. The answers' mean of all questions of the axes (work intentions) was between (3.9:4.0), the mean of the public attitude for work intentions = 3.977777778, which corresponds to the attitude (agree) in the estimated balance of the Likert five-point scale.

By extrapolating (Table 2) it is clear that the answers' mean of the question about the career decision was 4.711111111 which corresponds to the attitude (continue) in the estimated balance of the Likert five-point scale.

7.2 The Confirmatory Factor Analysis

The confirmatory factor analysis (see Fig. 8) was used was used in order to test the main questions of the questionnaire or the hypotheses of the study to measure the correlation coefficients between the hypotheses, and from the previous picture it is clear that the strong direct relationships between the hypotheses.

7.3 The Simple Liner Correlation Analysis

We have conducted a linear correlation analysis of the scientist Kendall's tau_b and Spearman's rho for the five research hypotheses that have been mentioned in the theoretical framework, the results were measured according to the Likert five scale ($R = 0$ = Non-existent, $0.00 < R < 0.25$ = weak, $0.26 < R < o.75$ = medium, $0.76 < R < 1$ = strong, $R = 1$ = complete) and through the analysis of the first hypothesis that was stating (There is a statistically significant effect of work passion at the alpha level of significance ($a = 0.01$) on work intentions) the result of the analysis was that the

Table 1. The frequencies, percentages, mean and standard deviation of career decision

Axes	Question	Strongly disagree	disagree	neutral	agree	strongly agree	mean	Std. Deviation	public attitude
motives	personality effects on my work	2(4.4%)	1(2.2%)	3(6.7%)	25(55.6)	14(31.1%)	4.06666667	0.939051746	agree
	Organizational characteristics effect on work passion	3(6.7%)	2(4.4%)	2(4.4%)	21(46.7%)	17(37.8%)	4.04444444	1.106911254	agree
	Job characteristics effects on work passion	2(4.4%)	3(6.7%)	2(4.4%)	23(51.1%)	15(33.3%)	4.02222222	1.033284456	agree
	My work corresponds to practical inclinations	4(8.9%)	1(2.2%)	2(4.4%)	23(51.1%)	15(33.3%)	3.97777778	1.137958477	agree
	My work in faculty effects on work passion	1(2.2%)	4(8.9%)	2(4.4%)	24(53.3%)	14(31.1%)	4.02222222	0.965045663	agree
	My work enriches experiences	3(6.7%)	2(4.4%)	2(4.4%)	21(46.7%)	17(37.8%)	4.04444444	1.106911254	agree
	My work reflects qualities	2(4.4%)	3(6.7%)	1(2.2%)	21(46.7%)	18(40.0%)	4.11111111	1.049290284	agree
	the public attitude for the motivates of work passion						4.041269841		agree
work passion	can't control impulse to do work	3(6.7%)	2(4.4%)	2(4.4%)	23(51.1%)	15(33.3%)	4	1.087114613	agree
	work dominates mind most of the time	1(2.2%)	3(6.7%)	3(6.7%)	20(44.4%)	18(40.0%)	4.13333333	0.967658843	agree
	work increases enthusiasm	4(8.9%)	1(2.2%)	2(4.4%)	23(51.1%)	15(33.3%)	3.97777778	1.137958477	agree
	I have passion for work	2(4.4%)	2(4.4%)	3(6.7%)	21(46.7%)	17(37.8%)	4.08888889	1.018515458	agree
	the public attitude for work passion						4.05		agree
consequences	Work Passion effects positively on organizational behavior at work	3(6.7%)	1(2.2%)	3(6.7%)	23(51.1%)	15(33.3%)	4.02222222	1.055050384	agree

(*continued*)

Table 1. (*continued*)

Axes	Question	Strongly disagree	disagree	neutral	agree	strongly agree	mean	Std. Deviation	public attitude
	Work Passion effects positively on job behavior at work	3(6.7%)	2(4.4%)	2(4.4%)	24(53.3%)	14(31.1%)	3.97777778	1.076376263	agree
	the public attitude for the consequences of work passion						4		agree
work intentions	work in faculty effects on work intentions	4(8.9%)	1(2.2%)	2(4.4%)	24(53.3%)	14(31.1%)	3.95555556	1.127256435	agree
	work passion effects on work intentions	4(8.9%)	1(2.2%)	2(4.4%)	22(48.9%)	16(35.6%)	4	1.148120995	agree
	the public attitude for work intentions						3.977777778		agree

Table 2. Frequencies, percentages, mean and standard deviation of career decision

Axes	question	leave	shift career	waiting for retirement	staying employed with burnout	continue	mean	Std. Deviation	public attitude
work intentions	career decision	0(0.0%)	0(0.0)	2(4.4%)	9(20.0%)	34(75.6%)	4.71111111	0.548643874	continue

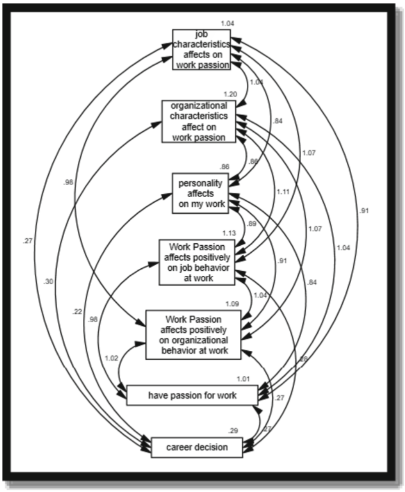

1.04
job characteristics affects on work passion
1.04
1.20
organizational characteristics affect on work passion
.84
1.07
.86
.86
personality affects on my work
1.11
.98
.91
.27
.89
1.07
1.13
Work Passion affects positively on job behavior at work
1.04
.91
.30
.84
1.04
1.09
.22
.98
Work Passion affects positively on organizational behavior at work
1.02
.28
1.01
have passion for work
.27
.29
.27
career decision

Fig. 8. The confirmatory factor analysis from AMOS program

equation of the correlation coefficient is (Kendall's tau_b: R = 0.901666, Spearman's rho: R = 0.914520) Which means according to the scale that the correlation is positive and strong at the alpha level of significance (a = 0.01,1-tailed). Through the analysis of the second hypothesis that was stating (There is a statistically significant effect of the personal characteristics at the alpha level of significance (a = 0.01) on work passion) the result of the analysis was that the equation of the correlation coefficient is (Kendall's tau_b: R = 0.880625, Spearman's rho: R = 0.898178) Which means according to the scale that the correlation is positive and strong at the alpha level of significance (a = 0.01,1-tailed). Through the analysis of the third hypothesis that was stating (There is a statistically significant effect of the organizational characteristics at the alpha level of significance (a = 0.01) on work passion) the result of the analysis was that the equation of the correlation coefficient is (Kendall's tau_b: R = 0.929577, Spearman's rho: R = 0.942386) Which means according to the scale that the correlation is positive and strong at the alpha level of significance (a = 0.01,1-tailed). Through the analysis of the fourth hypothesis that was stating (There is a statistically significant effect of the job characteristics at the alpha level of significance (a = 0.01) on work passion) the result of the analysis was that the equation of the correlation coefficient is (Kendall's tau_b: R = 0.862598, Spearman's rho: R = 0.886410) Which means according to the scale that the correlation is positive and strong at the alpha level of significance (a = 0.01,1-tailed). Through the analysis of the fifth hypothesis that was stating (There is a statistically significant effect of the work passion at the alpha level of significance (a = 0.01) on job behavior and organizational behavior) the result of the job behavior analysis was that the equation of the correlation coefficient is (Kendall's tau_b: R = 0.900683, Spearman's rho: R = 0.918766) Which means according to the scale that the correlation is positive and strong at the alpha level of significance (a = 0.01,1-tailed), the result of the organizational behavior analysis was that the equation of the correlation coefficient is (Kendall's tau_b: R = 0.940761, Spearman's rho: R = 0.945957) Which means according to the scale that the correlation is positive and strong at the alpha level of significance (a = 0.01,1-tailed).

7.4 The Simple Liner Regression Analysis

We have conducted a linear Regression analysis on the first and main hypothesis (There is a statistically significant effect of work passion at the alpha level of significance (a = 0.01) on work intentions), the result of the analysis:

By extrapolating (Table 3), it is clear that (Sig. = .000b) and it is lease than (0.01%) which mean that (H0 " work passion didn't effect on work intention" is refused) and (H1" The effect of work passion on work intentions" is accepted), as a result "There is a significant regression between the independent variable work passion and the dependent variable work intentions".

By extrapolating (Table 4), the equation of linear Regression analysis is (y = b0 + b1x) Substituting into the equation, The output is (y = -.300 + 1.052x), it means when work passion change by 1 percentage, work intention changes by 1.52 percentage.

Table 3. ANOVA test

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig
1	Regression	50.477	1	50.477	288.522	.000[b]
	Residual	7.523	43	.175		
	Total	58.000	44			

a. Dependent Variable: work passion effects on work intentions
b. Predictors: (Constant), have passion for work

Table 4. Coefficient's test. Dependent Variable: work passion effects on work intentions

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig
		B	Std. Error	Beta		
1	(Constant)	-.300-	.261		-1.150-	.256
	have passion for work	1.052	.062	.933	16.986	.000

Table 5. Estimates for Regression Weights from Amos model

v20 < --- v16	Estimate	S.E	C.R	P	Label
	1.052	.061	17.182	***	par_1

Table 6. Model Fit Summary of Amos model

Model	CMIN	DF	RMR	GFI	NFI (Delta1)	IFI(Delta2)	CFI	Chi-square
Default model	0.000	0.000	0.000	1.000	1.000	1.000	1.000	0.000

7.5 AMOS Analysis

The previous model (see Fig. 9), shows that whenever the independent variable work passion changes by the amount of (1.00), the dependent variable changes by the amount of (1.05), Which confirms the contribution of work passion at work intentions and confirms that the relationship between them is a strong direct relationship.

By extrapolating (Table 5), Estimate of regression weight when work passion goes up by 1, work intentions go up by 1.052. S.E. value: The regression weight estimate, 1.052, has a standard error of about .061.

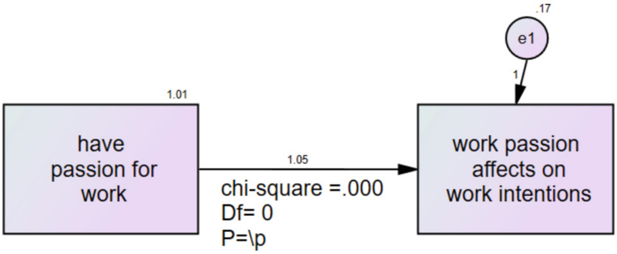


Fig. 9. The Amos model about the effect of work passion on work intentions

C.R. value: Dividing the regression weight estimate by the estimate of its standard error gives (z = 1.052/.061 = 17.182). In other words, the regression weight estimate is 17.182 standard errors above zero.

P. value: The probability of getting a critical ratio as large as 17.182 in absolute value is less than 0.001. In other words, the regression weight for work passion in the prediction of work intentions is significantly different from zero at the 0.001 level (two-tailed), (***) it means the model is perfect.

By extrapolating (Table 6) CMIN means the Default model has a discrepancy of 0.000 means the model is fit, df means (df = d = p-q = 0.000) which mean the model has 0 degrees of freedom, An RMR of zero indicates a perfect fit, GFI is less than or equal to 1. A value of 1 indicates a perfect fit, NFI means normed fit index = 1.000, IFI means incremental fit index = 1.000, CFI values close to 1 indicate a very good fit, because Chi-square = 0.000 RMSEA was not counted, through these results, all values indicate that the model of the relationship between work passion and work intentions is a verified, strong and very good model, and all indicators have a degree of strength.

8 Discussion

In this section,

we have collected the intellectual outcome of the current study, whose subject was chosen due to the importance of the impact of work passion on work intentions and the lack of research on the subject and semi-ignoring its scientific status. The main purpose of this.

study is to examine the psychological mechanism explaining why and how work passion are differentially associated with work intentions. The results showed that work passion was positively related to work intentions.

Based on the theoretical proposals within the various global and Arabian studies, it is clear that there is a lack of interest in the effect on the work passion on work. Although the traditional fundamentals and concepts of career passion are covered in a comprehensive, extensive and in-depth manner, the researcher did not find Arabic writings and research to support modern approaches to the study of the contribution of work passion at work intentions, there are a lot of scientists like Vallerand, R. J. (2008). Drea Zigarm, Fred J. Galloway and Peyton Roberts Taylor. Drea Zigarmi, Kim F. Nimon. (2009) Jeffrey M. Pollack, Ernest H. O’Boyle. and Bradley L. Kirkman, Violet T. Ho. (2020), cared about studying work passion and its relationship with work intentions, but all these studies weren't recent, not exhaustive of all aspects of the two variables.

The recent study dealt with the relationship between the two variables more deeply than other studies, as this study dealt with the outcomes of this relationship, which was not addressed by these studies, this study has dealt with the impact of functional passion on intentions in detail in all its aspects and motives, whether personally, practically or institutionally, as well as work intentions with all the influences that affect them from the culture and qualities of the institution and the reward system, incentives and personal qualities of the individual and on the other hand the study has studied the existence of a relationship between work passion and work intentions or not, and the extent of the impact that exists, and the products of this impact on work intentions, so this is the first comprehensive integrated study of the relationship between the two variables.

This section presents the findings of a study that examines the impact of work passion on work intentions. The study addresses the lack of research and insufficient attention given to this topic. Its main objective is to understand the psychological mechanism underlying the differential association between work passion and work intentions. The results indicate a positive relationship between work passion and work intentions.

While previous global and Arabian studies have extensively covered traditional concepts of career passion, there is a lack of Arabic literature supporting modern approaches to studying the contribution of work passion to work intentions. Although some researchers like Vallerand et al. (2008), Zigarmi et al. (2009), Pollack et al. (2020), and Kirkman et al. (2020) have explored work passion and its relation to work intentions, their studies are not recent and do not comprehensively cover all aspects of the variables.

In contrast, this recent study delves deeper into the relationship between work passion and work intentions, considering various personal, practical, and institutional factors. It examines the impact of functional passion on intentions in detail and explores the influences of culture, institutional qualities, reward systems, incentives, and individual traits on work intentions. Furthermore, the study investigates the existence and extent of the relationship between work passion and work intentions, as well as the resulting effects on work intentions. Overall, this study represents the first comprehensive and integrated examination of the relationship between these two variables.

8.1 Theoretical Implications

It is clear from the theoretical framing of the study, the diversity in the dimensions of the component of the functional passion, which is agreed upon by most researchers, that is what the researcher used in modeling the selected dimensions and arranging the contents of each dimension so that this study is the first comprehensive deep study, with a new scientific addition.

The theoretical framework of this study has divided the relationship into causes or motives and the relationship itself and then the results or consequences, as highlighted the work intentions with all its effects down to the career decision, which prostrates on all previous studies, where the researcher assumed the null hypothesis, which was that there is no relationship between work passion and work intentions and the development of the alternative hypothesis, which was the existence of the effect of work passion on work intentions, The results proved the alternative hypothesis and denied the null hypothesis, in addition to measuring the extent to which work passion affect work intentions, as well as measuring the career decision consequentially.

8.2 Practical Contributions

The practical implications according to our findings, organizations should be aware of the benefits of work passion, how to measure it between their employees, in order to treat any missing points, then measure the work intentions of their employees, to know what the employees decided to do in their work to male an alternative work plan to make sure that their work won't stop, work passion enhances work intentions through a lot of ways we mentioned above, organizations should care and develop employees' passion.

This study suggests the need for each organization to pay great attention to the work environment and its characteristics by creating a work environment that supports work passion and enriches the experiences of its employees in order to create positive and fruitful work intentions that develop from work in the company.

8.3 Limitations and Future Research Directions

The only shortcoming aspect of the study is the number of study samples, as it was only 45, but on the other hand, the sample was random due to the accuracy and impartiality of the research and to give the results high credibility.

The future research should pay great attention to researching the relationship between work passion and work intentions in other respects, for example by applying field research to another segment of non-lecturer employees and in another institution belonging to a sector other than the Ministry of Higher Education sector and in a country other than Iraq, or the sample may be from several countries and institutions.

9 Conclusion

In summary, this exploratory study conducted among lecturers in the engineering faculties at Mosul University has revealed the significant contribution of work passion to work intentions. The findings reject the null hypothesis, indicating a positive relationship between work passion and work intentions. Various factors, including personality traits, work characteristics, and organizational factors, were found to contribute to work passion.

While the study highlights the positive impact of work passion on organizational behavior, job behavior, and work intentions, it acknowledges certain limitations. The sample size was limited to a specific university and faculty, which may restrict the generalizability of the findings. Future research should aim to replicate the study with larger and more diverse samples for enhanced external validity.

Additionally, the study focused on the positive outcomes of work passion and did not explore potential negative effects or the downsides of excessive work passion. Future research could examine the boundary conditions of work passion and its potential negative consequences, such as burnout.

The implications of the study emphasize the importance of cultivating work passion among employees, as it positively influences work intentions. Organizations should consider implementing strategies and interventions that promote work passion, such as providing autonomy, skill development, and recognition. Managers and leaders play a crucial role in creating a work environment that fosters passion and supports employees' intrinsic motivation.

Overall, this study contributes to the understanding of work passion and its impact on work intentions. However, further research is necessary to expand upon these findings, address the study's limitations, and explore the broader implications of work passion in diverse settings and populations.

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Proposals for Improving Public Administration in the Field of Counterterrorism: A System-Cybernetic Approach

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Abstract. Based on the global approaches to the problem of terrorist threat, the state policy in this field should stipulate the introduction of a whole range of measures, which are primarily aimed at identifying and eliminating the causes and conditions that can lead to terrorism. Integration of Ukraine into the global security space leads to the need of improvement and adjustment the system of public administration in this area. The researches defined the role and tasks of public administration bodies in preventing and combating terrorism in Ukraine and proposed creating an effective system of calculating and evaluating terrorism in the context of globalization, European integration, expansion of democracy and civil society.

1 Introduction

The realities of today indicate that the fight against terrorism exist and will remain in the future. It is one of the main tasks of the state in the field of national security. Ukraine has a very favourable geographical position and has a large and extensive transport system, many technogenically hazardous facilities are located on its territory, including numerous chemical and other environmentally hazardous industries, and these are the points why the problem of terrorism is growing and spreading.

The fight against terrorism is one of the components of the Concept of National Security of Ukraine. It indicates national security as a field of protection of important interests of all individuals, society and the state from internal and external threats. It is a prerequisite for the preservation and enhancement of spiritual and material values.

It is one of the keys in the development of any society. This is due to the fact that the effectiveness of solving political, economic, social, legal, moral and ethical issues determines the stability of the state development and security of the nation.

A social system that is unable to ensure its own national security will always be on the verge of risk and will constantly suffer from certain internal and external factors.

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Therefore, prevention of terrorism is one of the components of the National Security Concept of Ukraine.

In the early 21-st century terrorism has become one of the greatest threats to international security. The processes of globalisation have led to the internationalisation of terrorism, transformation of its ideological and institutional base, significant expansion of forms and methods. Recent years, the world community has realised that terrorism is beginning to dominate such dangerous global threats as organized crime, drug trafficking, nuclear and environmental disasters.

Anyone or anything in the world can become a potential target of a terrorist attack. First of all, countries that are fighting terrorism, are actively involved in anti-terrorist measures, and are members of anti-terrorist associations. But those, that stand aside, are no less vulnerable.

Violence affects both highly developed and less developed countries of the civilised world. Almost all continents are covered by "metastases of terrorism", but humanity is most concerned about the emergence of preconditions for global terror. The wave of terrorist acts that has recently swept the planet has once again confirmed the well-known postulate that terrorism has no borders. In addition, it is becoming more obvious that the fight against terrorism is not a problem of any single state. This is because terrorists continue bloody atrocities in different parts of the world. That is why the scientific interest to the problem of terrorism will not diminish.

Taking into account the specifics of modern weapons (from the use of nuclear materials to information weapons) and modern technologies, even one terrorist act can cause global consequences. This is the scale of the problem that makes countries talk about terrorism as a global threat, a threat not only to national security, but also to international one. The XXI century will be the century not of total wars, but of molecular wars. It is the time of the fight against terrorism. Therefore, we have to adopt modern, advanced experience of other countries, participate in international programs, form our own view on the causes of this phenomenon and possible mechanisms of counteracting terrorist acts. This is due to the fact that terrorism is becoming the most common tool of resolving conflicts and putting under pressure the power structures of different states, and as a form of armed or informational struggle, even having an asymmetric nature, terrorism is the most effective form of not just resistance, but also modern warfare. As it has no clear front line, it is not subject to the rules of war or the Geneva Humanitarian Conventions [1].

2 Structure of the Article

1. Research objective
2. Discussion
3. Results
4. Conclusions
5. References

3 Research Objective

The purpose of the research is to improve and adjust public administration to prevent terrorism in Ukraine.

The objectives of the research are the following: to analyze Russia's increased use of terror against Ukraine; to indicate, starting from 2014 with the annexation of Ukrainian territories, and from February 24, 2022, that Russia uses terror as a method of warfare on the territory of Ukraine; to substantiate terrorogenic factors in the context of modern political and economic changes in Ukraine; to identify external factors that contribute the emergence and development of a conflict situation in society, which can lead to domestic terrorism; to develop a model of a conflict situation.

Object of research is terrorism as a socio-political phenomenon and public administration aspects of combating it.

Subject of research is theoretical and methodological foundations of substantiation of improvement and adjustment of public administration in the field of calculation and evaluation of terrorism in Ukraine.

Methodology. Structurally, the materials of the scientific research can be divided into the following parts: the problem statement; a brief analysis of the problem of improving public administration in the field of combating terrorism; allocation of internal and external factors that determine the emergence and development of a conflict situation in society, that is solved by terrorist tools; a model of a conflict situation in the form of a cybernetic system; the national system of calculation and evaluation terrorism.

In the scientific research, scientists implicated empirical (observation and comparison), complex (analysis and synthesis, induction and deduction) and theoretical (ascent from the abstract to the concrete and the general form of scientific cognition, the law of reflection of reality in thinking) methods of research.

4 Discussion

Researching the issue of improving public administration in the field of counterterrorism, it is impossible to avoid the topic of the Russian-Ukrainian war.

Eight years ago, February 2014, the Russian-Ukrainian war began. The Russian Federation, by violating the norms and principles of international law, bilateral and multilateral agreements, annexed the Autonomous Republic of Crimea and the sity Sevastopol, occupied certain areas of Donetsk and Luhansk regions. Today the Russian-Ukrainian war continues as the full-scale invasion.

Russia began to use terror against civilian Ukrainians in 2014, persecuting civilians in the occupied territories who neither resisted with weapons nor were loyal to the occupation administration. We are talking, for example, about the Euromaidan activists in Crimea, such as film director Oleg Sentsov, public figure Oleksandr Kolchenko, farmer Volodymyr Balukh, who were first tortured and then illegally sentenced to long prison terms on trumped-up cases. It is also about the deputy of Horlivka City Council Volodymyr Rybak or a juvenile football player Stepan Chubenko, who were first tortured and then killed in Donbas.

The most significant act of international terrorism on the part of Russia and the LDPR terrorist groups controlled by it before the full-scale invasion was the shooting down of the Malaysian airliner MH17. All passengers and crew members of the plane (298 people) were killed. According to the international commission's investigation, the airliner was shot down by a “Buk” anti-aircraft missile system belonging to the Kursk 53rd Air Defense Brigade, and two Russian army officers were directly involved in the crime. Despite the evidence published by several independent sources, Russia still does not admit its guilt in this act of international terrorism.

After the full-scale invasion of Ukraine February 24, 2022, Russia has only intensified the use of terror as a method of warfare. This includes terror through torture, murder, rape, forced displacement of the local population in the occupied territories, which also has signs of genocide. And systematic air and missile attacks on civilian objects. As a result of indiscriminate bombing Borodyanka in Kyiv region, Mariupol and other cities of Donbas were almost completely destroyed. Russia continues to destroy Mykolaiv. The victims of missile strikes were visitors of the shopping center in Kremenchuk, diagnostic center and other civilian institutions in the center of Vinnytsia, residents of residential areas of Kharkiv, Kyiv, Chernihiv, Mykolaiv, Odesa. All the destruction and suffering caused by Russia’s missile terror is difficult to calculate.

The murder on July 29 in Olenivka of at least 50 Ukrainian prisoners of war who had left Azovstal under security and exchange guarantees from the UN and the Red Cross, and the nuclear blackmail of the whole world using the Zaporizhzhia nuclear power station have become blatant evidence that Russia is a terrorist state [2, 8].

In April, the Verkhovna Rada of Ukraine officially recognized Russia as a terrorist state, which aims to commit genocide of the Ukrainian people and resorts to mass murders and crimes in Ukraine. And in May, the Seimas of Lithuania also declared Russia as a terrorist state.

But the term “terrorist state” is explained only by Ukrainian legislation (since May). The law defines it as a state “that openly, with the use of its own armed forces, other armed groups, or covertly, with the use of armed groups acting on behalf of and (or) in the interests of such a state, commits terrorist acts, acts of international terrorism”.

However, the international law does not have such a term and therefore there are no clear consequences of granting Russia the status of a “terrorist state”. Currently, this concept has a political rather than legal meaning, explains Oleksandr Merezhko, Chairman of the Verkhovna Rada Committee on Foreign Policy and Interparliamentary Cooperation. However, Ukraine is trying to change this and is lobbying for the emergence of an international convention that would consolidate the definition of “state terrorism” and “terrorist state” [3, 9].

Terrorism with its politically motivated violent ideology is a danger for the world community and individual states, including Ukraine. The main factors of terrorism in the current political and economic changes in Ukraine are the following: large-scale corruption in the state authorities, which has become systemic; general decline in the level of morality of social relations, especially among young people; legal nihilism; high crime rate; stratification of society and aggravation of confrontation, which made radicalization possible.

5 Results

The factors of domestic terrorism, which are divided into external and internal, occupy a special place (Fig. 1). The external factors of terrorism include the following factors: an increase in the number of terrorist manifestations in the near and far abroad; social and political as well as economic instability in the neighbouring countries of both the former USSR and Europe; strategic attitudes of some foreign intelligence services and foreign (international) anti-terrorist organisations; lack of reliable migration control in Ukraine and neighbouring countries; and the existence of a significant "black" arms on the market in some neighbouring countries.

Internal factors that cause manifestations of terrorism are: unfavorable social and economic situation in the state; a separation of region or regions; unbalanced national policy; disregard for the interests of national or religious minorities; infringement of their rights. The spread of terrorist manifestations is also facilitated by the presence of an illegal "arms" on the market in the country and the relative ease of its acquisition; the presence of a significant stratum of a person who have passed the ATO (JFO) and other "hot spots" and are not sufficiently socially adapted in a society in transition; weakening or complete absence of a number of administrative and controlling legal regimes; the presence of criminal groups with weapons and explosives; loss of ideological and spiritual life guidelines by many people.

Based on scientific research, the general set of factors that contribute to the emergence and development of a conflict situation in society, which is resolved, including by terrorist means, are:

- economic crisis;
- chronic political instability;
- destruction of historical, cultural, moral, humanitarian values;
- growth of nationalism, national intolerance, religious extremism and separatist sentiments;
- interest in destabilizing the situation on the part of other states, a number of foreign terrorist, religious, national radical and other organizations;
- negative processes in the social structure that led to the marginalization of numerous social groups;
- decrease of living standards, a state of psychological discomfort, anxiety and hopelessness, insecurity, which was felt by a significant part of the population;
- growth of social aggression.

The model of a conflict-inducing situation in the form of a cybernetic system – a control system with feedback – can be presented in the form of a scheme, Fig. 2, where it is indicated:

$\underline{X} = \{x_1, x_2, ..., x_i, ..., x_m\}$, where x_i – relevant factors of the conflict-inducing situation;

$\underline{Y}$ – the degree of conflict-inducing situation;

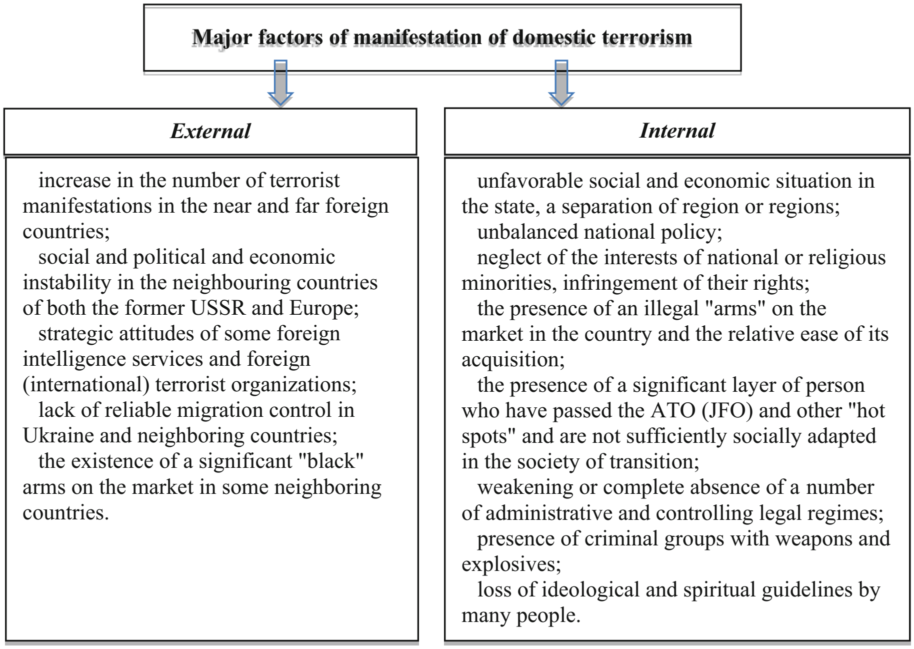
Π – stabilization (negative feedback) or destabilization (positive feedback) amplifier;

$\underline{\Psi}$ – stabilizing influence of management in the system;

$\underline{Z}$ – destabilizing impact on the system.

The level of consequences of the terrorist threat (Rz) can be estimated in the form of functional (1):

$$R_z = \sum_{i=1}^{n} k_i p_i, \tag{1}$$



Major factors of manifestation of domestic terrorism

External

increase in the number of terrorist manifestations in the near and far foreign countries;

social and political and economic instability in the neighbouring countries of both the former USSR and Europe;

strategic attitudes of some foreign intelligence services and foreign (international) terrorist organizations;

lack of reliable migration control in Ukraine and neighboring countries;

the existence of a significant "black" arms on the market in some neighboring countries.

Internal

unfavorable social and economic situation in the state, a separation of region or regions;

unbalanced national policy;

neglect of the interests of national or religious minorities, infringement of their rights;

the presence of an illegal "arms" on the market in the country and the relative ease of its acquisition;

the presence of a significant layer of person who have passed the ATO (JFO) and other "hot spots" and are not sufficiently socially adapted in the society of transition;

weakening or complete absence of a number of administrative and controlling legal regimes;

presence of criminal groups with weapons and explosives;

loss of ideological and spiritual guidelines by many people.

Fig. 1. Major factors of manifestation of domestic terrorism

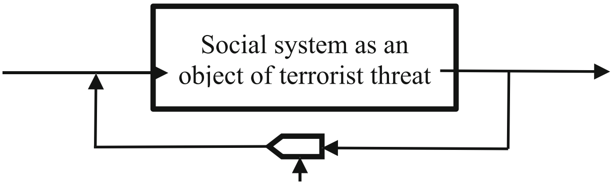


Fig. 2. Model (cybernetic system) of a conflict situation

where k_i – is the weighting factor of the degree of functional importance of the i-th component (state) of the system that is the object of the terrorist threat (attack);

p_i – probability of terrorist threat (attack) against the i-th component (state) of the system;

n – total number of components (states) of the system being evaluated.

The process of making a decision on the possibility of a terrorist threat, that is, in fact, a terrorist attack, can be characterized by information entropy based on the well-known formula of Claude Shannon [6]:

$$H = -\sum_{i=1}^{n} p_i \cdot \log_2 p_i. \tag{2}$$

Let us assume that in real conditions in the system (Fig. 2) there is no reliable information about the state of both the environment and the system itself. Then the conditional entropy of the system varies in the limit values from Hmin to Hmax, where and characterizes the deterministic system ($p_i = 1$),and Hmax characterizes the system without control ($p_1 = p_2 = \ldots = p_i = \frac{1}{n}$). Taking into account the Shannon formula (2) can be written:

$$0 < H(Y/X) < H(Y)_{\max} = \log_2 n. \tag{3}$$

According to the statistical theory of information, the ratio of maximum and conditional entropy is the value of mutual information $I(X, Y)$, and their numerical difference determines the amount of information [6, 7]:

$$I(X, Y) = H(Y)_{\max} - H(Y/X), \tag{4}$$

$$I(X, Y) = H(X) - H(X/Y). \tag{5}$$

Mutual information can be offered as an indicator of the quality of governance in the system.

From the comparison of expressions (4) and (5), the boundaries of the possibility of control in the system are determined

$$H(Y/X) = H(Y)_{\max} - H(X) + H(X/Y), \tag{6}$$

where entropy $H(X)$ depends on the stabilizing influence Ψ, and conditional entropy $H(X/Y)$ takes into account the destabilizing factor Z.

Thus, as a result of the Wiener-Ashby law of cybernetics, in order to improve the quality of management in the system, that is, to reduce the conditional entropy $H(Y/X)$, , it is necessary to look for ways to reduce the variety of vulnerable components (states) of the system $H(Y)$ and increase the variety of controlling (stabilizing) influences $H(X)$, as well as to actively identify and reduce destabilizing influences on the system, that is, to reduce the conditional entropy $H(X/Y)$, which is possible if there is reliable information about the states of the system in certain periods of time and factors of possible environmental impact.

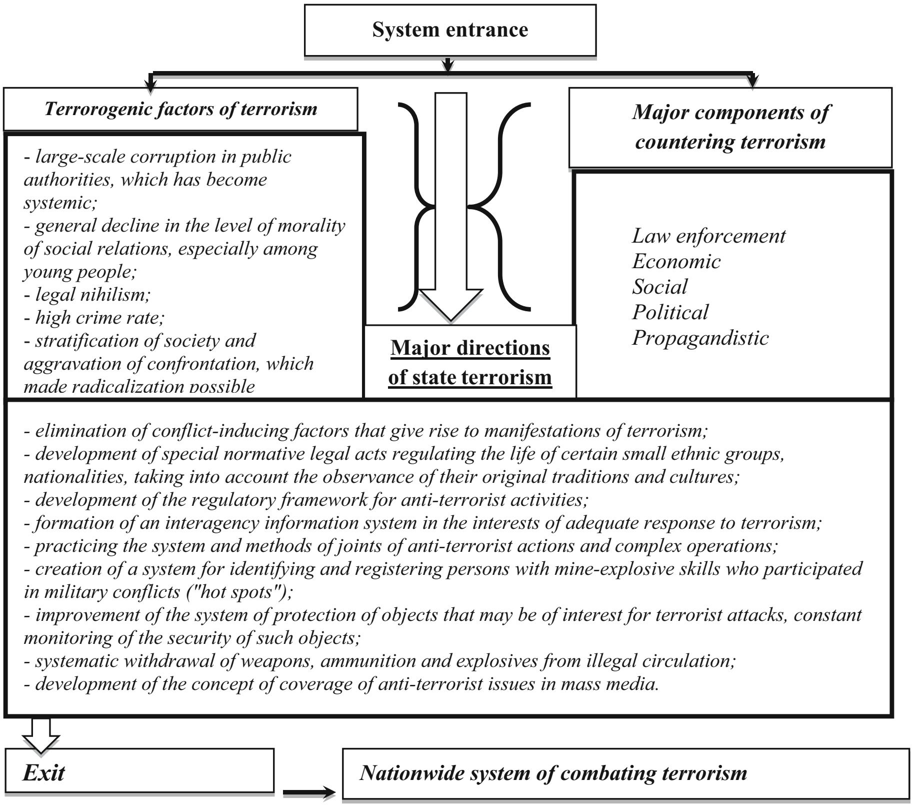
Therefore, taking into account the possible terrorist threats, it is advisable to substantiate the national system of calculation and evaluation of terrorism (Fig. 3). Such a system should include not only law enforcement, but also economic, social, political and propaganda components. Legislative and executive authorities, local self-government bodies, socio-political associations and public organizations, mass media and religious organizations should participate in the implementation of anti-corruption activities.

The major directions of the state counteraction to terrorism should be:

- elimination of conflict-inducing factors that give rise to manifestations of terrorism;
- development of special normative legal acts regulating the life of certain small ethnic groups, nationalities, taking into account the observance of their original traditions and cultures;
- development of the regulatory framework for anti-terrorist activities;
- formation of the system of interagency information in the interests of adequate response to terrorism;

- working out the system and methods of joints of anti-terrorist actions and complex operations;
- creation of a system for identifying and registering persons with mine-blasting skills who participated in military conflicts ("hot spots");
- improvement of the system of protection of objects that may be of interest for terrorist attacks, constant monitoring of the security of such objects;
- systematic withdrawal of weapons, ammunition and explosives from illicit trafficking;
- development of the concept of coverage of anti-terrorist issues in the media [4, 10].

Taking into account the above, it can be concluded that successful solution of the problem of combating terrorism only by means and tools of force is impossible.


System entrance
Terrorogenic factors of terrorism
Major components of countering terrorism
Law enforcement
Economic
Social
Political
Propagandistic
Major directions of state terrorism
Exit
Nationwide system of combating terrorism

- large-scale corruption in public authorities, which has become systemic;
- general decline in the level of morality of social relations, especially among young people;
- legal nihilism;
- high crime rate;
- stratification of society and aggravation of confrontation, which made radicalization possible

- elimination of conflict-inducing factors that give rise to manifestations of terrorism;
- development of special normative legal acts regulating the life of certain small ethnic groups, nationalities, taking into account the observance of their original traditions and cultures;
- development of the regulatory framework for anti-terrorist activities;
- formation of an interagency information system in the interests of adequate response to terrorism;
- practicing the system and methods of joints of anti-terrorist actions and complex operations;
- creation of a system for identifying and registering persons with mine-explosive skills who participated in military conflicts ("hot spots");
- improvement of the system of protection of objects that may be of interest for terrorist attacks, constant monitoring of the security of such objects;
- systematic withdrawal of weapons, ammunition and explosives from illegal circulation;
- development of the concept of coverage of anti-terrorist issues in mass media.

Fig. 3. Scheme of the national counter-terrorism system

This requires significant efforts from the state authorities to reduce the level of conflict and localize the medium of terrorism. Based on global approaches to the problem of terrorist threat, Ukraine's integration into the global security space leads to the need of reforming the public administration system.

Public administration reform is one of the major reforms in countries with economies in transition that are implementing comprehensive reforms in various areas of public policy. An effective public administration system is one of the main factors of the country's competitiveness. The effective activity of the Cabinet of Ministers of Ukraine in the development of state policy in various spheres is possible in the presence of a professional, efficient and effective system of central public administration. Reducing the administrative burden of state regulation, improving the quality of administrative services, ensuring the legality and predictability of administrative actions improves the position of the state in the world rankings of competitiveness. Furthermore, an effective public administration system is one of the main prerequisites for democratic governance based on the rule of law and legal system [5].

The authorized state authorities in the field of combating terrorism should direct their effords and forses to conduct active explanatory work among the population about the danger and unacceptability of terrorism; improve the legal framework in the field of combating terrorism; improve the material and technical support of the subjects of the fight against this negative phenomenon; increase the level of anti-terrorist protection of objects against possible terrorist attacks, as well as pay attention to ensuring social rehabilitation of people affected by terrorist attacks [11].

A prerequisite for calculation and evaluation terrorist threats is the formation of an effective state policy of calculation of terrorism, which requires the development of a clear national system of calculation of terrorism and strategy, basic principles, conceptual and regulatory framework, as well as determination of ways of their practical implementation. The state policy in the field of combating terrorism provides the implementation of a comprehensive set of measures aimed primarily at identifying and eliminating the causes and conditions that may lead to manifestations of terrorism. There is also a need to deepen cooperation between the authorized state authorities, local governments and the public, to develop international cooperation in the field of calculating such a negative phenomenon as terrorism. In general, this issue requires special attention of scientists to the issues of coordination of activities of all government agencies responsible for calculation and evaluation terrorist threats at the national level, creation of conditions in society for the consolidation of the public in solving the problems of modern Ukrainian society, the presence of which may lead to manifestations of terrorism.

The problem of combating terrorism in Ukraine is multidimensional, and its components have geopolitical, geostrategic, historical, global, general civilization, bureaucratic, functional social and economic, social and political, biological, technical, military and other dimensions. Therefore, a comprehensive solution of this problem should be based on a methodology that would allow to synthesize an effective system of counter-terrorism on a purely scientific basis.

This methodology is a necessary prerequisite for adequate reflection and consideration of the multidimensional nature of the concept of terrorism in the practical activities of the subjects of state administration in the fight against terrorism, as well as updating diverse knowledge in the field of social, natural, technical and military sciences into an organic unity in solving practical problems of this issue.

6 Conclusions

Thus, the following conclusions can be made:

1. Terrorism is a complex problem, which can be effectively calculated and evaluated only through the implementation of a system of economic, social, legal, informational and propaganda, operational and investigative, organizational and technical measures. These measures in the context of globalization should be implemented both at the national and interstate levels, within the framework of international cooperation.
2. Terrorist activity in today's world is an unacceptable crime for which due responsibility must be brought – no matter if the terrorists are a group of political or religious radicals or one of the largest countries in the world.
3. Counter-terrorism should be based on a balanced, consistent and systematic state policy of harmonization of social relations, timely elimination of contradictions and negative processes in the economic, social, social and psychological spheres of society.
4. The system of public administration should establish an understanding that the implementation of anti-terrorist activities by certain subjects of the fight against terrorism is a component of the state policy in this area, which should be comprehensive and addressed on the basis of systemic counteraction. One of its priority directions should be the improvement of preventive mechanisms aimed at eliminating the causes and conditions that generate terrorism.
5. Taking into account the European choice and European perspective, Ukraine needs to improve the public administration system. The state should continue political, social and economic, legislative and institutional reforms in accordance with European standards of good governance in the transformation of the public administration system, which will lead to Ukraine's integration into the global security space and increase the country's competitiveness.
6. Prospects for further research should be based on the results of the best practices of the countries of the European Union in the fight against terrorist activity, taking into account national characteristics and the possibilities of building Ukraine's sovereignty after the end of Russia's military aggression on its entire territory.

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Ecological and Economic Modelling of Balanced Use of Agricultural Waste

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Abstract. In 2020, Ukraine's gross value added increased by 1.6% compared to 2019. It should also be noted that the Ukrainian indicator of gross value added since 2019 is higher than in some European Union member states, in particular Hungary, Latvia, Lithuania and Estonia. Whereas in the EU, the main waste generating sectors are construction, mining and quarrying, industry, recycling and water supply services, etc. The share of waste recycling is up to 60.2% in 2020. At the same time, according to the results of the research, there is a decrease in the share of waste disposal by 21.3%. In other words, it contradictory that the EU countries have reached a level of development when the developed tools for the recycling of waste are able to ensure production growth in virtually all sectors of the economy without attracting additional resources and energy. As for the balanced development of the Ukrainian economy, the economy is mainly more resource-consuming. The developed model is adaptive and aimed at calculating the volume of each type of waste in all economic areas of production.

Keywords: production · resources · waste · recycling · treatment

1 Introduction

The ecological and economic modelling of the balanced development of the economy is considered as a system that should take into account the principles of active treatment of natural (organic) resources-waste, and hence, accordingly, the system "Ecology-Production-Resources" itself. Significant reserves for increasing the efficiency of the use of secondary resources and waste are hidden in the construction of new rational (optimal) schemes (projects, concepts, approaches) of implementation into production, and in general in the economy.

The main task is to use natural resources rationally and reduce the level of environmental pollution. The prospects for the balanced development of the economic sector can be implemented through the solving of the following problems: restructuring of the ecological and economic environment of the state on the basis of technical re-equipment of the economic complex of the national economy; the introduction of innovative scientific

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achievements, energy and resource-saving technologies, waste-free and environmentally friendly technological processes; the use of renewable energy sources and solving the problems of disposal and use of all types of waste, etc.

In terms of sustainable development of Ukraine, the main goals by 2030 are to overcome poverty, develop food security, improve nutrition and promote sustainable development by implementing a systematic approach to waste treatment at the national and regional levels, reducing waste production and intensify its recycling and reuse [1–3].

Under such conditions, the ecological and economic modelling of the balanced development of the Ukrainian economy should be a system that is based on the principle of active management of natural (organic) resources-waste, and hence, accordingly, the system of "Ecology-Production-Resources". Since significant reserves for increasing the efficiency of secondary resources and waste use are hidden in the construction of new rational (optimal) schemes (projects, concepts, approaches) for their implementation in production, and in general in the economy.

Structure of the Article

1. Research objective
2. Discussion
3. Results
4. Conclusions
5. References

2 Research Objective

The aim of the research is to substantiate the methodological aspects and practical recommendations for ecological and economic modelling of balanced development of the Ukrainian economy.

Research tasks:

- to conduct a comparative analysis of the processes of waste production and reuse of it in Ukraine and the EU;
- determine their division by types and analyze the tools for their treatment;
- to determine the impact of capital expenditures on waste treatment and the amount of waste and polluters released into the environment;
- to investigate the tools of recycling of the waste in the EU and develop spheres and directions of its application in the sectors of national economy;
- to substantiate the "Ecology-Production-Resources" model, which will allow planning the volumes of waste production by types of economic activity and developing a long-term action plan for their disposal in various ways.

Methodology. To conduct a scientific research and achieve the goals of this research, analyze general and special methods of exploration including:

- analytical method (for the analysis of theoretical and methodological aspects of the formation and use of waste as recycling resources);

- methods of analysis and synthesis (to test the hypothesis of this research);
- abstraction method (in the process of research of waste treatment toolkit);
- induction and deduction methods (to determine the impact of waste production, disposal and use of funds for waste treatment);
- graphical method (for interpreting the results of the research on the formation and feasibility of waste reusing as a recycling resource);
- method of mathematical and computer modelling (study of certain real processes in the system “Ecology-Production-Resources”);
- methods of systematization, grouping and logical generalization (for processing information, forming conclusions and scientific proposals).

3 Discussion

In the second half of the 20th century, the quandary surrounding the accretion and reutilization of refuse as supplementary material reservoirs has progressively assumed paramount precedence within the realm of global scholarship, emerging as an incontrovertibly consequential facet of the milieu of equitable economic advancement.

Even Karl Marx proved the result of social labor is “waste”, which again becomes new elements of production” [4, p. 320]. The authors underscored the significance of waste recycling as an inventory of finite production resources and emphasized the augmentation of economic efficiency in its utilization. Concurrently, this research refrained from addressing the issue of waste accumulation and its environmental storage.

Rachel Carson, in her publication “Silent Spring” (1962) pointed out the appearance of man on the stage of history cancels the problem of balance in nature. It means that the equilibrium observed in nature derives from the intrinsic interdependencies inherent within the living biosphere and its intricate entwinement with the surrounding environment. This principle does not negate humanity’s pursuit of advancing its interests; however, it underscores the imperative for mankind to act judiciously, with unwavering cognizance of both the actions to undertake and the repercussions they may entail [5]. She also elucidates the conundrum concerning the nexus between economic expansion in the generation of societal commodities and the concomitant degradation of the environment.

Boulding (1966) expounded upon the imperatives of adopting an economic framework for comprehending the ecological system, characterized by its finite resource pool [6]. He conceded the presence of material and energy constraints within the economic sphere, advocating for a shift from the paradigm of the “cowboy economy” to that of the “spaceman economy”.‘ Under the aegis of the “cowboy economy”, success hinged upon metrics centered on the quantity and celerity of production and consumption. In the “spaceman economy”, on the contrary, “we are primarily concerned with maintaining life support, so that any technological change that leads to the ability to maintain a given general level of life support with a decreased flow of resources (i.e. with less production and consumption) is obviously a benefit”.

Herman Daly presents a formidable challenge to the field of economics, contending that it predominantly adheres to neoclassical doctrines, failing to account for the constraints imposed by the biosphere’s limited capacity to sustain economic processes, which teeter on the precipice of natural resource exhaustion. Consequently, an adequate appraisal of their efficiency, whether at the local or global level, remains elusive [7, p. 6]. H. Daly delineated the trajectories for further harnessing waste recycling as an ancillary resource. Nonetheless, the exigency to devise pragmatic instruments, applicable at the level of individual economic entities, for the realization of waste-free production and the attainment of tangible outcomes from such endeavours became manifest.

The response to this challenge, in 1997, was provided by scientists E. Weizsäcker, E. Lovins, L. Lovins in the work "Factor Four: Doubling Wealth, Halving Resource Use". Their work is founded on the concept of "resource productivity", as elucidated by the authors. They characterize this concept as the capacity to achieve double efficiency while simultaneously expending only half the resources. Thereby, substantiating the assertion that it is conceivable to quadruple productivity, hence the title of their book [8]. In subsequent researches, these scholars contend the majority of technical solutions for waste recycling already exist, yet they languish as untapped prospects for both economic and environmental progress [9].

Walter Stahel's research, as outlined in "The Performance Economy" (2010), furnishes compelling substantiation of augmented material production within industrial systems committed to waste reduction through the recycling of waste into biomass [10].

The challenges pertaining to the accumulation of waste and its incorporation as biomass within the national economy are addressed through the enactment of legislation and the practical application of scientific advancements [20].

Nowadays in Ukraine waste management is governed by the Law of Ukraine "On Waste", the State Waste Classifier, State Standards, and other related regulations. Notably, the Law of Ukraine "On Waste" primarily addresses the legal obligations and responsibilities of waste producers in relation to waste management. However, these legal documents do not comprehensively encompass the environmental and economic dimensions associated with the utilization of waste as biomass [11].

DSTU 2195-99 (National Standard of Ukraine) establishes waste within the environment is primarily regarded as a form of pollution, occupying a defined spatial dimension and exerting adverse effects on both living organisms and inanimate entities. Additionally, it recognizes waste as secondary material and energy resources that can be potentially utilized either immediately upon generation or following appropriate processing [12]. Concurrently, emphasis is placed on harnessing waste as an alternative reservoir for the production of material goods and energy, thereby underscoring its potential for resourceful utilization.

Utilization of biomass as a biofuel gives rise to justifiable apprehensions regarding the potential diminution of food production and concurrent environmental degradation, manifesting as soil desiccation.

I. Grabchuk, I. Petrunenko, T. Vlasenko, E. Petrova, and L. Strikha in their research "Ensuring the Food Security of European Union Member States within the Framework of Sustainable Development" (2021) reveal a landscape characterized by a multifaceted array of challenges pertaining to the European Union's policy framework. These challenges manifest particularly in the domain of sustainable development objectives concerning food security [13].

O. Ivanenko, V. Bugaychuk, S. Belei, N. Grynchuk, T. Kulinich "Financial equalization of territorial development of eastern European countries and its impact on quality of life" (2021) delineated a pivotal facet within the financial policy paradigm of European Union (EU) member states. It underscores the allocation of fiscal resources earmarked for multifarious objectives encompassing economic, environmental, technical, technological, and social domains.

This conspicuous divergence contributes substantively to the fostering of innovative technologies within the realm of waste recycling, notably exemplified in the burgeoning domain of biotechnologies applied in agricultural production. The deployment of these biotechnologies not only underpins the optimization of resource utilization but also manifests through an amplified agricultural output per unit of resource consumption, concurrently enhancing profitability within the agricultural sector [14, 19].

Thus, contemporary civilization attained a state of advancement wherein the expansion of production across all economic sectors can occur with a level of resource and energy efficiency that virtually obviates the need for supplementary inputs. This confluence of factors engenders the requisite conditions and prospects for the comprehensive recycling of accrued waste materials.

4 Results

In 2020, the total amount of waste generated in the EU by all economic activities and households was 2 151 million tonnes or 4 808 kg per capita. Table 1 provides an analysis of data on the generation and treatment of waste in the European Union (EU). The analysis is based solely on data collected in accordance with the European Parliament and Council Regulation (EU) No 2150/2002 on waste statistics.

Table 1. Waste generation by economic activities and households in 2020 (% of total waste)

	Mining and quarrying	Manufacturing	Energy	Waste/water	Construction and demolition	Other economic activities	Households
EU	**23.4**	**10.9**	**2.3**	**10.7**	**37.1**	**6.0**	**9.5**
Belgium	0.0	20.9	1.5	31.4	30.5	7.9	7.8
Bulgaria	81.6	4.2	5.2	2.9	1.6	2.5	2.0
Czechia	0.3	12.1	1.1	15.5	42.9	12.2	15.9
Denmark	0.1	5.4	3.9	7.5	54.8	10.3	18.0
Germany	1.3	13.7	20	12.0	56.3	5.1	9.6
Estonia	15.2	24.6	35.0	4.6	9.8	7.4	3.4
Ireland	14.2	24.7	1.1	10.7	13.6	24.4	11.4
Greece	36.6	17.8	6.1	13.2	1.1	7.3	18.0
Spain	2.3	12.5	0.7	20.3	30.7	11.5	22.0
France	0.1	7.1	0.4	8.0	67.6	6.3	10.7
Croatia	11.6	7.5	1.1	16.3	23.8	19.5	20.2

(*continued*)

Table 1. (*continued*)

	Mining and quarrying	Manufacturing	Energy	Waste/water	Construction and demolition	Other economic activities	Households
Italy	0.8	15.2	0.9	24.6	37.8	4.1	16.6
Cyprus	6.9	9.5	0.1	6.5	50.2	9.8	17.0
Latvia	0.0	17.0	41	33.7	9.7	12.9	22.6
Lithuania	1.0	32.7	2.3	18.4	8.3	16.3	20.9
Luxembourg	1.1	6.5	0.3	3.5	82.1	4.2	2.2
Hungary	0.8	15.8	11.2	9.8	27.1	6.1	29.1
Malta	1.3	1.0	0.0	2.9	82.7	5.5	6.5
Netherlands	0.1	10.6	0.4	7.4	65.4	8.7	7.4
Austria	0.1	7.5	0.6	3.5	76.5	5.2	6.7
Poland	36.6	16.1	6.6	13.4	13.0	6.6	7.8
Portugal	0.1	17.8	1.3	22.9	10.7	15.4	31.8
Romania	84.3	4.6	3.1	2.0	0.9	2.2	3.0
Slovenia	0.1	17.9	12.1	3.8	6.3	51.4	8.4
Slovakia	1.6	24.0	5.5	8.9	9.0	32.5	18.5
Finland	75.1	8.2	0.8	10	11.8	1.0	2.1
Sweden	76.5	3.1	1.2	4.5	9.3	2.3	3.1

The distribution of waste generation among various economic sectors and households in the year 2020 is illustrated in Fig. 1. Within the European Union (EU), the construction sector held the largest share, contributing to 37.1% of the total waste generated in that year. Subsequently, the mining and quarrying sector followed with a share of 23.4%, while the manufacturing sector contributed 10.9%. The domains of waste recycling and water services collectively accounted for 10.7%, with households contributing 9.5% to the overall waste generation. The remaining 8.4% was attributed to waste generated by other economic activities, with services comprising the majority at 4.5%, followed by the energy sector at 2.3%.

In 2020, the European Union (EU) processed approximately 2,029 million tons of waste, as depicted in Fig. 1. It is noteworthy that this figure encompasses waste treatment within the EU, inclusive of both domestically generated waste and imported waste subjected to treatment within EU borders.

The represented figures illustrate the percentage of total waste subjected to treatment within the EU. The volume of recycled, landfilled, or incinerated waste with energy recovery exhibited a notable uptick of 40.3% from 870 million tons in 2004 to 1,221 million tons in 2020. Consequently, the proportion of recycling within the overall volume of treated waste escalated from 45.9% in 2004 to 60.2% in 2020. In accordance with the findings presented in Fig. 2, there has been a concurrent decline of 21.3%. Furthermore, the share of landfilling within the ambit of total waste treatment shifted from 54.1% in 2004 to 39.8% in 2020.

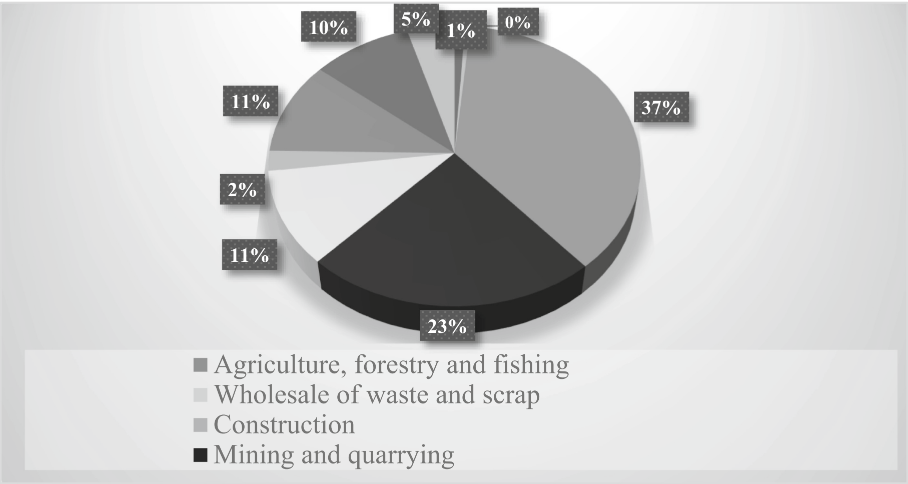

Fig. 1. Waste generation by economic activity and households, EU, 2020 (% of total waste)

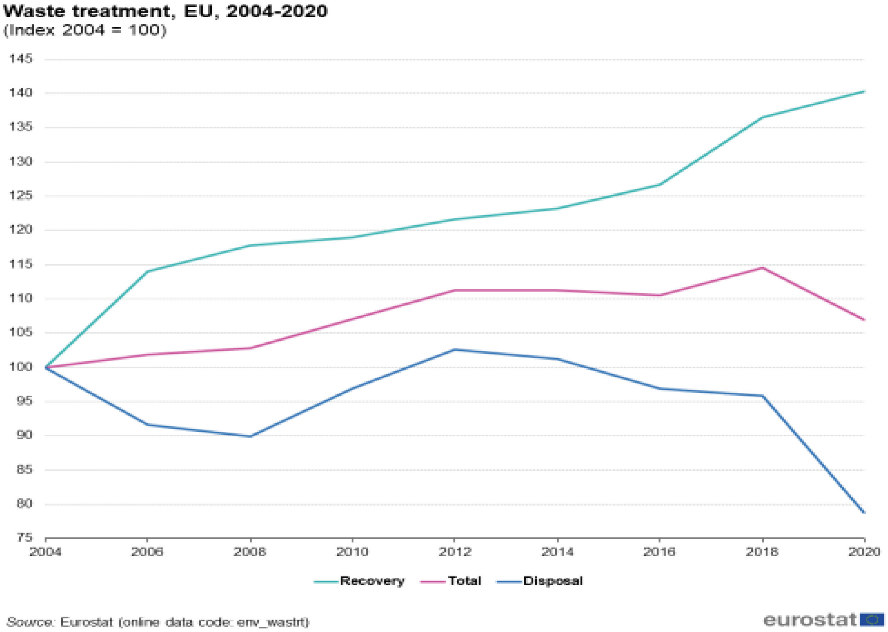

Fig. 2. Waste recycling, EU, 2004–2020 (index 2004 = 100)

As mentioned above, more than half, to be exact (60.2%) of the waste in the EU in 2020 was treated by means of recycling: recycling accounted for 39.2% of the total amount of waste treated; landfill – 14.6%; energy recovery – 6.4%. The remaining 31.3%

was buried, 0.5% was incinerated without energy recovery and 8.1% was disposed of in another way.

Significant differences in the use of waste disposal methods can be observed between EU Member States. For example, some of the member states had very high recycling rates, namely: Italy, Belgium, Slovakia and Latvia. In other countries landfills are the predominant treatment category. Such countries include Romania, Bulgaria, Finland, Sweden and Greece.

During 2005–2020, the amount of waste in all types of economic activity in Ukraine also increased (Table 2). Annual waste generation averages up to 17 million tons. In 2020, compared to 2005, their flow into the environment increased by 231.18 million tons or almost exactly 2 times. Ukraine ranks ninth among the countries with the largest amount of waste per capita. The annual amount of waste per person in 2019 is 10.6 tons.

The increase in the mass of waste has not always been accompanied by an increase in production. At the same time, 50.51% of the total mass of waste generated is utilized and a small share is burned for energy production, and half is stored in the environment.

Figure 3 illustrates the implementation of waste treatment expenditures in the period 2015–2020.

According to the figures, during 2015–2020, waste treatment costs were growing, but their increase in 2020 by UAH 6.6 million is insignificant. According to the Law of Ukraine "On the State Budget for 2022", a total of 0.2% of Ukraine's GDP is planned to be spent on nature protection, while EU member states spent almost 2% of GDP on environmental protection in 2021.

The main strategic direction of Ukraine in the direction of effective waste treatment should be the development of the "Ecology-Production-Resources" model, which will allow to plan the volumes of waste generation by types of economic activity and develop a long-term action plan for their disposal in various ways.

In the suggested researcher's mathematical model, the dynamics of ecological and economic processes in the system "Ecology - Production - Resources" can be described by a nonlinear inhomogeneous differential equation of the first order, which takes into account the procedure of waste recycling in the production process and significantly increases the efficiency of the system under consideration.

Therefore, taking as a basis the nonlinear model of production dynamics [1, 2], which takes into account the stages of formation of the production process and active growth, within which the maximum dynamics is observed, as well as the mechanism of saturation of production, Eq. (1)

$$\frac{dy(t)}{dt} = k_y(t)\, y(t) \left[y_{\max} - y(t)\right], \tag{1}$$

then the mathematical ecological and economic model of the dynamics of the production process, taking into account recycling, is represented as Eq. (2):

$$\frac{dy_w(t)}{dt} = k_y(t)\, y(t) \left[y_{\max} - y(t)\right] + Rw(t), \tag{2}$$

where $y(t),\ y_w(t)$ – normalized functions that describe the production process without and with the "resource-waste" function;

Table 2. Waste generation in Ukraine by types of economic activity, 2005–2020 million tons

Type of economic activity	2005	2010	2015	2016	2017	2018	2019	2020	2020 / 2019 +, −
Waste generated, total	**231,19**	**422,55**	**312,27**	**295,87**	**366,05**	**352,33**	**441,5**	**462,37**	**20,87**
including: agriculture, forestry and fisheries	2,59	8,30	8,74	8,71	6,19	5,97	6,75	5,32	−1,43
mining and quarrying industry	161,82	347,44	257,86	237,46	313,74	301,45	390,56	391,08	0,52
manufacturing industry	54,80	47,68	31,00	34,09	32,18	31,52	30,75	52,31	21,56
supply of electricity, gas, steam and conditioned air	8,11	8,64	6,60	7,51	6,19	6,32	5,96	5,33	−0,63
construction	0,20	0,33	0,38	0,30	0,49	0,38	0,19	0,014	0,176
other types of economic activity	3,67	3,80	1,64	1,44	1,41	1,15	1,41	2,37	
Amount of received and collected waste from households	–	6,36	6,05	6,36	5,85	5,54	5,90	5,95	0,05
Amount of waste generated from economic activity per unit of GDP in constant prices of 2011 by PPP	677,4	1159,6	957,5	883,8	10,73,0	999,7	1011,9	1006,5	−5,4

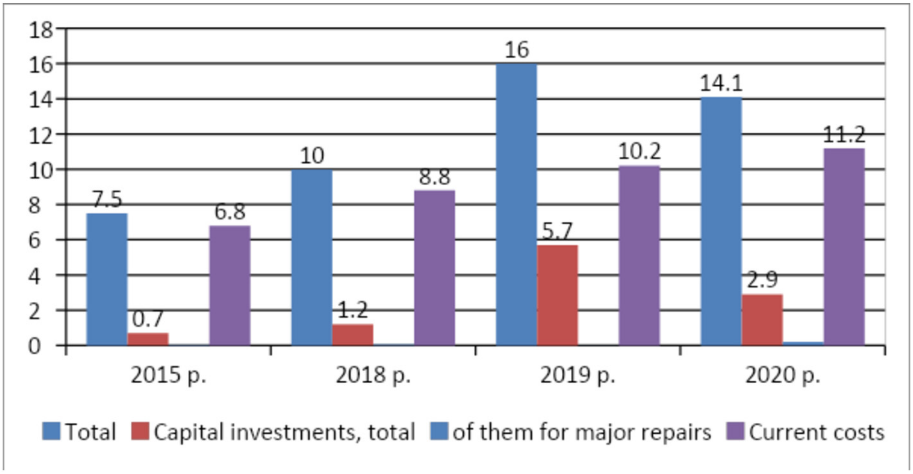

Fig. 3. Waste treatment costs in Ukraine for 2015–2020, mln. UAH. Based on: built according to [15]

$y_{\max}$ – a specified, desired marginal (maximum) level of production. As an operational parameter of the model, it is obtained on the basis of statistical data and normalized to the average value for the research period, taking into account extrapolation for two years;
t – a normalized period of time;
$k_y(t) = \frac{k(t)}{y_{\max}}$ – normalized coefficient for considering the process of regulating the dynamics of production;
$k(t)$ – The coefficient-function for managing the dynamics of economic processes in the system "Ecology - Production - Resources" was obtained in the form of a regression model using correlation-regression analysis based on a statistical sampling for the research period (Table 2);
$Rw(t)$ – "resource-waste" function, which includes recycling, reuse of agricultural waste of animal and vegetable origin. As an operational parameter of the model, it plays the role of an additional resource-investment and is an interpolation equation obtained on the basis of statistical data (Table 2, Fig. 3).

The modelling results considering the calculated operational parameters of the offered model are shown in Fig. 4.

Analysis of the modelling results demonstrates that: 1 – the stage of slow growth, the formation of the production process is reduced; 2 – the period of saturation (the process of achieving the desired (specified) maximum level of production) is not just reduced, but is accompanied by an increase in the dynamics of the production process, that is, the production rate increases significantly; 3 – there is a significant increase in the maximum level of production. The developed model is adaptive and aimed at calculating the volume of each type of waste in all economic areas of production. This

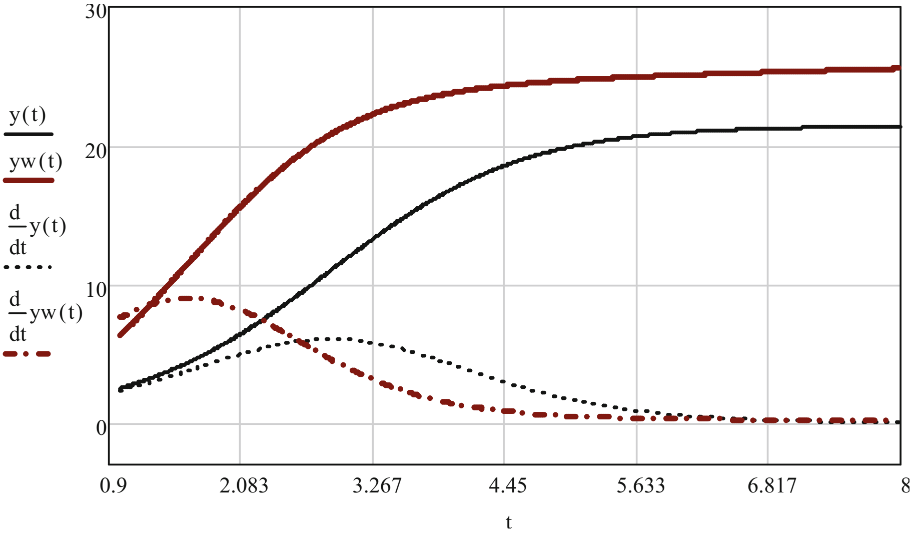

Fig. 4. Results of modelling economic dynamics in the system "Ecology - Production - Resources"
*$y(t)$ – excluding resource-investment; $yw(t)$– considering resource-investment.

calculation will allow planning the budget of funds for waste treatment, adjusting the surplus of erroneously budgeted funds. That is, unlike others, this model is aimed not only at analyzing the amount of waste by type, but also at automatically adjusting the budget for waste treatment.

5 Conclusions

Thus, the main task of today is to use natural resources rationally and reduce the level of environmental pollution.

The analysis demonstrates that the structure of waste generation in the EU and Ukraine is somewhat different. As a result, the main sectors in Ukraine that generate a significant amount of waste are mining and processing industries, agriculture. It should be noted that the increase in the mass of waste is not always accompanied by an increase in production. Half of the total mass of generated waste is utilized and a small part is burned for energy production, and the other half is stored in the environment.

In the EU countries, the most waste-generating sectors are construction, mining and quarrying, industry, recycling and water supply services, etc. The share of their utilization in the total amount of recycled waste increased from 45.9% in 2004 to 60.2% in 2020. At the same time, according to the results of the research, there is a decrease in the share of waste disposal by 21.3%. That is, it can be argued that the EU countries have reached such a level of development when the developed tools for the recycling of waste are able to ensure production growth in virtually all sectors of the economy without attracting additional resources and energy. Regarding the balanced development of the Ukrainian economy, the economy is mainly more resource-consuming.

Based on the analysis of waste generation and recycling, it is proposed to consider the ecological and economic modelling of the balanced development of the Ukrainian economy as a system that should take into account the principle of active management of natural (organic) resources-waste, and hence, accordingly, the system "Ecology-Production-Resources".

Ignoring and paying little attention to the problem of waste accumulation can lead to an ecological cataclysm. The non-rational construction of the waste management system and the imbalance of their secondary use will lead to economic losses. The perspective of further research should be a cluster analysis of the waste system according to the volumes of their accumulation and the possibilities of their use in various sectors of the economy, as elements of the growth of value added. Solving this problem will reduce the impact on the environment, strengthen the rationality of the use of natural resources as interdependence, reduce the cost of production at the local level of each enterprise and its structural production unit, increase the financial and economic results of the enterprise and the development of the national economy.

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A Study on Customer Preference Towards Coupon – Code Based Promotional Activities in Various Selected Fields with Special Reference to Coimbatore City

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Abstract. The modern market is full of offers and discounts. Marketers use several promotional programs to entice customers to buy products and services. While advertising goals are long-term in nature and typically aimed at building a brand, sales promotion programs often have a single goal, namely to maximize sales in the short term. A coupon is a ticket or document that can be exchanged for a financial discount or discount on a product purchase. Coupons can attract customers to a business, increase engagement with existing customers, and generate new revenue. This study examines customer preferences for coupon code-based promotions in various areas including clothing, food, travel, entertainment, medical, beauty, and personal care. The purpose of the study is to analyze how coupon codes influence customers' purchasing decisions, as well as examine the overall level of customer satisfaction. This study covers almost all the areas where coupon code is used as a promotional activity to increase sales and can help entrepreneurs and business people in making important financial decisions in sales and marketing.

Keywords: Sales promotion · customer preference · coupon code · making financial decision

1 Introduction

The modern market is full of offers and discounts. Marketers use several promotional programs to entice customers to buy products and services. While advertising goals are long-term in nature and typically aimed at building a brand, sales promotion programs often have a single goal, namely to maximize sales in the short term. Consumer promotion programs are visible to audiences because they are frequently advertised in the media. A coupon is a ticket or document that can be exchanged for a financial discount or discount on a product purchase. Coupons allow you to instantly save on certain products. This means that consumers receive an instant price reduction at the time of purchase. They don't have to send anything to the manufacturer, they don't have to enter any competitions. They leave the store satisfied that they saved money.

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Customer preferences for promotions based on coupon codes can vary depending on several factors, such as the type of product or service offered, the target audience, and the overall value of the promotion. Some customers may be more price sensitive and prioritize discounts over other factors, while others may be more focused on the convenience of promotion or the quality of the product or service offered.

Companies must understand the preferences and behavior of their target audience in order to develop effective promotions based on coupon codes. For example, offering a higher percentage discount may be more effective for price-sensitive customers, while a promotion offering a free trial or additional service may be more attractive to customers who prioritize convenience. Overall, understanding customer preferences and developing targeted promotions based on coupon codes can be an effective way for businesses to increase customer engagement, drive sales and build brand loyalty.

1.1 Statement of the Problem

Generally, Business or a product can be promoted in 'n' number of ways. But the most common and traditional way of promotion includes giving attractive offers via coupons. Frequent deals and special offers can entice customers to shop at your store instead of competitors' sites. One of the most important issues prevailing among the businesses is that they may not always target the right audience. So, this study concentrates on opinion and real time experience of the customers and analyse how it will be influenced in the sales of the business and thereby, helps to identify the targeted audience who likely to make purchase with coupon codes. Overall, the outcome of the study is to identify in what ways the customer is getting influenced using coupons and to find out their preference and overall satisfaction level while using it under various circumstances.

1.2 Objectives of the Study

- To determine the reach of coupon codes among customers.
- To analyse the effectiveness of coupon codes across different industries such as food, clothing, travel, medicine, entertainment, beauty and personal care.

1.3 Research Methodology

1.3.1 Area of the Study

Coimbatore is the area chosen to conduct this study where it is famous with textile industries and is one of the most industrialized cities of Tamil Nadu and is widely known as the "textile capital of South India". The city is home to a number of large textile factories, engineering firms, automobile parts manufacturers, healthcare institutions, educational institutions, etc. Coimbatore is also home to many small and medium enterprises (SMEs) that contribute to the growth and innovation of the city.

1.3.2 Source of Data

The primary data has been collected through the following basis by observation, through personal interview, by mailing of questionnaires. The secondary data has collected through research articles, newsletters, magazines etc.

1.3.3 Sampling Design

A research design is the systematic plan of action to be carried out in association with a proposed research work. It brings together both descriptive and analytical method of study. The number of respondents from whom the data was collected were 125 respondents.

1.3.4 Sampling Technique

The sampling technique used for collecting the primary data is purposive sampling method which comes under non-probability sampling. The study is conducted in Coimbatore district.

1.3.5 Tools Used for Analysis

To analyse the data, SPSS software was used. The following tools are used to analyse the collected data and they are

- Percentage Analysis
- Weighted Average
- Chi-Square Test
- Henry Garrett's Ranking

2 Review of Literature

Aia Jean Taguinod (2016) has conducted a study to understand the effects of coupon promotion on customer. This study aimed to determine the effects of using coupons on customer. These will measure as a how customers will perceive coupons as an influence to whether they will return to the shop. Coupons also play a considerable role in purchase decisions in that they motivate consumers to obtain more products in bulk or to purchase them ahead of time. It concluded that people come back with other groups to try the product.

Anam Bhatti (2018) has conducted a study on sales promotion and price discount effect on consumer purchase intention with the moderating role of social media in Pakistan. The study concentrated on the social media effects of Price discount and the consumers purchase intentions. The study has been conducted to determine the influence of the sales promotion and the price discount on the consumers purchase intention in Pakistan. The study has overcome some issues such as the sales promotion and the social media that had an influence on the consumers purchase intention. This study concludes that the social media moderated the relationship between the sales promotion and the consumers purchase intention.

Anuraj Nakarmi (2018) has conducted a study to understand the effects of sales promotion consumer behavior. This study aims to find out the practice of the sales promotion that has great impact on consumer behavior. This study focused on how different types of sales promotional activities have different impact on consumer's buying behavior. This study concluded with the importance of understanding of consumer's buying decision.

Mukaram Ali Khan, Amna Tanveer, Syed SohaibZubair (2019) has conducted a study that focused on various tactics used to attract as well as retain customers through sale promotion strategy. The Objective of this study is to analyze different coupons codes used by various customers. They identified the impact of various sale promotion strategies and consumer buying behavior. The study concluded that buy one get one free, price discounts and coupons were positively related with consumer buying behavior.

Huan Liu, Lara Lobschat, Peter C. Verhoef, Hong Zhao (2020) examined the influence of a permanent discount strategy on customer purchase behavior. It mainly focused on customer expectations of discounts interacted with current discount levels in their influence on spending. The study concludes that order coupons positively influence customer spending and purchase quantity at an increased rate. It is found that both product-specific price discounts and order coupons offered in a digital environment significantly influence customers' actual spending and purchase quantity, but in quite different ways.

Janani Rajasekar, John Britto (2022) has conducted a study on coupon code based promotional activities in garment retail shops in Trichy. It focused on how coupon code influenced people and the various kinds of coupons that reached among customers. The study concluded that coupons have a great market in retail industry and every kind of people are attracted towards the coupon.

3 Result Analysis

Table 1. Respondents demographic profile

Demographic profile	Occupation	Respondents	Percentage (%)
Gender	Male	54	43.2
	Female	71	56.8
	Total	**125**	**100**
Age	18–25 years	96	76.8
	26–35 years	14	11.2
	36–45 years	3	2.4
	More than 45 years	12	9.6
	Total	**125**	**100**
Occupation	Student	12	9.6
	Self employed	13	10.4
	Private sector employee	95	76
	Public sector employee	5	4
	Total	**125**	**100**
Area of Living	Rural	25	20
	Urban	78	62.4

(*continued*)

Table 1. (*continued*)

Demographic profile	Occupation	Respondents	Percentage (%)
	Semi-Urban	22	17.6
	Total	**125**	**100**
Usage of coupons	Yes	119	95.2
	No	6	4.8
	Total	**125**	**100**

Source: Primary data.

Interpretation

Table 1 shows the demographic profile that out of 125 sample respondents taken for the study, the majority of the respondents 71 (56.8%) of them were female, the majority 96 (76.8%) of the respondents were within the age group of 18–25 years, the majority 95 (76%) of the respondents are Private sector employee, the majority 78 (62.4%) of the respondents resides in urban area, and majority 119 (95.2%) of the respondents have used coupons to make a purchase.

Table 2. Different types of coupons used by the respondents

S. No.	Types of coupons	No. of Respondents	Percentage (%)
1	Discount coupon	101	80.8
2	Buy one Get one	52	41.6
3	Free shipping	53	42.4
4	Lottery coupon	27	21.6
5	Referral coupon	43	34.4
6	Gift card	53	42.4
7	URL coupon	25	20
8	Cash back coupon	37	29.6
	Total	**125**	**100**

Source: Primary Data.

Interpretation

It was inferred from the Table 2, that out of 125 respondents taken for the study, 101 (80.8%) of the respondents use discount coupon while purchasing products and services, 53 (42.4%) of the respondents use free shipping and gift card coupon while purchasing products and services, 52 (41.6%) of the respondents use buy one get one coupon to make purchases, 34.4% of the respondents use referral coupon to make purchases, 37 (29.6%) of the respondents use cash back coupon to make purchases, 27 (21.6%) of the respondents use lottery coupon to make purchases and 25 (20%) of the respondents use URL coupon while purchasing products and services.

It was concluded that, majority 101 (80.8%) of the respondents use discount coupon while purchasing products and services.

Table 3. The source of coupon preferred by the respondents

S. No	Source	No. of Respondents	Percentage (%)
1	In-Store promotions	70	56
2	Online websites	81	64.8
3	Newspaper/Magazines	36	28.8
4	E-mail	32	25.6
5	Social media promotions	43	34.4
6	Friends/Family	43	34.4
	Total	**125**	**100**

Source: Primary Data.

Interpretation

It was inferred from Table 3, that out of 125 respondents taken for the study, 81 (64.8%) of the respondents find coupon from Online websites to make purchases, 70 (56%) of the respondents find coupon from In-Store promotions to make purchases, 36 (28.8%) of the respondents find coupon from Newspaper and Magazines to make purchases, 32 (25.6%) of the respondents find coupon from E-mail to make purchases, 43 (34.4%) of the respondents find coupon from both social media promotions and friends and family to make purchases.

It was concluded that, majority 81 (64.8%) of the respondents find coupon from Online websites to make purchases.

Table 4. The types of coupons used by the respondents in different fields

S. No	Coupon	No. of Respondents	Percentage (%)
1	Food and Beverages	69	55.2
2	Clothing and Accessories	102	81.6
3	Travel and Experience	35	28
4	Entertainment	48	38.4
5	Medicine	26	20.8
6	Beauty and Personal care	38	30.4
	Total	**125**	**100**

Source: Primary Data.

Interpretation

It was inferred from Table 4, that out of 125 respondents taken for the study, 102 (81.6%) of the respondents use clothing and accessories coupon to purchase clothing products and services, 69 (55.2%) of the respondents use food and beverages coupon to buy food products and services, 48 (38.4%) of the respondents use entertainment coupon to get entertainment services, 38 (30.4%) of the respondents use beauty and personal care coupon to buy beauty products, 35 (28%) of the respondents use travel and experience coupon to get travel services and 26 (20.8%) of the respondents use medicine coupon to buy medicinal products and services.

It was concluded that, majority 102 (81.6%) of the respondents used clothing and accessories coupon to purchase clothing product and services.

Table 5. Rank of the occasions prefered by the respondents to use coupon

TABLE 5.1: No. of respondents rank on each occasion

S. No	OCCASION	1	2	3	4	5
1	Festivals and celebrations	36	7	29	22	31
2	Special events	11	41	26	28	19
3	Purchasing expensive items	13	19	36	25	32
4	Unique reward	16	29	34	29	19
5	Reward for previous purchases	14	24	33	23	31

Source: Primary data

TABLE 5.2: Ranking the following occasion on the basis of its Garrett value

S. No	DESCRIPTION	1st	2nd	3rd	4th	5th	Total	%	Rank
1	Unique reward	1200	1740	1700	1160	456	6256	62.56	**I**
2	Festivals and celebrations	2700	420	1450	880	744	6194	61.94	**II**
3	Special events	825	2460	1300	1120	456	6161	61.61	**III**
4	Reward for previous purchases	1050	1440	1650	920	744	5804	58.04	**IV**
5	Purchasing expensive items	975	1140	1800	1000	768	5683	56.83	**V**

Source: Primary Data

Interpretation

It is inferred from Table 5, Unique reward was ranked as first with the score of 62.56 Garrett points, Festivals and celebrations is ranked as second with score of 61.94 Garrett points, Special events is ranked as third with the score of 61.61 Garrett points, Reward for previous purchases is ranked as fourth with the score of 58.04 Garrett points and purchasing expensive items is ranked as fifth with the score of 56.83 Garrett points.

It was concluded that, majority of respondents prefer Unique reward to use coupons while purchasing, with Garrett points of 62.56.

Table 6. Positive reasons on the impact of coupon by the respondents

S. No	Reasons	No. of Respondents	Percentage (%)
1	Value oriented spending	22	20.4
2	Encourage to shop again	43	39.8
3	Minimize your expenditure	35	32.4
4	Repeat orders	8	7.4
	Total	**108**	**100**

Source: Primary Data.

Interpretation

It was inferred from Table 6, that out of 125 respondents taken for the study, 43 (39.8%) of the respondents prefer coupon as it encourages to shop again, 35 (32.4%) of the respondents prefer coupon to minimize their expenditure, 22 (20.4%) of the respondents believe that coupon creates value-oriented spending and 8 (7.4%) of the respondents prefer coupon to repeat their orders.

It was concluded that, majority 43 (39.8%) of the respondents prefer coupon as it encourages them to shop again.

Chi Square Analysis

Hypothesis:

H0: There is no significant relationship between the gender and the various coupon codes on food and beverages.
H1: There is a significant relationship between the gender and the various coupon codes on food and beverages.

Table 7. Chi-square values-Gender and types of food coupon

Features	Chi square value	P value	Significance/Non significance
Percentage off	0.989	5.365	NS
Buy one get one	0.999	3.279	NS
Cashback	0.393	15.837	NS
Free delivery	0.509	14.222	NS
Initial purchase coupon	0.36	16.332	NS

(S-Significant @ 5% level (p Value ≤ 0.05) and NS-Not Significant @ 5% level (p values $\geq$ 0.05).

Interpretation

It is concluded from Table 7, that the null hypothesis (H0) is accepted for the gender and types of food coupon. Features like percentage off (0.989), Buy one get one (0.999), cashback (0.393), free delivery (0.509) and initial purchase coupon (0.360) shows a non-significant relationship as the above-mentioned values are greater than the significant value (0.05).

Hypothesis:

H0: There is no significant relationship between the discount percentage and influence of travel coupon.

H1: There is a significant relationship between the discount percentage and influence of travel coupon.

Table 8. Chi-square Values-Discount percentage and Influence of travel coupon

Features	Chi-square values	P values	Significant/Not significant
Percentage off	0.51	24.918	NS
Zero cancellation	0.05	32.829	S
Promo code coupon	0.09	30.907	NS
Free Membership	0.22	28.002	NS
Cashback	0.47	25.221	NS

(S-Significant @ 5% level (p Value ≤ 0.05) and NS-Not Significant @ 5% level (p values ≥ 0.05).

Interpretation

It is concluded from Table 8, that the null hypothesis (H0) is accepted for the discount percentage and influence of travel coupon. Features like percentage off (0.51), promo code coupon (0.09), free membership (0.22) and cashback (0.47) shows a non- significant relationship as the above-mentioned values are greater than the significant value (0.05). Whereas the null hypothesis (H1) is rejected for zero cancellation (0.05) as the value is equal to the significant value (0.05).

Hypothesis:

H0: There is no significant relationship between the gender and significance on clothing and accessories coupon.

H1: There is a significant relationship between the gender and significance on clothing and accessories coupon.

Table 9. Chi-square values-Gender and Significance on clothing and accessories coupon

Features	Chi square values	P value	Significant/Non-Significant
Upto 50–70% on men, women and kids fashion products	0.629	12.657	NS
10% off on first order	0.803	10.256	NS
Extra 10% off on new arrivals	0.296	17.388	NS
Free shipping for Members	0.516	14.12	NS
Earn upto 6–8% cashback	0.504	14.27	NS

(S-Significant @ 5% level (p Value $\leq$ 0.05) and NS-Not Significant @ 5% level (p values $\geq$ 0.05).

Interpretation

It is concluded from Table 9, that the null hypothesis (H0) is accepted for the gender and types of Clothing and accessories. Features like Upto 50–70% on men (0.629), women and kids fashion products (0.803), 10% off on first order (0.296), Extra 10% off on new arrivals (0.296), Free shipping for Members (0.516), Earn upto 6–8% cashback (0.504) shows a non-significant as the above-mentioned values are greater than the significant value (0.05).

Hypothesis:

H0: There is no significant relationship between the gender and types of entertainment coupons.

H1: There is a significant relationship between the gender and types of entertainment coupons.

Table 10. Chi-square values-Gender and types of Entertainment coupon

Features	Chi square values	P values	Significant/Non-significant
Student offer	0.49	14.466	NS
UPI Offer	0.007	31.553	NS
Credit cards	0.46	25.311	NS
Pay later	0.012	30.067	NS
Return policy	0.59	24.365	NS

(S-Significant @ 5% level (p Value $\leq$ 0.05) and NS-Not Significant @ 5% level (p values $\geq$ 0.05).

Interpretation

It is concluded from Table 10, that the null hypothesis (H0) is accepted for the gender and types of entertainment coupon. Features like student offer (0.490), UPI offer (0.007), credit cards (0.46), pay later offer (0.012) and return policy (0.59) shows a non-significant relationship as the above-mentioned values are greater than the significant value (0.05).

Hypothesis:

H0: There is no significant relationship between the age and significance on medical coupons.
H1: There is a significant relationship between the the age and significance on medical coupons.

Table 11. Chi-square Values-Age and significance on medical coupon

Features	Chi square values	P values	Significance/Non significance
Old patient	0.16	29.105	NS
Use code	0.47	25.237	NS
Emergency offer	0.07	19.79	NS
Reward coupon	0.121	21.507	NS
Referral Coupon	0.22	27.943	NS

(S-Significant @ 5% level (p Value $\leq$ 0.05) and NS-Not Significant @ 5% level (p values $\geq$ 0.05).

Interpretation

It is concluded from Table 11, that the null hypothesis (H0) is accepted for the age and significance on medical coupon. Features like old patient offer (0.16), use code offer (0.47), emergency offer (0.070), reward coupon (0.121) and referral coupon (0.22) show a non-significant relationship as the above-mentioned values are greater than the significant value (0.05).

Hypothesis:

H0: There is no significant relationship between the age and significance on beauty and personal care coupon.
H1: There is a significant relationship between the the age and significance on beauty and personal care coupon.

Table 12. Chi-square values-age and significance on beauty and personal care coupon

Features	Chi squares values	P values	Significance/Non significance
Exclusive coupon	0.001	37.813	S
Trail coupon	0.29	17.492	NS
Buy one get one	0.001	39.511	S
Newbies	0.002	35.852	S
Warranty	0.003	34.917	S

S-Significant (P Values $\leq$ 0.05) and NS-Not Significant (P values $\geq$ 0.05).

Interpretation

It is concluded from Table 12, that the null hypothesis (H0) is rejected for the age and significance on beauty & personal care coupon. Features like exclusive coupon (0.001), buy one get one (0.290), newbies (0.002) and warranty (0.003) shows that there is a significant relationship as the above-mentioned values are less than the significant value (0.05). Whereas, the null hypothesis (H1) is accepted for trail coupon (0.290) as the P value is greater than the significant value (0.05).

Table 13. Satisfaction level upon various channel used by the respondents to receive coupons

S. No	Platform	5	4	3	2	1	Total	Average
1	E-Mail	49	41	21	10	4	125	3.968
		245	164	63	20	4	496	
2	Social Media	30	59	26	5	5	125	3.832
		150	236	78	10	5	479	
3	Mobile Apps	37	49	30	7	2	125	3.896
		185	196	90	14	2	487	
4	Text Messages	32	43	33	12	5	125	3.68
		160	172	99	24	5	460	
5	Print Media	28	40	41	11	6	126	3.579
		140	160	123	22	6	451	
6	Referral	31	45	36	7	6	125	3.704
		155	180	108	14	6	463	
7	Program	25	39	44	10	7	125	3.52
		125	156	132	20	7	440	
	Total							**3.739**

Source: Primary Data.
Formula used: (W = 26.179/7 W = 3.736).

Interpretation

Table 13, which the calculated value of weighted average score is 3.739 close to the Referral platform (3.704) which has a highest satisfaction level upon various channel used to receive coupon and Program channel (3.52) having the least satisfaction level upon various channel used to receive coupons. Followed by E-Mail platform (3.968) with second highest satisfaction level, Mobile apps (3.896) with third highest satisfaction level, social media (3.832) with fourth highest satisfaction level, Text messages (3.68) with fifth highest satisfaction level and Print media (3.579) with average satisfaction level upon various channel used to receive coupons.

It was concluded that, majority of the respondents have highest satisfaction level from Referral platform upon various channel used to receive coupons.

4 Recommendations

In the study area, shoppers in rural areas are much less aware of coupon codes and the various benefits of using coupon codes compared to shoppers in suburban and urban areas. And new strategies need to be implemented to promote this in rural areas. Consequently, companies can also promote coupon codes through free sample distribution and cash back bonuses, as well as through interactive games. Companies should improve promotion of coupon codes through newspapers/magazines, social media and email. Hence, companies must start implementing various plans to maximize promotion through these platforms. This can be achieved by using various strategies such as coupon reminders and exclusive discounts. Customer satisfaction levels with coupon codes through the use of print media channels, referrals and programs. Therefore, companies can use various ways to promote their coupon codes in various other ways.

5 Conclusions

Consumers can take advantage of coupon codes to get discounts on products or services they want to purchase. From the study, it could be observed that coupon codes are used by a large number of customers. This stimulates the sale of new products. Apart from attracting new customers and re-engaging existing customers, promotional activities based on coupon codes also help brands increase sales of new products and services. Coupons and discount codes give shoppers an extra incentive to spend money on new products. It also increases brand loyalty among customers. This will also serve as one of the bases for future business expansion, where there is a significant number of potential customers. This also reduces companies' advertising costs.

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Emotional Intelligence as a Determining Factor of the Personnel Motivation System

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Abstract. The article reveals the essence of emotional intelligence (EQ), and characterizes its main components. Emotional intelligence includes self-awareness; self-regulation as the ability to manage one's emotions and impulses; motivation; empathy and social skills. The history of the development of the concept of emotional intelligence is analyzed. Today, emotional intelligence comes to the first plan. One reason is that it cannot be given by artificial intelligence. After all, no one can replace management decisions that are related to a specific organization. Attention is focused on internal motivation, as a key component of emotional intelligence. People with high emotional intelligence (EQ) are more inclined to achieve goals for their own sake. Instead of looking for external stimulation, they want to do something because they think it is possible and worth doing. The ability to understand and manage one's own emotions, as well as to understand the emotions of other people, is an important social skill, and its main feature is the ability to control one's emotions and convey what needs to be seen by everyone around. People, who have emotional intelligence, find contact with people faster and get pleasure from communication. The need to develop emotional intelligence is due to the fact that a specialist must have a well-developed ability to reflect as a result of the ability to understand one's own emotions and the emotions of others, which makes it possible to objectively evaluate oneself and others in the process of professional activity, identify intrapersonal and interpersonal contradictions, seek ways to eliminate them, build concepts of professional development and strategies for its implementation. Emotional intelligence is a powerful tool for forming harmonious relationships with others. These two factors significantly increase the chances of success in work and personal life.

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1 Introduction

Since the working relationships of people began to be formed under the influence of such behavioral forms as cooperation and dominance (the action of which is triggered by emotions), emotional information plays a decisive role in the professional activity of each person.

It should be noted, that emotional intelligence is the ability to understand, realize and manage one's own emotions, one's motivation, thoughts and behavior, to regulate one's emotional state, as well as the ability to manage the emotional states of other people, notice their actual needs, empathize and develop their strengths. It is worth also noting that developing own emotional intelligence, a person becomes more attentive to himself, his feelings, desires and needs, at the same time, it allows him to better understand other people, to feel their needs, motives, and behavior [1].

Those, who have emotional intelligence, quickly find contact with people and get pleasure from communication. They make decisions faster and get what they want, can take responsibility and are able to overcome problems at the stage of their inception.

The processes of digitization of society, changes in the structure and intensity of consumer demand, globalization of markets, scientific and technological progress, etc. affect the management system of the organization in general and the system of personnel motivation in particular, which is undergoing transformation. This requires paying special attention to the study of the role and approaches to the development of emotional intelligence in management as a source of internal competitive advantages of the organization.

2 Literature Review and Methodology

Many scientific works have been devoted to the development of emotional intelligence (EQ). Emotional intelligence is studied not only from the point of view of psychology, but also from the economic and social point of view. For example, J. Meyer, P. Salovey [8, 9] studied the theory of emotional and intellectual abilities of a person; the subject of D. Golman's study [3, 12] was emotional competence; R. Bar-On and D. Lucin investigated the non-cognitive theory of emotional intelligence and the two-component theory of emotional intelligence, respectively.

Social intelligence was studied by R. Thorndike. Intellectual and non-intellectual components of emotional intelligence were studied by D. Veksler. The concept of multiple intelligence was proposed by G. Gardner, in particular: intrapersonal and interpersonal intelligence. The term "Emotional intelligence" was proposed by such scientists as J. Meyer and P. Salovey, and they also looked for methods of measuring its level. The study of "Emotional Intelligence" was continued by D. Goleman, special attention was paid to the study of the leader's emotional intelligence [3, 12]. However, the overwhelming majority of scientific works must be rethought from the standpoint of the possibilities of their use, taking into account the fundamentally new economic conditions in Ukraine.

The goal of the article is to find out the essence of the definition of "emotional intelligence", to study its main components, the meaning and features of its influence on the motivation of personnel. In accordance with the set goal, the main tasks are: to reveal the essence and features of emotional intelligence, its main characteristics; explore the history of the development of the concept of emotional intelligence and evaluate the importance of EQ for the effective and successful performance of any professional. Various scientific methods of research were used to solve the set goal, since the ways of knowing a person are a system of "soft" principles and techniques that have the nature of abstraction, and not rigidly fixed standards. The research used symptomatic and social attachment of the described phenomena, it is based mostly on psychological aspects. Regarding the theoretical basis for understanding the vectors of the movement of consciousness of both an individual and society as a whole, it is worth noting that the world of abstractions is based on concrete influences and words. Therefore, such general scientific methods as analysis, synthesis, abstraction, comparison, systematization and generalization are applied in the research.

3 Results of the Investigation

The history of the development of the concept of emotional intelligence spans less than three decades, and even within such an insignificant period of time from the point of view of science, several milestones of its formation and development can be identified.

a) 1990 – the concept of emotional intelligence was presented for the first time and its four-component model was given, which was called the "ability model" (J. Mayer, P. Salovey).
b) 1995 - based on Mayer-Salovey's theory and cross-cultural empirical studies, the "mixed model" of emotional intelligence (D. Goleman) and the "model of emotional and social intelligence" (R. Bar-On) were presented.
c) 1996 - presentation of the first psychodiagnostic method of research of emotional intelligence (R. Bar-On).
d) 2000 - to our time - active development of tools for research and development of various aspects (psychophysiological, psychological, social, cultural) of emotional intelligence (P. Salovey, D. Mayer, D. Goleman, R. Boyatsis, E. Mackie, G. Gardner, K. Petridis) [2].

The basis of five elements that determine emotional intelligence was developed by the American psychologist D. Goleman (Table 1). This structure improves and reveals emotional intelligence more, since D. Goleman proclaimed the unity of intelligence and emotions, which is necessary for the successful activity of a manager, but he considers the cognitive component to be secondary. Emotions, in his opinion, are more important, and in case of danger, emotional centers (limbic system) subjugate all mental activity of a person [3].

In the context of the above, it should be noted, that the existence of the organization depends entirely on its success and ability to make profits here and now. If the organization cannot adapt to modern trends, use new opportunities and brings only losses, then it will be liquidated quite quickly.

Greater responsibility for one's own decisions is required from the manager, as well as creativity and flexibility, which is impossible without a deep understanding of the capabilities and characteristics of one's own subordinates. The manager's inability to establish quality contact with the members of his team will certainly be reflected in the social and psychological atmosphere and lead not only to emotional, but also to financial losses.

In the works of Mayer and Salovey [8, 9], the components of emotional intelligence are more detailed:

The first characteristic is realized in the form of a person's awareness of his own emotions. This property is considered leading in emotional intelligence, because the ability to manage one's own emotions, to regulate their expression, begins from the moment when a person understands the causes of his experiences, their nature and intensity. The ability to realize one's true experiences and understand their origin enables a person to better cope with them.

The second component of emotional intelligence is manifested in the form of emotion regulation. The ability to regulate one's own experiences is based, of course, on their self-awareness. Management of one's own emotions manifests itself in the form of efforts to calm oneself down, get rid of the anxiety state that arises, sadness, or irritation. People, who do not possess this property, are constantly in a state of distress and helpless attempts to overcome their own negative feelings. While those who have the ability to control emotions, overcome unwanted emotional states much more efficiently and quickly [7].

The third component of emotional intelligence was defined as the ability to motivate oneself to work. It is realized in a person's efforts to direct his own emotions to the benefit of achieving the goal of the activity, to self-motivation for new achievements, to creative activity. One of the components of the ability to motivate oneself to achieve the goal of activity is self-control. It is realized in the form of the ability to postpone receiving instant gratification in order to achieve a more significant distant goal. A person's ability to postpone the gratification of momentary impulses is a very important prerequisite for his further successful activity [7].

The fourth component of emotional intelligence is interpreted as recognizing and understanding the emotions that arise in other people. This ability is realized, in particular, in the form of identifying empathy. People who are able to show empathy are more sensitive to weak social signs that indicate that other people around them have some problems or experiences and they need to be taken into account in communication [7].

The fifth component of emotional intelligence is implemented in the form of the ability to maintain friendly relations with others. It is considered by the authors, quite rightly, as a kind of art of positive attitude towards other people, as a very valuable social skill, which is realized in a person's ability to cope with emotions that arise when interacting with other people [7].

Developed emotional intelligence allows a manager to:

- to be in harmony with one's own intentions and experiences;
- to ensure the trust of subordinates and confidence in the success of one's own future;
- to create a unique psychological climate that encourages subordinates to share their ideas and ways of solving specific tasks;
- expertly manage the motivation of subordinates;

Table 1. Characteristics of emotional intelligence

Characteristic	Essence
Self-awareness	The most important part of emotional intelligence. Self-aware people do not allow emotions to rule their lives, trust their intuition, have experience in constructively getting out of crisis situations, know their weaknesses and strengths, are ready to work on themselves because they understand their emotions well
Self-regulation (the ability to manage one's impulses and emotions)	The characteristics of self-regulation are focus, flexibility and adaptability to new conditions, integrity and the ability to say "no"
Motivation	Persons with a high degree of emotional intelligence are usually motivated; ready to postpone immediate results for the sake of long-term success; productive, prefer challenges and are very efficient in any task
Empathy	It is the ability to identify and understand the willings, needs and perspectives of those around us. People capable of empathy (sympathy) recognize other people's feelings well, even when these feelings are hidden and not obvious; perfectly manage relationships, listen and attend to the needs of another person; avoid stereotypes and superficial judgments and live their lives openly and honestly
Social skills	Persons with a strong social skills are usually easy-going and good team players; they do not focus only on their own success, they help others develop and realize their own potential; can resolve conflicts, help in solving complex tasks, build and maintain constructive relationships

Formed according to the source [3].

- maintain subordinates' high level of creativity and willingness to take healthy risks;
- maintaining a focus on continuous development and training in the team;
- increase labour productivity due to the rational management of emotional states in the team [2].

Emotional intelligence can be the key to success in the workplace, and here's why:

- EQ can lead to better business decisions;
- employees, who are emotionally intelligent, more likely to keep their emotions under control;
- those, who have high emotional intelligence, are better able to cope with conflicts;
- emotionally intelligent leaders, as a rule, have great empathy;

- employees with high emotional intelligence are more inclined to listen, reason and respond to constructive criticism [4].

It worth noting, that emotionally intelligent people are able to put themselves in another person's place and understand how they feel. Empathy is more than simply being aware of how others feel; it also includes how you respond to those emotions [5]. In the workplace, empathy allows to understand the different dynamics between colleagues and managers. It also allows to learn in whose hands the power is and how this affects the behavior, feelings and interactions that arise from such relationships.

Internal motivation is the key component of emotional intelligence. People with high emotional intelligence (EQ) are more inclined to achieve goals for their own sake. Instead of looking for external incentives, they want to do something because they believe it is possible and worth doing. The motivational process can be considered as a form of emotional. Motivation is an emotion plus a direction of action. Emotional behavior is expressive, not goal-directed, its direction changes with a change in emotional state. The strength of the motive determines the stability of the personality, which is reflected in the effectiveness of its activity. Money, status and recognition are important, but people who are very successful in anything are usually motivated by something bigger. They are devoted to their work, passionate about what they do, ready to take on new challenges, and convey their enthusiasm to others. Such people are able to inspire others to work just as hard to achieve their goals, do not give in to obstacles and problems [4, 6].

Leaders and employees, who have a high level of emotional intelligence build productive working relationships, find mutually beneficial solutions, better control their own emotions and impulses, and usually consider the situation from all points of view.

The ability to understand and manage one's own emotions, as well as to understand the emotions of other people, is an important skill, and its main feature is the ability to control one's emotions and project what everyone around you needs to see. People who have emotional intelligence find contact with people faster and get pleasure from communication. They make decisions faster and get what they want, can take responsibility and are able to overcome problems at the stage of their inception. Emotional intelligence is needed to be more aware, to better understand your emotions and yourself. Also, it is a powerful tool for forming harmonious relationships with others. These two factors significantly increase the chances of success in work and personal life [10, 11].

It is worth emphasizing that the development of emotional intelligence is very important for the effective and successful work of a personnel manager. The performance of personnel management functions, namely: recruitment and selection of personnel, their adaptation and development, development of organizational culture, personnel motivation, and others, require "reference" behavior from the personnel manager. He should be an example for both the staff and the leaders of the organization. The most suitable for this, the styles of the emotional leader are idealistic, educational, sociable and democratic. Their use means that the manager does not deviate from his own principles and values, lives and works in the rhythm of a full and emotionally rich life. A high level of emotional intelligence ensures favorable relationships in the team, understanding between the manager and subordinates, and an active position of the enterprise, institution, organization as a whole.

Practicing recognizing your own emotions is one of the first steps to using emotional intelligence skills in the workplace. Awareness of various aspects of oneself, including emotions and feelings, means self-awareness - which is one of the main components of emotional intelligence. First of all, a person must first understand himself, in order to recognize emotions and understand what causes these feelings [4].

Self-regulation is also an important part of the development of emotional intelligence. People with good self-regulation are able to quickly adapt to changing situations. They do not react impulsively and think about how their emotional expressions affect others [4].

Research in the psychology of emotions shows that people with high EQ also have strong social skills. Since they know how to recognize other people's emotions, they can respond adequately to the situation. Since social skills lead to more effective communication and interaction, the overall organizational culture, they are highly valued in the workplace [4].

4 Conclusions

Leaders and employees, who possess high social skills, are able to establish productive relationships with colleagues and effectively promote their ideas. Not only are they excellent team players, they can take on leadership roles when needed.

EQ is the main component in achieving the maximum feeling of happiness and successful self-realization. Emotional intelligence is an indispensable factor, that activates and elevates a person's mental skill; that is, when feelings are recognized by a person and he is guided by them in a constructive way, then this increases the intellectual powers of the individual.

It is possible to improve the level of emotional intelligence, but not through traditional training programs, that target the part of the brain, that controls our rational ideas. Long-term practice, feedback from colleagues, as well as personal enthusiasm for the achieved changes in oneself are essential for successful self-realization.

The need to develop emotional intelligence is due to the fact that a specialist must have a well-developed ability to reflect as a result of the ability to understand one's own emotions and the emotions of others, which makes it possible to objectively evaluate oneself and others in the process of professional activity, identify intrapersonal and interpersonal contradictions, seek ways to eliminate them, build concepts of professional development and strategies for its implementation.

The constantly growing importance of the human factor requires additional research in the field of emotional intelligence as an additional source of increasing the efficiency and effectiveness of any organization, which determines the prospects for further researches.

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Trends in the Development of E-Commerce in Ukraine

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Abstract. The article examines trends in the development of E-commerce in Ukraine and the world. The main institutional features and challenges faced by national online stores are identified, such as personalization and changes in consumer demand, macro factors of influence - the growth of competition, the Covid 19 pandemic and the war with russia. Summarized are the main trends in the development of Internet trade. It has been proven, that today, thanks to the rapid development of modern information technologies and logistics companies, the scaling and availability of online payment, when online orders can be made from almost anywhere in the world, as well as the openness of borders and almost no restrictions, the field of E-commerce has completely transformed the retail market. E-commerce acts as a powerful engine for the development of both the national economy of Ukraine and the world economy, since it is thanks to E-commerce that the national labor market is continuously developing and transforming, and new jobs are constantly being created, including in newly created sectors of the economy. It has been proven that thanks to the development of the E-commerce sphere, the national Ukrainian business, regardless of its size, gained the ability to scale, which contributed to the growth of export volumes, an increase in the average level of qualification of the employed population of Ukraine, and an increase in the total amount of taxes paid to the state and local budgets. The dynamics of global Internet trade in recent years have been analyzed. Has been studied the forecasting of the development of the E-commerce sphere in Ukraine and the world. There were proposed possible ways of further development of the E-commerce

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sphere in Ukraine. The conducted analysis can be used in the future as a basis for researching prospects for the development of the E-commerce sphere, determining global trends in its development.

Keywords: e-commerce · e-business · online platform · online store · marketplace · online trade

1 Formulation of the Problem

The rapid implementation of the processes of world globalization in all spheres of social life, the creation of global communications and global social networks, a steady trend towards the growth of Internet users, the transformation of the banking sector, the transfer of payments, settlements and other financial transactions to the Internet environment contributed to the rapid development of the field of electronic commerce as in the world, and in Ukraine in particular. Currently, the field of E-commerce acts as a powerful engine for the development of both the national economy of Ukraine and the world economy, since, regardless of the COVID-19 pandemic or the war with Russia, it is precisely thanks to E-commerce that the national labor market is continuously developing and transforming forces, new jobs are constantly being created, including in newly created branches of the economy. According to the results of the United Nations Trade and Development Conference in 2022, Ukraine ranked 46th among 193 countries in the world according to the E-Government Development Index and 57th among 193 countries in the world according to the e-Participation Index UN (E-Government Survey) [1]. Thanks to the development of the E-commerce sphere, the national Ukrainian business, regardless of its size, has gained the ability to scale, which has contributed to the growth of export volumes, an increase in the average level of qualification of the employed population of Ukraine, and an increase in the total amount of taxes paid to the state and local budgets. Even under the conditions that the war will continue in 2023–2024, conditions are constantly being created in Ukraine for the stabilization and growth of production and business, and therefore for the stabilization and further development of the E-commerce sphere. Therefore, the analysis of prospects for the development of the E-commerce sphere, the determination of global trends in its development with the aim of implementation in the Ukrainian economic space is relevant and does not cause doubts.

2 Literature Review and Methodology

To date, there are a number of publications by both international and Ukrainian researchers on the development of the E-commerce field, which include analysis of market trends, forecasts, competitive analysis, etc. In order to analyze trends in the transformation of the E-commerce sphere, we reviewed publications on such information platforms as ResearchGate [2], Scopus [3], Web of Science [4], analyzed the reports of Digital 2023 [5], Statista [6], Forbes [7], European E-commerce report 2023 [8], Promodo [9] and others. Currently, there are various methodological approaches to their identification in research. Part of the research has a theoretical and academic character, the phenomenon of E-commerce is considered as an object of scientific research [10, 11, 12], the questions of the formation of modern trends in the development of the E-commerce sphere are considered in publications [11, 13], questions of the specifics of development in different countries are studied in work [10, 11, 14], the issue of expanding the scope of application of E-commerce is considered in works [11, 12, 15], the issue of business internationalization based on E-commerce technologies is studied by scientists [13, 15]. Applied aspects of the development of the modern digital space are presented in analytical reports [11, 13, 14]. However, despite the wide range of research on the development of the E-commerce sphere, it needs further research in order to identify trends and patterns of development of relations in the national e-commerce market of Ukraine.

The purpose of the article is the analysis of modern trends in the development of E-commerce in the world market with the aim of implementing successful practices in the national market of Ukraine. The research was conducted using general scientific and special methods of studying economic phenomena: analysis of statistical data to identify trends in the development of the digital economy of Ukraine; method of logical generalization for summarizing information and formulating conclusions; graphic method for visual presentation of research results. The information base of the research is analytical reports of domestic and foreign organizations, assessments of experts in the field of digital economy, statistical data of the United Nations, the State Statistics Service of Ukraine, as well as the database of statistics of trade in goods of the United Nations.

3 Results of the Investigation

At present, thanks to the rapid development of modern information technologies and logistics companies, the scaling and availability of online payment, when online orders can be made from almost anywhere in the world, as well as the openness of borders and almost no restrictions, the field of E-commerce has completely transformed the retail market.

According to Statista Digital Market, the population of the Earth as of the beginning of 2022 was 7.83 billion people [6]. More than half of the world's population uses the Internet, namely 59.5%. Therefore, the potential for the development of E-commerce on the world market is virtually unlimited. According to Statista Digital Market, in 2019, the share of the E-commerce sector in the global turnover of retail sales was 14%, in 2020 and 2021, it had an upward trend and amounted to 17% and 19.5%, respectively. Dynamics of the population of Ukraine in comparison with the population of Europe, the share of European and Ukrainian Internet users and the share of E-commerce users with a defined forecast value for 2023. Presented in Fig. 1.

According to the European E-commerce report 2023, Japan, the USA, Great Britain, Germany, Canada, China, France are the leading countries in the world in which the E-commerce sector is developing rapidly [8]. Therefore, the development of the E-commerce sphere in European countries and in Ukraine is characterized by their institutional features and occurs at different rates. In the countries of Europe, the development of E-commerce in recent years has shown stable growth trends, therefore it is rapidly

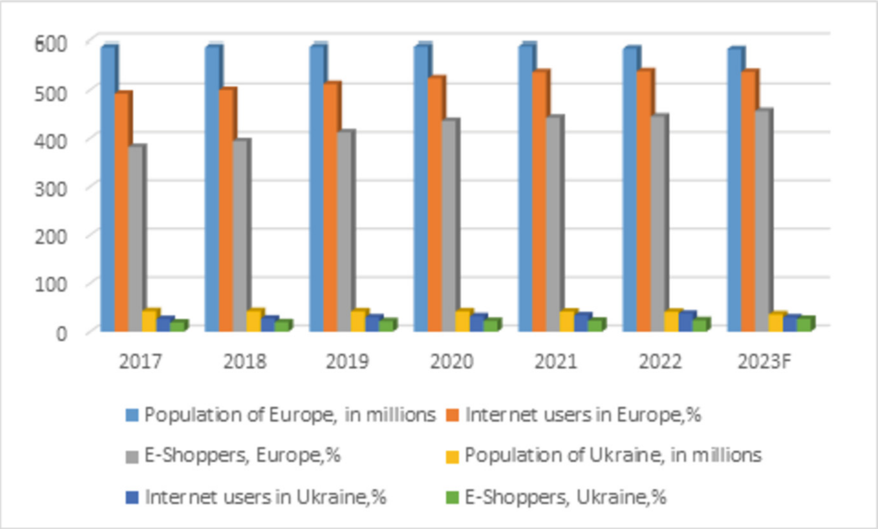

Fig. 1. Dynamics of the population of Ukraine in comparison with the population of Europe. Source: Authors' calculations based on [6].

developing and increasing its popularity. Thanks to the steady growth trend of the European E-commerce market, more than 4 million new jobs were created, which positively affected the development of the economy as a whole. Since Europe consists of certain regions, namely Northern, Southern, Western, Central and Eastern, the development of E-commerce in each of them also has its own characteristics. For example, the leader among European regions in the development of E-commerce is the Western region, which includes such countries as Germany, France, Austria, the Netherlands, Belgium, Luxembourg, Liechtenstein and Switzerland. Regional and language restrictions do not allow us to single out one powerful leader among the leading European Internet platforms. Internet platforms such as Allegro, with a market niche of 13 million active users, and the OTTO Internet network are among the popular ones. Its clients include more than 50% of all German families, Internet companies Flubit and Amazon, which have placed more than 150 million goods and services on their platforms. The Internet company Flubit uses blockchain technologies, it has already become the largest platform that offers the possibility of paying for goods and services using cryptocurrency.

Regarding the situation in Ukraine, according to Statista 6, the field of E-commerce was characterized by rapid growth before the start of full-scale military operations. A number of factors contributed to this, namely: the direct growth of Internet penetration in Ukraine, a change in consumer behavior due to the spread of the Covid-19 pandemic - Ukrainian consumers, in order to avoid health risks, chose online shopping more often, the spread of mobile devices. According to the Ministry of Digital Transformation of Ukraine, in the last five years of the pre-war period, the sphere of E-commerce in Ukraine grew by almost 25% annually [6]. The dynamics of the development of the E-commerce sphere in Ukraine in comparison with the dynamics of the development of the E-commerce sphere in Poland is presented in Fig. 2.

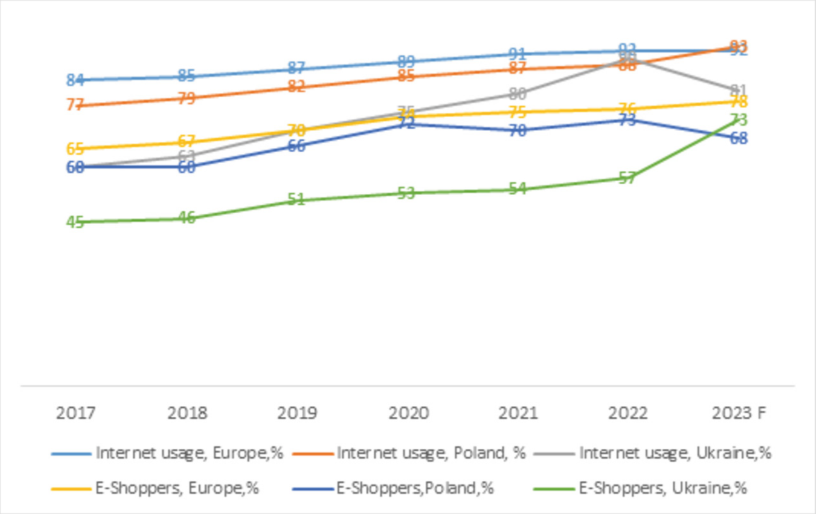

Fig. 2. The dynamics of the development of the E-commerce sphere in Ukraine in comparison with the dynamics of the development of the E-commerce sphere in Poland. Source: Authors' calculations based on [6].

To conduct a comparative analysis of the development of E-commerce in Ukraine, a European country like Poland was chosen, because these two countries have similar institutional features, which will ensure the representativeness of the sample.

Therefore, the development of the E-commerce sphere in Poland, as well as in pre-war Ukraine, was characterized by rapid growth. In addition, the population of Poland, the quantitative characteristics of the E-commerce sphere, the peculiarities of the development of similar spheres of the economy are approximately appropriate for Ukraine. In the territorial aspect, both in Ukraine and in Poland, the sphere of E-commerce develops primarily in large cities. In Ukraine, these are Kyiv, Lviv, Kharkiv, Odesa, Dnipro. In Poland - Warsaw, Gdansk, Krakow, Wroclaw, Przemyśl. The establishment of reliable close Ukrainian-Polish interstate relations, strategic partnership and fraternal support of Poland in difficult war times, establishment of cooperation in various fields of economy, science, and politics have a positive effect on the recovery of the economy of Ukraine in general and the field of E-commerce in particular.

According to the study "European E-commerce report 2023", currently about 90% of Poles who use the Internet choose to make purchases online [8]. Cross-border sales are gaining momentum. This is the direction in which most online stores are developing. Integration with the world's leading marketplaces and delivery services, fast intelligent translation provide expansion and access to new markets of Germany, Slovakia, the Czech Republic, Greece, Romania, Hungary and others.

The Ukrainian E-commerce market also has its own institutional features. For example, Ukrainian consumers of online goods and services prefer such a form of financial settlement as cash on delivery or cash on delivery, which creates certain challenges for the development of the E-commerce sector on the one hand, and on the other hand has a positive effect on increasing the level of quality and competitiveness of goods. National online stores use various business models in their activities, the main ones being an electronic marketplace, an electronic store, an electronic bulletin board, a price aggregator, and hybrid business models. For example, Prom.ua, Shafa.ua, and Bigl.ua marketplaces use the business model of organizing communication between sellers and buyers of goods and services, organize the settlement procedure by carrying out a transaction in accordance with established rules. Such online stores as, for example, OLX, Allbiz use the business model of a bulletin board, where both private individuals and business structures have the opportunity to post their ads for the purchase and sale of goods and services. Supermarkets such as Fozzi, Eldorado, Novus, Rozetka, Foxtrot, Lamoda, Kasta and others sell goods on behalf of sellers, mostly using their own stock. Each such business model has its own advantages and features. Her choice depends on the business strategy implemented by the online store, as well as on the needs and preferences of its customers [16].

The challenges faced by the development of e-commerce in Ukraine are the lack of infrastructure. The low level of development of logistics significantly complicates the quick and convenient delivery of goods to consumers, especially in hard-to-reach rural regions, where delivery can take up to several weeks.

The lack of trust of Ukrainian consumers in online transactions is another institutional feature of the development of the national E-commerce sphere, which unfortunately has a negative effect on it. The low level of financial and cyber security, the sufficiently high cost of Internet services, the possibility of organizing fictitious online stores, substantiate the stated fears of Ukrainians to carry out online settlement operations, which accordingly poses obstacles to the growth of e-commerce.

The trend of the development of E-commerce both in Poland and in Ukraine is the personalization of both goods and their consumers. With the help of this tool, it became possible to create product configurators on the platforms of online stores, and the buyer, experiencing an individual approach to meeting his needs, has the opportunity to independently configure and shape the selected product. In 2023, packaging characteristics were added to the development trend of the E-commerce sphere - buyers pay attention to such packaging characteristics as personalization, creativity, environmental friendliness, aesthetics.

The next feature that is developing into a trend is omnichannel - that is, the ability of buyers to freely choose where it is more convenient for them to buy goods - in an online or offline store. The presence of the latter significantly increases trust in the chosen brand and practically affects the decision-making by buyers to purchase the product.

Other trends in the development of E-commerce that are worth paying attention to are – mobile sales in social networks and the growth of social commerce, voice search, the use of artificial intelligence to form an individual offer to the buyer based on his search history, previous purchases, the convenience of instant payments, getting the opportunity seamlessly pay for goods and services from any electronic device using digital wallets or even cryptocurrencies, use of chatbots, new standards of customer service, delivery of orders using drones.

With features like Shoppable Instagram, TikTok's social media has become increasingly popular as a place to sell and buy goods and services. Statista predicts that sales through social media will grow to nearly $3 trillion in 2026 [6].

A definite trend in the development of the E-commerce sphere, especially in industries where the sold product is needed by buyers on a cyclical basis with a defined interval - every week or month, is sales with a subscription. Such areas of E-commerce include sellers who offer cosmetics, biologically active supplements, hygiene products, etc.

In addition, augmented reality has become an important development trend in the field of E-commerce. Many customers who shop online want to be sure that the product they receive will fit them and they will like it. Smart brands in the field of E-commerce - Zappo's, IKEA, Kipling, Warby Parker's use augmented reality to form an exciting interaction with buyers of goods and services. Creating a virtual opportunity to apply make-up, try on personal clothes, arrange individual furniture in the living room - and all this before the order is made.

An equally important trend in the development of E-commerce is the readiness of store owners to implement M-commerce - a mobile version of the store, which should be as simple and convenient to use as possible.

Another interesting trend in the development of the E-commerce sphere is the growing demand for used goods. Consumers are looking for used goods on the Internet for a number of reasons, the main ones of which can be highlighted - saving money, growing interest in environmental friendliness, partly due to rising inflation, etc. Clothes, bags, shoes, and books are popular among second-hand items.

The impact of the war with Russia on the economy of Ukraine in general and on the sphere of E-commerce in particular cannot be denied. After the events of February 24, 2022, e-commerce in Ukraine suffered heavy losses, according to Promodo research [9]. Thus, during the spring period of 2022, all Ukrainian online stores lost more than 80% of traffic, and the revenue of Ukrainian online stores in the first week decreased by 92% [9]. There were also trends of reduction of almost 60% in the import of non-critical clothing and footwear, some international operators closed their stores due to logistical problems and the impossibility of importing non-critical goods [9]. A significant majority of Ukrainian buyers - almost 90% - did not buy goods in offline stores during the period before the war. The demand for food products, drinking water and promotional food products had a tendency to grow rapidly [16].

However, according to Statista forecasts, as early as the end of 2023. in Ukraine, the volume of e-commerce is expected to increase to the level of 2020, and in 2025 will exceed the pre-war level in 2022 [6].

According to a Statista study, in the pre-war years, the revenues of Ukrainian companies in the field of E-commerce per user increased. If from 2017 to 2019 the increase was quite small, then starting from 2020 it turned out to be quite significant. The highest annual income per user - about $140 per year, was observed in such niches as food products, electronics, and fashion [6]. In 2022, after the military aggression, the strongest subsidence occurred in all directions. The revenue of companies per user even in the food industry has risen to $11.59 per year. In other segments, it became twice as small [6].

However, according to Statista forecasts, in 2023, Ukraine will almost reach the level of 2020, and in 2024, it will reach the indicators of 2021. Then, a further increase in user costs and, as a result, an increase in business income are predicted [6].

Globally, we believe that the war in Ukraine practically did not affect the global E-commerce market. Therefore, the leading condition for a significant increase or decrease of the global E-commerce market should be a significant change in the number of the planet's population. And even such a serious cause as war cannot affect the general world situation. According to Statista's forecasts for the development of the global E-commerce market in 2023, the volume of sales will reach 2728.00 million dollars, the annual growth rate will be 13.84% already by 2027. With a projected market size of USD 1495.00 billion in 2023, most of the revenues will be generated in China [6]. The volume of the global E-commerce market will reach in 2027. Mark of 4582.00 million dollars [6]. The number of consumers in the e-commerce market will reach 24.8 million by 2027. With a projected market volume of 1495.00 billion US dollars in 2023, most of the revenues will be generated in China [6]. User penetration will be 58.8% in 2023 and 63.6% in 2027. Average revenue per user will reach $126.30 With a projected market size of $1495.00 billion in 2023, most of the revenue will be generated in China [6]. Analysts note that if earlier the E-commerce market was a rather simple concept of retail trade, now it is turning into a global ecosystem. Many online and offline retail players are moving to multi-channel strategies and are seeking to offer potential customers even more convenient ways to shop online [6].

Therefore, for the rapid development of the E-commerce sphere in Ukraine, it is important to implement the European rules for conducting Internet business, to harmonize the rules for conducting Internet business between different countries. Currently, Ukraine has fulfilled all its obligations regarding electronic commerce under the Association Agreement with the countries of the European Union. Ukraine has implemented Directive 2000/31/EC, protection of consumer rights and unsolicited commercial messages, electronic signature. But according to preliminary assessments, the implemented norms do not always correspond to the national legal system, which has a negative impact on implementation and development. In addition, it is advisable to use reliable business mechanisms and tools that are universal and safe for all participants, to agree on the issue of tax burden and tax collection rules, safe use of payment systems, ensuring data security, etc.

4 Conclusions

Thus, on the basis of the conducted research, it was determined that the sphere of E-commerce in Ukraine is a rapidly growing sector that is ready for further transformation, and new trends and technologies will contribute to innovation and growth. A statistical analysis of the state of development of the E-commerce sphere in Ukraine was carried out, the main trends formed in this sphere were studied, namely: personalization of both goods and their consumers; mobile sales on social networks and the growth of social commerce; voice search; using artificial intelligence to form an individual offer to the buyer based on his search history of previous purchases; getting the opportunity to seamlessly pay for goods and services from any electronic device, using digital wallets or even cryptocurrencies; use of chatbots; new standards of customer service; delivery of orders using drones; augmented reality; growing demand for used goods. It was determined that Ukrainian online consumers are increasingly starting to use the Internet for shopping. The challenges faced by the development of e-commerce in Ukraine are analyzed: lack of infrastructure; the low level of development of logistics significantly complicates the quick and convenient delivery of goods to consumers, especially in hard-to-reach rural regions, where delivery can take up to several weeks; lack of trust of Ukrainian consumers in online transactions; low level of financial and cyber security; sufficiently high cost of Internet services; the possibility of organizing fictitious online stores. A list of the most popular e-commerce business models used in Ukraine has been compiled. Poland was chosen to conduct a comparative analysis of the development of E-commerce in Ukraine, because these two countries have similar institutional features.

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Electric Generator Market Development: Global Experience and Ukrainian Practice

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Abstract. In the article the dynamics and structure of the world market of electric power generators, factors influencing its development are determined. The main suppliers and consumers of electric power generators in the world market are identified. The export orientation of the world production of electric power generators is identified. The unified methodological approach to the identification of electric power generators by commodity subheadings of the Harmonised Commodity Description and Coding System (HS) is substantiated to form an information and statistical base comparable in the international space. The article uncovers a causal and coherent relationship between rolling blackouts in Ukraine due to the Russian energy terror and indicators of development of Ukraine's foreign trade in electric generators. It is established that the forced transition of businesses to generators had a significant impact on production costs, led to an increase in demand for fuel, a transformation of the consumption structure in favour of durable goods, a reduction in total exports and an increase in imports of petroleum products and equipment for restoring the power system. The findings of this analysis can be used as a basis for studying the macroeconomic possibilities of the potential for the development of electric generator markets in the event of economic shocks and emergency mobilisation of resources to implement the principles and mechanisms of strategic management of the formation and development of independent energy.

Keywords: electric generators · power generators · world trade · foreign trade · power generators market · energy infrastructure · rolling blackouts

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1 Formulation of the Problem

The global power generators market includes a wide range of products used to generate electricity in various industries, including industry, construction, transport and others. Over recent years, this market has been growing due to an increase in global electricity consumption. However, the power generator market is affected by political and economic factors, such as changes in energy policy regulations, fluctuations in fuel and other resource prices, and global crises. Generally speaking, there is a direct link between economic growth and the expansion of demand for power generators, but there are regional and sectoral specifics and trends in the market.

In 2022, prolonged rolling blackouts in Ukraine led to an extensive development of demand for power generators, which was reflected in the formation of a "generator economy". To determine trends in the development of the electric generator market, it is advisable to create a unified information and statistical base for monitoring global and domestic trade, to identify sources of demand and their importance for economic development.

The first part of the article is focused on the analysis of the global market of electric power generators, which allowed to determine its geospatial dynamics, industry structure, and key development factors. The second part of the article examines the hysteresis of the power generators market in Ukraine under martial law, which allowed to assess the impact of rolling blackouts on the supply and demand for power generators, as well as the consequences for the economic development of the country in general.

2 Literature Review and Methodology

To date, there are a number of publications and studies on the power generators market, which include analysis of market trends, forecasts, competitive analysis, etc. The general monitoring of the global power generators market is considered in the reports [1–3]. The peculiarities of sectoral markets are revealed in the reports [4, 5]. An overview of the Ukrainian market of power generators and its development trends is presented in the study [6]. These studies are, of course, based on real data on regional and sectoral specifics, but they reflect a static market model and do not consider the impact of shock factors.

The aim of the article is to survey the current situation in the market of electric generators on the basis of a unified methodological approach to their identification in the international information and statistical space, which allows identifying key factors, immanent and explicit trends in its development.

Methods. Electric generators are classified as goods of lower than average technological level [7, 8]. At the same time, studies have different methodological approaches to their identification. In particular, the report [3] considers data only for HS heading 8502, while the study [2] takes into account certain subheadings of HS heading 8501.

In order to avoid amorphous and heterogeneous market conditions and ambivalent methodological approaches to international trade, the authors propose to use the global practice of classifying goods, according to which electric generators are identified by

HS codes 850161, 850162, 850163, 850164, 850211, 850212, 850213, 850220, 850231, 850239, 850240. This standardised methodological approach allows for the formation of a unified statistical database for coordinated and harmonised efforts at the national and international levels.

The survey of the electric generators market includes the collection and analysis of data provided by Fortune Business Insights, Mordor Intelligence, Pro Consulting, The Business Research Company, United Nations and obtained from the National Bank of Ukraine, State Customs Service of Ukraine, State Statistics Service of Ukraine.

To assess the dynamics and state of the global power generators market, data for 2021 and 2022 are compared. To study the national market of Ukraine, the analysis was carried out for 2018–2022.

3 Results of the Investigation

3.1 Trends in the Development of the World Market of Electric Power Generators

The global market of power generators reached USD 26.7 billion in 2021. In 2022, it was USD 27.8 billion [2]. Almost 90% of power generators are traded internationally. According to the UN, in 2021, global exports amounted to USD 23.8 billion, imports - USD 29.5 billion (Fig. 1).

In 2021, three groups of generators accounted for almost 2/3 of global exports. The greatest demand exists for wind power generators under HS code 850231 (30% of total generator exports), spark-ignition internal combustion piston engines under HS code 850220 (21.3%) and alternators with a capacity of more than 750 kVA under HS code 850164 (14.2%).

The largest markets for power generators are the UK and China, which jointly accounted for 14% of the global market. The UK's leadership is due to the high demand for wind turbines in the country. Another 9 countries (Brazil, the US, India, Indonesia, Turkey, Japan, Nigeria, South Korea, and Angola) account for another 15% of the market.

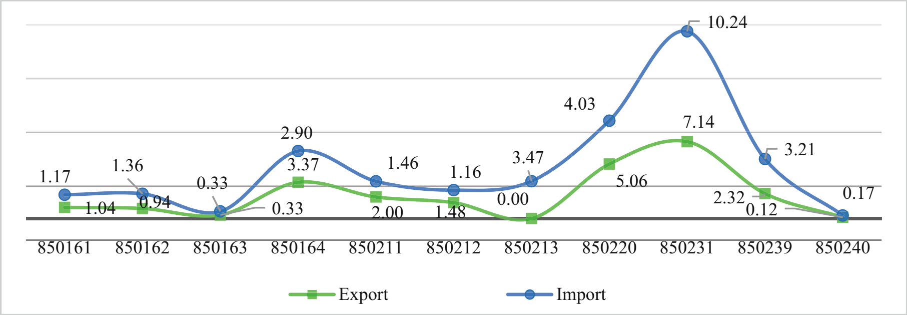

Fig. 1. Dynamics of world trade of electric generators, 2021, USD billion. Source: Authors' calculations based on [9].

Net exporters of power generators are China (USD 8 of exports equals USD 1 of imports), Germany (USD 4.2) and Italy (USD 1.8). The UK, the USA, South Korea and France are net importers.

More than half of the world's exports were provided by generators from the following 5 countries: China (27%), Germany (15.9%), the USA (7.7%), Italy (3.2%) and the UK (2,7%). The top 5 importers are the United States (11%) and the United Kingdom (8.4%), Germany (3.1%), China (2.7%) and South Korea (2.5%).

The structure of the global power generator market is divided into three categories of consumers: industrial, commercial and residential segments. In 2021, the commercial segment (healthcare, telecommunications, aquaculture, agriculture, government, data centres, educational institutions, and hospitality) accounted for the largest revenue share of 45% and is expected to record significant growth in the short term.

The industrial applications segment accounted for the second largest revenue share in the generator sets market in 2021 (30%). It includes the oil and gas, transport and logistics, mining, power generation, manufacturing, and construction sectors. Favourable government schemes for industrial development in emerging economies (China, Brazil, and India) are a key factor driving the demand for generator sets in this segment [10].

The residential segment accounts for a relatively smaller market share compared to other segments (25%). The growing number of power outages, increasing consumer awareness and rising demand for primary grid load are some of the key factors driving demand for generator sets in the residential sector.

The residential sector in developed economies, the commercial and industrial sectors in emerging economies, and the growing need for defence capacity are expected to create significant opportunities for market participants in the near future.

Geographically, the Asia-Pacific market accounted for the largest revenue share in 2022 (29%). China had the largest share of revenue in the region, accounting for 22.6%. The expansion of commercial office space, increasing power demand shortages, and the growing number of infrastructure projects and manufacturing facilities in the country are expected to drive the market across the region [11].

In 2022, North America had the second largest market share at 20%. The growing weakness of the power grid to weather-related disruptions, coupled with the expansion of data centre infrastructure and other commercial sectors, has raised the demand for reliable backup power solutions, thereby driving the demand for generator sets across the region. The presence of major power generation players and original equipment manufacturers, abundant shale gas reserves, favourable government policies for the development of cleaner fuels, and reliable infrastructure for natural gas transportation are expected to stimulate the demand for generator sets over diesel generator sets in the US market.

The global power generator market is extremely competitive and concentrated. The main European players in the global power generators market are FG Wilson (United Kingdom), ABB and MTU Onsite Energy (Germany), Aggreko (Netherlands), Wärtsilä (Finland), Atlas Copco (Sweden), the Asian players are AKSA Power Generation (Turkey), Doosan Corporation (South Korea), Kirloskar Electric Co. Ltd. (India), Honda Siel Power Products Ltd. (Japan), the US - Caterpillar Inc., Cooper Corporation, Cummins Inc., Generac Holdings Inc., General Electric, Kohler Co. [12].

Growing demand for electricity, imperfect power infrastructure, especially in areas far from large cities, the need to provide guaranteed power supply, and the need for backup power for critical infrastructure (hospitals, government offices, business centres, airports, train stations, etc.) and technical equipment (communication towers, data centres, industrial plants, etc.) are key drivers of demand for power generators.

The global average consumption of power generators is estimated at 2.92 units per 1000 people. The highest levels of power generator consumption were in Angola (30 units per 1000 people), South Korea (8.23 units per 1000 people), Japan (7.40 units per 1000 people) [13].

The COVID-19 pandemic has had a negative impact on the genset market globally due to lower demand for electricity, mainly from institutional consumers (industrial and commercial sectors), as many manufacturing plants and retailers were closed during the quarantine. At the same time, the increased use of batteries and other energy storage technologies is not contributing to the market development. Thus, these economic preconditions are slowing down the recovery in the power generator market.

Although the pandemic is hampering business investment, it is helping to increase the provision of equipment to healthcare facilities and raise demand for portable generators. Additional demand may be created in countries with outdated centralised power supplies, such as many African countries. In addition, lower oil prices are making fuel more widely available. Consequently, the cost of electricity generated by fuel-fired equipment is falling, promoting the use of electric generator sets. Growing social anxiety, as well as the threat of isolation due to the virus, may lead to the purchase of portable generators for future use in the event of a power outage in an emergency. The global portable generator market is expected to reach USD 2.5 billion by 2024.

The growing demand for energy from the manufacturing industry will provide greater market opportunities for generators. However, factors such as high installation and operating costs, preference for environmentally friendly alternatives (e.g. solar, fuel cells, etc.), and overcapacity are restraining market growth. Another restraining factor is the development of Industry 4.0, which allows for more efficient energy consumption [14]. Generators below 75 kW are estimated to hold the largest market share, supported by increasing demand from telecommunications, retail, other commercial buildings, and the residential sector. In the industrial segment, demand will be driven by generators with a capacity of 1000 kW and above.

As industrial and other high-capacity generators are expensive equipment, their installation and use correspond to capital expenditure amidst the overall growth of industry and trade. Construction dynamics also directly impact the generator market: business centres, retail outlets, infrastructure and social facilities are increasingly equipped with backup generator sets, while residential construction is driving demand for portable generators for private homes, which are typically purchased for power outages. Another fundamental driver of market growth is the expansion of the IT and telecommunications sectors: the world's wireless and mobile Internet coverage grows, and the infrastructure for these requires a stable power supply. The development of electric transport (especially electric cars) will require the creation of a large-scale network of charging stations, creating a demand for generators (local generators can become additional or even primary sources of energy for charging stations in hard-to-reach locations). Measures to mobilise the medical system and equip temporary hospitals will require many generators.

While economic growth in emerging markets is increasing industrial activity and promoting the generator market, regional government initiatives to maintain reliable energy infrastructure and raise environmental standards will restrict the generator market.

In the wind energy segment, with worldwide exports of USD 6.1bn in 2019, favourable government policies worldwide are also an additional factor. Increased environmental focus and the political goal of reducing the carbon emission will lead to higher demand for alternative energy generators, including wind turbines.

Considering the above, the dynamics of the global power generator market generally reflects the overall GDP growth. Russian aggression has undermined the chances of the global economy recovering from the COVID-19 pandemic in the short term.

In 2023, the global market volume for power generators is forecast to reach USD 29.54 billion. In the medium term, as the global economy recovers from the effects of the pandemic, the power generator market is expected to grow gradually. Demand will increase from industries such as mining, oil and gas, and pharmaceuticals. The global market for electric generators will grow to USD 36.27 billion in 2027, with an average annual growth rate of 5.3–6.5% [1]. This indicates that countries are turning more attention to their energy autonomy.

The market is expected to show a slight upward trend until 2030, which is projected to increase the market volume to 25 million units.

3.2 Analysis of the Electricity Generator Market of Ukraine

In 2022, massive Russian missile attacks on Ukraine's energy infrastructure, especially on transformer substations responsible for supplying electricity from the plant, complicated the work of transporting electricity. The level of damage to the Ukrainian power system as a result of the Russian attacks ranged from 35% to 45%. Overall electricity production in Ukraine decreased by 27.5% and consumption by 31.5% [15]. This situation led to a "generator boom". As domestic production of generators did not meet demand, the deficit had to be covered by imports from other countries.

In 2022, Ukraine imported nearly USD 555 million worth of power generators. This is a 9-fold increase compared to 2021, and more than USD 13 million worth of generators were exported. The total value of exported generators was more than USD 13 million (1.7 times less than in 2021). This led to a significant increase in the foreign trade deficit in this group of goods, which reached USD 0.54 billion (Fig. 2).

In 2022, Ukraine exported 67.6 thsd units of electric generators. Electric generators with motors with a capacity of no more than 37.5 W (Ukrainian Classification of Goods for Foreign Economic Activity code 8501109300) made up 74.7% of the total number of exported electric generators; direct current generators with a capacity of no more than 750 W (8501310098) – 7.4% and single-phase electric generators with alternating current motors with a capacity of no more than 750 W (8501402090) – 6.6%. The largest markets for Ukrainian electric generators in 2022 were Poland (74.5%), Moldova (7.1%), Hungary (4.6%), the Netherlands (4.2%), and Germany (2.8%).

In 2022, the relevance of generators in Ukraine has never been higher. Long rolling blackouts have become a global problem for both ordinary Ukrainians and businesses.

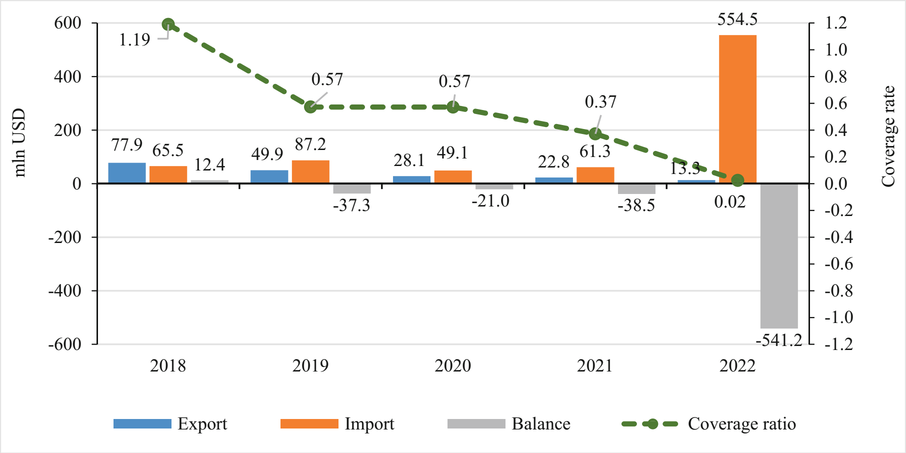

Fig. 2. Foreign trade balance of electric generators in Ukraine, 2018–2022. Source: Authors' calculations based on [16, 17]

Due to missile attacks on the energy infrastructure, generators have become the most sought-after commodity. Given the current situation, to help Ukrainians overcome the consequences of attacks on Ukraine's energy system, in early November 2022, the Government expanded the list of goods that can be imported into Ukraine without paying import duties and VAT. The list includes generators, batteries, other uninterruptible power supplies and electrical equipment. The possibility of importing such goods without paying customs duties was valid until 1 May 2023. However, until the end of 2023, a zero rate of import duty is applied to generators manufactured in EU countries.

Furthermore, to overcome the critical situation in the energy sector and to supply the domestic market with equipment for the restoration and stabilisation of electricity supply, the Government of Ukraine has made a decision to sell power generators, batteries and other devices without the requirements of technical regulations (without a declaration of conformity and without marking with a sign of conformity with technical regulations) until the termination or cancellation of state of war and for the next three months [18].

In 2022, Ukraine experienced a "generator boom", as 645,500 generators were imported, of which 95% were imported by enterprises and only 5% by individuals [19]. From January to early November 2022, 199.7 thousand units of various types of power generators were imported to Ukraine for the amount of USD 109 million. After the implementation of the tax incentives, over the next 2 months, more than 2.2 times more generators were imported and more than 4 times more expensive.

Zero customs duties resulted in a 52 times increase in imports in December 2022 compared to January 2022. If we multiply the number of generators by the minimum capacity in the sector, we get more than 1 GW, which is equal to one power unit of the Khmelnytsky NPP. However, this capacity covers only 1% of Ukraine's electricity needs [20]. Therefore, there is no question of a "generator economy", i.e. one in which generators cover more than half of the needs.

At the same time, there is a downward trend in the average price of imported power generators. While in 2018 the average price of a generator was USD 2,034 per unit. In 2022, it decreased to USD 859 per unit. USD/unit (Fig. 3).

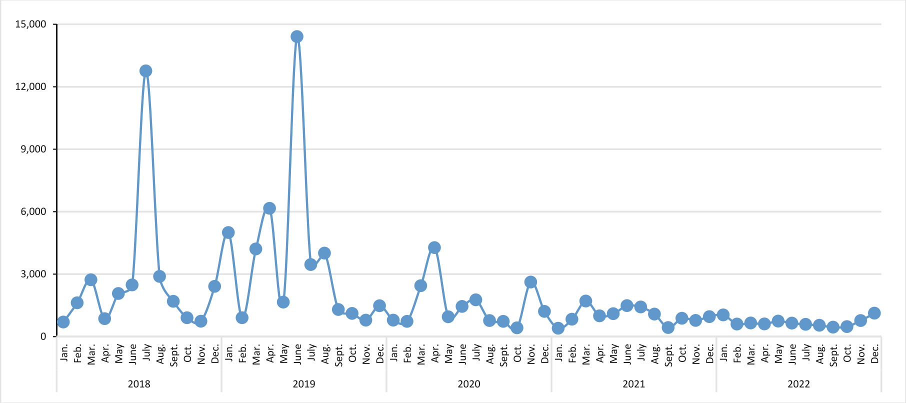

Fig. 3. Average price dynamics of electric generators imports to Ukraine, 2018–2022, USD/unit. Source: Authors' calculations based on [17]

However, due to increased logistics costs and rising fuel prices, the price of imported power generators on the Ukrainian domestic market has increased 2–3 times. In 2022, only 20% of critical retail establishments and about 15% of bank offices were provided with generators [21]. Key infrastructure facilities (including medical institutions) have been equipped with generators before. But one of the main tasks of the state and local authorities was to provide them with additional, more powerful and efficient equipment.

In Ukraine's foreign trade, imports of electric generators with a piston engine with spark ignition with a capacity up to 7.5 kVA (Ukrainian Classification of Goods for Foreign Economic Activity code 8502202090) accounted for 83% of the total imports of electric generators; with a capacity over 7.5 kVA but up to 375 kVA (8502204090) - 6%; electric generators with a piston internal combustion engine with compression ignition (diesel or semi-diesel): with a capacity up to 75 kVA (8502112090) - 4.8%; with a capacity over 7.5 kVA but up to 75 kVA (8502118090) - 4.5%. The total number of imports of electric generators in 2022 was 645.5 thousand units. The largest suppliers of power generators to Ukraine were China (84%), the European Union (8.6%) and Turkey (6%).

Ukraine does not have a full cycle of power generator production. Only a limited number of companies (10–12) manufacture this equipment from imported components [22]. The volume of sales of Ukrainian-made electric motors, generators, and transformers in 2022 was the lowest in the last 6 years. The total volume of sales was USD 67.89 million. The value of sales was USD 67.89 million, of which 77.2% were in Ukraine and the other part was sold outside the country [23] (Fig. 4).

Since the Ukrainian producers can not meet domestic market demand for electric generators, it is filled with foreign brands, such as: AKSA, Dalakiran, JJ Power, Tecsan, and others: AKSA, Dalgakiran, KJ Power, Tecsan (Turkey); Atlas Copco (Sweden),

Europower (Belgium), Caterpillar, Cooper, Cummins, Olimpian (USA), Elcos, Genmac, Green Power, Onis Visa, Tessari (Italy), FG Wilson (United Kingdom), Geko, RID, United Power (Germany); Pezal, Edon, Compass (India), MAST Group, Gucbir, Semi Ultra, PRAMAC (China), etc.

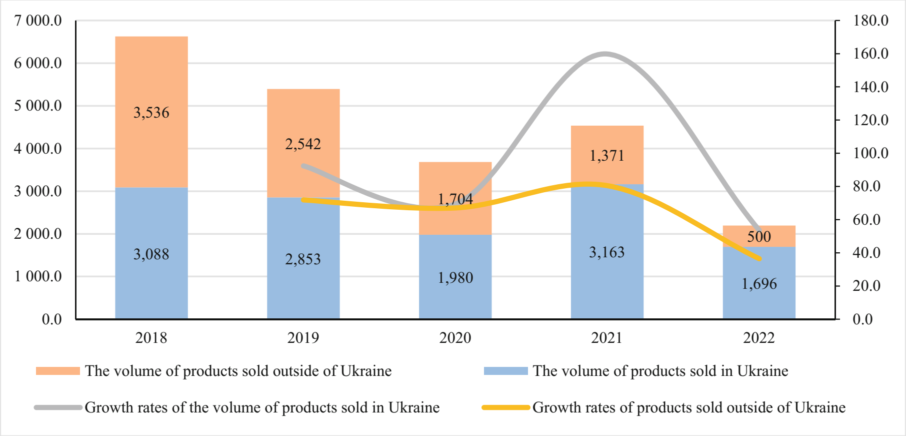

Fig. 4. Ukraine-made electric motors, generators and transformers sales, 2018–2022, UAH million. Source: Authors' calculations based on [23].

On the Ukrainian domestic market, the most popular item among Ukrainians is petrol generators with a capacity of up to 7.5 kW (over 80% of purchased generators), which are suitable for powering both private homes and small businesses. The most popular petrol generators are with a capacity of 2.5–3 kW and 5–6 kW, the price of which ranges from USD 770–1240. USD [21].

The price of electricity in 2022 was $0.05 US per kWh for households and for enterprises 0.15–0.19 USD/kWh. USD/kWh. This is significantly cheaper than the cost of generator electricity (up to USD 1/kWh) [24].

For the simultaneous operation of all generators in Ukraine for one day of rolling blackouts, approximately USD 37.1–74.2 million is required. This is 0.02–0.04% of GDP. The massive switch to generators increased the demand for fuel in Ukraine by 10–20%, which was reflected in its price increase by 68–85% [25].

Moreover, the volume of international humanitarian aid for industrial generators, which can be used to ensure the uninterrupted operation of hospitals, thermal power plants and power stations, pumping units for drinking water supply and other vital facilities, has increased [26].

Ukraine's GDP does not show a linear dependence on a reduction in electricity consumption. The most energy-intensive industries (electricity accounts for more than 10% of intermediate consumption) account for only 20% of GDP. Ukrainian businesses are adapting to the energy terror by using generators and rising prices.

Considering the ongoing military aggression and the increased risk of repeated damage to energy infrastructure, it is advisable to continue the practice of liberalising tariff regulation of generator imports to Ukraine. Due to import dependence on certain types of fuel, it is appropriate to focus on gas generators, as more than half of gas consumption is covered by domestic production. If it is required to launch generators in “peak” mode, it is advisable to cover the needs of critical infrastructure, as well as the population and industry on schedule.

The National Bank of Ukraine estimates that the Ukrainian economy lost 1.3% of its total output in 2022 due to the energy terror. The electricity shortage in 2023 will cost the Ukrainian economy up to 3.6% of economic growth, up to USD 4 billion in additional foreign trade deficit, and an additional 2.5% to inflation. GDP losses due to power outages will also be significant in 2024 - up to −1.5% of economic growth, up to USD 1.2 billion in additional foreign trade deficit. USD of additional foreign trade deficit and an additional 0.4% to inflation [27].

4 Conclusions

The global power generator market exists because of imperfect electrical infrastructure. It has maintained a positive development trend both during the pandemic and Russian aggression. The main consumer is the commercial segment, which needs uninterrupted power supply. Competitive pressure and high concentration of producers amid rising consumer demands are forcing the market to grow expansively. Regions with environmentally oriented government policies are experiencing intensive development of the power generator market. The significant export orientation of production is confirmed by the fact that 9 out of 10 generators produced are involved in international trade. Monitoring of the of the global trade in power generators on the on the basis of a unified statistical database has revealed the avant-garde of exporting countries (China, Germany, USA, Italy, UK) and importing countries (USA, UK). The main trade item is diesel generators for wind power. The key industry demand is the rapid development of the mining, oil and gas, and pharmaceutical industries, as well as construction, alternative energy and telecommunications. The market is projected to expand further by 5.3–6.5% annually as generators become a fundamental condition for national energy stability.

Under the conditions of martial law and due to the constant rolling blackouts in Ukraine, consumers were forced to adapt to the new conditions by providing themselves with backup power sources. There is almost no production of power generators in Ukraine, so the critical demand for these products was met by imports from China, Turkey and the EU. The formation of energy autonomy was facilitated by the duty-free import of generators. Ukraine did not become a “generator economy” despite extensive imports at the end of 2022. The transition of businesses to generators was reflected in a growing foreign trade deficit and inflation, which slowed Ukraine’s economic development in general. The continued military aggression increases the risk of rolling blackouts and heightens the need for power generators in the domestic market.

Further study will require an assessment of the economic effect of using generators during rolling blackouts for energy-dependent industries, including separating the share of the costs of using generators in the value of final products.

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The Use of Goal-Oriented Responsibility System to Motivate Staff in Chinese Construction Companies

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Abstract. The rapid growth of Chinese construction companies today has emphasized effective management and employee motivation by adopting a goal-oriented responsibility system to align employee benefits with corporate goals and boost their motivation and performance. However, employees' reluctance towards this system and ineffective supervision still exists in many Chinese construction companies, which eventually impedes project execution. As a result, this study examines how employee motivation using a goal-oriented responsibility system (GORS) is carried out in a Chinese construction company. We used purposive non-probability sampling to gather 200 employee data from Chinese construction companies through a self-administered questionnaire (SAQ) using Five-Point Likert Scale. We discovered a strong correlation between goal clarity, commitment, and employee motivation. The findings of this study would assist managers of Chinese construction companies in understanding how to increase employee motivation.

Keywords: Employee · Motivation Effect · Goal-Oriented Responsibility System · Construction · Chinese

1 Introduction

Given the current state of the market, it appears that many construction companies across the globe have achieved economic benefits—and employees have also achieved their benefits. As conventional management practices are no longer adequate for most of the company, the concept of "creating efficiency for the company is to increase individual benefits" is applied to the work and has become a cornerstone for construction companies these days [17]. Furthermore, the motivation of employees turned into a key driver in achieving economic benefits for the companies [14], and motivated and engaged employees are more likely to show strong performance and commitment and make a substantial contribution to the overall achievements of the company [14, 20].

Over the past year, the number of construction companies in China has increased and expanded, by 10.3% annually, reaching 128,746 companies in 2021 [1], where most companies have adopted a goal-oriented responsibility system that connects employees

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with the company's objectives, which lends credence to this phenomenon. This system boosts employee motivation in relating company's objectives to clear and specific goals through constructive feedback, promoting goal commitment, and addressing issues to ensure that the employee works effectively [4, 16].

Nevertheless, several Chinese construction companies are still struggling with employee dissatisfaction, which lower worker productivity and quality of work [7]. Moreover, lack of motivation can impede the growth of the company's development, and poor quality of work results in dissatisfied clients and, consequently, a poor company's reputation [23]. Therefore, it is crucial to look into how the goal-oriented responsibility system affects employee motivation in achieving goal setting and motivating staff in Chinese construction companies.

2 Literature Review

2.1 Theoretical Framework

Goal-setting theory has been hailed as the most convincing and robust research paradigm to measure worker motivation [10, 12]. Goal-setting theory explains that individuals' ideas and intentions govern their behaviour, and setting high goals increases task performance [22]. Performance will increase, and attainment is probable when an individual is dedicated and focused on defining a specific goal [9, 13]. This is due to the fact that objectives act as a roadmap for behaviour and provide employees with a sense of direction and purpose [21].

The five critical components of successful goal-setting are task complexity, commitment, feedback, goal clarity, and challenge [11]. When goals are precisely defined, performance performs best as employees can focus and concentrate on what needs to be done [3]. Furthermore, achieving specific goals might facilitate accomplishing other desirable company goals, including lowering the turnover rate, absenteeism, and tardiness [11]. Not only must a goal be clearly defined, but it also needs to be challenging, meaning that goals can be achieved with a bearable amount of difficulty—employees' performance increases when they are given a distinct high performance to strive toward [12]. If goals are merely assigned to employees, they may not be committed to the goals––when goals are challenging to achieve, commitment is particularly crucial as it requires more endurance and effort in the face of unavoidable setbacks [12].

When completing tasks, employees need feedback as it shows how well goals are being attained [11]. Employees can determine the performance improvements required to advance through feedback [15]. Moreover, some objectives require more complexity to be achieved, but it should be reasonable. If a company's goals are overly complex, it may have a negative impact on employee motivation [13]. In order to increase employee engagement inside the organisation, a company should break down goals into more manageable tasks [3].

2.2 Hypotheses

The following five hypotheses were set up to test the various dimension relationship between goal setting and employee motivation:

H_1: Goal clarity and employee motivation are positively related.
H_2: Challenging goal and employee motivation are positively related.
H_3: Goal commitment and employee motivation are positively associated.
H_4: Feedback and employee motivation are positively correlated.
H_5: Job complexity and employee motivation are positively related.

A conceptual framework has been established and developed based on the Goal-Setting Theory in order to get a better understanding (see Fig. 1).

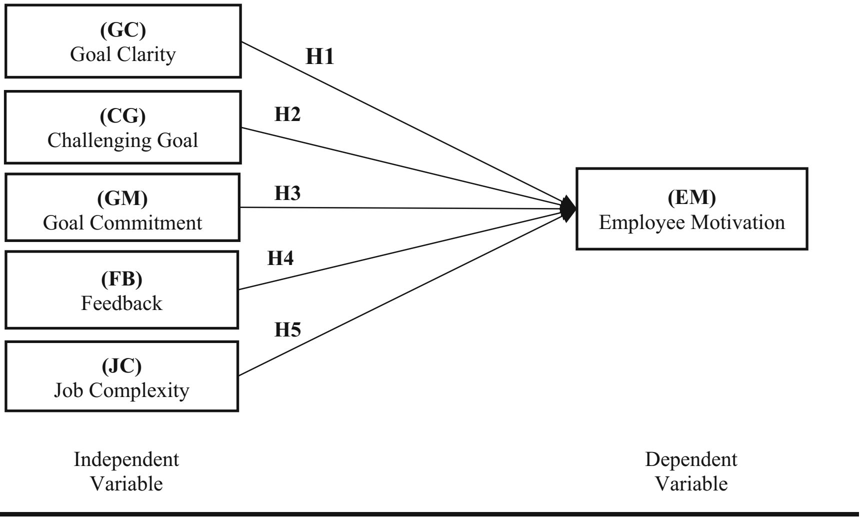

Fig. 1. Proposed Conceptual Framework

3 Research Methodology

In this study, we aim to find out how a goal-oriented responsibility system affects the motivation of adult male and female employees aged 18 to 60 who work for Chinese construction companies in China. A purposive non-probability sampling technique is used to collect samples from the respondents as we would like to access a specific subset of the samples with certain characteristics—in this case, the workers of Chinese construction companies.

Due to the COVID-19 pandemic and movement control restrictions, all data was gathered online over 14 days. A self-administered questionnaire (SAQ) was created using the WeChat form builder, in which 200 data were gathered. Additionally, we utilised a Five-Point Likert scale, which ranges from 1 ("strongly disagree") to 5 ("strongly agree"), as it gives respondents more options without making them feel overwhelmed and provides a deeper understanding of their thoughts and feelings.

4 Data Analysis

A total of 200 responses were gathered and met the requirements of the questionnaire, where we utilised the Statistical Package for Social Science (SPSS) v.26.0 to generate the data and test the hypotheses. Table 1 reports the descriptive statistics.

Table 1. Demographic Statistics

Demographic	Characteristics	Percentage (%)
Gender	Male	71.5
	Female	28.5
Age	18–25	6.0
	26–33	25.0
	34–41	38.0
	42–49	22.0
	50–60	9.0
Years of Working	Below 1 year	6.0
	1–2 years	25.5
	3–4 years	44.0
	5 years and above	24.0
TOTAL		**100.0**

Source: Authors' survey

4.1 Descriptive Statistics

We assessed the variables' central tendency, dispersion, and overall distribution using descriptive statistics in a dataset. As shown in Table 2 below, the respondents generally show positive perceptions towards all variables with moderate variability.

4.2 Reliability and Validity Measurement

Cronbach's Alpha (α) is used to assess the reliability of items; a higher value denotes a higher level of reliability and internal consistency among the items in a [18]. All of the constructs employed have coefficient α greater than 0.7, indicating that all constructs have better consistency among the items (see Table 3).

The Kaiser-Meyer-Olkin (KMO) metric was used to assess the adequacy of the sample size for conducting a factor analysis (see Table 4). Further, a KMO value ranges from 0 to 1, with values between 0.8 and 1.0 indicating adequate sampling and values below 0.6 indicating the need for corrective action [5, 8]. As a result, factor analysis is justified, and all constructs employed in this study have KMO values over the permissible cut-off [2].

Table 2. Descriptive Statistics

Construct	Items	Missing	Mean	Median	Standard Deviation
Employee Motivation	EM1	0	3.525	4	1.45256
	EM2		3.580		1.35750
	EM3		3.540		1.35558
	EM4		3.500		1.24811
Goal Clarity	GC1	0	3.585	4	1.38650
	GC2		3.450		1.32903
	GC3		3.360		1.34889
	GC4		3.340		1.38709
Challenging Goal	CG1	0	3.350	4	1.44844
	CG2		3.490		1.38546
	CG3		3.440		1.34366
	CG4		3.455		1.31782
Goal Commitment	GM1	0	3.580	4	1.40122
	GM2		3.645		1.39236
	GM3		3.545		1.35171
	GM4		3.670		1.34168
Feedback	FB1	0	3.600	4	1.39633
	FB2		3.510		1.32998
	FB3		3.625		1.29936
	FB4		3.625		1.34664
Job Complexity	JC1	0	3.520	4	1.34486
	JC2		3.660		1.32786
	JC3		3.625		1.46118
	JC4		3.610		1.35168

Source: Authors' survey

4.3 Multiple Linear Regression

This study conducts multiple regression to predict the correlation between EM and the five predictor variables proposed (e.g., GC, CG, GM, FB, and JC). As can be observed, there is a strong positive relationship between the set of predictor variables and EM, with the R-value of the model is 0.912 [6]. Additionally, the R Square value of 0.831 indicates that only 83.1% of the variance in EM can be explained by the model [6], and a Durbin-Watson of 2.026 indicates there is little autocorrelation in the residuals, suggesting that the model's assumptions about independence of observations are met (see Table 5).

Table 3. Reliability Measurement

Construct' Items	No. of Items	Cronbach's Alpha (α)
EM	4	0.928
GC	4	0.886
CG	4	0.897
GM	4	0.927
FB	4	0.924
JC	4	0.915

Source: Authors' survey

Table 4. Validity Measurement

Construct's Items	KMO	Approx. Chi-Square	Sig.
EM	0.841	640.936	0.000
GC	0.799	449.555	0.000
CG	0.805	489.941	0.000
GM	0.862	613.443	0.000
FB	0.860	593.626	0.000
JC	0.836	568.399	0.000

Source: Authors' survey

Table 5. Model Summary

Model Summary[b]					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.912[a]	.831	.827	.51135	2.026

[a] Predictors: (Constant), Job Complexity, Goal Clarity, Feedback, Challenging Goal, Goal Commitment

[b] Dependent Variable: Employee Motivation

Source: Authors' survey

The overall significance of the multiple regression model is evaluated using the ANOVA—if the significance value falls below the cut-off of 0.05, the model of this study is considered statistically significant, and the null hypothesis can be ruled out [6] (see Table 6).

Based on our findings in Table 7, GC and GM are statistically significant as the significance value is below 0.05, indicating that both variables significantly affect EM. However, CG (0.837), FB (0.303), and JC (0.201) are not statistically significant, which

Table 6. ANOVA Results

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	250.198	5	50.040	191.371	.000[b]
	Residual	50.727	194	.261		
	Total	300.925	199			

[a] Dependent Variable: Employee Motivation

[b] Predictors: (Constant), Job Complexity, Goal Clarity, Feedback, Challenging Goal, Goal Commitment

Source: Authors' survey

Table 7. Coefficients

Coefficients[a]							
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	.109	.119		.920	.359		
GC	.476	.076	.456	6.290	.000	.166	6.038
CG	.017	.080	.016	.206	.837	.141	7.098
GM	.451	.079	.456	5.736	.000	.138	7.269
FB	−.079	.076	−.078	−1.032	.303	.153	6.531
JC	.108	.086	.108	1.258	.210	.118	8.481

[a] Dependent Variable: Employee Motivation

Source: Authors' survey

indicates that these constructs may not have a significant impact on EM. Additionally, all constructs have tolerance values higher than 0.1 and VIF values below 10, meaning there are no multicollinearity issues among all the constructs [6] (see Table 7).

5 Conclusion and Discussion

In Chinese construction companies, goal clarity and goal commitment are the main predictors of employee motivation. Employees are more likely to be motivated and perform well when they clearly understand their goals and are committed to achieving them. On the other hand, other factors like challenging goals, feedback, and job complexity are not statistically significant in explaining employee motivation. However, these factors may be important in explaining employee performance and job satisfaction.

5.1 Implication of the Study

The study's implication reinforces the Goal-Setting Theory paradigm to understand the factors affecting employee motivation. This study highlights how critical it is for managers of Chinese construction companies to set clear, precise, and challenging goals to boost employee motivation. Providing clear and specific goals aligned with employee values and interests makes employees more likely to commit to their jobs. In this way, a more engaged and productive workforce can be motivated to meet the challenges of a changing business environment.

5.2 Limitation and Recommendation for Further Research

This study was successfully carried out—however, as the authors went through, several limitations discovered in this study need to be addressed. The first limitation is the method used to gather samples, where purposive non-probability sampling limits generalization as it is applied to a specific group of employees [19]. Consequently, it is advised that future research may replicate the current findings in other sectors to increase the generalizability of the results. Another limitation discovered is that this study only proposed five factors that may impact employee motivation, which may not adequately represent the full spectrum of potential factors that could affect employee motivation. Lastly, this study's lack of a mediating variable restricts our understanding of a clear cause-and-effect relationship. In subsequent studies it is advisable to add mediating variables to comprehensively appraise the relationship underpinning the motivating effect of a goal-oriented responsibility system to achieve its optimal maximum impact [6] in the model. Based on the results and the limitations, it would be captivating to consider these limitations, which would help managers of Chinese construction companies to comprehend how to implement a goal-oriented responsibility system in order to achieve and optimized increase employee motivation in various contexts.

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Sustaining Businesses on the Historic Braga Street, Bandung, Indonesia: An Exploratory Study Using Experience Economy Concept

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Abstract. This paper explores the application of the Experience Economy concept by business owners on the historic Braga Street in Bandung, Indonesia. It involved 11 respondents, including business owners and staffs, with whom in-depth interviews were conducted. Findings suggest that the strategic location of Braga Street became the primary reason for setting up the businesses in the area. However, some respondents were aware of the special characteristic of Braga Street and its old buildings, which they deemed to have contributed to the unique atmosphere of the businesses. Thus, Experience Economy is present as part of the products sold on Braga Street. Several aspects that can be used to sustain businesses on Braga Street include local communities' support, product innovation, provision of public infrastructures and facilities as well as maintaining cleanliness, and continuous marketing using the latest technology, such as social media. This study contributes to the heritage tourism domain, and can be improved by involving more respondents and ample time for further exploration of the phenomenon.

Keywords: Business Sustainability · Experience Economy · Heritage Buildings · Historic District · Heritage Tourism

1 Introduction

'Business sustainability' can be an ultimate goal of a business. It can be defined as "meeting the needs of the organization and its stakeholders today while also protecting, sustaining, and enhancing the environmental, social, and economic resources needed for the future" [1]. Even though 'business sustainability' is an emerging discipline, business practitioners and scholars have applied, studied, and proposed various business sustainability concepts and formulas for helping businesses achieve their sustainability [1]. Some scholars specifically have been studying tourism and hospitality businesses

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that utilize heritage buildings and the experience economy aspect of such businesses [e.g. 2–4]. However, as far as the authors were concerned, little is known regarding how businesses that utilize heritage properties can sustain themselves. This paper presents a result of a study that explored how businesses that reuse heritage buildings can sustain themselves, based on a case study that involved businesses on the historic Braga Street in Bandung, the capital of West Java, Indonesia.

Braga Street, strategically located in the heart of Bandung, is one of the city's historic districts. The history of Braga Street began after the Dutch East Indies administration decided to relocate the capital from Batavia, now Jakarta, to Bandung in the hinterland of Western Java in 1917. During the 1920s and 1930s, Braga Street flourished as one of the most prominent shopping streets in the Dutch East Indies, now Indonesia. Buildings on this street were designed in Art Deco architectural style from the 1920s and 1930s, that has given this street a distinguished look compared to other cities in Indonesia. After Indonesia proclaimed its independence in 1945, the street experienced a constant downfall in function and fame over time. Despite the fact that many buildings on Braga Street have been reconstructed in different architectural styles in the following decades, many are still intact and conserved in its original style. Some of the conserved buildings even were enlisted as Bandung's heritage, which ensures their protection. However, starting in the second decade of the new millennium, Braga Street began to regain its popularity as a commercial street with the emergence of a number of businesses that revitalized the old buildings [5]. Such revitalization was not part of the municipal government's programs but emerged as a sporadic and spontaneous phenomenon based on the business owners' initiatives. The reuse of several local heritage buildings eventually spread to many others on the street, creating a circumstance that had never occurred before, where the street became lively with businesses and visitors. Most of the local businesses on Braga Street today provide food and beverages that cater to both residents and tourists visiting this street.

The rapid growth of businesses on Braga Street since about the mid-2010s has raised authors' interest to explore. Among the questions that rose included: What interested business owners to choose the historic Braga Street as their business location? What are the benefits and challenges of running a business on the historic Braga Street? And what aspects do these business owners' think that can help sustain their businesses on the historic Braga Street?

To explore the phenomenon, this study employed Experience Economy as a conceptual framework. Experience Economy (EE) is defined as "an economy in which many goods or services are sold by emphasizing the effect they can have on people's life" [6]. In other words, the products sold in the EE is a combination of goods and services that collectively and ultimately create experiences to the customers [7]. This study is specifically intended to explore if business owners on Braga Street applied the EE concept to their business operations.

This study was based on the authors' assumption that the unique ambiance of the business sites became an element that complements the goods and services sold on Braga Street. In analyzing the findings, including what interested business owners on Braga Street to select the location and reuse the heritage buildings, what benefits they gained and what challenges they faced in the operation of their businesses, and what aspects they think are important to sustain their businesses, the EE concept was used. Findings of this study can contribute to the knowledge bodies of EE and heritage tourism, as well as to generate preliminary information on the aspects that can help business owners on Braga Street sustain their businesses. The authors considered it is necessary to generate knowledge about how businesses that reuse heritage buildings can sustain their businesses since heritage can give an identity to a place and be an asset to a city tourism.

2 Conceptual Review: Experience Economy

According to Pine and Gilmore [8], EE is an economy concept of providing something valuable to the consumers. The goods or services offered not only have economic values but also give different experiences to the consumers. Based on these characteristics, EE offers experiences or intangible output. Many consumers need experiences beyond purchases of goods. A study by two psychology professors, Carter and Gilovich, summarized that the purchase of experiences makes people happier, with a greater sense of wealth than just buying goods [9, 10]. The same is true with a research by The Economist that summarized that happiness is "'experiences' over commodities, pastimes over knick-knacks, doing over having" [11].

The EE concept lies on the fourth stage of a product value line. The first stage is commodities, where products are low valued as they are still in a form of basic material, such as coffee beans. The second stage is goods, or products in a form of processed raw materials that have added values, such as coffee powder. The third stage is service, or products that combine processed materials and services, such as a cup of coffee sold at a store or a cafe. The fourth stage is experience, where the aforementioned goods, services, and atmosphere are combined to create experience for the consumers, such as a cup of coffee enjoyed in a comfortable setting with personal attention given by staffs to the customers [8]. For example, Starbucks does not only sell coffee-based beverages as its products but also services and atmosphere where customers can enjoy its beverages while also receiving individual services and enjoying a comfortable ambiance.

Application of EE can create a more relevant offer based on individual buyer's needs and wants. What's more, the goods and services offered have their uniquenesses that differentiate them from the competitor's products, so the prices offered are appropriate and suitable to sell to the buyers because the experiences offered through the goods and services. On each stage in the EE product value line, products effectively reach consumers through sensation approach, impression, and planned performances so every consumer has unforgettable experiences. This causes the importance of customization in every stage in the EE concept. When a company adjusts itself to the consumers, it means the company has involved consumers in the offer produced only for the consumers, and can easily gain a good impression.

In regard with tourism, EE is closely related as tourism involves services and experiences. One of the sectors that builds tourism is service or hospitality industry, such as food and beverages, hotel, and transportation industries. In the growing EE era like today, a multitude of service or hospitality businesses serve not only food, beverages, rooms, transportation, and the accompanying services as their main products, but also a special atmosphere that eventually build experiences.

3 Methods

Based on the research questions, which intended to explore the business owners' application of the EE concept to their business operations on Braga Street, this study used a qualitative approach. A qualitative approach usually is exploratory, which requires deep exploration of data from carefully selected, qualified respondents.

The characteristics of the study population in this study were narrowed down to include any representative of selected businesses on Braga Street, that included any business owner or staff who was assigned by the business owners to provide data for this study. In particular, the selected businesses should be those that occupy a heritage building on Braga Street that still maintains their original physical condition from the era when the building was constructed, regardless of the lifetime of the business. In addition, the businesses should be non-franchise to help the authors learn the business owners' original intention regarding the design of the physical and non-physical aspects of their goods and services rather than what was standardized by the corporation as applied by franchise businesses. Selection of the business also was limited to that that was in the line of food and beverages, as this kind of business wholly exemplifies EE.

A preliminary field work in February 2023 managed to identify about 66 old buildings on Braga Street that were used as business sites. Of the 66 old buildings, the number was narrowed down to 21. Such decision was made considering food and beverages businesses clearly involve all the elements of EE, namely goods, services, and atmosphere. Using a snowball sampling method, the interview began with one respondent who was considered as knowledgeable of the business, who then gave a recommendation on the following respondents, resulting in a final number of 11 respondents. The 11 respondents, anonymously coded R1 to R11 to protect their identity and privacy, included owners, as well as managers, supervisors, and staffs. The supervisors and staffs were selected and assigned by their managers, who were unavailable for interviews, and selected based on the managers' consideration that the supervisors and staffs have the sufficient knowledge to answer the interview questions. The interviews were conducted between May and July 2023, before the data obtained were considered to have reached saturation.

This study used primary data based on interviews with the 11 respondents as well as on field observation regarding the recent conditions of the buildings included in this study. In obtaining such data, data collection methods included in-depth interviews with the 11 respondents, field observation, and literature study regarding the history of Braga Street in general. Such observation was used to observe the conditions of the external and internal buildings used as business sites, and the general surrounding environments, which is Braga Street. The literature study, which included academic papers studying the same topic as this study, was used to get an idea of the concepts and findings of the previous studies. This effort was conducted to get an idea of the gap in the theme of the study.

The instruments used in obtaining the data included interview guidelines and the interview questions. Recorded interviews were then transcribed verbatim into a transcription, which was then identified using each respondent's code. Aside from that, photo documentation of Braga Street was done to record the most recent conditions of the street and the buildings used for business by respondents.

The data obtained were then analyzed through the following steps, including transcriptions of the written documents, development of coding tables, which served as a guide to data reduction, reduction of data into display table and organization of data in a form of quotes that are suitable with each theme in coding, test of the quality of data using triangulation to validate study data, interpretation of data through a table, and, finally, writing of the findings and insertion of quotes as a result of coding to support findings of interview.

4 Results and Discussion

Interviews with the 11 respondents revealed that location is the main factor for the business owners in selecting the business location. In terms of the benefits and challenges of reusing heritage buildings, ambiance and economy were the main advantages, whereas building restoration and maintenance as well as the local socio-cultural environments as the challenges. Respondents opined that cleanliness, use of information technology, provision of supporting public facilities, and innovative products are some aspects that can help sustain their businesses on Braga Street.

4.1 Results

Location Was the Primary Factor to the Business Owners in Selecting Braga Street as Their Business Location. Seven respondents conveyed that location was the primary and determinant factor in selecting Braga Street as their business location. They said the location of Braga Street, which was strategically situated in the center of Bandung, attracted them to build and operate their businesses on this street. A few of the business owners previously based their businesses on some other locations in the city before relocating them to Braga Street.

Despite the location factor that many respondents conveyed, to some respondents, the historic and heritage value of Braga Street and its old buildings that drew visitors was another consideration to select Braga Street as their business location, as shared by one respondent (R3):

> As time goes by – well, because I'm new here [so I'm learning that …] – the concept or atmosphere presented in this establishment tends to be vintage. This was, historically, a movie theatre. So, the first floor is where the cashier was, and the second floor is where the movie theatre was. So, the company did not change the element of history, and that becomes an attraction for the café. That's why it's different from the other cafés – here, we tend to sell the authenticity of the old-time design when it functioned as a movie theatre.

As a new staff in the establishment, R3 was not aware in the first place of the historic and heritage value of the building. However, at some stage, R3 realized that such value became a distinctive value and competitive advantage to the business. R3 also shared the business owner's attitude toward such value, which also reflected their awareness of the importance of maintaining such value for the business.

Ambiance and Economy Were Major Advantages of Using Old Buildings on Braga Street as Business Location to the Business Owners. Five respondents perceived the ambiance of the old buildings they utilized on Braga Street as an advantage to their businesses. They realized that the physical aspect of the buildings – such as the architectural style, the façade, and the interior – as an added value to their businesses. To some other respondents, the vintage atmosphere had contributed to the attractiveness of their businesses, as conveyed by one respondent (R5), "There is the real benefit [of the vintage atmosphere] to the sales because of the experience [as a product as in experience economy] as I mentioned. It's because it has a different atmosphere, which makes people automatically enjoy it." The vintage aspect added to the specialty of the street and the old buildings, which became an appeal to most visitors to Braga Street and some customers of their businesses.

In addition to the ambiance, one respondent, R3, expressed that the old building utilized can generate economic benefits. R3 thought that the heritage or historical aspect of the old building added values to the business. R3 also opined that old buildings could be used as business sites while their special values are maintained. Further than that, R3 thought that the economic benefits included those that directly impact the business owners, such as generating profits as well as creating new job opportunities for the community.

Restoration and Maintenance of the Old Buildings, and Lack of Support from the Local Community, Were the Challenges of Utilizing Old Buildings on Braga Street. Two respondents revealed that one of the challenges of utilizing the old buildings on Braga Street as business sites was the restoration and maintenance work. They said that restoring and maintaining old buildings would be more challenging, specifically in terms of high costs and maintenance of the building materials, compared to newer buildings. One respondent (R5) said:

> The challenge is real because – like a hotel where it has many ballrooms that cater for large capacities – here it's more about a building that is enlisted as a protected heritage one so we're not allowed to reconstruct it, and this leads to a limited capacity. So, if, for example, a guest or a client intends to hold an event or a meeting here, I prefer inviting them to check out the condition first. Also, because it's an old building, it's quite challenging. It's not plastered with cement but limestone. So, when it gets a little moisty, there will be blisters [on the walls] so we need to repaint them, sometimes crack them because of these blisters. So, we recreated this [space] because it's impossible to reconstruct the interior part.

Meanwhile, all respondents agreed that lack of support from the local community who lived in the surrounding area of Braga Street was a challenge. They said that such lack of support resulted in lack of cleanliness on Braga Street, rise of thugs, and unorganized allocation of street vendors that could reduce the appeal of Braga Street and their own businesses.

Cleanliness, Use of Information Technology, Provision of Supporting Public Facilities, and Innovative Products Were Some Aspects That Could Help Sustain Businesses on Braga Street. In terms of business sustainability, respondents thought that the following aspects were important to achieve the longevity of their businesses, which included cleanliness, use of information technology, provision of supporting facilities, and creation of innovative products.

Ten respondents said that the cleanliness on Braga Street was important in supporting the sustainability of their businesses, as conveyed by one respondent (R7):

> I tend to think about the fact that this [street] is a tourist area so its cleanliness needs to be maintained. Our challenge is, as occurred recently, some graffiti on the walls along Braga Street. We hope the government will issue a warrant for cleaning, moreover this is a historic area of Bandung so it needs government's support to do that – it's not our fault. We don't know who did that but we have to take the responsibility for the cleaning. That's something we feel sorry for so we hope the government will do something about it in the future instead of us do constantly do the job.

Another important aspect to help sustain their businesses was the use of information technology, particularly social media, in promoting their products, as conveyed by nine respondents. Supporting facility primarily was concerned with public access to parking. Seven respondents found that one of the issues on Braga Street was the lack of parking sites, for both local community members and visitors. Provision of sufficient parking lots could contribute to the appeal of Braga Street as a historic street, which was frequented by visitors. The other important aspect to support their business sustainability was product innovation, which included addition of new products, promotion, and socialization of products. This means, respondents need to find innovations to make their products interesting and to attract ever changing customers from time to time.

4.2 Discussion

As applied to businesses in general, location was the main reason for most respondents to build and operate their businesses on Braga Street. As previously mentioned, Braga Street's strategic location being in the center of Bandung was the main reason, which made it ideal for businesses. Only some respondents were drawn by the heritage and historic values of Braga Street, envisaging the idea of such values as an attraction for visitors to the area. This finding suggests that the respondents in this study still were attracted by the strategic location and the significance of the old buildings, which could contribute to the uniqueness and the attractiveness of both Braga Street as well as their businesses. This finding also reflects that of a previous study regarding the limited awareness among the Indonesian people in general of conscious heritage conservation and its benefits to the community at large [5]. The study revealed that conscious heritage conservation and its importance in Indonesia only emerged for the first time in the mid-1980s, specifically among a small segment of scholars in the architecture domain. Even though conscious heritage conservation has been diffusing among a wider range of stakeholders since then, it still can be assumed that the number of people in general with awareness of the importance of heritage conservation is still relatively low compared to the number of the Indonesian population.

However, at some point in the running of the business, some respondents became aware of the heritage and historical values of Braga Street. As they were managing the businesses, they learned that such values can contribute to the uniqueness of Braga Street and the old buildings they utilize. This implies some respondents' rising awareness of the advantage of conserving the vintage atmosphere of Braga Street to the businesses. This reflects the existence of the EE notion among some respondents. Respondents agreed that the vintage ambiance can contribute to the attractiveness of the business sites. This awareness occurred as they were managing the businesses, when they realized that customers visit their establishment not only to consume the goods and the services provided but also the vintage atmosphere. The rising fame of the EE concept, which was applied and clearly demonstrated by the growing modern coffee culture as exemplified by Starbucks, seem to have contributed to the diffusion of the concept among the Indonesian society in general and the respondents in this study in particular.

In terms of challenges, respondents unanimously agreed that local community's support for the business had been a central issue. The areas surrounding Braga Street are heavily populated, thus it is only possible that different perspectives on Braga Street emerged among local community members. Some community members may favor the rebirth of Braga Street with positive attitudes while some others may disagree or take advantage from the phenomenon in a less positive manner, creating what some respondents called "thugs". Only a few respondents were aware of the challenge of maintaining the physical aspect of the old buildings. This condition probably reflects the main concern among the respondents regarding strategic location as the primary consideration, and their lack of awareness of heritage conservation.

In terms of business sustainability, most respondents conveyed some factors that they thought will help with achieving the goal. The factors included local communities' support, product innovation, provision of infrastructures and facilities as well as cleanliness maintenance, and continuous marketing using the latest technology, for instance social media. All these factors were, in fact, common among other kinds of business. This finding implies the importance of focusing on the product development and promotion using the latest technological tools, building cooperation among the business owners and the municipal government, particularly to provide a safe and comfortable environment for the business owners, visitors, and local communities. Identification of these factors can help plan for a sustainable business for the business owners on Braga Street.

In summary, the EE concept was reflected in the first two of the three stages, namely the stage in which the business owners selected Braga Street and the stage in which they learned the benefits and challenges of managing the businesses on Braga Street.

5 Conclusion and Limitation of Study

It can be concluded that some of the business owners already were aware of and applied the EE concept. At some point, a few respondents in this study recognized both the challenges and benefits of reusing old buildings on Braga Street as their business sites. The benefits included the vintage ambiance and job creation, whereas the challenges included lack of local community's support to a conducive socio-cultural and socio-economic of the local businesses on Braga Street, particularly in terms of cleanliness, safety, and orderliness of the area, as well as the higher costs and difficulties in maintaining old buildings. In sustaining their businesses that are situated in a historic district, respondents raised several concerns, including cleanliness of the area, the need to deploy information technology for marketing their products, provision of supporting public facilities in the area, and creation of innovative products. In general, some respondents became aware of the EE concept at one stage.

This study still poses some limitations, including the time constraint to conduct the study using a qualitative approach. This study could have been improved through a multiple, more thorough interviews with each respondent to obtain more sufficient data. Thus, this study can be used as a preliminary research, which can be continued with a more thorough data collection and involve more qualified respondents. Sufficient time also was crucial in obtaining data in a more rigorous manner. Despite these limitations, however, this study already gave an insight into the application of the EE concept among some of the business owners on Braga Street. Findings of this study contribute to the heritage-related discipline, such as heritage tourism and heritage conservation, as well as that related to EE.

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The Impact of Remote Work and COVID-19 Pandemic on Diversity Management

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Abstract. The paper aims to identify the relationship between remote work and the COVID-19 pandemic on diversity management. Data from previous studies were collected using the systematic review method. The findings confirm that remote work can positively impact diversity management in the presence of the COVID-19 pandemic and beyond. This relationship creates a work-life balance to provide an organizational environment that benefits everyone. The research recommends taking the relationship between remote work and diversity management into careful consideration to survive social crises such as the COVID-19 pandemic.

Keywords: Remote work · Diversity management · COVID-19 pandemic · Systematic review

1 Introduction

In recent days, there has been tension and anxiety about the entry of technology into everything related to our lives and our work in what has been called the digital age (Hantrais et al., 2021). Thus, most sectors have entered the transformation from traditional work to immersion in digital platforms (e.g., companies, industries, banks, universities, etc.) (Hermes et al., 2020). The COVID-19 pandemic forced almost all businesses to move from face-to-face work to work via online platforms. Consequently, this led to the rapid and sudden entry of digitization into our lives (Stephens et al., 2020). Many studies have shown that most of the businesses in 2020 have shifted to work-from-home, where homes became their offices and their worksites (Lund et al., 2020; Williamson et al., 2020). In the Eurofound study (2020), in which 87,477 samples from 27 European countries participated, the study showed that the percentage of those who were working from their homes during the pandemic was 50%. Besides, The United States statistics showed that remote work in the United States reached more than 33% of American employees due to the global impact of COVID-19 (Loewenstein, 2021).

Remote work offers many advantages (e.g., flexibility to work, more time available at home, ability to take care of the family, etc.) (Lewis & Cooper, 2005). However, it has some negatives such as psychological impact, boredom, and lack of achievement in many cases, especially among the male participants (e.g., Guy & Arthur, 2020).

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Diversity management is the practices, plans, and systems that maximize the advantages of the ability to manage people (Abaker et al., 2018). It is an organizational process that generates a diverse organizational cultural environment, which serves employees from different cultural backgrounds to be flexible in rooting differences and addressing concerns (e.g., religious, ethnic, professional, and cultural) (Kellough & Naff, 2004; Pitts, 2006). Fulton et al (1996) argued that remote work has had a tangible impact on the cultural diversity within organizations. Furthermore, it has provided the employees with high flexibility and independence and changed the nature of work and the nature of communication between employees. It motivated the changes in the hierarchical structures to become more flexible and more controllable.

In reviewing the studies of the previous literature, it was found that most of the studies took the quantitative aspect into account concerning studies that talk about remote work, diversity management, and the effect of the Covid-19 pandemic on them (Liberati et al., 2021; Sigahi et al., 2021; Adekoya et al., 2022). On another hand, this study will take a different perspective regarding this field to use the descriptive analytical approach to review the previous literature and draw a valuable conclusion that enriches the theoretical framework with high-quality contributions to the current study. The current study aimed to clarify the relationship between remote work and diversity management in the light of the COVID-19 pandemic of various previous literature and compare it to reveal the effects of cultural, scientific, and technological differences, and other factors. In this regard, the current study question circles around: Does remote work affect diversity management in light of the COVID-19 pandemic? It is an interesting question that needs scientific explanation.

2 Literature Review

2.1 Remote Work

Remote work is an unconventional way of working outside the general framework of the organization, which differs in time and place, as it provides high flexibility in organizing the work schedule and choosing the appropriate location for all parties (Buchanan et al., 2021). The term remote work refers to the balance between life and work, so the individual can work from home to manage his family affairs and complete the required work at the same time (Muralidhar et al., 2020). The sudden entry of the Covid-19 pandemic forced people to stay in their homes to safeguard their health. Therefore, to have to move from working in an organized place to working from home provides the ability to achieve balance and equality between work and life (Adekoya et al., 2022). The entry of the pandemic led to a global economic recession that affected most of the business sector, forcing the world to change the plan for digital transformation to be able to stop losses and try to revive the market again to balance health and work (Buchanan et al., 2021). The telework revolution began in scientific publications in the seventies, in 1974 the book "Future Shock" by the American sociologist Alvin Toffler stated that it was possible to shift work and move the office to homes (Morgan, 1974). Nilles (1997), argued that electronic devices can be used to work in a home office for businesses.

The concept of remote work came into force during the eighties in the USA. Currently, most Americans or all of them will work remotely (Huws et al., 2018). Unfortunately, this project stopped due to the high cost, the difficulty of adapting to information technology, the lack of readiness of the administration, and the inability of unions to protect information at that time (Huws et al., 2018).

In 1994, Thierry Breton presented an improved model for using wired, wireless, and computer equipment to perform remote work (Nilles, 1997). Afterwards, the structural model at work was changed to the official nature of voluntary work from a distance in the entry of social revolutions accompanied by economic developments in a noticeable way (Huws et al., 2018). In the 21st century, technological development has amplified dramatically, especially in the European Union, where revolutions have taken place in the form of globalization, increased mobility, and de-concentration of work, which has led to the acceleration and the use of information technology in multiple sectors (Doganis, 2005). Furthermore, in entering the Covid-19 pandemic, all sectors and businesses, large and small, were forced to work remotely to stop losses and revive the economy again for the ability to compete and be sustainable in the labor market (Kapoor, 2020).

2.2 Diversity Management

Diversity management is practices and systems implemented to manage people, which provide advantages for diversity while trying to reduce defects in those management practices, as it is an organizational environment that seeks to serve employees from different environments (Abaker et al., 2018). It is also used to address religious, ethnic, cultural, and scientific conflicts and differences that represent a radical contradiction between them (Mousa et al., 2020).

Recent studies have shown that organizations or societies that support this type of diversity management facilitate dealing within the scope of work and help mitigate conflicts within these organizational boundaries, which helps encourage employees to use cultural programs that are compatible with all differences in human nature (Dennissen et al., 2020). For example, institutions that help in consolidating family relations, are satisfactory for married families. Unfortunately, unmarried individuals feel that this law is against them, which distinguishes married people from them (Casper et al., 2007). This leads to conflicts between the beneficiary and the non-beneficiary of this service in organizations, and this makes individuals unwilling to these family-friendly laws to avoid any conflict with other employees in the scope of work (Casper et al., 2007). Diversity management has a major role in mitigating problems and finding a solution that works for everyone (Koellen, 2021). Only recent studies have highlighted the importance of this type of organization in managing diversity for the ability to impose policies that may protect all parties and be in the process of equality and justice in the framework of work (Mousa et al., 2020). In the matter of remote work, diversity management increases the participation of individuals in work, which increases diversity and attracts employees from different countries and environments to resort to managing diversity to preserve employees and the ability to equalize them and create an organizational environment capable of serving everyone (Ozimek, 2020).

3 Methodology

3.1 Research Design

The study utilized a rigorous systematic review to analyse a multitude of previous studies related to the impact of remote work and the COVID-19 pandemic on diversity management in various countries. The ultimate goal was to provide a comprehensive comparison of findings and address any existing gaps in this area of research.

3.2 Sample Target

The study aimed to analyze the latest research studies in this field and identify cultural differences, values, and norms between different countries. The ultimate goal was to develop a unified policy that aligns with diverse goals and brings together a common vision to achieve desired outcomes for organizations.

3.3 Procedure

Through careful examination of previous studies, this study revealed important insights regarding the impact of remote work and the COVID-19 pandemic on diversity management. The study conducted a systematic and analytical comparison of the data collected, which led to valuable results indicating the improvement of remote work, which in turn reduces conflict and tension in the workplace. These results aim to establish a suitable culture for global companies and enhance diversity and inclusion.

3.4 Analysis of Studies

A systematic review was conducted using the descriptive analytical method to analyze previous contemporary studies conducted in different environments and countries. The objective was to compare results, identify gaps, and come up with enriched subsequent literature. The review followed a purely analytical logic to analyze the results and developments of the studies.

3.5 Systematic Review

The systematic review presents the most important results of contemporary studies, which are presented in a critical concept to highlight the most significant development of theories from the latest to the earliest, as shown in Table 1.

3.6 Remote Work, Diversity Management and COVID-19 Pandemic

Remote work affects the culture of organizations, which is what led to the discussion of the new way of working, as the nature of remote work allows employees flexibility in movement and independence at work (Aloisi & De Stefano, 2021). Also, it changed the organizational structures and the nature of work toward decentralization, which challenged the traditional view of work (Arunprasad et al., 2022).

Table 1. Summary of previous studies

No	Researcher(s)	Year	Study Variables	Key Findings
1	Kähkönen, T	2023	Remote work during the pandemic, Working life impacts, Data protection abilities, Trust outcomes	Organizations must be aware of the impacts of remote work on employees' work-life, data protection capabilities, and trust dynamics Employers should provide resources to bolster data protection and build trust in a remote work context
2	Suortti, C., & Sivunen, A	2023	Communicative tensions in remote work during the pandemic	Effective communication becomes more challenging in remote settings, leading to tensions Organizations must develop communication strategies tailored to the remote environment to reduce misunderstandings and conflicts
3	Margarida, P., et al.	2023	Remote work, HR challenges from the pandemic	Different countries face unique HR challenges in the context of the pandemic, as shown by the experiences of Italy and Portugal Cross-country learning can provide insights into better HR strategies in the face of global crises
4	Grueso-Hinestroza, M. P., et al.	2022	Workplace Responses during COVID-19, HR Processes	Organizations need to tailor their HR processes in light of the lessons learned during the COVID-19 pandemic Emphasizing diversity and inclusion is vital during crises to ensure equitable workplace responses

(*continued*)

Table 1. (*continued*)

No	Researcher(s)	Year	Study Variables	Key Findings
5	Shirmohammadi, M., et al	2022	Remote work, Work-life balance, HRD lessons from the pandemic	HRD (Human Resource Development) practitioners should re-evaluate remote work policies, emphasizing the importance of work-life balance Lessons from the pandemic can guide organizations in refining remote work strategies to support employees better
6	Horváthová, P., et al	2022	Remote work, COVID-19 effects in enterprises and cultural management	The pandemic had diverse impacts across sectors, with cultural management facing unique challenges Strategies should be tailored to address the nuances of each sector during similar future events
7	Slavković, M., et al	2022	Remote work implementation, Organizational response to COVID-19	Organizations need a structured approach to remote work implementation to navigate crises effectively Occupational safety and health considerations remain paramount, even in remote settings
8	Gembalska-Kwiecień, A., & Milewska, E	2022	Impact of the Pandemic on management, Remote work challenges	The pandemic has reshaped management practices, highlighting the importance of flexibility and adaptability Companies and employees must address the new challenges of remote work together, emphasizing training and support

(*continued*)

Table 1. (*continued*)

No	Researcher(s)	Year	Study Variables	Key Findings
9	Vedernikov, M., et al	2022	Remote staff management, HR recruiting during the pandemic	HR departments should consider integrating advanced technology into their hiring processes, especially during crises. Smart HR Recruiting technology can streamline and enhance the efficiency of the hiring process
10	Wijngaards, I., et al	2022	Cognitive crafting, Work engagement among remote health workers	Cognitive strategies might be employed to increase engagement among remote and frontline healthcare workers, potentially reducing burnout and turnover in the healthcare sector
11	Chambel, M. J., et al	2022	Teleworking, Family-supportive supervisor behaviors, Work-family management, Exhaustion, Work engagement	Supervisors who support the familial needs of their employees can enhance work-life balance, reducing exhaustion and bolstering engagement
12	Miglioretti, M., et al	2022	Telework quality, Employee well-being in Italy	Organizations should prioritize the quality of telework environments to enhance the well-being of their employees, which can potentially improve retention and job satisfaction
13	Arunprasad, P., et al	2022	Remote work challenges during the pandemic	Companies should address challenges linked with remote work by applying evidence-based models and practices tailored to their unique organizational needs

(*continued*)

Table 1. (*continued*)

No	Researcher(s)	Year	Study Variables	Key Findings
14	Van Zoonen, W., et al	2021	Stressor-strain relationships, Social support, Remote work adjustment, Work-life conflict	Social support plays a critical role in mitigating stressors and enhancing employees' adaptation to remote work Organizations should focus on minimizing work-life conflicts to reduce strain and improve well-being during crises
15	van Zoonen, W., et al	2021	Adjustment to remote work, Initial responses to the pandemic	Organizations should be cognizant of varying factors affecting the ease with which employees adapt to remote work. Tailored interventions may be needed for different employee groups to enhance productivity and well-being
16	Wang, B., et al	2021	Effective remote working strategies	Effective remote work is achievable with the right work design strategies. Organizations should optimize the design of remote work tasks to boost productivity and worker satisfaction
17	Aloisi, A., & De Stefano, V	2021	Essential jobs, Remote work, Digital Surveillance	Oversight and regulation of digital surveillance tools are essential to safeguard employee privacy rights, especially in essential jobs that shift to remote platforms

(*continued*)

Table 1. *(continued)*

No	Researcher(s)	Year	Study Variables	Key Findings
18	Yarberry, S., & Sims, C	2021	Impact of virtual/remote work on career development	Virtual work environments might necessitate additional tools and strategies to foster career development, leveraging social learning theory and emphasizing belongingness
19	Davies, A	2021	COVID-19, Remote working	Remote working can bring economic opportunities to rural areas. Policymakers and businesses should consider this when strategizing about regional economic development
20	Bezzina, F., et al	2021	Remote working in the Maltese Public Service during the pandemic	Governments can leverage best practices from the Maltese Public Service's remote work experience during the pandemic to guide future remote work policies
21	Zhang, C., et al	2021	Public sentiment, Enforced remote work during COVID-19	The formulation of remote work rules by businesses should be influenced by the prevailing public mood towards the enforcement of remote work. It is important to acknowledge that a uniform approach to remote work may not be practical or preferable in all cases
22	Madero Gómez, S., et al	2020	Stress, Myths related to remote work during the pandemic	Misconceptions and myths about remote work can add to employees' stress levels Addressing these myths can help organizations foster a more supportive and productive remote work environment

(continued)

Table 1. (*continued*)

No	Researcher(s)	Year	Study Variables	Key Findings
23	Nash, M., & Churchill, B	2020	Care during COVID-19, Remote working and caring responsibilities in Australia	Universities and similar institutions should be mindful of the gender dynamics at play when setting remote work policies, ensuring equitable treatment and support for all staff
24	Eikhof, D. R	2020	COVID-19, Inclusion, Workforce diversity in the cultural economy	The cultural sector must be proactive in fostering diversity and inclusion in the face of challenges posed by the pandemic
25	Bae, K. B., et al	2019	Telework programs, Effects of being a female supervisor, Supportive leadership, Diversity management	Increasing participation in telework programs within U.S. federal agencies might require fostering a more inclusive leadership environment and prioritizing diversity management

Working remotely changed the classical perspective of work, especially after the pandemic, transactions were done remotely rather than face-to-face due to the fear of the spread of the epidemic. Therefore, the relationship between administrative and functional centers became stronger as the goals and work policies aligned to achieve a common goal (Arunprasad et al., 2022). In addition, the team working spirit is at the center of the new working perspective (Yarberry & Sims, 2021). Otherwise, the consequences of dissatisfied employees will lead to failure of the nature of the work (Nash & Churchill, 2020) (Aloisi & De Stefano, 2021). Consequently, managing diversity can reduce employee dissatisfaction and create an organizational environment that serves everyone (Davies, 2021).

With the emergence of pragmatism, it is possible to create an environment in harmony with the administrators to benefit from the performance of the organization (Aloisi & De Stefano, 2021). Managers must learn ways to rethink the work they perform and interact within a specific situation (Yarberry & Sims, 2021). Flexibility in making decisions helps create new challenges, and from this standpoint, the manager plays the role of the manager in creating this change and plays the role of a “distinguished leader”, because the leader plays a distinguished role in consolidating trust with employees and contributes to their independence and creating the role of work in the spirit of one team, these characteristics are very important to be able to perform the work as required (Yarberry & Sims, 2021).

There are three critical things for the ability to trust, control and balance each other to develop the modern managerial role (Arunprasad et al., 2022). Thus, the administration's goal is to improve and develop by providing provision and support to employees and guiding them in completing the required work (Bezzina et al., 2021). The trust that the leader creates by controlling diversity management seeks to make an exchange in dialogue that helps in consolidating the relationship and links within the limits of the work environment to make the work go smoothly and easily (Arunprasad et al., 2022). This matter seeks to succeed in overcoming the economic crisis caused, by the COVID-19 pandemic, to create the consolidation of a healthy relationship between the manager and the employee that the diversity management seeks, which is carried out through different workplaces, more smooth and flexible in working remotely and in different cultures, which created a unified organizational environment (Davies, 2021). It obliged the leaders, in abnormal and unprecedented circumstances, to create innovations and flexible administrative foundations capable of adapting to their environment (Yarberry & Sims, 2021). The remote evaluation reflects the administrative behavior of monitoring, as the change has been made from the daily monitoring method to the synthesis of trust and the building of future management for the ability to think before implementation (Yarberry & Sims, 2021).

The government was interested in obligating social distancing, which created a relationship and common interests between the people and the state (Eikhof, 2020). Governments made it clear that they are part of societies and containment that obligated everyone in isolation, and social distancing, and then to create new solutions that contribute to the development of society and societies once the crisis is over (Eikhof, 2020). Therefore, based on the previous arguments, the study can come up with the following proposition, shown in Fig. 1.

Proposition: remote work and the COVID-19 pandemic positively affect diversity management.

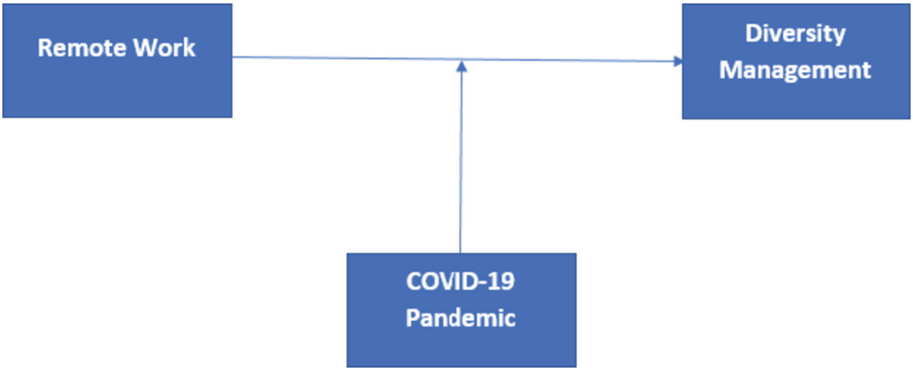

Fig. 1. The conceptual research model clarified that remote work and the COVID-19 pandemic on diversity management

4 Discussion

Through a systematic review of the narrative of previous literature regarding remote work, diversity management and the Covid-19 epidemic, the study analysed the articles and the theoretical frameworks, which reflect the concept of previous theories in this field as follows, the Covid-19 pandemic was devastating to the world, which led societies to the use of methods that enable them to confront this thunderbolt shock through the close cooperation between the family life and work, which led to a digital transformation in the use of remote work techniques to avoid material losses and the economic decline witnessed by the entire world and in the face of the epidemic at the same time, where consensus was reached between work and health by activating digital mechanisms and applying the remote work system in various public and private sectors and in large and small companies to avoid the spread of the epidemic by limiting confrontational work (Anderson & Kelliher, 2020; Arunprasad et al., 2022). Subsequently, the world has become a small village where communities and countries of different races, religions, cultures, etc. are involved (Aloisi & De Stefano, 2021). To reduce the clash in the aforementioned cultural differences, it is necessary to use cultures that are suitable for everyone by applying the theory of diversity management in creating a strong relationship between the employee and the manager based on trust, compatibility, and harmony for all parties in the organizational structure (Bae et al., 2019).

The COVID-19 epidemic has resulted in notable changes in organizational dynamics, namely in the domains of telecommuting and diversity administration. The present distant work landscape, precipitated by the worldwide epidemic, has shown a variety of possible benefits and obstacles. Shirmohammadi and colleagues (2022) highlighted the benefits associated with flexibility and the attainment of a harmonious equilibrium between professional and personal domains. Nevertheless, scholars Kähkönen (2023) and Suortti & Sivunen (2023) have cautioned about possible challenges that may arise in remote work settings, including issues related to communication problems and the potential blurring of boundaries between professional and personal spheres. The need to facilitate efficient communication and ensure robust data security in this evolving situation cannot be overstated.

The dynamics of leadership and the management of diversity have changed in response to the implementation of remote working settings. Bae et al. (2019) as well as Grueso-Hinestroza et al. (2022) have emphasized the role of supportive leadership in increasing engagement and involvement in remote work contexts. This aligns with the need to maintain an inclusive approach, as highlighted by Eikhof (2020) and Nash & Churchill (2020), who examined the distinct difficulties encountered by women and the cultural economy under these challenging circumstances. Hence, organizations need to give precedence to inclusive policies that address the different requirements of their workforce, thereby fostering an environment where all workers, regardless of their origins, have a sense of worth and get enough support.

As the research engages in a thoughtful examination of the future direction of remote work and its impact on organizations, many key factors emerge for consideration. Margarida et al. (2023) and Vedernikov et al. (2022) have emphasized the expanding function of human resource departments and the change of recruiting procedures in a mostly distant terrain. These transformations indicate the need for firms to readjust their strategies, guaranteeing that they are aligned with the current state of affairs while still placing importance on the welfare of employees and the inclusion of the company.

Due to this epidemic, many social, economic and health problems came to light (Bae et al., 2019). Consequently, new innovative methods must be used to keep pace with the digital transformation of remote work at the same planned and required level until the epidemic ends completely. On the other hand, creating new opportunities in the labor market merged many cultures at the same time for one goal, which is to get out of the epidemic crisis to normal life (Kapoor, 2020). The role of diversity management has mainly been embedded in reducing the chances of clashes and conflicts in religious and ethnic differences in different cultures. This is by creating an organizational environment that protects all human rights and is based on justice and equity, which led to an increase in work and productivity in various fields (Mousa et al., 2020; Ozimek, 2020). The concept of remote work in the discoveries of future research is found to be related to dynamic relationships rather than causal relationships in the interpretation of the various issues of work (Pretti et al., 2020; Zhang et al., 2021).

5 Limitations

This study's finding is bound to a set of limitations that might limit the generalization of the results. The findings are based on the analysed studies, other studies might have different insights so future studies need to consider this. The fact that this study emphasises the era of COVID-19 and the post-COVID-19, provides a perspective that might be different from other perspectives of previous studies. This study's main keywords that were used to perform the analysis shaped the sample. Therefore, the results came based on them. Considering other keywords might present different results. However, this study provides significant guidance for future studies.

6 Recommendations for Future Research

The COVID-19 pandemic has had a complex and diverse influence on remote work and diversity management, presenting several opportunities for future study. An imperative field of study should include a more comprehensive examination of the enduring psychological and social consequences of prolonged distant labor on individuals in the workforce. Although there exist preliminary findings regarding the immediate obstacles and advantages of remote work, as evidenced by the studies conducted by Wang et al. (2021) and Zhang et al. (2021), it is imperative to gain a comprehensive understanding of the long-term effects of remote work on job satisfaction, organizational commitment, and mental well-being.

A further area of significance is the analysis of the transformation of organizational structures and cultures in a post-pandemic era. The examination of structural, cultural, and operational changes and their impact on workforce diversity and inclusiveness becomes imperative when firms shift towards hybrid models or permanent remote work arrangements.

Based on the argument presented by Vedernikov et al. (2022) that the evolution of human resource practices, particularly in the realm of recruiting, is a burgeoning area of interest, future research endeavors may explore the transformative effects of Smart HR Recruiting Technology and comparable innovations on the processes of talent acquisition, onboarding, and training within the context of an ever-evolving digital landscape. Simultaneously, analyzing the evolution of leadership styles and techniques in response to these transformations, particularly concerning the maintenance of long-term team cohesiveness, trust, and motivation, would provide valuable insights.

Expanding upon the study conducted by Bae et al. (2019), it would be advantageous to conduct additional research exploring the relationship between leadership, diversity management, and remote work. This investigation could potentially establish correlations between leadership strategies, employee engagement, and organizational performance within diverse remote teams.

This study highlights the importance of organizations implementing comprehensive diversity management strategies, as they have been found to positively affect workplace flexibility and promote cooperation between managers and employees in resolving conflicts related to cultural differences. Therefore, future studies could take this further by applying additional factors to the equation and investigating the overall effect.

The study offers a thorough examination of the several benefits linked to remote work, including enhanced flexibility, increased personal time availability, and the capacity to meet familial responsibilities. Nevertheless, it is crucial to acknowledge that there exist constraints linked to this methodology. The limits include many psychological effects and a perceived feeling of underachievement, particularly among the male population. However, it is possible to tackle these issues by using work-life balance strategies that are essential to the implementation of diversity management. Future research might be required to put this to the test in certain cultural settings.

The study advocates for the ongoing emphasis on remote work, underscoring that its importance should not be diminished after the COVID-19 pandemic, given its inherent advantages such as the flexibility it provides in terms of both place and time. Consequently, this phenomenon contributes to increased productivity by eliminating the constraints associated with commuting. Therefore, future studies could emphasise this matter.

7 Conclusion

The complex interplay of remote work, diversity management, and the issues arising from the COVID-19 epidemic has revealed significant revelations about current workplace practices. The study emphasizes the significance of using diversity management practices, not just as a symbolic gesture, but as a strategic approach to use the advantages of diverse cultural backgrounds, ultimately fostering more adaptable and cohesive work environments. The current epidemic has brought significant attention to the advantages of remote work, including more flexibility and improved work-life balance. However, it is also important to acknowledge and address the possible drawbacks associated with this arrangement, including feelings of isolation and a sense of underachievement. The significance placed on leadership quality highlights the crucial role that leaders play in effectively executing remote work, hence emphasizing the importance of trust, autonomy, and cooperation under these exceptional circumstances. The study's findings have significant implications for the future of work, highlighting the need for adaptation, inclusion, and forward-thinking leadership in the ever-changing global employment environment. These lessons are not only relevant in the present moment but also have long-lasting effects.

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A Comprehensive Review of Crowdsourcing Platforms, Applications, and Methods: Insights for Practitioners and Researchers

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Abstract. Crowdsourcing is a dynamic and powerful tool that harnesses collective intelligence, skills, and resources to address intricate problems, generate innovative ideas, and gather valuable data. This systematic review aims to analyze the existing literature in order to gain valuable insights into crowdsourcing platforms, applications, and methods. The study highlights the significance of understanding various crowdsourcing platforms and their governance mechanisms. It also delves into the utilization of crowdsourcing in diverse industries and scrutinizes the strategies employed to efficiently oversee and motivate contributions from the crowd. Comprehensive literature searches were utilized to analyze pertinent articles and synthesize the findings, thereby making a valuable contribution to the current body of knowledge on crowdsourcing. This review provides valuable guidance for future studies on crowdsourcing.

Keywords: Crowdsourcing · Applications · Platforms · Methods

1 Introduction

Crowdsourcing is a potent tool that harnesses the collective intelligence and skills of a sizable group of individuals to tackle intricate problems, generate ideas, and gather data (Pavlidou et al., 2020). This process involves assigning tasks to online users who willingly volunteer their time, knowledge, and expertise (He et al., 2022).

Previous research has underscored the significance of understanding various crowdsourcing platforms and the governance mechanisms that oversee them (Blohm et al., 2018). Various platforms have unique features and functionalities, underscoring the significance of selecting the most suitable platform for a particular crowdsourcing task (Blohm et al., 2018). Furthermore, the literature highlights the exploration of crowdsourcing applications in diverse sectors such as agriculture, marketing, and computer science (Minet et al., 2017; Nasution et al., 2022; Majava & Hyvärinen, 2022). Understanding the specific contexts in which crowdsourcing has thrived provides valuable insights for both practitioners and researchers.

Additionally, the techniques utilized to supervise and inspire crowd contributions are pivotal factors in determining the success of crowdsourcing endeavors. Literature

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examines the implementation of effective quality control measures and mechanisms that guarantee the dependability and precision of crowdsourced data (Minet et al., 2017). Furthermore, it explores the design elements related to crowdsourcing initiatives, including payment methods and the participation of influencers (Soratana et al., 2022). By meticulously examining these methods, individuals can discern the most effective practices and identify areas that offer opportunities for improvement in managing crowdsourcing projects.

In our systematic review, we employ text mining techniques to analyze a diverse range of relevant articles. Our objective is to provide a comprehensive overview of crowdsourcing platforms, applications, and methods by synthesizing the findings from these studies. This review contributes to the current body of knowledge on crowdsourcing and provides valuable insights for practitioners and researchers who are interested in harnessing the potential of crowdsourcing for various purposes.

2 Methodology

To conduct this systematic review, a thorough literature search was carried out. This search included prominent databases such as Scopus, Web of Science, and Google Scholar. A set of meticulously selected keywords, including "crowdsourcing," "crowdsourcing platforms," "crowdsourcing methods," and "crowdsourcing applications," was employed in order to ensure the retrieval of pertinent studies. The criteria for inclusion were studies that were directly relevant to the topic of crowdsourcing and those that were published in reputable journals or conference proceedings.

Following an initial screening of titles and abstracts, a meticulous selection process was implemented to identify studies that met the inclusion criteria. The studies selected serve as the foundation for our systematic review, which enables an in-depth and comprehensive analysis of the topic.

3 Results

3.1 Crowdsourcing Platforms

Several articles in the literature emphasize the significance of effectively managing crowdsourcing platforms. In their study, Blohm et al. (2018) present a persuasive argument for the implementation of internal services within organizations. The essence of their argument centers on the idea that these services have the potential to significantly improve accessibility to crowdsourcing platforms, thus enabling more efficient project implementation. This systematic approach ensures the seamless integration of crowdsourcing initiatives into an organization's overall strategy and operations.

In their study, Martinez-Corral et al. (2019) present a framework for analyzing crowdsourcing initiatives. This framework consists of four essential pillars: the crowdsourcer, the crowd, the crowdsourced task, and the crowdsourcing platform.The literature also delves into the effectiveness of crowdsourcing platforms. Köhler (2017) examines the scalability of these platforms, with a specific focus on the cost-effectiveness per output or per worker in comparison to traditional business models. Meanwhile, Zhang et al. (2022)

focus on evaluating the service quality of crowdsourcing platforms by examining service quality attributes. It is crucial to emphasize the importance of identifying strategies for crowdsourcing services in order to optimize the platform's effectiveness. Furthermore, the literature explores the impacts of crowdsourcing platforms. Suen et al. (2020) examine the utilization of crowdsourcing platforms for employer ratings on social media, with a particular focus on highlighting the significance of crowdsourced employer branding platforms in furnishing job seekers with transparent and dependable information. Kashive et al. (2020) emphasize the significance of crowdsourced employer branding platforms in understanding employee sentiments, thereby improving employer branding efforts.

The literature also covers diverse applications of crowdsourcing platforms across various industries. Mansor et al. (2022) discuss the crowdsourcing ecosystem in Malaysia, underlining how these platforms offer opportunities for individuals outside organizations to leverage their expertise and earn income. Asamoah et al. (2023) propose a blockchain-based crowdsourcing loan platform for funding higher education in developing countries, showcasing the potential of crowdsourcing platforms in addressing social challenges.

Benefits of Crowdsourcing Platforms for SMEs

Numerous studies underscore the advantages of crowdsourcing platforms for SMEs. Djelassi and Decoopman (2013) discuss how involving customers in product development through crowdsourcing can enhance customer satisfaction and loyalty. They present four successful crowdsourcing cases, emphasizing the significance of effective management and engagement strategies. Carbone et al. (2017) focus on the emergence of crowd logistics and highlight how crowdsourcing platforms empower SMEs to co-create logistics value. They stress the role of internet platforms in facilitating open calls to the crowd.

Crowdsourcing platforms grant SMEs access to a diverse pool of talent and expertise, enabling them to tap into a global network of individuals with various skills and perspectives (Djelassi & Decoopman, 2013). This fosters the generation of innovative ideas and solutions that may not have been feasible within the organization alone (Tran et al., 2012). Additionally, crowdsourcing platforms allow SMEs to scale their operations and access resources that may be lacking internally, such as design and manufacturing capabilities (Qin et al., 2016). This helps SMEs overcome resource constraints and compete with larger organizations.

Challenges and Implications of Crowdsourcing Platforms for SMEs

While crowdsourcing platforms offer numerous benefits, they also present challenges and implications for SMEs. One primary challenge is ensuring the quality and reliability of the crowd's contributions. SMEs must carefully select and manage the crowd, ensuring they possess the necessary skills and expertise to deliver high-quality results (Devece et al., 2019). This involves effective screening, training, and monitoring processes (Saxton et al., 2013). Implementing quality control mechanisms, providing clear instructions, and establishing effective communication channels with the crowd are essential (Djelassi & Decoopman, 2013).

Nasution et al. (2023) discuss the challenges faced by SMEs in adopting social media, which can be extended to crowdsourcing platforms. They emphasize the need for identifying success factors and deriving concrete performance implications for SMEs. Blohm et al. (2018) explore the effective management of crowdsourcing platforms, highlighting the importance of platform design, governance mechanisms, and community management. They underscore the need for further research to understand the effectiveness of governance mechanisms in the crowdsourcing context.

Beyond operations, crowdsourcing platforms have implications for organizational culture and stakeholder relationships. SMEs must assess how crowdsourcing impacts internal culture and employee engagement (Scupola & Nicolajsen, 2021). Engaging external contributors via crowdsourcing can also affect relationships with customers, and other stakeholders (Nasution et al., 2022).

Factors Influencing the Adoption of Crowdsourcing Platforms Among SMEs

Several factors influence the adoption and success of crowdsourcing platforms among SMEs. Devece et al. (2019) highlight the moderating role of transformational leadership and organizational learning in the effectiveness of crowdsourcing in knowledge-based industries. They emphasize the importance of leadership and learning capabilities in leveraging the potential of crowdsourcing for SMEs.

Liu et al. (2022) discuss the role of governance mechanisms in crowdsourcing and highlight the moderating roles of task and environment complexities. They emphasize the need for empirical evidence to understand the effectiveness of governance mechanisms in the context of crowdsourcing.

Another crucial factor is the organizational culture of the SME. The alignment between the crowdsourcing initiative and the organizational culture can determine the level of employee participation and support for the initiative (Scupola & Nicolajsen, 2021). They emphasize the importance of SMEs fostering a culture of openness, collaboration, and innovation to encourage active employee contributions.

3.2 Crowdsourcing Methods

Crowdsourcing provides SMEs with a variety of methods to harness the collective intelligence of the crowd, including idea generation, problem-solving, design, and innovation.

Idea Generation

Crowdsourcing engages ordinary users in the ideation phase of new product development (Nasution et al., 2023). It is a popular approach that leverages the collective intelligence and creativity of a diverse crowd. By doing so, organizations can generate a wide range of ideas and solutions to complex problems (Qin et al., 2016). Crowdsourcing is applicable in various domains, including manufacturing, new product development (NPD), problem-solving, design, testing, expert support, and collaborative work (Qin et al., 2016).

One key advantage of crowdsourcing for idea generation is the ability to harness the collective wisdom of a diverse group of individuals. Crowdsourcing can outperform in-house activities for generating product ideas, particularly under certain conditions (Tran et al., 2012). Engaging a large number of participants allows organizations to access a wide range of perspectives, knowledge, and expertise (Nasution et al., 2023).

This diversity can lead to the generation of more innovative and creative ideas (Szwajlik, 2018).

Crowdsourcing also offers the benefit of increased ideation rates. By involving a large crowd, organizations can generate a higher volume of ideas compared to traditional methods such as brainstorming (Nishikawa et al., 2017). The "numbers argument" suggests that the more ideas generated, the higher the likelihood of producing a few exceptional ones (Nishikawa et al., 2017). This is especially valuable for organizations seeking breakthrough innovations or new-to-the-world products (Zahay et al., 2018).

Design

Crowdsourcing in design involves gathering ideas, solutions, or contributions from a large group of people, typically through online platforms (Köhler, 2015). It has gained popularity in design as a means to tap into the collective creativity and expertise of a diverse crowd (Nasution, 2023). Brands with popular products can leverage crowdsourcing, as participants are often willing to provide design solutions (Herter, 2023). This approach enables companies to access a wide range of design ideas and perspectives, fostering innovative and original designs (Zhang et al., 2015). Brands can run short-term challenges on niche crowdsourcing platforms to tap into specialized communities of designers, developers, animators, filmmakers, engineers, or scientists (Zhang et al., 2015). Crowdsourcing can also enhance the design and installations of hotels, reducing product defects and room maintenance issues (Martin-Fuentes & Mellinas, 2018).

Crowdsourcing for design offers the key advantage of harnessing the collective intelligence and creativity of a large group of individuals (Li et al., 2020). By opening the design process to a crowd, companies can benefit from diverse perspectives and ideas that traditional design approaches may not provide. This fosters more innovative and original designs with broader appeal. Additionally, crowdsourcing streamlines the design process, making it more efficient and cost-effective (Pollok et al., 2019). By tapping into a crowd of designers, companies can access a larger pool of talent and expertise without the need for extensive in-house design resources. This results in faster turnaround times and reduced costs compared to traditional design methods.

Innovation

Crowdsourcing is an innovation method that has garnered significant attention for organizations. It involves harnessing the collective intelligence and creativity of a large group of individuals, often through online platforms, to address problems, generate ideas, and contribute to the innovation process (Köhler, 2015). Crowdsourcing is widely recognized as a valuable tool for organizations seeking to tap into external knowledge sources and enhance their innovation capabilities (Xu et al., 2015). It facilitates access to a diverse range of perspectives and expertise, fostering the generation of novel and innovative ideas (Vignieri, 2021).

A key advantage of crowdsourcing is its capacity to engage a large number of problem solvers, enabling organizations to address complex issues and improve the quality of their new products (Lee et al., 2019). Involving a diverse crowd provides access to a wide range of skills, knowledge, and experiences, which, in turn, leads to more creative and innovative solutions (Schemmann et al., 2016). Crowdsourcing also offers the opportunity for organizations to connect with external crowds and potential solvers, expanding their network and increasing their likelihood of finding innovative solutions (Pollok et al., 2019).

Crowdsourcing is particularly valuable in the context of open innovation, where organizations collaborate with external stakeholders to co-create value (Nasution et al., 2022). It enables organizations to access a broader pool of ideas and expertise, helping them overcome internal limitations and leverage external resources (Hossain & Simula, 2017). Involving the crowd in the innovation process allows organizations to benefit from the collective wisdom and creativity of a diverse group of individuals (Malhotra & Majchrzak, 2019). This often leads to the development of breakthrough innovations and the identification of new market opportunities (Köhler, 2015).

Problem-Solving

Crowdsourcing is a method that organizations use to solve complex problems by leveraging the collective intelligence and expertise of a crowd (Prpić et al., 2015). It involves posing a well-defined problem to a crowd and asking for actual solutions (Nasution et al., 2023). This approach is particularly useful for tackling complex or expensive problems that can be efficiently solved by dividing tasks between different participants who have different resources or expertise. Crowdsourcing has become a part of several research fields and provides a new problem-solving paradigm. It is often used for innovation, problem-solving, and efficiency (Majava & Hyvärinen, 2022).

One form of crowdsourcing that is widely adopted for problem-solving tasks is contests. Contests allow organizations to tap into the creativity and problem-solving abilities of a crowd by offering incentives or rewards for the best solutions (Zhang & Du, 2021). This approach has the potential to address pressing social needs and problems. In addition to contests, crowdsourcing can also be used in the context of business process management, where organizations decide whether the crowdsourcing approach is appropriate to solve their internal problems (Thuan et al., 2017).

3.3 Crowdsourcing Applications

Crowdsourcing offers SMEs access to a diverse pool of talent, ideas, and resources that they may not have internally. It enables SMEs to tap into the collective intelligence of the crowd, leading to increased innovation, problem-solving, and cost-effectiveness (Devece et al., 2019). By leveraging the power of the crowd, SMEs can overcome resource limitations and compete with larger organizations. Crowdsourcing also allows SMEs to engage with customers and stakeholders, fostering a sense of co-creation and community (Nasution et al., 2023).

Crowdsourcing in New Product Development

One of the key areas where SMEs can benefit from crowdsourcing is in new product development (NPD). Crowdsourcing enables SMEs to gather feedback, ideas, and suggestions from a wide range of individuals, including customers, experts, and enthusiasts (Qin et al., 2016). This input can help SMEs refine their product concepts, improve design performance and quality, and accelerate the NPD process. Additionally, crowdsourcing can facilitate the scaling-up of design and manufacturing operations for SMEs (Qin et al., 2016).

Simula and Vuori (2012) emphasize that crowdsourcing can lead to the generation of new ideas and innovations, effective problem-solving, cost reduction, and shorter product development cycles. Furthermore, Tran et al. (2012) suggest that crowdsourcing through Web 2.0 platforms can leverage bottom-up tools for the benefit of product development, involving customers and the crowd in the innovation process. Jiao et al. (2021) argue that crowdsourcing is an efficient way to solicit new product design ideas from external partners, particularly consumers.

Crowdsourcing for Problem Solving and Innovation

Several studies have highlighted the benefits of crowdsourcing for SMEs in terms of problem solving and innovation. For instance, Li et al. (2020) argue that crowdsourcing allows SMEs to integrate external innovations into their internal processes, compensating for self-innovation capacity deficits and enhancing design flexibilities. Additionally, crowdsourcing enables SMEs to generate extra competencies that may not be obtained due to the lack of high-quality human resources or investment (Li et al., 2020). Moreover, crowdsourcing is cost-effective and attracts a large number of individuals, providing SMEs with innovation agility (Mansor et al., 2022).

Nasution et al. (2023a) suggest that crowdsourcing can be used as a problem-solving model for collaboration issues in organizing continuous product development and commercialization. The study emphasizes the importance of crowd participation patterns in different phases of the product development process. Furthermore, Huang et al. (2020) found that a well-articulated task description reduces uncertainties and increases the willingness of crowd participants to engage in problem-solving activities.

Crowdsourcing for Marketing and Branding

Crowdsourcing can also be utilized by SMEs for marketing and branding purposes. SMEs can engage the crowd in activities such as logo design, content creation, and social media campaigns (Nasution et al., 2023b). By involving the crowd in these activities, SMEs can benefit from the creativity and expertise of a larger community, resulting in more impactful marketing materials and brand messaging (Zahay et al., 2018). Crowdsourcing can also help SMEs build a loyal and engaged customer base through co-creation and collaboration (Nasution et al., 2022). Crowdsourcing enables companies to tap into the collective wisdom of the crowd, which can lead to the generation of innovative ideas and solutions (Malhotra & Majchrzak, 2019). By involving customers in the product development process, companies can gain valuable insights and create products that better meet customer needs (Djelassi & Decoopman, 2013).

Additionally, crowdsourcing can enhance brand engagement and purchase intention (Herter et al., 2023). It allows customers to actively participate in brand-related activities, fostering a sense of ownership and loyalty towards the brand (Herter et al., 2023). Moreover, crowdsourcing can be a cost-effective approach for marketing research, as it leverages the power of the crowd to collect and analyze data (Nishikawa et al., 2017).

4 Conclusion

Crowdsourcing platforms have gained popularity in various domains, offering individuals with opportunities to participate in tasks and projects. However, there are several areas that require further research in order to enhance the effectiveness and sustainability of these platforms. One crucial aspect to consider is the motivation and participation of the crowd workers. In a study conducted by Huang et al. (2020), it was discovered that trust in crowdsourcing platforms plays a crucial role in fostering individuals' motivation to continue participating and has the potential to amplify the impact of monetary incentives. Understanding the factors that influence the participatory behavior of crowd workers is crucial in order to design effective incentive mechanisms and ensure long-term engagement.

Scaling up crowdsourcing platforms is an area that requires attention. Although it is indeed true that successful crowdsourcing companies hold significant prominence and importance, our comprehension of the challenges associated with expanding platforms remains somewhat limited (Köhler, 2017). Further research is necessary to explore strategies and insights related to the rapid and sustained growth of crowdsourcing platforms. This exploration should take into consideration various factors, including technological infrastructure, user acquisition, and platform governance.

One critical area for future research in crowdsourcing is the comparison between consumer participation in crowdsourcing and consumer engagement in online brand communities. Djelassi and Decoopman (2013) suggest that future research should delve into the nuances between consumer participation in crowdsourcing and consumer engagement in online brand communities that are funded and supervised by the brand. This comparison will offer a more comprehensive understanding of the motivations, behaviors, and outcomes linked to various forms of customer involvement.

Another promising avenue for future research would be to delve into the micro-foundational aspects of crowdsourcing campaigns. Cappa et al. (2019) propose the utilization of a micro-foundational lens for the analysis of how the traits, actions, and interactions of individuals, along with the practices they adopt, impact the commencement and administration of crowdsourcing campaigns. This approach will illuminate the individual-level factors that contribute to the success or failure of crowdsourcing initiatives.

Finally, future research could explore the ethical and privacy implications associated with crowdsourcing. Liu et al. (2020) emphasize the significance of privacy protection mechanisms in crowdsourcing systems, particularly in light of the growing utilization of crowdsourcing platforms and the substantial data collection from participants. To ensure responsible and ethical utilization of crowdsourcing in various fields, it is crucial to have a comprehensive understanding of the ethical considerations involved and to establish appropriate safeguards.

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Monitoring Coastal Ecosystems of Karaburun-Sazan National Marine Park with Common Indicator 16

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Abstract. Karaburun-Sazan National Marine Park (NMP) is a Protected Area with national and international importance, due to its natural features, high biodiversity and historical and cultural values. It is the first National Marine Park in Albania with an area of 12,570.82 hectares, where the marine area near Karaburun Peninsula is 9,848.95 hectares and marine area near Sazani Island is 2,721.87 hectares.

The rapid urbanization in most cities of Albania, which is now spreading in the coastal areas and the development of the economic activities, especially tourism, have had a huge impact in the environment. In most cases the impact is evident in the man-made infrastructure built in the response to tourist's demand and for other economic profits. The situation is not very promising also for the Karaburun-Sazan NMP, which in the last decade has become a touristic attraction and has welcomed many tourists every year.

In this study, it has been conducted a monitoring of the Karaburun-Sazan NMP using the monitoring protocol compiled by IMAP and also the relevant Guidance Fact Sheet for Common Indicator 16. The data were collected by field trips in the study area in the first coastline and in a distance till 100 m from the coast. From the National Authority for Geospatial Information were taken Orto photos and from different websites were downloaded satellite images in order to identify all man-made structures in the Park and to estimate their impact on the environment and biodiversity.

Keywords: Karaburun Peninsula · Sazan Island · National Marine Park · Common indicator 16 · monitoring protocol · man-made structures etc.

1 Introduction

The rapid urbanization that began in Albania after the decline of communist regime in 1990, has reached its peak in the main cities and nowadays has shifted toward the natural coastal areas. The development of most economic activities, especially of tourism in these

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areas with the main goal of financial profit, without taking into account the impact on the nature it is evident in the many man-made structures built such as: marinas, docks, jetties etc. These structures, especially when they are very near or along the coastline cause damage in these fragile ecosystems, which sometimes is irreversible such as: losses in habitat and biodiversity, altering of the shoreline configuration; disruption of sediments transportation, reduction of the ability of the shoreline to adapt to the natural factors and fragmentation of the coasts. It is estimated that almost 40% of the coastal areas in the Mediterranean coasts is under some form of artificial land cover, which should be further studied and providing accurate information to be used for the future management of these areas in order to protect and restore their natural beauties. In this article we have used the Common Indicator 16, in order to assess the status of the Karaburun-Sazan National Marine Park coastline, by evaluating the length of artificial and natural coastline by measuring the length of coastline subject to physical disturbance due to the man-made structures.

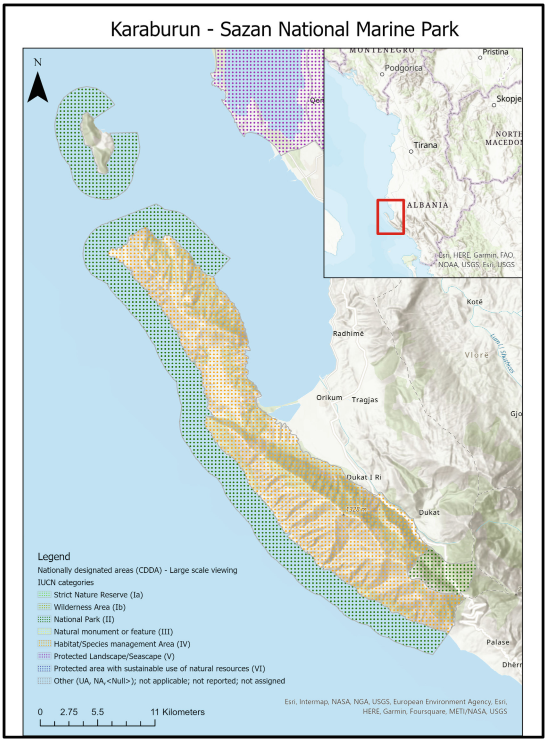
In the Mediterranean, there is not a systematic monitoring of the coastline to assess its status regarding the man-made structures presence and influence. There are only a few countries in the Mediterranean, Italy, Montenegro and France, which have implemented the monitoring of EO8 common indicator on national level by performing similar inventories [1]. As for Albania, there is not such a monitoring in national level, although the man-made structures are spread now in the whole its coastlines are influencing them. Even though the impact these structures is seen and the consequences are obvious, there is still no official complete data on the level of the changes of the coastline, thus the implementation of the monitoring protocol of Common Indicator 16 is of major interests.

Another important aim of this article it is to evaluate and give solutions for the arising conflict between the increasing number of the man-made structures and their spreading even in the coastlines that are under any protection regarding the categories of natural protected areas in Albania, as it is the case of Karaburun-Sazan National Marine Park. The common indicator 16 it is used in this study, because it offers the possibility to evaluate the level of man-made structures consequences on the coastline for a period of time and because it is recommended to be performed periodically in accordance to the monitoring protocol.

In the end of the article, the results and discussion lead to the solutions for the future restoration and protection of Albanian coastline.

1.1 Study Area

Karaburun Peninsula and the Sazan Island are located in the west southern of Albania, in Vlora district. According to the Albanian system of categorization of Protected Areas, adapted by IUCN, Karaburun-Sazan is classified as category II (National Marine Park) and includes a marine area of 1 mile from the coasts around Karaburun-Peninsula and Sazan Island. The Ministry of Environment, Forest and Water Administration prepared the proposition for the Park and the Council of Ministers proclaimed, on April 4th, 2010, National Marine Park Karaburun-Sazan with an area of 12,570.82 ha. The marine area near Karaburun Peninsula is 9,848.95 hectares and marine area near Sazani Island is 2,721.87 hectares [2]. The area of this Park was extended by 9.7 hectares by the decision no.59 on January 26th, 2022 (Fig. 1. Map of Karaburun-Sazan NMP) [3].


Karaburun - Sazan National Marine Park
N
MONTENEGRO
Pristina
Podgorica
Skopje
NORTH MACEDO
Tirana
ALBANIA
Esri, HERE, Garmin, FAO, NOAA, USGS, Esri, USGS
Kotë
Radhimë
Vlore
Lumi i Shushicës
Orikum
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IUCN categories
Strict Nature Reserve (Ia)
Wilderness Area (Ib)
National Park (II)
Natural monument or feature (III)
Habitat/Species management Area (IV)
Protected Landscape/Seascape (V)
Protected area with sustainable use of natural resources (VI)
Other (UA, NA,<Null>); not applicable; not reported; not assigned
0 2.75 5.5 11 Kilometers
Esri, Intermap, NASA, NGA, USGS, European Environment Agency, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS

Fig. 1. Map of Karaburun-Sazan NMP

The Park has national and international importance due to its historical and cultural heritage as well the high biodiversity. Inside the Karaburun-Sazan MNP are found species and habitats, which are listed in some important conventions. Respectively 36 species of international importance are located inside the Park, as well as 75% of the species of the Red List of Albania [2]. The coastal area is also rich in different habitats such as: *Posidonia oceanica, Cystoseira amentacea, Lythophylum byssoides* which are also classified as conservation targets. The NMP of Karaburun-Sazan is also host of many important species such as monk seal *Monachus monachus*, sea turtle *Caretta caretta* and *Chelonia mydas* and even dolphin *Delphinus delphis* and *Tursiops truncatus*. The Management Plan of Karaburun-Sazan NMP was prepared and approved in 2015 as an important tool for the protection of its high biodiversity by coordinating and regulating the activities inside the Park. The implementation of the Management Plan in the Park aims to achieve a better management of the total area by controlling the activities which are allowed and prohibited according to the zoning model. The zoning model used actually in the Karaburun-Sazan NMP was approved on February 6th, 2019 with decision no. 57 "On the criteria and zoning of the territory of a protected area", it divides the area in three management zones (Fig. 2):

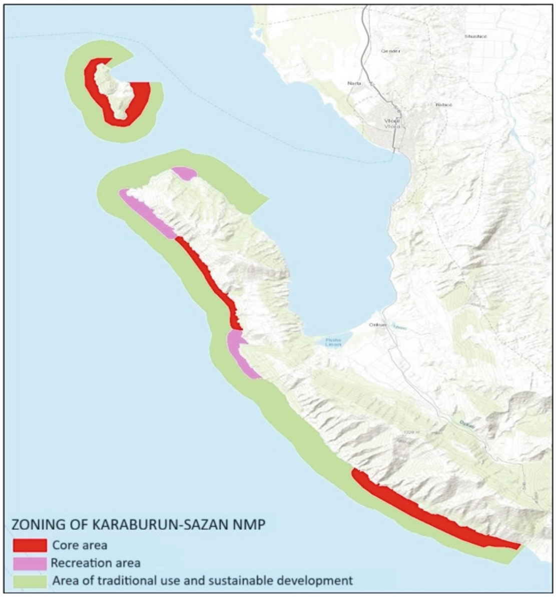
ZONING OF KARABURUN-SAZAN NMP
Core area
Recreation area
Area of traditional use and sustainable development

Fig. 2. Zoning of Karaburun-Sazan National Marine Park (2022)

1) *Core area-* includes the areas which have highest level of biodiversity and with higher importance for the community. This area has the highest level of protection and no human activity is allowed in it.
2) *Recreation Area-* which is a zone where are allowed educational and recreational activities in accordance with the functions of the protected area and its ecological and natural values.
3) *Area of traditional use and sustainable development* - allows the implementation of traditional activities that enforces the connection of local community with the area and gives the possibility to the visitors to not only explore but also learn about the traditional use of it.

Apart from the Marine Park, the terrestrial part of Karaburun Peninsula is proclaimed a Protected Area under Category IV of IUCN, Natural Managed Reserve (NMR) on July 27th, 1977. With a surface of 20,000 hectares. In 2022, based on the decision no. 60, date 26.01.2022 “For the proclamation of natural ecosystems, natural managed reserve/natural park, and for the approval of the status change of existing surfaces of protected areas of these categories” the surface of Karaburun RNM was reduced to 17, 490ha [3]. In addition, the management zones were re-evaluated as in Fig. 3.

Sazan Island, is located in the entrance of the Gulf of Vlora and is the largest island in Albania with an area of 5.7 km^2. Currently, the island is a military base and as a result it is closed for the public most of the year and it opens only during the summer season from May to September for touristic visits. The island know has an abandoned small town, which was built during the communism period. The best-known period of the island is after the 50 s when it began to transform into a military naval base. The

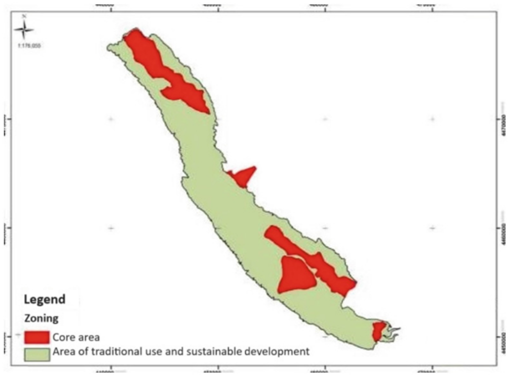

Fig. 3. Zoning of Karaburun-Sazan Natural Managed Reserve (2022)

terrestrial part of the island isn't a protected area even though it has high biodiversity values.

2 Methods

The territory of Karaburun Peninsula and Sazan Island was monitored in November-December 2022, according to the Monitoring Protocol compiled by IMPA and the relevant Guidance Fact Sheet for Common Indicator 16 [2]. There were organized field trips in the Karaburun Peninsula and Sazan Island to identify and document the man-made structures, but there were used also Orto photos captured by the National Authority for Geospatial Information and satellite images.

The examination of the area was made in the first 100 m from the coast. An inventory of the man-made structures in the coastal area in direct contact with the sea and land was compiled and later with the data were created maps in ArcGIS, to show the distribution of them and to identify the hotspots with higher concentration of man-made structures. The areas were classified as: artificial, all the areas that have man-made structures and natural the areas that did not have any man-made structures. Structures located inside the sea are considered irrelevant and are not represented in the final product. The information regarding the artificial and natural areas are shown in maps created using ArcGIS pro and ArcGIS online.

The monitoring was conducted for year 2007, 2015 and 2022 in order to evaluate the Common indicator 16 and with the data gathered it was prepared the full inventory of the coastal man-made structures found in the area. For the zones where changes were identified from the satellite images, there were extracted screenshots in a scale of 1:2000. In addition, was completed also a detailed inventory of man-made structures located within100 m from the coast with data on the coordinates of the structures, total area and screenshots from satellite images.

3 Results

3.1 Actual Situation and Vision for the Karaburun-Sazan NMP

The changes in Albania and the development of Tourism in the last decade has impacted also the management of Karaburun-Sazan NMP, which is now considered as an area with high economic potential, especially for tourism and recreation. In the past years has been noticed a major income of local and foreign tourists in the national marine park, reaching 67,232 tourists in 2022 (Fig. 4), furthermore the highest number of tourists is in 2021, respectively 79,636 tourists (Fig. 5).

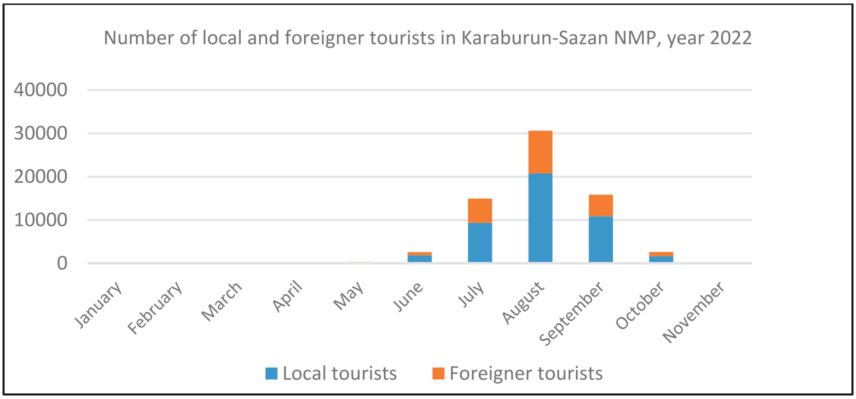

Fig. 4. Graph of the number of tourists in Karaburun-Sazan NMP, year 2022

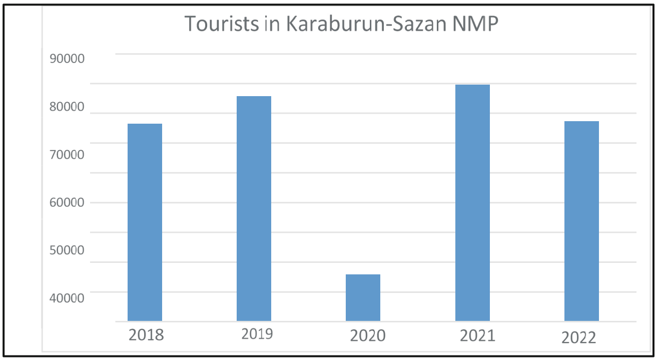

Fig. 5. Graphic of trends in the number of tourists in Karaburun-Sazan MPA from 2018–2022

The Integrated Cross sectorial for Coast done by NATP in 2015, shows that the vision for the area of the marine park is listed as “local center specialized in tourism”. This vision and the development of the tourism sector is considered positive in the economic point of view, but it should be managed very carefully to have in the end a win-win situation both on economic and environmental aspects [5].

The situation is not very favorable in regard to the protection of environment and biodiversity, as the data show a large number of tourists visiting Karaburun-Sazan NMP in a very short season, which is above its daily carrying capacity. The effects of such tourist's flow becomes even stronger considering that there is no diversification of the destinations were these tourists are located and even more there is no diversification in the time range of when they visit these destinations. Furthermore, the increase of visitors and tourism activities requires the implementation and development of the adequate infrastructure that facilitates them. The building of such these types of man-made structures cause major problems in the coastal area such as destruction of the landscape, loss of habitat and biodiversity. This is why any intervention in nature must be preceded by a thorough study on the impacts it will cause in the environment and anticipate activities to mitigate them. In the study area, for example, it has been observed that the man-made structures built for various functions (military during communist regime and mostly touristic after 1990) affect the self-regulating cycles of the coastal zone and also the sedimentation process.

Another factor strongly related to the changes in the natural structure of coastal areas is erosion. Vlora Municipality is endangered by marine erosion and coastal floods from the Vjosa estuary to Triport. The coastal area is endangered by massive landslides and the western part of Karaburun Peninsula is threatened from coastal erosion, thus the building of man-made structures can damage the biodiversity and natural environment in the area.

3.2 Common Indicator 16 Monitoring Protocol and the Results for Karaburun-Sazan NMP

The monitoring of this Common Indicator entails an inventory of the length and location of human- made coastline (hard coastal defense structures, ports, marinas). Soft techniques e.g. beach nourishment are not included. With regard to the coastline to be considered: the fixed reference official coastline as defined by responsible Contracting Party should be considered.

The monitoring of the Common Indicator 16 entails an inventory of:

- the length and location of manmade coastline (hard coastal defense structures, ports, marinas. Soft techniques e.g. beach nourishment is not included.
- land claim, i.e. the surface area reclaimed from the 1980's onward (ha); and
- the Impervious surface in the coastal fringe (100 m from the coastline).

The optimal resolution should be 5 m or 1: 2000 spatial scale. Once a proper geographic scale has been established, monitoring should focus, in particular, on the location, the spatial extent and the types of coastal structures taking into account the minimum coastal length that can be classified as artificial or natural. The identification procedure of human-made structures should be carried on based on typical situations added to the indicator guidance factsheet, including the minimum size (length, width of human-made structures) to be taken into account. As monitoring should be done every 6 years, every CP should fix a reference year in the time interval 2000–2012 in order to eliminate the bias due to old or past human-made infrastructures. The length of artificial coastline should be calculated as the sum of segments on reference coastline identified as the intersection of polylines representing human-made structures with reference coastline ignoring polylines representing human-made structures with no intersection with reference coastline.

The minimum distance between coastal defense structures should be set to 10 m in order to classify such segments as natural, i.e. if the distance between two adjacent coastal defense structures is less than 10 m, all the segment including both coastal defense structures is classified as artificial. The total length of coastline influenced by human-made structures and the share of this coastline in total country's coastal length should be provided on a map showing the coastline subject to physical disturbance due to human-made structures (artificial segments) in red line and the rest (natural segments) in green line. The assessment output should be reported as a common shape file format with GRS as WGS84 [4].

3.3 Indicator 16 for the Karaburun-Sazan NMP Natural and Artificial Coastal Zone

The study shows that the Karaburun-Sazan marine park is subject to the spread of many man-made structures in the coastal area. This process of introducing human infrastructure in a natural Protected Area has continued throughout the years, even though most of the artificial structures were already built in the reference year 2007. In Table 1 are shown the types of the artificial structures and the respective information regarding them.

As shown in the Fig. 5 the artificial structures, respectively, tunnel, docks, marinas and jetties for the year 2007 and 2015 are located in Shën Vasili Bay, the area between Shën Vasil and Dhimkushtë, Shën Jan Bay, Galloveci Cape, Moli i Veriut, Brisan Bay, Inglezi Bay, Grama Bay and Sazan Island. In 2022, there is another intervention in the coastal area of Dhimkushta where the rock was transformed for the placement of umbrellas and also a dock was built for the anchorage of boats.

In total, for the years 2007 and 2015 the entire natural coastline for Karaburun Peninsula and Sazan Island was 116.32 km and the entire coastline with human infrastructure 0.46 km. Meanwhile in 2022 it is seen a small change in the ratio of natural and artificial coastline, respectively the natural coastline makes up for 116.28 km and the artificial coastline makes up for 0.49 km. The changes in 2022 show a trend for the increase of man-made structures in the coastline of the marine park as result of the increase in the number of tourists and the higher request for relevant infrastructure.

3.4 The Presence of Man-Made Structures Within 100 m from the Coastline

The monitoring of the coast in Karaburun-Sazan NMP was conducted not only in the first line very near the coast, but it continued with the monitoring of the presence of man-made structures within 100m from the coastline. The buildings observed in the territory of Karaburun peninsula and Sazan Island were from different periods, but most of them were built during the communist regime 1945–1990. These structures, 148 in total, include bunkers, tunnels, storage buildings, military buildings (Fig. 6).

The most spread in the area are the bunkers built during the communist regime. There are 84 bunkers built with very heavy material and with high damage in the territory and environment. Then there are 15 docks and jetties, mostly built after the decline of

Table 1. Information regarding artificial coastal area structures in Karaburun-Sazan MPA.

No.	Man-made structure	Location	Coordinates (Longitude)	Coordinates (Latitude)	Length (m)
1	Dock	Shën Vasil	19.38065575	40.40184246	8
2	Tunel	Between Shën-Vasil Dhimkushtë	19.36272924	40.4159543	1
3	Tunel	Between Shën-Vasil Dhimkushtë	19.36272924	40.4159543	1
4	Dock	Shën Jan	19.33600986	40.4315647	11
5	Dock	Shën Jan	19.32884808	40.43209447	9
6	Dock	Shën Jan	19.32884808	40.43209447	13
7	Dock	Moli i Veriut	19.29554052	40.42412477	9
8	Dock	Brisan	19.37755852	40.31480145	15
9	Dock	Gjiri i Inglezit	19.43656169	40.2440218	4
10	Dock	Gjiri i Inglezit	19.43656169	40.2440218	5
11	Dock	Gramë	19.47311251	40.21610399	14
12	Dock /Jetties	Sazan	19.28539005	40.50198497	332
13	Dock	Sazan	19.28539005	40.50198497	8
14	Jettie	Sazan	19.28539005	40.50198497	20
15	Dock	Sazan	19.28527801	40.50194497	6
16	Dock	Sazan	19.28527801	40.50194497	3
17	Dock /Rock	Dhimkushtë	19.35705087	40.42210772	36

communist regime, unclassified buildings 47, storage building 1, lighthouses 2, church 1 and 1 hut. The area occupied by these structures is represented in Fig. 7, where it can be seen that 5081 m^2 of the land is with buildings whose function isn't known, but the highest area, 7123 m^2 is occupied by docks and jetties.

Another element that shows the anthropogenic impact is also the existence of a terrestrial road that is being used by the military base and management authorities for patrolling. The road, as seen in Fig. 7 sometimes falls inside the 100 m area and sometimes is out of it. All the man-made infrastructures are shown in the map [6] in Fig. 8.

In 2015, which marks also the year of the proclamation of the marine park, the interest of the area for tourism activities arise and as a result, four service points were built in Shën Vasil Bay. At the beginning, as shown in Fig. 9 the infrastructure in this service points were quite minimal but in 2022 the situation is much more different.

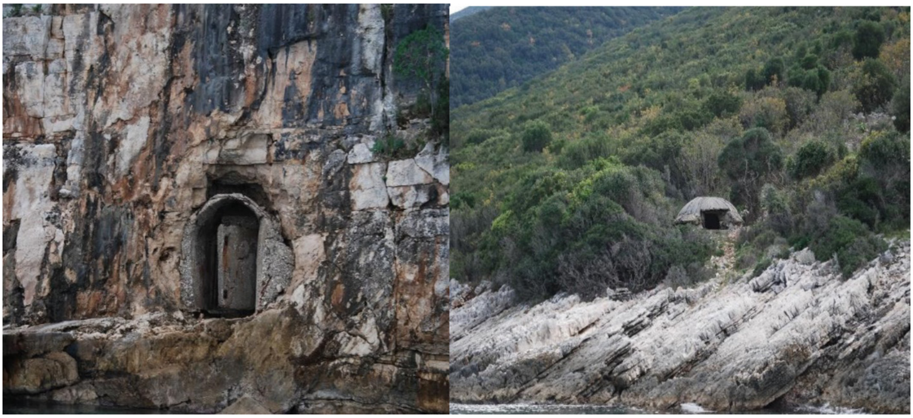

Fig. 6. Photos of man-made structures inside the 100 m area

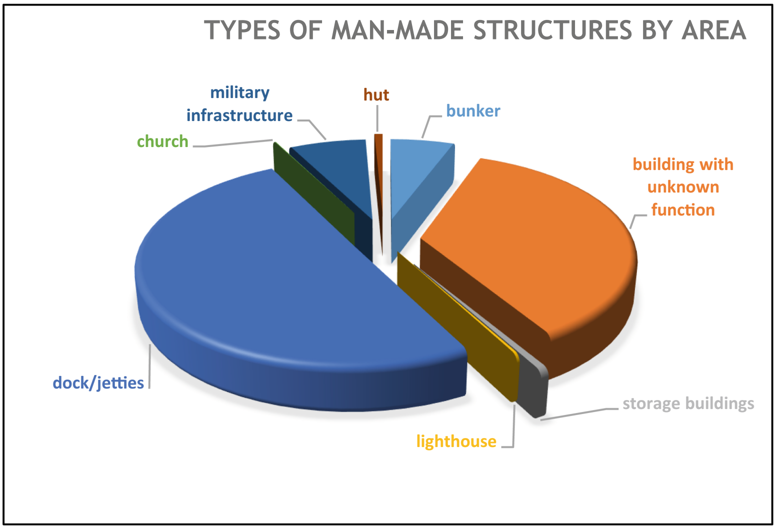

Fig. 7. Graph of the types of man-made infrastructure by area

Major changes are made in the beaches of Shën Vasil and Dhimkushtë meanwhile smaller changes are made in Grama Bay and Shën Jan Bay. Must be taken into consideration that Shën Vasil bay, located in the eastern side, is not part of Karaburun-Sazan MPA but due to its vicinity with the park is considered as part of it. In addition, another area that is located in the western border of the MPA, Palasa Bay has undergone major changes, shown in Fig. 10. The changes noticed in these areas confirm even more the increased pressure for the man-made structures in the coastal areas.

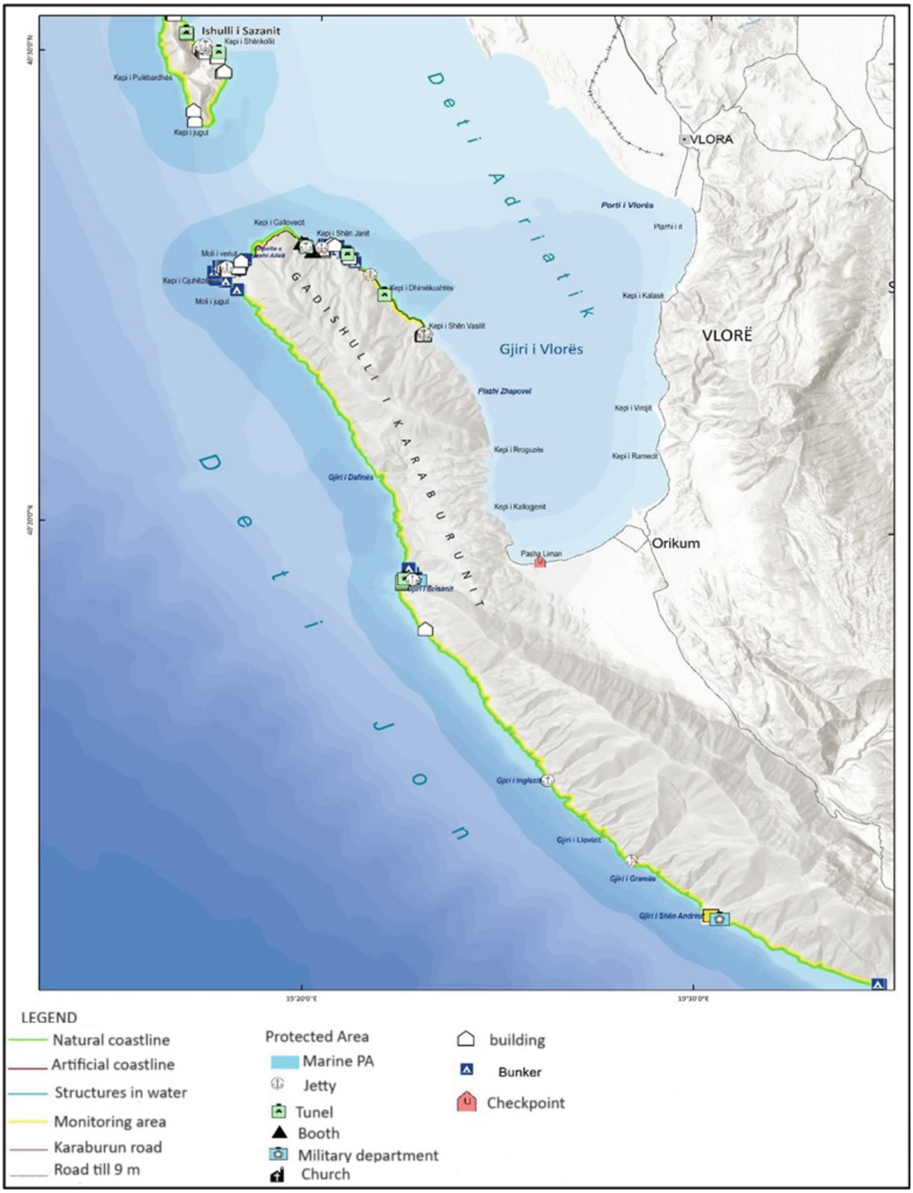
Ishulli i Sazanit
Kepi i Shënkollit
Kepi i Pulëbardhës
Kepi i jugut
Deti Adriatik
VLORA
Porti i Vlorës
Kepi i Gallovecit
Kepi i Shën Janit
Moli i veriut
Kepi i Gjuhëzës
Moli i jugut
Kepi i Dhimëkushtës
Kepi i Shën Vasilit
GADISHULLI I KARABURUNIT
Gjiri i Vlorës
Kepi i Kalasë
VLORË
Plazhi Zhapovel
Kepi i Rroguzës
Kepi i Kallogjenit
Deti Jon
Gjiri i Dafinës
Orikum
Pasha Liman
Gjiri i Brisanit
Gjiri i Inglezit
Gjiri i Llovizit
Gjiri i Gramës
Gjiri i Shën Andreut
40°30'0"N
40°20'0"N
19°20'0"E
19°30'0"E
LEGEND
Natural coastline
Artificial coastline
Structures in water
Monitoring area
Karaburun road
Road till 9 m
Protected Area
Marine PA
Jetty
Tunel
Booth
Military department
Church
building
Bunker
Checkpoint

Fig. 8. Map of man-made infrastructure in Karaburun-Sazan NMP

4 Discussion

This article discusses the monitoring of Karaburun-Sazan NMP using the monitoring protocol for the Common indicator 16.

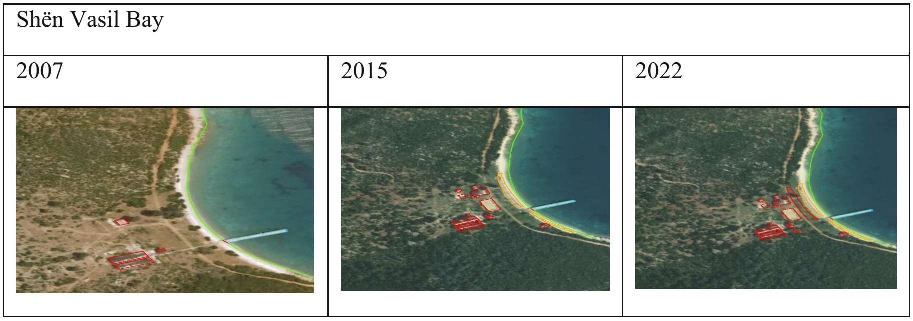

Fig. 9. Changes identified in Shen Vasil Bay

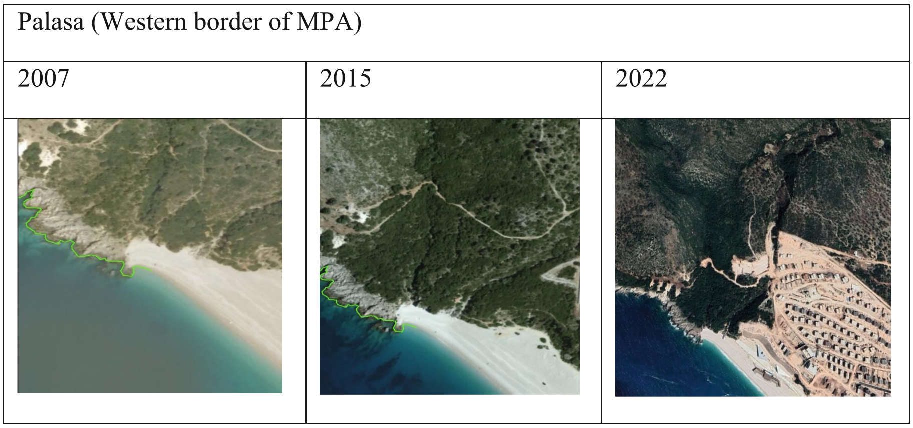

Fig. 10. Changes in the infrastructure in the coastal area of the western border of the MPA.

This National Park has a national and international importance, due to its rich biodiversity, natural landscapes and historical and cultural values. The rapid urbanization and general economic development of Albania in the last decades has had its impact in these natural areas.

Karaburun-Sazan NMP is in the Category II, according to the Albanian system of Protected Areas, which is adapted by the IUCN categorization. Its management should be carefully planned according to this category and to the main objectives of protection.

The data on tourism development in the Park and the number of tourists in the peak seasons show an inadequate management of it and allowing more tourists than the carrying capacity of the area.

The monitoring of Common indicator 16 was conducted for three years 2007, 2015 and 2022 with different methods and tools. From the monitoring there were identified many man-made structures in the Karaburun-Sazan NMP's in their coastlines and in a distance of 100 m from the coast.

Although there are many bunkers and other buildings from the communist regime, in the last years it is observed a spread of new man-made structures in support of touristic demand.

This trend is damaging the wild nature of the Park, its landscapes and biodiversity and measurements to mitigate its effects should be taken from the local and central government as well from the agencies and organizations dealing with environment.

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The Impact of Entrepreneurship Institutional Support and Alertness Traits on Entrepreneurial Action: The Mediating Role of Opportunity Evaluation Stage

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Abstract. The design of entrepreneurial processes deserves a concept as complex as the phenomenon of entrepreneurship. In fact, designing a single process in which an individual with specific entrepreneurial traits can evaluate the opportunities and move forward the entrepreneurial action within an institutional environment, is very challenging. The aim of this research is to envision a contingent model of entrepreneurship effective in terms of entrepreneurial activity dynamism. Drawing a recent literature, the formal institutional support, alertness trait, opportunity evaluation, and entrepreneurial action, have been identified as main important ingredient of the current designed conceptual framework. The originality of this research lies in presenting a complete outline of entrepreneurship while exploring the effectiveness of alertness trait among nascent entrepreneurs and the way they perceive entrepreneurship formal institutional support, in improving their competence in evaluating opportunities and passing to the action stage. The research also enables the discussion of more research questions in addition to many other challenges facing policymakers about how to stimulate entrepreneurship activity, especially in developing countries.

Keywords: Formal institutional support · alertness · opportunity evaluation · entrepreneurial action

1 Introduction

The focus of entrepreneurship research changed in the late 1990s, as authors proposed a more holistic approach to the study of entrepreneurship (Chandra, 2018). A fundamental characteristic of the field of entrepreneurship and its research is the focus on venture creation (Baron, 2007; Gartner, 1985; R. K. Mitchell et al., 2000). In this sense, entrepreneurship is a complex phenomenon that derives from psychological, emotional social, spatial, and institutional contexts that influence the entrepreneurial behaviors, processes and expected outcomes (Elert & Henrekson, 2017; Henrekson et al., 2010; Liguori et al., 2020). This complexity consists mainly in the duology individual, as set

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of traits, skills and intention (Liguori et al., 2020; Petridou & Mintrom, 2021), and the entrepreneurial process from the stage of ideation to the one of the creation (Bennett & Chatterji, 2023).

As entrepreneurs are part of institutions, institutional entrepreneurship represents activities of actors that have an interest in promoting certain institutional arrangements, and that leverage resources to create new institutions or transform existing institutions (Mahzouni, 2019). As is well known, institutions change over time, affecting opportunities for and constraints on entrepreneurship, especially in developing countries. This calls for scientific research on how entrepreneurship can change in line with the transformation of institutions. In fact, the role of the enterprise in promoting the perception and fruitful recognition of new opportunities has been identified by many researchers around the world focusing on the successful entrepreneurial process within a distinctive entrepreneurial environment. However, evaluating the efficiency of this process in terms of entrepreneurial outcomes is still not sufficiently studied because the diversity of mechanisms makes each country take a unique approach when designing its program to stimulate entrepreneurship. Furthermore, the relationship between formal institutions and traits has been highlighted by many researchers, who have been interested on innovativeness, or risk taking (Kreiser et al., 2010) or even in other traits (de Clercq & Dakhli, 2009); however no research until now has focussed its role on alertness as important traits to the pursuit of opportunities.

2 The Alertness Trait in the Core of Entrepreneurial Processes

This concept of entrepreneurial alertness was born with, who argues that entrepreneurs are not just risk-takers or innovators; they are individuals who possess a unique ability to perceive market disequilibrium and profit opportunities that result from the gaps between the current market situation and a potential equilibrium state. The development of the alertness trait concept based on Israel Kirzner's theory has led to the evolution of frameworks that explore the role of alertness in entrepreneurship. Some of them emphasized the role of alertness in identifying and evaluating opportunities based on existing information while focusing on the cognitive aspects of how entrepreneurs perceive and evaluate opportunities. This framework has been soon supported by many researchers while offering refinement to the alertness scale (Tang et al., 2012). Nowadays, the entrepreneurial alertness trait is an important ingredient of entrepreneurial processes. Indeed, entrepreneurial alertness influences how entrepreneurs recognize and capitalize on opportunities (Tang, 2008), and navigate the dynamic and uncertain landscape of entrepreneurship. They are more likely to take swift action when they identify an opportunity. They understand that timing is crucial in entrepreneurship, and they are willing to move quickly to exploit opportunities before they become saturated or obsolete (Gaglio & Katz, 2001). It has also an impact on the decision involving the maintenance of competitive advantage in more mature organization (Roundy et al., 2018). The alertness affects the passion among entrepreneurs to make strategic change (Montiel-Campos, 2021) or to build strong social networks allowing them to identify opportunities (Ma et al., 2020) while improving their self-efficacy and intention toward the entrepreneurial act (Jiatong et al., 2021). Hence successful entrepreneurs have a high level of entrepreneurial alertness enabling them to identify and capitalize on potential opportunities in the market that others might overlook (Sharma, 2019).

3 Alertness Toward the Entrepreneurship Institutional Support

Formal and informal institutions are important for the quality and quantity of entrepreneurship, and that there is a dynamic relationship between institutions and economic development (Chowdhury et al., 2019). Formal institutions, including legal rules, government support measures, and procedures, have been considered critical in in shaping the entrepreneurial activity, especially in the emerging economies (Halilovich & Efendic, 2021; Sarfati, 2019). There is an ambivalent relationship between entrepreneurs and institutions. Certainly, institutions have a significant impact on the entrepreneurial process, and understanding the specific institutional factors that affect entrepreneurship is crucial for policymakers and practitioners to improve the entrepreneurial activity (Arabiyat et al., 2019). However, the entrepreneurs can also affect institutions in various ways, including through innovative political entrepreneurship (Henrekson et al., 2010). An entrepreneur's institutional role perception can affect how they navigate these frameworks and whether they see themselves as disruptors, conformists, or collaborators within the existing institutions (Sutter et al., 2013). This awareness can influence their role perception as rule-followers or rule-challengers, depending on whether they choose to comply with existing regulations or work to change them (Elert & Henrekson, 2017). Alert nascent entrepreneurs might identify areas where established institutions are lagging. This can lead them to develop innovative solutions and opportunities that challenge the status quo. Some formal institutions offer innovation challenges, competitions, and grants to encourage novel solutions to societal problems. Alert entrepreneurs identify these opportunities and leverage their creativity to develop innovative products or services that align with the institution's goals (Fuentelsaz et al., 2015, 2019). They might recognize areas where innovation is needed or where current institutions are lacking, thus shaping their role perception as potential change-makers. From a strategic perspective, the alertness traits help the entrepreneurs to adjust their institutional role perceptions based on changing circumstances. If there are shifts in regulations or economic conditions, entrepreneurs with high alertness can quickly adapt their strategies to fit the new context (Eiadat & Fernández-Castro, 2022).

4 Opportunity Evaluation vs Entrepreneurial Action

Since 2009 the number of publications focusing on the opportunity evaluation process has increased exponentially (Wood & Mckelvie, 2015), as it is a crucial step toward the entrepreneurial action (J. R. Mitchell & Shepherd, 2010). Indeed, the opportunity evaluation in entrepreneurship is a complex process that involves cognitive and rule-based decision-making through the perception of risk (Dali & Harbi, 2016; Hean Tat Keh et al., 2002; Riquelme & Alqallaf, 2020), the financial and social attributes of an opportunity (Smith et al., 2010) and mainly by concretizing existing and novel ideas into feasible prototypes (Pretorius et al., 2023). Entrepreneurs use socially constructed rules to evaluate opportunities, and that individual differences in knowledge and worst-case scenario thinking influence opportunity evaluation (Wood & McKinley, 2010). They evaluate opportunities based on their existing knowledge resources but may also pursue the acquisition of new resources that are inconsistent with their existing knowledge (Haynie et al., 2009). Hence, the opportunity evaluation process is a structured approach used by individuals, entrepreneurs, and organizations to assess the potential of a business idea, project, or venture before committing significant resources to it. This process involves gathering relevant information (Autio et al., 2013), analyzing various aspects of the opportunity, and making informed decisions about whether to pursue or abandon the opportunity (Haynie et al., 2009, 2010; D. Shepherd & Haynie, 2009).Opportunity evaluation is a distinct and a very complex phenomenon and there is a tough passage from the opportunity evaluation stage to the one of action, which needs more exploration to understand this enigma. Indeed, some entrepreneurs might struggle with or delay the execution of opportunities even after evaluating them positively due to many factors psychological, cognitive, and contextual factors that affect this critical phase of entrepreneurship, such as entrepreneurs' perception of uncertainty, their temporal orientation, and the socio-cognitive challenges they face (McMullen & Shepherd, 2006; D. A. Shepherd et al., 2007). Does it represent the solid bridge between the stage of ideation and the one of creation (Williams & Wood, 2015; Wood & Williams, 2014)?

5 Alertness Trait and Opportunity Evaluation Process

Entrepreneurial alertness significantly and directly predicted opportunity recognition (Li et al., 2015; Meera Ntayi et al., 2022) which subsequently influences the entrepreneurial action (Neneh, 2019). Indeed, Alert individuals are attuned to changes, trends, and signals within the market. They can spot shifts in consumer preferences, emerging technologies, regulatory changes, and other factors that create opportunities for new products, services, or business models (Srivastava et al., 2021) through the recognition of inefficiencies or suboptimal processes within industries. The entrepreneurs with high level of alertness are synthetizing information from different sources and disciplines to uncover novel opportunities at the intersection of various fields as the patterns they then perceive in these events or trends suggest ideas for new products and services (Baron, 2006). Figure 1 displays the conceptual framework.

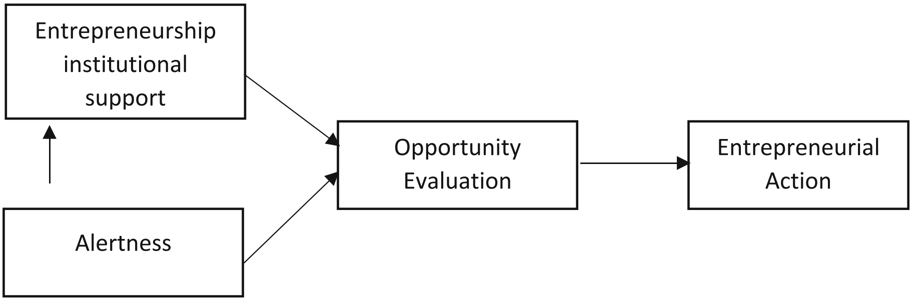

Fig. 1. Conceptual Framework

6 Limitation and Future Research

An examination of the comprehensive literature in the last two decades shows that the majority of scholars have failed to provide a clear definition of entrepreneurial opportunity or a method of how this complex process works. In this sense, the gap in the literature is very huge and the limitations are numerous. In fact, we concluded that only 20% of the 75 articles examined in these provided tools for measuring opportunities within the entrepreneurial process with the number of opportunities discovered. What's more, 30% of the articles that presented conceptual models of opportunity provided no consensus either on its definition or on its recognition through some process. Thus, we conclude the following limitations: (1) lack of experimental research; (2) lack of tools to measure opportunity recognition; (3) There is no consensus on the determinant of opportunity recognition; (4) Unclear definition of opportunity recognition; (5) There is no link between intention and opportunity recognition; (6) There is no link between identifying an opportunity and moving into employment.

The conceived framework is a foretaste for further empirical investigation, to answer the research questions "what", "why" and "how" to improve the entrepreneurial ecosystem to be effective in terms of entrepreneurial action (Petridou & Mintrom, 2021).

7 Conclusion

Entrepreneurship requires action whether conceptualized as creating new products or processes, entering new markets, or creating new ventures (Gartner, 1985), entrepreneurship typically involves a meso-level phenomenon in which Personal initiative over system-wide activity and outcomes (McMullen Shepherd 2006). Being an entrepreneur therefore means acting on the possibility that one has identified an opportunity worth pursuing. Hence, the goal of the current research: To build the process of entrepreneurial action while investigating theoretically the role of the alertness trait and the entrepreneurship institutional support on evaluating the opportunity and moving toward the effective act. Hence, some business concepts were identified as the only way, so far, to give a clear trace that helps to recognize the opportunity.

The current research had contributed to the enrichment of the opportunity recognition literature by filling some gaps regarding the transition of the nascent entrepreneurs, from the perception of the entrepreneurship institutional support to the opportunity evaluation stage, and then to the entrepreneurial action one, while considering the effectiveness of the alertness trait in such entrepreneurial process.

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The Impact of Authentic and Transformational Leadership on Employees' Creativity in the Omani Public Sector: The Mediating Role of Organizational Commitment

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Abstract. Stimulating the creativity among the employees of public sector institutions remains one of the most challenging missions of any leadership style. Drawing a recent emergent literature dealing with leadership styles and creativity, the paper identifies recent theoretical and empirical research highlighting organizational commitment as an important bridge between leadership practices and the employees' creativity enhancement. Hence, the current proposed conceptual framework aims to focus on the impact of authentic and transformational leadership on the employees' creativity of the public sector, through the mediating role of organizational commitment. The originality of this paper is toward highlighting the indispensability of organizational commitment in consolidating a robust bridge that may make these leadership styles more effective in generating creative dynamism in public institutions. This paper could open a great debate for the community of researchers to focus more on contingent models of leadership effectiveness in terms of "what", "why' and 'How" stimulating the creativity of public sector employees.

Keywords: Authentic and transformational leadership · creativity · Organizational Commitment · Public Sector

1 Introduction

A Successful and effective governmental institution depends on its public personnel. Hence, governments improving the innovation of their public services to solve the continual problems is a must. It is expected that creative public employees are more likely to develop opportunities by coming up with fresh and practical concepts for things like products, services, and procedures (Houtgraaf et al., 2021; Sherief, 2019). "What" and "how" making public sector employees' creative remains one of the important research questions among the community of researchers. Some of them argue that the proactive personality and motivation are the origin of that creativity, while others related it to information technology use (Yang et al., 2022), while many of them are linking the subject

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with the leadership styles, such as the transformational leadership (Afshari & Ayoufu, 2011; Çekmecelioğlu & Özbağ, 2016), or the servant leadership (Karatepe et al., 2020), however, there is still a need to explore the authentic leadership style outcomes in terms of performance in general and creativity in particular.

Recent studies show that the mediating role of work engagement seems to be an important stimulating variable in concretizing the employees' work outcomes notably their performance (Aboramadan & Dahleez, 2020) and even their creativity (Yang et al., 2022). In fact, employees are motivated to work for the public organization's success either by work engagement or by organizational commitment (Musabah & Zefeiti, 2017). Hence, it is interesting to shed light on the relationship between organizational commitment, authentic leadership, and creativity (Wu & Chen, 2018). Moreover, despite the importance of the authentic leadership style in improving the outcome of any institution and in any cultural context (Zhang et al., 2021) and its organizational effectiveness (Lee, 2018) in terms of employees' performance (Pillai & Mikkilineni, 2021; Ribeiro et al., 2018; Zeb et al., 2020) and work engagement (Oh et al., 2018), the link between the authentic style of leadership and the creativity of the employees, mainly in the public sector, namely in the emergent countries, needs to be critically highlighted (Al-Awlaqi, Aamer et al. 2021, Gelaidan, Al-Swidi et al. 2023, Yğkğlmaz and Sürücü 2023). Thus, this triangular relationship causality deserves to be explored as the creativity dynamism enhancement remains a very challenging mission of the leaders in emergent countries and an interesting research field of investigation.

2 Transformational Leadership and Employees' Creativity

These days, leadership is contemplated as an administrative and departmental procedure that affects and manages the venture of companies. Recent research confirmed empirically the effects of the internal creative dynamics of self-discerned creativity, and transactional, transformational, and servant leadership styles on the creativity of public servants (Gelaidan et al., 2023). This study also confirms that psychological empowerment is affected by meditation. Hence, these studies inferred the conclusion that creativity is an important construct and if it is properly examined, there is a possibility of having a greater positive effect on the development of the organization. Indeed, the transactional and transformational leadership styles positively predicted innovative work behaviour.

In today's dynamic and competitive business environment, creativity has become a habit as organisations seek new and unconventional ideas to stay ahead. Transformational leadership has become a powerful force driving creativity in a team or organization. Transformational leaders enable their teams to be creative by creating a shared vision, competing skills, and building trust and collaboration. Transformational leaders create a shared vision that encourages and motivates their teams to work towards a common goal. When leaders have a clear and appropriate vision, employees can align their goals with the organization.

This engages employees and keeps them working for a reason. With this kind of drive and focus from the leader, employees will be creative and create new ideas that will help them realize unity. Transformational leaders challenge stereotypes and foster creativity. They understand that the status quo is not enough, and that creativity is necessary to innovate and do business. By accepting new ideas, they gain confidence in their employees' ability to innovate and solve problems in unique ways.

This creates an environment of risk, experimentation and sharing of ideas, all necessary aspects of creativity. Transformational leaders build excessive trust and collaboration within their teams, which may sometimes lead to a lack of focus and favouritism. By fostering an atmosphere of mutual respect and support, leaders can create open lines of communication, foster collaboration, and support everyone's unique perspectives (De Clercq and Mustafa 2023). When there is trust, team members are more likely to share ideas and take new risks. This leads to better problem-solving and more strategies for moving forward.

Transformational leaders empower employees by providing support, resources, and creativity. They understand that their success depends on their employees, and they try to encourage them to be independent and satisfied with their work. This creates a healthy competitive environment where employees are motivated to do more, and their contribution is appreciated. As a result, transformational leaders can foster creativity in the workplace (Juyumaya and Torres 2023). By creating a shared vision, fostering creativity, fostering trust and collaboration, and empowering employees, they encourage partners to take risks and create new and complete ideas.

Transformational leadership fosters a culture of innovation and enables employees to contribute their best ideas, ultimately supporting the growth and success of the organization. Creative efforts at the organizational level are the effects of innovation. Gaining insight into the transformational style of leadership on organizational innovation is as significant as understanding the effects on the creativity of the employee. In addition, it has been found that transformational leaders develop better relationships with their followers. Group work interactions, divisional affiliation and the exchange of information between the subordinate and the leader imply that transformational leadership has an important role in shaping and creating the behaviour of the employees. Also, innovative behaviour is related to the relationship between the supervisors and the subordinates. In addition, it has also been noted that challenges, debate, openness, and involvement play a critical role in supporting creativity.

3 Authentic Leadership and Employees' Creativity

Creativity and innovation are essential to the development and performance of any organization (Agbor, 2008). Revising the growing body of research in terms of leadership and different organizational outcomes, leadership is playing a great role in stimulating the innovativeness spirit among employees (Anderson et al., 2012). This ambivalent relationship has been proven even in an individual or a group level (Hemlin & Olsson, 2011).

Thinking, acting, and leading creatively is the pillar of engendering change within any group of people. Indeed, to succeed in educating employees to creative behavior is crucial for any leaders seeking to bring this change within the organization (Harding, 2010). In that sense, the leaders in the public sector are more accountable to the stakeholders in creating a good wind for creative initiatives. Similarly conducted an analytical and descriptive study that examined the impact of leadership on employee motivation and productivity in the Omani Water Sector. The findings made it abundantly clear that leadership has an effect on employee behaviour, innovation, and creativity in a strong way (Awais Bhatti, Mohamed Battour et al. 2014).

Numerous conceptualizations and empirical investigations show that leadership influences the creative performance of employees rather frequently. Although research on leadership that fosters innovation has been conducted, little is known about the mechanisms that link it to the innovation process, which encompasses both creativity and the application of innovative ideas. The authentic leadership of the team members directly affects the creativity of the individuals of the team members. The creativity of the employee affects authentic leadership based on factors such as psychological meaningfulness & safety & work engagement (Chaudhary & Panda., 2018). There is a positive arbitrating impact of affective & cognitive-based trust linking the connection between authentic leadership & the employees‘ communal connection. Even the creativity of the students impacts authentic leadership based on the regulatory-focused behaviour of the students.

An important element that fosters creativity in both individuals and teams is psychological safety (Maximo et al., 2019; YEŞİLTAŞ et al., 2023; Zubair & Kamal, 2015). The employees under the authentic leadership style practices are intrinsically motivated to think creatively while solving problems and creating adequate solutions. This style of leadership encourages the staff to be authentic and share their distinct viewpoints. Employees are more inclined to provide the company with creative ideas when they feel free to express themselves (Kim et al., 2022). Hence, a climate of trust is established, and employees are more likely to take chances and make innovative suggestions when they believe in their managers (Baquero, 2023). Indeed, the employees of the public sector are fostering a supportive and welcoming workplace where staff members feel psychologically comfortable expressing their thoughts without worrying about being judged.

4 The Mediating Role of Organizational Commitment

There is a profuse amount of research papers that explain the mediating role of organizational commitment. The mediating impacts of the organizational commitment affect the employee, satisfaction of job & performance. A recent study has given empirical confirmation using the example of an educational organization. In fact, the mediating character of the organizational commitment of the teachers depends on the connection between their work engagement (WE) & emotional labor (EL). Other researchers are looking into how organizational justice & organizational citizenship behavior (OCB) behavior relate to one another, contemplating the mediating effect of organizational commitment.

In a similar context, a positive and significant relationship is also found between the work environment, job contents, supervision practices, pay, promotional practices, coworkers, and organizational commitment in the Omani business sectors . It is noted that workplace spirituality has emerged as one of the most efficient methods for reducing intentions of employee turnover and fostering organizational commitment, job involvement, creativity, and innovation in the Omani public sector. With regard to the impact of Organizational Commitment on Employees' Creativity, found that employees' innovative behavior was positively correlated with their level of job satisfaction and organizational commitment.

In some emergent countries like the Sultanate of Oman, leadership and organizational commitment in the public sector have been discussed by some researchers. Organizational commitment has a significant impact on career growth for public sector employees in terms of encouraging retention and reducing intention to leave. Hence, focusing on the mediating role of the organizational commitment in Sultanate of Oman, may support these findings and open a new debate on its impact on creativity while discussing the role that may be played by authenticity in leadership in the public sector. Figure 1 shows the conceptual framework.

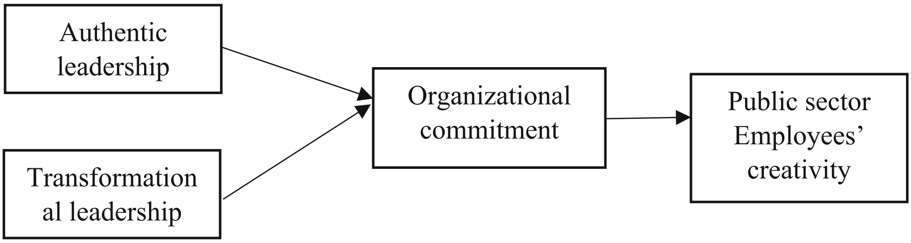
Authentic leadership
Transformation al leadership
Organizational commitment
Public sector Employees' creativity

Fig. 1. Conceptual Framework

5 Limitation and Future Research

Despite the existence of emergent literature dealing with the relationship between authentic and transformational leadership styles and creativity (Asif et al., 2019; Komang et al., 2020; Mubarak & Noor, 2018), there is a real need to explore this relationship while shed lighting the moderator role of the organizational commitment (Chaudhary & Panda, 2018), especially in the public sector context. Thus, A comparative research of successful case studies where transformational and authentic leadership styles have successfully fostered creativity in public sector organisations may be one of future research recommendations. This study can offer useful insights for leaders and policymakers who wish to apply these tactics more widely by identifying the tactics, processes, and leadership behaviours that have produced creative dynamism. Furthermore, another recommendation is to investigate possible obstacles, impediments, and the function of corporate culture in facilitating the adjustment of leadership approaches to enhance creativity in public sector environments.

The study investigates theoretically the relationship causality between the authentic and transformational leadership styles, the employees' creativity, and the organizational commitment in the public sector. Authentic and transformational leadership practices within an organization motivate employees and thus encourage them to work towards a single goal: maintaining a management system of innovation! Among the four existing leadership styles, the organization in today's world emphasizes transformational leaders and authentic leadership is seen as the final stage in the development of leadership styles. These types of leaders drive creativity in a team and thus contribute to improving the performance and overall growth of the company. The study has created a conceptual framework investigating the question of "what is" the role of authentic and transformational leaders in promoting organizational commitment and then the employees' creativity, however the question of "how" improving these leadership practices to be more effective in term of creativity dynamism in public sector, remains very ambitious. In-depth empirical research, using mixed method, may be necessary to create new variables reflecting the creativity dimensions in the public sector and then give validity of the existing constructs of the variables used in the designed conceptual framework.

6 Conclusion

In the era of the fourth industrial revolution, public sector organizations were also concerned with being competitive and creating value. This challenge is very complex for the public institutions which have hierarchical, bureaucratic cultures that place a high value on consistency and obedience to rules. Finding examples of creative places to study might be difficult because such cultures may impede innovation and creativity (Marco Berardi, 2023). Any leadership style is facing big challenges when it comes to improving the employees' creativity in government agencies and other organizations in the public sector (Bolden & O'Regan, 2018). Compared to private sector companies, the public sector may have less funding available for research (Albury, 2012; Schmidt et al., 2022). Due to this restriction, there may be fewer opportunities to investigate ideas like real leadership and creativity in public sector contexts. Due to the nature of their services and the potential consequences of errors, public sector companies frequently have a low tolerance for risk. The development of a creative workplace may be hampered by employees' unwillingness to take risks and try out novel concepts and cutting-edge procedures (James Batista Vieira & Amanda Batista de Araujo, 2020). Leaders in the public sector and decision-makers may not be aware of the value of authentic leadership or how it influences the development of creativity. Without this knowledge, there might be less incentive to fund research into these subjects (Hoai et al., 2022). There is still a need to learn more about the connection between authentic and transformational leadership's role in improving employees' creativity in these organizations. It is crucial to support a culture of openness to new ideas, fund research projects, and advance authentic leadership practices in the public sector.

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Is Attitude Towards Technology Use Powerful Enough to Moderate the Social Influence on Usage Behavior? A Study on an E-Healthcare Application for Generation Y in Jakarta

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Abstract. Will the post-COVID-19 pandemic produce the same urgency for many things as the pandemic, including health-care awareness? Does this also apply to members of Generation Y? This is the context for this research, which also includes generation Y, which tends to be more conscious or concerned about health services that are valuable and can be accessed at any time. This need is also what drives the importance of health services in digital form, such as in an application. The study employs a quantitative technique based on PLS-SEM modeling. This study uses SMART PLS 4.0 as an analysis tool. This investigation included 110 samples. A survey containing a questionnaire is used to collect data. On a scale of one (strongly disagree) to five (strongly agree), According to the findings of this study, social influence has a role in affecting the attitudes and behavior of generation Y in Jakarta when it comes to using health care applications. This is due to generation Y's proclivity to evaluate the effect of others around them and to pay specific attention to attitudes and usage behavior of health service applications. This study has limitations due to the use of only one generation and one region, as well as the absence of other personal criteria.

Keywords: Social Influence · Attitude Towards Using Technology · Behavioral Intention · E-Healthcare · App

1 Introduction

Will the post-COVID-19 pandemic provide the same urgency as the pandemic for many things [1–5], Is this also true for Generation Y? This is the context for this study, as generation Y, born between 1980 and 1994, is currently married or has a family. In terms of health services, this generation is more aware of or worried about health services that are beneficial and can be used at any time. This need is also what makes health services in digital form, such as in an application, such a vital need today. Aside from

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that, as previously stated, the COVID-19 epidemic can be considered over. On the other hand, awareness of the presence of this health care application must be researched more, especially when it is linked to community attitudes and behavior, particularly generation Y in big cities like Jakarta. Furthermore, an increasing number of health-care applications are being developed. The public will be presented with several health-care application options, each with its own set of advantages and downsides. This will alter social perceptions in society, which can influence attitudes and behaviors toward using a health care application.

2 Literature Review and Hypothesis Development

Attitudes toward using a health care application are more heavily influenced by user opinions of its usefulness and popularity. Social influences, such as friends, relatives, or family, are one role in its popularity [6]. However, given the negative or contradicting findings on these two factors [7, 8] this needs to be investigated further. Behavioral intention is an intervening construct (intermediate variable) in the relationship between user reactions to the use of information technology and actual use (use behavior) in the basic notion of user acceptance models that have been created. Several factors can influence a person's interest in utilizing a product, including both internal and external aspects. Internal influences include an individual's attitudes (attitude) and self-assurance (confidence), whereas external influences include family, friends, and individuals in the individual's environment [6]. A person's behavior is impacted by their purpose to carry out an action, according to reasoned action theory [9]. This study proposes the following hypothesis based on the explanations provided:

H1: Attitude towards technology use moderates the social influence on usage behavior.
H2: Attitude towards technology use affects the usage behavior.

Social influence is defined as the ability or encouragement of others to affect individual decisions. Other people in this situation could be from a friend or family group [10]. Although social impact can shape decision-making considerations in general, some earlier research have produced conflicting outcomes. Several research, for example [1, 2, 11–13] demonstrate the relationship between social impact and attitudes or behavior in decision-making. Several research, however [7, 8, 14, 15] show the reverse. This foundation then gives rise to the following hypothesis:

H3: Social influence affects the attitude towards technology use.
H4: Social influence affects the usage behavior.

Based on the literature analysis and hypothesis building, the following framework (Fig. 1) is proposed in this study:

3 Methods

The study employs a quantitative technique based on PLS-SEM modeling. This study uses SMART PLS 4.0 as an analysis tool. This study has 110 samples, which were calculated by multiplying the number of items (11 items) by 10 [16–18]. This sample is

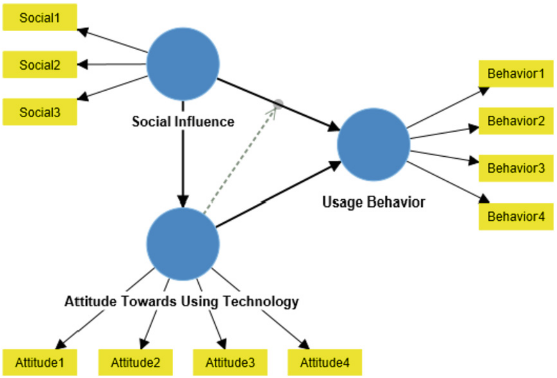

Fig. 1. Conceptual framework tested

made up of Jakarta residents who utilize the Halodoc health service application. A survey containing a questionnaire is used to collect data. This study consists of three variables, namely social influence, which has three items [10, 19] (people argue that they should use this health service application, people who are considered important think that it is important to use this health service application, and people who are considered important feel bad for people who suggest that they should not use this health service application). Furthermore, four factors comprise the attitude toward technology use variable [10, 19] good at utilizing this health service application, easy to grasp, beneficial, and like it. The behavioral intention variable consists of four items [10, 19] planning to use this health service application, willing to use it, will use it if they know or know several doctors on the service application for this health, and will use it in the future.

4 Results

This study uses the results of outer loading (OL) and composite reliability (CR) > 0.7 to determine reliability. Meanwhile, in this work, the validity test employed AVE results greater than 0.5 [20–25]. Items that do not meet the standards, such as Behavior2, will be removed. According to the reliability and validity results in Table 1, all items and variables in this study are reliable and valid.

This study examines the results of hypothesis testing based on a P value greater than 0.05, which explains hypothesis acceptance [5, 26–28]. According to the hypothesis testing results in Table 2, there are two acceptable hypotheses (H3 and H4) and two rejected hypotheses (H1 and H2).

Table 1. Reliability and Validity Tests

Variable	Item	OL	CR	AVE
Social influence	Social1	0.860	0.915	0.783
	Social2	0.940		
	Social3	0.851		
Attitude towards using technology	Attitude1	0.842	0.932	0.774
	Attitude2	0.897		
	Attitude3	0.896		
	Attitude4	0.882		
Behavioral intention	Behavior1	0.794	0.808	0.585
	Behavior3	0.711		
	Behavior4	0.787		

Table 2. Hyhoteses Test

Hypothesis	STDEV	T statistics	P values	Remark
H1	0.124	1.576	0.115	H1 rejected
H2	0.171	1.028	0.304	H2 rejected
H3	0.037	20.256	0.000	H3 accepted
H4	0.149	3.231	0.001	H4 accepted

5 Discussion

5.1 As a Moderator, Attitude Towards Technology Use is Insufficient

This study found that attitudes regarding technology use are not powerful enough to buffer the social effect and behavior of utilizing an e-healthcare application in Jakarta's generation Y. The factors contained in the perceived attitude of utilizing e-healthcare, such as the fact that e-healthcare services are good, easy to grasp, beneficial, and liked nowadays, are regarded as normal and acceptable. This is also demonstrated by the lack of influence between attitudes and usage behavior. User opinions toward the usefulness of e-healthcare do not always influence usage behavior. As is well known, e-healthcare is becoming a necessity for society, especially considering the COVID-19 epidemic. People are becoming more conscious of the need of always having personal health services available. The findings of this study support the notion that intentions influence usage or purchase decisions [6, 9, 11]. This means that if a need exists, an intention will be established, which will influence a usage decision. Because, once again, e-healthcare is a service requirement for society that is urgent and a priority, these other factors can be ignored [29–31] Furthermore, based on the age features of generation Y [32], it can be deduced that this generation is generally married or has children, with health services being one of the most pressing needs. In addition, this generation is more open to literacy and technological progress [33].

5.2 Social Influence is Important

Another intriguing finding from this study is that social influence has a significant impact on e-healthcare using attitudes and behavior. People live next to one other and socialize with their friends, relatives, and family. Individual decisions are highly likely to be impacted by others. This shows how other people's considerations might influence decision-making. This is inextricably linked to the use of a health-care application. These findings support the notion that social influence has a significant impact on decision-making [11–13]. The findings of this study also highlight that in terms of social impact, individuals who are regarded as influential and influence the decision to utilize a health care application play the most crucial role. This study's findings also invalidate research findings that stress the reverse [14, 15].

Based on the findings of this study, a conceptual framework in which social influence plays an essential role in shaping attitudes and behaviors when utilizing a health care application can be provided, as illustrated in Fig. 2 as follow:

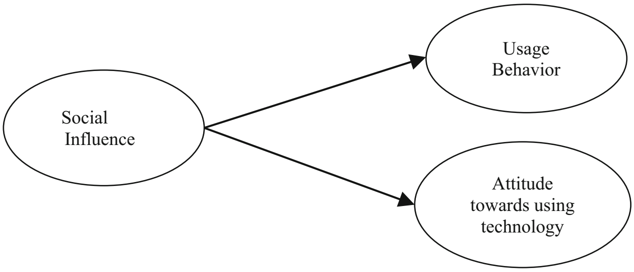

Fig. 2. Conceptual framework developed

6 Conclusion, Limitations, and Recommendations

According to the findings of this study, social influence has a role in affecting the attitudes and behavior of generation Y in Jakarta when it comes to using health care applications. This is due to generation Y's proclivity to evaluate the effect of others around them and to pay specific attention to attitudes and usage behavior of health service applications. Aside from the use of the application, the need for health services, advice, or experience from others may be a deciding factor in this scenario. As is well known, Generation Y is becoming a major decision-maker in terms of the health services offered to the family. This study has limitations, particularly in that it only used one generation and one region. Aside from that, the study's weakness is that it does not include other personal factors such as job, frequency of use of health service applications, or amount of money spent using this health app. As a result, it is suggested that future study incorporate these criteria. Furthermore, intergenerational comparisons can be used in future studies to supplement study results based on this approach.

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Procedure for Traffic Accident-Prone Area Monitoring Based on Kernel Density Estimation

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Abstract. To prevent traffic accidents, a variety of interventions can be implemented. Among many causes of traffic accidents, the one caused by the failure of road systems is something that should be able to be prevented by continuously monitoring the historical data of accidents. The prevention of traffic accidents via accident data analysis necessitates comprehensive procedures to ensure that continuous improvement is happening. The procedure utilizes kernel density analysis to pinpoint the accident-prone area to monitor. Accident-prone areas are classified into five categories: "Very High," "High," "Moderate," "Low," and "Very Low." In addition, overlay mapping of "Very High" category from different years provides the prioritization of accident-prone areas to monitor. The top priority for monitoring is the intersection of the "Very High" overlay from consecutive years. The accident-prone area to be prioritized is then observed to investigate the cause of the problem and then provide recommendations to improve the road systems. The effort should become the responsibility of many relevant stakeholders. The recommendations are sent to the relevant stakeholders for further action. A demonstration of the procedure was conducted in a regency in Indonesia with a high accident rate, resulting in a successful analysis of traffic accident-prone monitoring.

Keywords: monitoring procedure · traffic accident analysis · kernel density overlay

1 Introduction

The increasingly high people mobility leads to more dangers involving road users, especially regarding traffic accidents. Road segments with higher traffic volume naturally experience more accidents [1]. A similar observation also indicated that the probability of traffic accidents is higher when more vehicles are on the road [2]. Indonesian Law states that the country must protect every citizen. Thus, every risk to traffic and transportation safety within the society becomes the state's responsibility. This responsibility is held by stakeholders from many related institutions in Indonesia that are joined in the Traffic Communication Forum.

A traffic accident may be caused by several factors, such as driver negligence, vehicle breakdown, or the failure of the road system itself. A big accident may be caused by

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driver negligence, however, if there is a recurring accident happening in a particular location then we might suspect that there is a problem in the road system in that location. Therefore, it is important to ensure the road system is working properly. This necessitates a procedure where continuous improvement of road safety can be conducted regularly through monitoring traffic accident cases periodically. What is important is that the procedure can ensure that the location where road systems fail to accommodate traffic safety can be located correctly. Thus, recognizing accident-prone area where accident level is always high annually become very important to traffic managers.

Monitoring is a cycle of activities that includes collecting, reviewing, reporting, and acting on information about a process that is being implemented [3]. Traffic accident monitoring is important to carry out with the aim that all input data or information obtained from past accidents can become the basis for making decisions on how to prevent them. It is possible to obtain a mapping of traffic accident rates based on the number of traffic accidents by implementing the *kernel density* analysis [4]. Accident-prone locations can be obtained through analysis by implementing kernel density to obtain a traffic accident-prone density map. Previous research has provided the foundation for traffic accident analysis. Implementing kernel density in the procedure serves as one of the monitoring stages. Through the visualization of accident-prone density mapping, further observations can be conducted in areas with high accident rates to generate recommendations for improving road conditions as transportation infrastructure.

2 Background and Related Work

2.1 Traffic Accidents

An accident that occurs on open roads may result in injuries, death, fatalities, vehicle damage, or material losses. The definition of traffic accidents according to Indonesian Law (no. 22 dated 2009) concerning Traffic and Road Transportation states that a traffic accident is an unforeseen and unintended event on the road involving human victims and/or property damage. An accident-prone area is a location (i.e., road segment) with the highest accident rates, the highest accident risk, and the highest potential for accidents. Common criteria for determining accident-prone areas include high accident rates, the occurrence of accidents concentrated in location, accidents happening within a relatively similar time and space, and accidents having specific causative factors.

2.2 Kernel Density

In essence, *kernel density* aims to estimate the intensity distribution of points within a certain radius on a plane [5]. *Kernel density* is a type of density that uses a non-parametric statistical formula for estimating density and can be applied using ArcGIS software. ArcGIS is one of the Geographic Information System (GIS) applications, an integrated computer system for the input, storage, analysis, and output of spatially referenced data [6]. Thus, GIS combines three fundamental elements: system, information, and geography. ArcGIS is widely used for analyzing the density distribution patterns within an area.

The analysis of traffic accident-prone areas using kernel density has been researched, such as the development of procedure based on clustering [7]. The kernel density method can be used to identify areas with the highest accident incidence and highest accident severity [8]. Kernel density estimation was used to test variable relationships efficiently, which shows that this method can develop prediction models [9]. Implementation of kernel density mapping is for accident analysis is possible using GIS [10] and even possible for sea transportation [11]. One of the implementations of the kernel density method produces an analysis of traffic accident levels in Jakarta, the capital of Indonesia [12].

To be able to see which accident-prone area, overlay is used. Overlay is a process in spatial data where geographic layers are combined to obtain new information. In particular, the overlay process aims to reveal areas of compatibility between two or more datasets. The overlay process involves several procedures, including calculating intersection points, forming intersection points, displaying topology and new objects, removing small interfering polygons and merging polygons, and generating new attributes and performing addition/union processes in attribute tables [13].

3 Method

3.1 Accident-Prone Monitoring Procedure

A monitoring procedure for accident-prone areas based on mapping visualization results from standard kernel density can provide recommendations to reduce the potential for traffic accidents in the highest accident-prone areas. The steps can become a standard procedure which is expected to be a guide to monitor the level of accidents and provide recommendations for improvement. The flow of the procedure can be seen in Fig. 1.

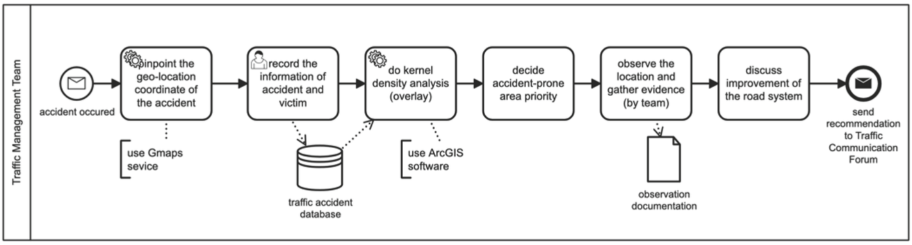

Traffic Management Team
accident occured
inpoint the geo-location coordinate of the accident
use Gmaps sevice
record the information of accident and victim
traffic accident database
do kernel density analysis (overlay)
use ArcGIS software
decide accident-prone area priority
observe the location and gather evidence (by team)
observation documentation
discuss improvement of the road system
send recommendation to Traffic Communication Forum

Fig. 1. Steps in accident-prone area procedure.

When an accident occurs, a precise geolocation coordinate of the accident must be recorded. Applying the kernel density method can provide accident-prone density mapping through the number of traffic accident-prone points, thus forming accident-prone areas. The mapping results will show the road sections with the lowest to highest traffic accidents. Other information regarding the accident and also the victim should be recorded and put into the database. The coordinate data will then be used to conduct kernel density analysis. Using the result of the analysis, different accident-prone area is prioritized. Next, observations can then be carried out to see the real conditions of the road system. The observation should be conducted by a team of relevant stakeholder representatives concerned with traffic accident prevention. Documentation of the observation will show road conditions in areas prone to traffic accidents. Based on the observation results regarding the condition of areas prone to traffic accidents, recommendations are made by the team to improve the road systems. Various efforts can be made as a form of preventive action to reduce the potential for traffic accidents in accident-prone areas. This recommendation is then sent to the relevant stakeholders that manage the traffic. Periodical monitoring using this procedure is expected to continuously improve road systems, which will lead to a decrease in the number of traffic accidents.

3.2 Kernel Density Analysis Using ArcGIS

Kernel density analysis is used to identify areas based on the number of accident incidents. These areas are shown in the map, making the information easily understandable to the user. The coordinate points from the traffic accident location data will form an area based on its classification, which is determined by the density of accidents occurring in that area. The accident-prone levels are classified into 5 classes, ranging from "Very Low" to "Very High." The classification is based on user needs, in which the more detailed the classification, the smaller the range within each class. This means that the accident-prone areas mapped become more specific when there are more classification categories. The focus of monitoring is on areas classified as "Very High," which have a higher potential for accidents than areas in lower classes. Accident-prone priority areas can be obtained by overlaying the different years' visualization of "Very High" area within a map.

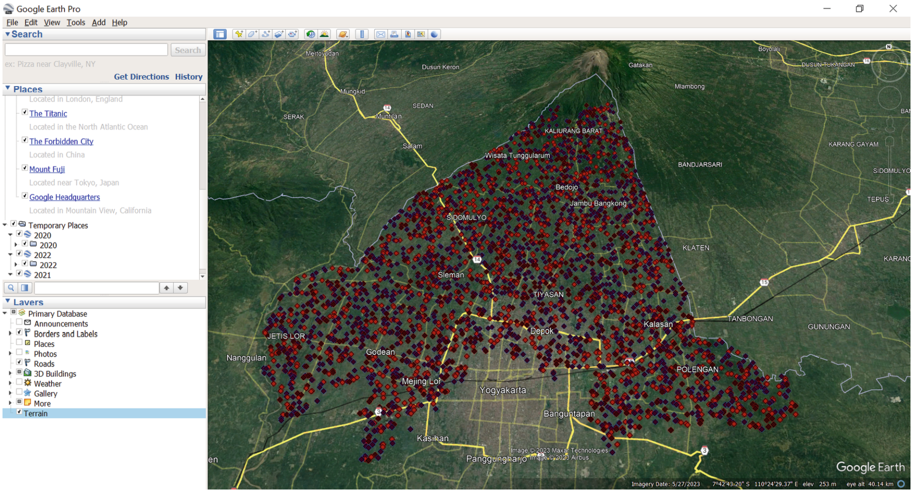
Another purpose of the overlay is to determine any shifts or changes happening in areas prone to accidents at each location. This aims to assess whether efforts or treatments to the road systems have effectively reduced the accident rate in a specific area. Consequently, areas that were initially accident-prone can be observed to have a reduced accident rate and no longer be categorized as areas with "Very High" accident-prone density.

4 Results and Discussion

4.1 Using Overlay to Determine Accident-Prone Area

The demonstration of the procedure takes place in one of the regions in Indonesia, specifically Sleman Regency, in the Yogyakarta Special Region. It is ranked fourth as the province with the most accidents, while being the smallest province in Indonesia. The high accident rate was certainly not expected by various parties. Periodically monitoring areas prone to accidents is expected to be able to minimize the traffic accidents potential.

Using recorded accident data coordinates from several years (see Fig. 2), a kernel density analysis can be conducted (see Fig. 3). The results of overlaying accident-prone density maps classified as "Very High" for 2020, 2021, and 2022 indicate several areas with different colors, signifying that these areas are accident-prone in different years.


Google Earth Pro
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ex: Pizza near Clayville, NY
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Located in London, England
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The Forbidden City
Located in China
Mount Fuji
Located near Tokyo, Japan
Google Headquarters
Located in Mountain View, California
Temporary Places
2020
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Primary Database
Announcements
Borders and Labels
Places
Photos
Roads
3D Buildings
Weather
Gallery
More
Terrain
Mertoyudan
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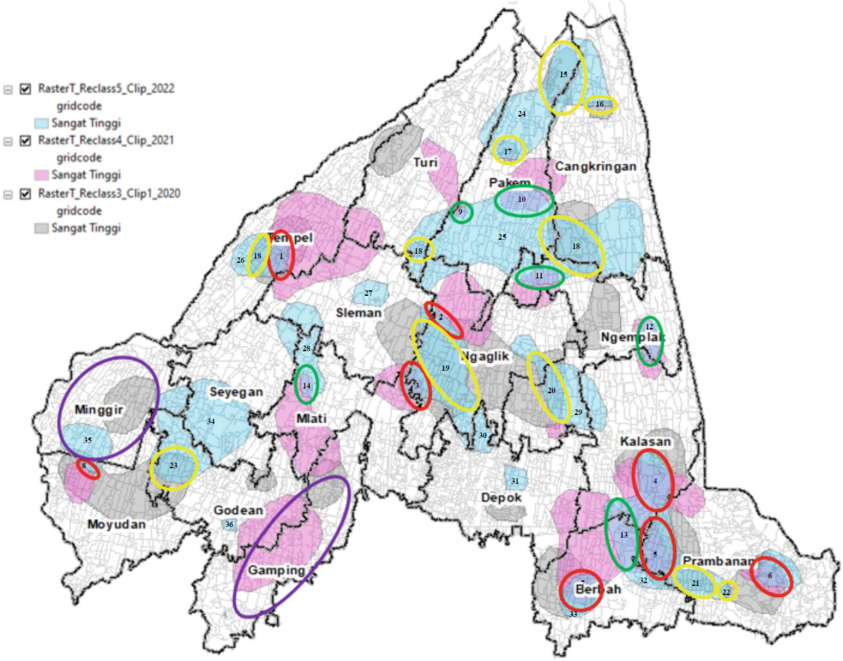
JETIS LOR
Depok
Godean
Nanggulan
POLENGAN
Mejing Lor
Yogyakarta
Banguntapan
Kasihan
Panggungharjo
Image © 2023 Maxar Technologies
Image © 2023 Airbus
Google Earth
Imagery Date: 5/27/2023 7°42'43.20" S 110°24'29.37" E elev 253 m eye alt 40.14 km

Fig. 2. Mapping of traffic accident coordinates in Sleman Regency from year 2020–2022 using ArcGIS

The gray color represents 16 "Very High" accident density areas that occurred in Sleman Regency in 2020, covering an area of 10756.98 hectares or 18.71% of the total area of Sleman Regency. The pink color represents "Very High" accident density areas in 2021, with 13 areas covering an area of 9208.73 hectares or 16.02% of the total area of Sleman Regency. In 2022, the "Very High" accident density areas are indicated in blue, with 16 areas covering an area of 12612.72 hectares or 21.942% of the total area of Sleman Regency. Based on kernel density analysis, the district with the highest accident rate may not necessarily have the largest accident-prone area. This is because the location points of accidents in that area are scattered and do not form a "Very High" density area that is the largest among other districts.

An overlay instead focuses on the area where "Very High" accident level always happening every year or period. Different scenarios may happen because of this overlay. Thus, resulting in different priorities of accident-prone areas to consider. Based on the accident-prone density mapping obtained from 2020–2022 accident incidents data, an overlay of annual density mapping was performed. The results of a three-year data overlay can be seen in Fig. 3.

By performing the overlay for three years, it is evident that not all "Very High" accident-prone areas in 2020 remained the same in 2021 or 2022, and vice versa. For instance, in Minggir district in 2020, there was a "Very High" accident-prone area, but the accident rate decreased in 2021, resulting in no "Very High" accident-prone area in that district. However, in 2022, Minggir district experienced an increase in accidents, but it occurred in a different area compared to 2020. Similarly, Gamping district shows that in 2020 and 2021, there were different "Very High" accident-prone areas, but no such areas were found in 2022 due to a decrease in accidents in that location. Table 1 provides the priority areas based on the overlay of accident-prone density maps in Sleman Regency for 2020, 2021, and 2022.


RasterT_Reclass5_Clip_2022
gridcode
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Sangat Tinggi
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Tempel
Sleman
Ngaglik
Ngemplak
Minggir
Seyegan
Mlati
Kalasan
Depok
Godean
Moyudan
Gamping
Prambanan
Berbah

Fig. 3. Accident-prone Density Map for "Very High" classification

Table 1. Different priorities resulted from overlay.

Priority	*Icon*	Year	Area code
1	🔴	2020, 2021, 2022	1-8
2	🟢	2021, 2022	9-14
3	🟡	2020, 2022	15-23
4	🔵	2022	24-36

There are eight intersecting areas between 2020, 2021, and 2022, marked with red circles in Fig. 3. These areas form intersections, indicating that they remained areas with "Very High" accident density. This means that these areas did not experience a decrease in the number of accidents each year. These areas are the primary focus for conducting observations to understand why they remained "Very High" accident-prone areas for three consecutive years. Next, the areas marked with green circles will also be the focus of further observation. It is known that 6 areas overlap between the high-density accident areas between 2021 and 2022. Two consecutives "Very High" accident rate in recent years shows a steady increase of traffic accidents in that area. This might be caused by a recent failure in road systems/infrastructure, thus requires observation. Next is the area with yellow circle that show although there is a decrease in 2021, there is increase again in 2022. This condition suggests that there has been no improvement in these areas, leading to them still contributing to a very high number of traffic accidents in 2022, or in essence, they have not experienced an actual decrease. This condition may also because of the pandemic situation where traffic decreases in that area during 2021. However, as the pandemic ends, the accident levels increase again. Therefore, an evaluation of the surrounding road conditions is needed to understand why the number of accidents, which had previously decreased in 2021, increased again in 2022. The last focus is on the areas marked in blue, indicating recently rising high-density accident areas in 2022. These areas are also quite important and require observation to evaluate road conditions and make improvements. Through observations, information can be obtained to evaluate and determine treatments or improvements to reduce traffic accidents in these intersecting areas.

4.2 Observation of Accident-Prone Area

Observations in accident-prone areas are conducted by examining locations classified as "Very High" accident-prone areas with top priority. The purpose is to evaluate and obtain recommendations for improvements in the road systems in these related accident-prone areas. Based on the map shown in Fig. 3, observations are carried out in areas identified as accident-prone all year.

In this case, observations are focused on areas that intersect in terms of "Very High" accident density for the years 2020, 2021, and 2022. For example, the observation location is in area code four (see Fig. 3), specifically along an approximately 650-m-long road from SMP (Middle School) 1 Kalasan leading to Masjid An Nurumi on Jl. Raya Solo-Yogyakarta (see Fig. 4).

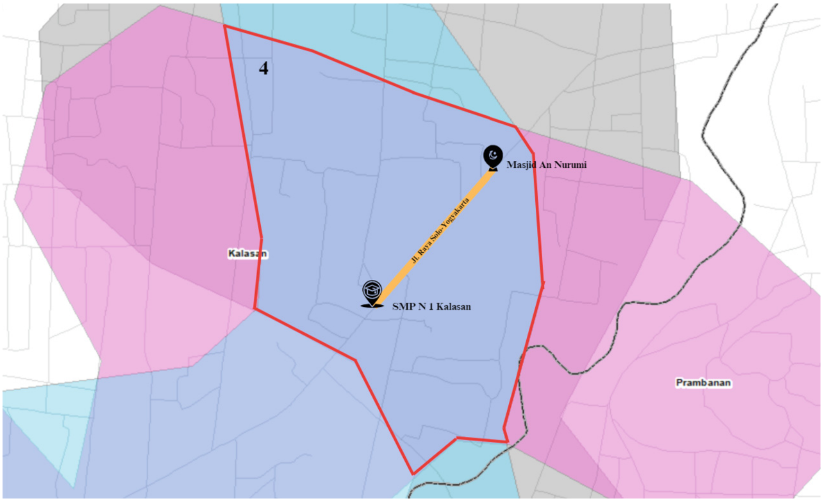

Fig. 4. Observation location for top priority accident-prone area

The intersection in this area indicates that for three years, the accident rate in this area has not decreased. Therefore, it becomes the primary focus for evaluation to provide recommendations for improvements so that this area does not remain accident-prone with a "Very High" accident density in the coming years. The observations were conducted to assess the local road conditions. During the observation, documentation in photographs or videos was taken to provide information about the road conditions and accurate evidence. The results of the observations are:

1) No zebra crossings at locations with pedestrian crossing signs.
2) Road lane markings have faded.
3) No directional signs for U-turn locations or no U-turn signs at each location with concrete road barriers.
4) No warning signs at intersections, maximum speed limit signs, and traffic signs with text.
5) There are traffic signs that are no longer in good condition or damaged,
6) Traffic signs is obstructed by trees around them thus cannot be seen.
7) Streetlights doesn't work.

4.3 Traffic Safety Management

The observation results should be addressed and the suggestions for improvement was reported to the road safety stakeholders, in this case, the Traffic Communication Forum. There are five pillars in managing traffic safety in Indonesia, in which the institution that represents them are involved in the forum, which are:

1. *Safe System.* The representative institution is BAPPEDA (*Regional Development Planning Agency*), responsible for managing activities that encourage stakeholder coordination and creating sectoral partnerships to ensure effectiveness and sustainability. It is also the source and manager of the budget at the provincial level.
2. *Safe Roads.* The representative institutions are DINAS PUP-ESDM (*Public Works, Housing and Energy and Mineral Resources Service*), BPTD (*Regional Transportation Management Agency*) and BPJN (*National Road Implementation Agency*). Those institutions are responsible for managing activities to provide safe road infrastructure by improving planning, design, construction, and road operations so that the infrastructure provided can reduce and prevent driving errors from road users.
3. *Safe Vehicles.* The representative institution is DISHUB (*Transportation Service*). It manages activities to ensure that every vehicle on the road has safety standards that can minimize accidents caused by vehicle systems that are not working properly. Apart from that, the vehicle must be able to protect the people involved in the accident to prevent further damage or loss.
4. *Safe Road Users.* This is represented by POLRI (*Police*). They manage activities to improve road user behavior by developing comprehensive programs including improving Traffic and Road Transport Safety education, vehicle driver competency, and law enforcement.
5. *Handling Accident Victims.* This pillar is represented by the DINKES (*Health Service*) and JASA RAHARJA (*Social Insurance*). Dinkes manages post-accident emergency

response activities by increasing the capacity of competent medical personnel in the emergency response system and victim handling, including long-term rehabilitation for accident victims. Jasa Raharja is mandated to compensate people who experience traffic accidents and collect and manage (insurance) funds from the community to fulfill community rights as regulated by law.

In this case, the recommendation heavily leans to the "Safe Roads" pillar. The recommendation might be directly related to all the pillars or only some of them. Therefore, a team of representatives from those institutions should be involved when conducting observations and making recommendations. This may lead to more comprehensive observation and recommendations for improvements. Different times of observation also may lead to different findings. For example, the behavior of road users may differ during busy hours (morning and evening) compared to other times. Thus, a well-planned observation will lead to a better quality of recommendations for improving road safety.

5 Conclusion

Using the accident-prone area monitoring procedure for density mapping based on the kernel density overlay method has shown the priority levels of traffic accident-prone areas from all cases that occurred in different years. The areas are divided into 5 classes of accident-prone areas of "Very High", "High", "Medium", "Low", and "Very Low". Overlay mapping produces comparisons that can show differences in accident-prone areas between each year. The intersection on the "Very High" classification overlay indicates the different priority for monitoring potential road system failure. Preventive actions that can be taken to improve the road system are obtained through observation and evaluation in the main priority areas (i.e., overlay intersection for consecutive years) so that recommendations to support accident prevention can be obtained, both related to traffic signs, road markings, and maintenance of road conditions. The recommendation will become input for traffic management relevant stakeholders to manage traffic safety.

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The GIS and SWOT Analysis for the Language in Tourism: A Study on the Local Dialect in Muar, Johor, Malaysia

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Abstract. Malaysia is fortunate to have a diverse range of cultures and languages. Nonetheless, there are limitation of previous studies conducted in Malaysia that emphasize on the value of local language, particularly on the distinctive local dialects in Malaysia. This research has two goals: first, to identify the local dialect of Muar along the Muar River through a Geographic Information System (GIS) software; second, using a SWOT analysis to determine the local dialect's potential as a tourism product with unique selling points for Muar, Johor, Malaysia. The qualitative technique was employed through interviews with locals in Muar. Two categories emerged from the findings: first, the Muar's distinct dialect is dispersed throughout the Muar River as shown by the GIS analysis. Second, based on the SWOT analysis, the information indicates that Muar's distinctive dialect around the Muar River will offer the locals a rich cultural legacy, which is considered a potential product for tourism in Muar. This research will add to the corpus of knowledge and help the local community to maintain Muar's distinctive dialect as a tourism offering.

Keywords: Cultural Heritage Tourism · Geographic Information System (GIS) · Language Tourism · Muar Dialect · SWOT Analysis

1 Introduction

The term "cultural heritage" refers to "artefacts, monuments, a group of buildings and sites, museums that have diverse values including symbolic, historical, artistic, aesthetic, ethnological or anthropological, scientific and social significance" [1]. Cultural heritage encompasses both intangible (such as language and literature) and tangible (such as buildings and monuments). One tourism product that might improve a destination's tourism experience is the distinctive language of the local culture. When it comes to cross-communication between hosts and tourists during a destination's tourism experience, the usage of language is crucial. However, certain concerns about communication barriers resulting from a linguistic barrier between the host and the visitor have been raised [2].

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Malaysia offers a diverse range of cultural history, encompassing historical buildings steeped in its own culture and languages (such “Pantun”) that are derived from many ethnic groups. Malaysia is expected to have 33.2 million people living there overall in 2023, of which 57.9% are of Malay ethnicity [3]. Despite the country’s official language being Malay, there are different dialects of the Malay language have spread throughout Malaysia’s states and districts. One of Johor’s districts, Muar is situated close to the Strait of Malacca’s shore in Malaysia. Melaka, in the north, and Johor, in the south, had an influence on Muar’s history and culture. As a result, Muar has a distinct dialect where [Ô] is used in voice phonetics [4]. Nonetheless, not much research has been done to pinpoint Muar’s distinctive dialect or explore the possibility of incorporating this distinctive culture into Muar’s tourism offerings. Therefore, the purpose of this study is to use a Geographic Information System (GIS) software to identify the local dialect of Muar along the Muar River and to conduct a SWOT analysis of the dialect as a potential tourism product that would have unique selling points for Muar, Johor, Malaysia. A Geographic Information System (GIS) was used in this study to identify the Muar Dialect along the Muar River because there is a limitation on previous study that integrate the language and the preservation for local culture which finally can improve the cultural heritage tourism in a destination. The potential of the Muar Dialect as a preservation effort will be examined further in more detail in this study through a SWOT analysis of its strengths, weaknesses, opportunities, and threats for Muar’s cultural heritage tourism.

This paper will explain the significance of language in travel and provide a general overview of the distinctive Muar dialect. The qualitative methodology in this study will involve the interviews and observations of the local community. In this study, the GIS data on the local Muar dialect that spread throughout Muar and the SWOT analysis on the local Muar dialect as a potential tourism product are the two main findings. In conclusion, this paper offers various prospects for further investigation, particularly when it comes to combining tourism and the local dialect in an attempt to maintain, sustain and preserve the local culture and its heritage.

2 Literature Review

2.1 Language in Tourism

The tourism industry is seen as the platform to ensure the sustainability of the language for the local community, including the indigenous community, through preservation efforts towards the local culture [5–7]. However, most of the studies focus on language usage through information transformation in the tourism discourse, technological aspect and the usage of language in travel agencies perspectives [8–12]. Hence, the study’s limitation focuses on preserving local culture, especially on the importance of the local language in contributing towards the place’s identity and creating a unique selling point (USP) as well as technological improvement [13, 14] for the tourism destination.

2.2 Background of Muar

Situated in the southern region of Malaysia, the state of Johor was ruled by the Majapahit Government Empire from 1361 until the 14th century, when the Melaka Sultanate took power [15]. Since the earliest settlement in this area was at the river's estuary, the word "Muara," which means the estuary, served as the inspiration for the name Muar. Muar was dubbed the Bandar Maharani in the past, and on November 24, 2012, it was proclaimed a Royal City [15]. One of the tourism images for Muar City is cultural heritage tourism because of its historic structures constructed before World War II and its regional cuisine, which includes "Mi Bandung" and "Satay". As a result, given the similarities between Melaka and Muar, there is a tough competition between the two tourist destinations. The 12 sub-districts of Muar with a range of tourism offerings, from cultural heritage to rural tourism are depicted in Fig. 1.

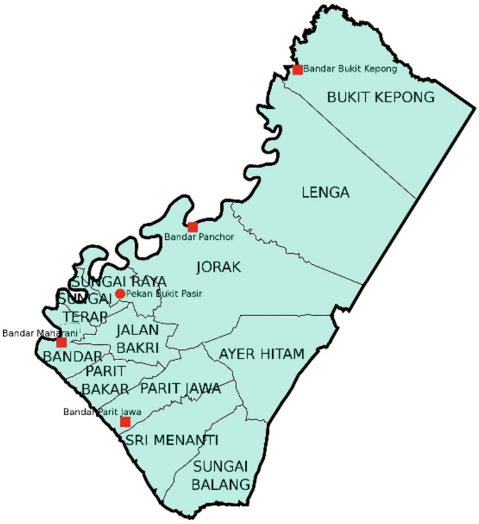

Bandar Bukit Kepong
BUKIT KEPONG
LENGA
Bandar Panchor
JORAK
SUNGAI RAYA
SUNGAI TERAP
Pekan Bukit Pasir
Bandar Maharani
JALAN BAKRI
BANDAR
AYER HITAM
PARIT BAKAR
PARIT JAWA
Bandar Parit Jawa
SRI MENANTI
SUNGAI BALANG

Fig. 1. The map of Muar District

2.3 The Uniqueness of Muar Dialect

The Malay genealogical boundaries were split between the Malaysian Peninsula's eastern and northern regions [16]. The Johor sub-area, Muar sub-area, and Mersing sub-area are the three sub-areas that formed by the Johor dialect [16]. Muar-Batu Pahat sub-area includes Muar Dialect. The Muar-Batu Pahat sub-area is known to the vocal phonetics that produce [Ô]. *Olob, lob* (title for men), endek (title for women), *ngape* (us), *ngkape* (you), *gelupo* (struggle in pain), *libang-libu* (back and forth), *melak* (maybe), *be'daah* (cheat), *kelesa* (lazy), *berendut* (love), *ba'atan* (excessive) and other terms are among the many linguistic expressions found in this Muar dialect. This dialect varies from the standard Malay language in terms of both phonological and lexical (word) usage. Moreover, it will also be interesting to anyone who is familiar with this dialect because of its tone and intonation.

3 Methodology

The amount of research based on dialectology or geolinguistics has increased recently. Currently, the researchers still did not pay much attention to studies on local subdialects in a state using Geographic Information System (GIS) software [17]. Hence, the interview and researcher observation techniques were employed in this study to collect the primary data. The local community in Muar was selected for this study which encompasses the respondents of the age of 13 and above, and resided in various villages in the Lenga, Gombang, and Bukit Kepong areas. Random selection was used to choose the respondents. In order to accomplish the study's primary goal of identifying the use of Muar Dialect along the Muar River, GIS software was utilized during the data analysis stage. Meanwhile, the data gathered from the observation and interview will be further examined to determine the strengths, weaknesses, potentials, and threats of Muar Dialect towards the preservation of this local culture and its own heritage values that can contribute to the tourism industry in Muar.

4 Findings

4.1 The GIS Software Analysis for the Muar Dialect

Based on the results in GIS software, the primary goal of the first objective is to locate the Muar Dialect along the Muar River. According to the findings of the interview session conducted with twenty residents, the dialect was used differently in each of the three Muar areas—Lenga, Gombang, and Bukit Kepong. However, it alludes to a lexical equivalent. The variations between a few lexical items in the Lenga, Gombang, and Bukit Kepong dialects are displayed in Table 1.

Table 1. The transcription of Muar Dialect

English	Transcription of Standard Malay Language	Transcription of Lenga Dialect	Transcription of Gombang Dialect	Transcription of Bukit Kepong Dialect
Dirty	/kɔtɔr/	/belutaʔ/	/nčəmɔ/	/lɔkoh/
Wasting	/boros/	/bunčah/	/poʔ/	/bončah/
Late/Slow	/lambat/	/kələlət/	/məlenə/	/ kəlečə/

Furthermore, the variations in the lexical for the word 'late' or 'slow' *(/lambat/)* indicate that there is a dialect usage around the study area. In Lenga, the */kələlət/* variant describes something in a slow context, for example, *"Ngkape la kawan ko ni* ***kelelet***

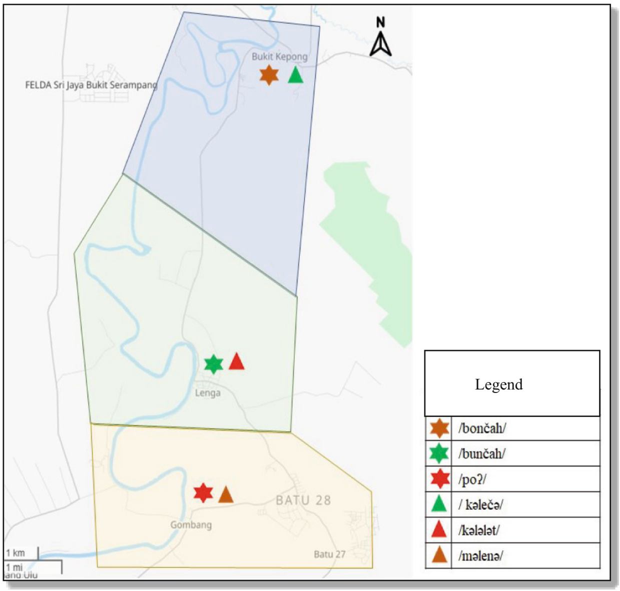


Fig. 2. The variation of lexical of the word 'late' or 'slow'

sangat ni? Dekat sejam dah aku tunggu ye!" (Why are you so slow? I've been waiting almost an hour!). This lexical uses dialects differently than the Gombang Dialect and Bukit Kepong Dialect. Figure 2 shows the GIS map for this lexical in different locations.

Thus, the GIS software analysis yields information about the local dialects and how geography influences them. More research is nevertheless required on a specific lexical that can be applied to customer service as well as marketing strategies to boost Muar as a tourism destination.

4.2 The SWOT Analysis of Muar Dialect for Tourism

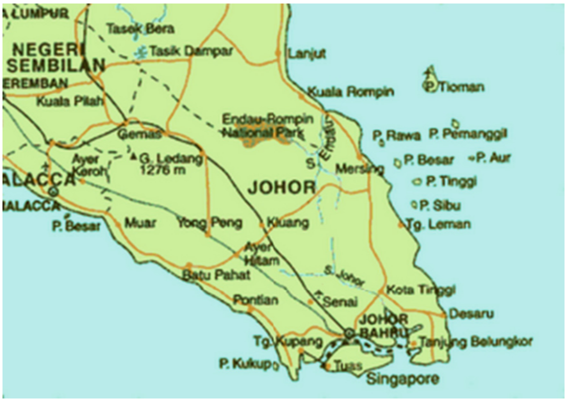
Studying dialectology or geolinguistics is essential, particularly for initiatives aimed at preserving cultural heritage. As part of the cross-cultural experience, learning and using the local language through the various dialects in Muar adds a distinctive element to the potential tourism experience. The identity of a tourism destination will be formed and local culture will be better understood due to this tourism experience. Hence, this study discovers there are strengths, weaknesses, potentials and threats of the local dialects as the potential element of the local cultural heritage that can be marketed as one of the tourism products in Muar. The SWOT analysis for this study is displayed in Table 2.

According to the research, Muar's distinctive dialects are influenced by the river. The Muar district's boundaries are shown on the map in Fig. 3. Muar and Melaka are adjacent to each other. The Melaka Malay community moved to the Muar region and settled in the Lenga, Gombang, and Bukit Kepong areas as a result of this distinction. The migration of Sultan Mahmud and some of his people across the border of Muar, Johor, following the fall of Melaka City in 1511 to the great Portuguese occupation is

Table 2. The SWOT Analysis

Strengths	Weaknesses
- The unique dialect used by the local community - The influence of the dialect and the history of the destination	- The decreasing practice of the local dialect among the young generations - Lack of research on the local dialect - Lack of integration of local language as the potential branding for the destination
Opportunities	**Threats**
- Encouraging the efforts in the preservation of Muar Dialects - Encouraging the inter-cultural exchange - Encouraging education, especially the youth generation, to learn and use the local dialect - The local dialect is the marketing strategy in the promotional materials and the branding of the destination, such as the tagline and the souvenir product	- Creating confusion between the standard Malay Language and the local dialect

the source of the spread of the Melaka Malay dialect [18]. Due to its contribution to the various dialects found in various parts of the Muar area, this history has given rise to the strengths of the Muar dialect.


LUMPUR
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NEGERI SEMBILAN
Tasik Dampar
EREMBAN
Kuala Pilah
Lanjut
Kuala Rompin
Tioman
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Gemas
P. Rawa
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P. Aur
ALACCA
JOHOR
P. Tinggi
ALACCA
P. Sibu
P. Besar
Muar
Yong Peng
Kluang
Tg. Leman
Ayer Hitam
Batu Pahat
S. Johor
Kota Tinggi
Pontian
Senai
Desaru
JOHOR BAHRU
Tg. Kupang
Tanjung Belungkor
P. Kukup
Tuas
Singapore

Fig. 3. The map of Johor

A few weaknesses in the study such as there are the decline in the use of the local dialect by younger generations, the restriction of the research to local dialects, and the no effort to incorporate the local dialect as a tool for destination branding and marketing in Muar. The primary concern on threat is in terms of the usage and practice of the local dialects by the local community, especially among the young generations due to the confusion and mixing of the local dialect with standard Malay. Hence, the sustainability of the local dialect for the next generations will be negatively impacted towards the efforts in the preservation of this valuable local heritage.

On the other hand, Muar has good opportunities to make use of its distinctive dialects, including supporting initiatives aimed at preserving Muar Dialects through development and research for the cultural heritage. This effort aims to preserve local dialects through research, thereby fostering intercultural exchange between domestic and foreign tourists. Additionally, this endeavour will promote learning and using the local dialect in the teaching and learning, particularly among the younger generation. Moreover, the local dialect can be used as a medium for a marketing strategy in promotional materials and increasing the branding of the local tourism destination by using the local dialects in the destination tagline to draw the attention in visitors. This distinctive tagline from the local dialect can be a part in the souvenir merchandise such as printed on t-shirts, keychains, and other mementos. As a result, this strategy will help visitors retain a specific impression and creating the destination image of Muar.

5 Conclusion

The two primary findings of this study are; 1) the local dialects were influenced by its geographical area along Muar River, and 2) the local dialects provide various potentials in research and development as well as the tourism product based on the SWOT analysis. Nonetheless, some recommendations are made for further research, particularly to identify the different lexical used in customer service for the travel and hospitality sector and to incorporate with the local dialects. This will improve the local context's tourism experience. Furthermore, the results of the SWOT analysis will strengthen Muar's marketing and promotional strategy by incorporating the local dialects into their plan.

Nevertheless, this study has certain limitations because of the constraints based on the previous research that concentrated on the preservation of local dialects and how they contribute to the sustainability of the local cultures through tourism industry. This study discovered that the majority of previous research had concentrated more on language usage for customer service, particularly in the travel and tour and hospitality sectors. For instance, much attention were given to the study on the significant languages such as Japanese or Spanish in customer service in the tourism and hospitality industry. Hence, this study creates the critical turn of the language for tourism studies by highlighting the importance of the local language or local dialects as one of the tools for tourism marketing strategies as well as a unique tourism product [19] which tourism is seen as the medium to preserve the local dialects due to its valuable cultural heritage.

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Smart Attendance System Utilizing Face Recognition Technology Based on Principal Component Analysis

A Case Study in Sultanate of Oman

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Abstract. Keeping track of attendance for daily activities is a difficult task. Because of the emergence of the coronavirus in late 2019, the world in general and the Sultanate of Oman in particular have become dangerous places that threaten the lives of ordinary people. Still, people should be careful while gathering or touching, and it is recommended that they wear masks everywhere, such as in schools, work, and hospitals. Students in their schools face the traditional attendance registration process daily, which requires touching if it is by handprint. As a result of the previous explanation, the problem can be identified; the virus can be transmitted among students by touching the handprint because of the traditional attendance registration process. This research uses artificial intelligence algorithms to create a smart attendance registration system. The system will eliminate the need for additional contact to record attendance and use artificial intelligence techniques to recognize the student's face and record his name in the attendance file as soon as the student passes in front of the camera. The PCA algorithm was used in the practical part of this research to discover students' faces and record their names. It showed the results of the PCA algorithm experiment using the confusion matrix method with high efficiency, where the accuracy rate reached 93% and the true positive was 100%. The results of the questionnaire showed the following percentages: 72.2% had heard of the smart attendance system, and 86.1% supported and agreed with the idea of applying the attendance system in schools.

Keywords: Face Recognition · Smart Attendance System · School · PCA

1 Introduction

It is problematic to record students' attendance at their schools using traditional registration methods, such as handprints or paper and pens, both generally and specifically in the Sultanate of Oman. It frequently takes a while for all students to finish the registration process because these traditional processes are time-consuming. According to

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the researcher who observed the traditional registration system in one of the schools in Oman, the biggest problem with this method of documenting students' attendance is time waste. This study looked at wasted time in the conventional, still-used attendance registration system in many Omani schools. The mixing and contact of students in handprint attendance registration systems were also covered in this study. The world has found it more difficult to mix and contact since the 2019 coronavirus outbreak. With many schools utilizing blended, flipped, and other technology while continuing to use conventional methods, the coronavirus also altered educational learning [1, 2]. The modern educational system is gradually shifting to incorporate both old and new technologies. For instance, several schools have adopted metaverse technology in some way. Smart technology is used in schools to automatically record events, and teaching methods use virtual reality, augmented reality, and other smart applications [13–15]. As a result, the attendance system ought to adhere to current developments in metaverse technology. By contacting the fingerprint reader, traditional attendance registration methods like handprints can transfer the virus from one student to another. The smart registration system developed in this study replaces the fingerprint with a camera-based facial recognition system to avoid touching the fingerprint and avoid time-wasting delays associated with traditional attendance registration techniques. The teacher can waste time calling students and taking attendance. Because of this, the effectiveness of the face recognition attendance system in addressing school attendance concerns will be assessed in this study. This study was done at Dhofar School in Thumrait for ninth-grade IT students. A total of 30 students have been sampled. To prevent mixing during the outbreak, the sample was separated into two 15-student groups. As instructed, 30 faces are sampled. The literature review for the current attendance technologies used in schools will be covered in the next section. The suggested system's approach is then explained in Part 3, followed by the results and discussion in Sect. 4, and finally, a conclusion and a limitation in the Final Section for accurate facial recognition [3]. The next section will discuss the literature review for the current attendance technology applied in schools. Then, the methodology of the proposed system will be discussed in Sect. 3, with the result and discussion in Sect. 4, and conclusion and limitation in the last section.

2 Literature Review

Children who attend class regularly perform better academically. Numerous studies have demonstrated the importance of regular attendance for academic success [4, 5]. Manual and automatic attendance monitoring techniques have been introduced to make sure that student attendance is always evaluated and documented. Face recognition technology and the registration procedure should be developed jointly to manage online registration [6]. A deep auto-encoder-based approach for figuring out the correspondence between visual and thermal face images is presented in [7]. The alignment of the visible face when employing thermal face recognition is also evaluated in this study, as is the potential for adaptive thresholding mechanism technology to increase recognition accuracy [8]. Three tensor analyses that significantly reduced the number of parameters were the subject of a study by [9], which also showed how well they worked with hierarchical neural networks. When faces were located and recognized in the database, [10] set up a camera inside the classroom and took pictures. The participants are then listed as present. If a student is judged absent, the study sends their parents a letter outlining their absence.

One of the most active areas in computer vision is face detection because it is difficult and is needed in many applications as a starting point. Frontal faces are recognized by face detection algorithms. Like image detection [11], it compares each individual person's image to each image in the database. Matching will be invalidated by any changes to a face's features in the database. Face detection is widely employed in biometrics as a component of (or in addition to) a facial recognition system. Additionally, it is utilized in picture database administration, human-computer interface, and video surveillance. The PCA approach is employed in this study to find and identify the human face. The PCA approach is employed because, in comparison to other methods, it offers excellent detection accuracy and speed. Making a face recognition-based attendance management system for Omani students was particularly challenging because most male and female students wear head coverings (*Kumma* for male and headscarf for female). Also, because students don't always present themselves in the best light at school, precise methodology is needed. An automatic attendance registration system can also address other problems, such as errors in manual attendance when the academic office enters data from papers into the system. Furthermore, it is common knowledge that the academic office's data accuracy cannot be guaranteed, which causes concerns when using the traditional method of recording students' attendance. The facial recognition technique consists of several steps, including capture, extraction, comparison, and matching [12].

3 Methodology

By describing the main computational elements of the recommended method for monitoring student attendance. Attendance and training are the two main parts of the proposed method. Throughout the training phase, the program builds a model that describes the visual characteristics of the students' faces as they were captured during a certain course. The attendance-taking step is responsible for recording each student's attendance using the model created in the training stage. All faces in the face space training set are displayed to determine a set of weights specifying the contribution of each vector to face space. To define the test image and obtain the proper set of weights, the test image must be projected into the area of the face. By comparing the test image's weights to the set of face weights in the training set, it is possible to identify the face in the test image. Throughout the course, all the students' images are compiled and saved. After that, the procedure runs consistently and takes a while for the initial steps to identify the kids' faces.

3.1 Proposed Training Approach for the Attendance-Taking System

The smart attendance registration system's foundations are a vector gradient graph and deep learning-based performance recognition. Logic and Python make up the back end, while the opened Camera Window GUI serves as the front end (back end). The system receives the camera's recorded images for further analysis, and it compares each student's input image to a database of referred images. The student's name and the time the student was seen are automatically saved in the comma-separated values (CSV) file if the camera detects the student's face in the dataset, indicating that the student is present. Once the camera was attached to the computer and positioned in front of the classroom entrance, the system was able to identify the students as they entered the room and record their names in a dataset. This smart attendance registration system uses facial recognition to minimize the shortcomings of the current method with the help of machine learning. A top-notch camera is utilized to take student pictures with the smart attendance registration system. There are principal component analysis (PCA) techniques for face recognition and the Haar feature for face detection. Installing a camera on a holder in front of the classroom door for students necessitated extra safety measures because the camera needed to be at the proper angle and protect the system from harm if a student or instructor unintentionally stepped on it. Additionally, we must think about the manners of allowing pupils to enter the classroom one at a time. The camera takes a photo of a student as they pass in front of it and analyzes it. It then compares the training dataset. If the system correctly matches the image, the student's name and the time of his admission are logged in the attendance file. Figure 1 below depicts how this component is laid out.

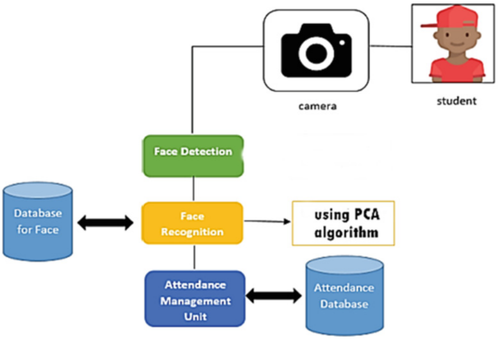


Fig. 1. Scheme of the attendance system

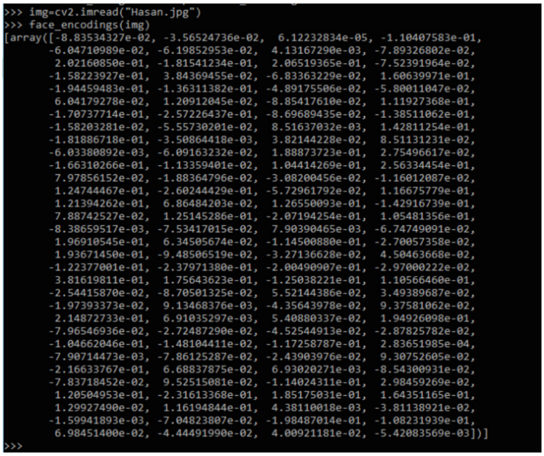
The method used here is PCA, so it is important to understand how face recognition works to find and identify the students' faces.

Face Recognition Process: The camera, which is used to take real-time photographs of each student as part of the smart attendance system approach, is the first step in the procedure. The HAAR classifier is used to identify the face in this image after it has been transformed into an RGB array and passed to the next stage. The deep learning face embedding algorithm receives the recognized face next.

Face Detection: Since the system receives the image captured by the camera or video, face detection is essential (in our case). The Dlib algorithm is used to identify the human faces in that image using the face detection technique.

Face Positioning: The term "facial landmark" describes 68 different areas of the human face. The main objectives of this stage are to locate the image and find the faces' contours. Python software that automatically recognizes facial features allows for the placement of the face as close to the camera as feasible without distorting the image.

Face Encoding: After the faces in the selected image have been recognized, the next step is to extract the face identification feature unique to each image. To obtain facial localization for each image input, 128 major face points are properly recovered, and these 128-d facial points are stored in a data file for face recognition. The matrix of the encoding image and the picture after encoding are displayed in Fig. 2 below.



```
>>> img=cv2.imread("Hasan.jpg")
>>> face_encodings(img)
[array([-8.83534327e-02, -3.56524736e-02,  6.12232834e-05, -1.10407583e-01,
        -6.04710989e-02, -6.19852953e-02,  4.13167290e-03, -7.89326802e-02,
         2.02160850e-01, -1.81541234e-01,  2.06519365e-01, -7.52391964e-02,
        -1.58223927e-01,  3.84369455e-02, -6.83363229e-02,  1.60639971e-01,
        -1.94459483e-01, -1.36311382e-01, -4.89175506e-02, -5.80011047e-02,
         6.04179278e-02,  1.20912045e-02, -8.85417610e-02,  1.11927368e-01,
        -1.70737714e-01, -2.57226437e-01, -8.69689435e-02, -1.38511062e-01,
        -1.58203281e-02, -5.55730201e-02,  8.51637032e-03,  1.42811254e-01,
        -1.81886718e-01, -3.50864418e-03,  3.82144228e-02,  8.51131231e-02,
        -6.03380892e-03, -6.09163232e-02,  1.88873723e-01,  2.75496617e-02,
        -1.66310266e-01, -1.13359401e-02,  1.04414269e-01,  2.56334454e-01,
         7.97856152e-02, -1.88364796e-02, -3.08200456e-02, -1.16012087e-02,
         1.24744467e-01, -2.60244429e-01, -5.72961792e-02,  1.16675779e-01,
         1.21394262e-01,  6.86484203e-02,  1.26550093e-01, -1.42916739e-01,
         7.88742527e-02,  1.25145286e-01, -2.07194254e-01,  1.05481356e-01,
        -8.38659517e-03, -7.53417015e-02,  7.90390465e-03, -6.74749091e-02,
         1.96910545e-01,  6.34505674e-02, -1.14500880e-01, -2.70057358e-02,
         1.93671450e-01, -9.48506519e-02, -3.27136628e-02,  4.50463668e-02,
        -1.22377001e-01, -2.37971380e-01, -2.00490907e-01, -2.97000222e-02,
         3.81619811e-01,  1.75643623e-01, -1.25038221e-01,  1.10566460e-01,
        -2.54415870e-02, -8.70501325e-02,  5.52144386e-02,  3.49389687e-02,
        -1.97393373e-02,  9.13468376e-03, -4.35643978e-02,  9.37581062e-02,
         2.14872733e-01,  6.91035297e-03,  5.40880337e-02,  1.94926098e-01,
        -7.96546936e-02, -2.72487290e-02, -4.52544913e-02, -2.87825782e-02,
        -1.04662046e-01, -1.48104411e-02, -1.17258787e-01,  2.83651985e-04,
        -7.90714473e-03, -7.86125287e-02, -2.43903976e-02,  9.30752605e-02,
        -2.16633767e-01,  6.68837875e-02,  6.93020271e-03, -8.54300931e-02,
        -7.83718452e-02,  9.52515081e-02, -1.14024311e-01,  2.98459269e-02,
         1.20504953e-01, -2.31613368e-01,  1.85175031e-01,  1.64351165e-01,
         1.29927490e-02,  1.16194844e-01,  4.38110018e-03, -3.81138921e-02,
        -1.59941893e-03, -7.04823807e-02, -1.98487014e-01, -1.08231939e-01,
         6.98451400e-02, -4.44491990e-02,  4.00921181e-02, -5.42083569e-03])]
>>>
```

Fig. 2. The output after the encoding process

Face Matching: The process of facial recognition ends at this phase. The system authenticates faces by generating a 128-d embedding for each face. Internally, using the compare face's function, the Euclidean distance between each face in the dataset and the face in the image is calculated. If the current image satisfies the 60% threshold for the current dataset, it will enter attendance marker mode.

The flowchart in Fig. 3 shows the many stages of the eigenface-based recognition system. A database must initially be updated with a set of images. Since it will be utilized for both picture comparison and the development of eigenface interfaces, this collection of images is referred to as a training group. The second step is to make faces at oneself. Eigenfaces are made by extracting differentiating characteristics from faces. The lips and eyes of the input images are aligned. They are then scaled to the same size. Eigenfaces can now be extracted from image data using the mathematical technique of PCA. The third step starts when the subjective faces are created. Then, each image is represented as a weighted vector. The fourth level of the system has been reached, and it is now ready to accept requests. The final step is to calculate the weight of the incoming unknown image, after which it is compared to the weights of the existing images in the system. If the weight of the input image is higher than a specific threshold, it is indeterminate. The input image is picked as the database image whose weights correspond most closely to those of the input image. The database image with the closest weight will be returned as a disappointment to the system user.

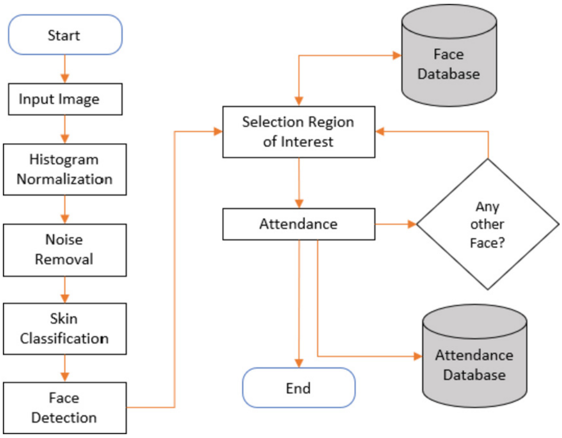


Fig. 3. Flow chart algorithm

4 Result and Discussion

The first dataset contains images of students taken in classrooms at schools in the Sultanate of Oman, and based on those, he compiled the student dataset. The second dataset, which is made up of arbitrary images taken from internet users, will be used in the following semester to identify students and track attendance. The first data set consists of a collection of photographs of students taken in one of the Sultanate of Oman's classrooms. Each student took 20 photographs of his or her face, totaling a total of 600 photographs. These photographs were then collected in a model and split into training and test groups before being used to test the person recognition system on all the students.

In the meantime, the researcher compiled several different people's faces from the Internet into a single model to create a second data set. The training and testing method was then carried out on all the outcomes from this approach in the following section. We used this dataset to assess the effectiveness of the suggested prototype for taking attendance of a class of 30 students (detection, recognition, and post-processing), i.e., a student who has 20 facial images of his or her face in the data set (i.e., we have 20 * 30 facial images on the data set) to obtain the best accuracy.

Haar Cascade math was used for detection in the previous part. We ran multiple trials using OpenCV 4.5 to tweak the algorithm's five parameters to increase real positive detections. The OpenCV Case Cade Classifier method now uses Haar cascade to evaluate the face-related XML file. Haar distinguishes eyes, nose, and mouth with three shapes. This information lets it recognize the face. To demonstrate how effectively a classification model performs on test data with known real values, we used the confusion matrix to evaluate the detection technique.

We used the confusion matrix to assess Haar Cascade face detection accuracy using 30 students and 20 face photos per student, totaling 600 images. To identify the discovered and undetected faces using the confusion matrix, we constructed the following table (Table 1).

Table 1. Confusion matrix table of face detection with HAAR

N = 600	Predicted: No	Predicted: YES	
Actual: No	TN = 49	FP = 50	99
Actual: YES	FN = 11	TP = 490	501
	60	540	

"Yes" and "No" are the two potential predicted classes. For instance, if the system were able to forecast the presence of an illness, the "yes" face would be correctly recognized while the "no" face would not. A total of 600 face images in the dataset were predicted by the classifier. Out of those 600 face photos, the classifier accurately predicted "yes" 490 times and "no" 11 times as face were not identified. 99 faces were not discovered among the 501 face-detected patients. True Positives (TP) which there are situations in which we correctly predicted that the face would be spotted. Face not detected and face not detected are examples of true negatives (TN). False Positives (FP) in which a face may have been discovered, but it wasn't the real face. (Also referred to as a "Type I mistake. False Negatives (FN) happen when incorrectly reported face detection is detected.

The face is accurately represented by the face space, so the reconstruction of the face should be a replica of the original with minimal reconstruction error. Images without faces will exhibit a significant reconstruction error that is bigger than some threshold r. The input face's proximity to a known face is determined by the distance of 2 k.

The technique was thoroughly tested on a group of 30 pupils in a Dhofar School class in the Sultanate of Oman by the researcher. To test the model on the students, the researcher created a data set for 30 students and stored the model. To identify each student, as soon as they enter the classroom, they must register their attendance and mount the camera on the classroom door. Once the student is inside the camera, the device snaps a photo of him, applies a live algorithm to identify the student's face, and then sends the image of the student's face to the PCA processor for recognition.

The student must compare it to a group of students' pictures in the data set, and at this point, there are two possible outcomes: either the system recognizes the student because he is registered in the data set, or it does not because he is not in the data set. The purpose of these tests is to gauge how well the PCA recognition model performs. The performance indicator in these studies was the model's accuracy, expressed as a percentage of faces correctly identified. The researcher employed the confusion matrix approach to study 30 students in this case to calculate the accuracy of face recognition for students using the PCA algorithm (Table 2).

The researcher chose 30 students from a classroom at the Dhofar School in the Sultanate of Oman for this trial. They then used the Haar algorithm to figure out how well the faces could be recognized. When the confusion matrix was used, the accuracy

Table 2. Face recognition confusion matrix for PCA algorithm

N = 30	Predicted: No	Predicted: YES	
Actual: No	TN = 1	FP = 2	3
Actual: YES	FN = 0	TP = 27	27
	1	29	

was 89%. Researchers use both a confusion matrix with a 93% rudder ratio and the PCA method to help the learner tell the difference between faces.

It has been shown that the attendance system can spot pictures of students wearing *kumma* in a range of lighting conditions and viewing angles. Faces that aren't in our training set are called "unknown." The system figures out real-time picture recognition attendance for each student, saves the information as a CSV file, and imports it again. The system will start the camera or video and then look for faces. See Fig. 4(a). If the student's face is in the dataset, the system will put a green rectangle around it, type his name on the screen, and save both his name and the time it was found in a CSV file. Figure 4(b) shows that if the student is not in the classroom, the screen will show "unknown student" above the student's face with a red square around it.

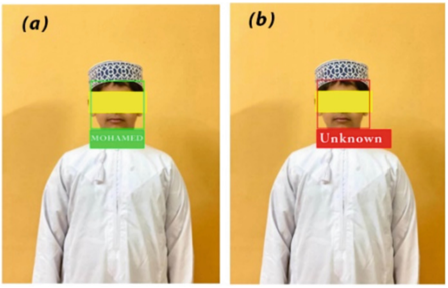


Fig. 4. The result of the student wearing *kumma* for found or not on the dataset.

A group of 30 pupils from the school were assessed using the system; two courses were combined to achieve better results. The software identified the faces of the students and saved a CSV file with their names and attendance information. The outcomes demonstrated that the system accurately recognizes students' faces in various lighting situations and viewing angles. The outcomes demonstrated that the algorithm quickly recognizes pupils' faces. The results of an experiment with an attendance system are shown in Table 3 below, along with the names of the students who were identified by the system and their precise attendance times.

A poll of instructors will be performed to determine how well a face recognition-based attendance system works. To obtain instructor input, a questionnaire from [1] is

Table 3. Result attendance system

Name	Time	Name	Time
Ahmed Naseb	8:30:23	Isaa	8:31:30
Mohamed Ali	8:30:25	Faysal	8:31:34
Ali Alshari	8:30:31	Salim Alshari	8:32:03
Klaled Faysal	8:30:37	Osama	8:32:09
Said Mihmd	8:30:45	Tarki	8:32:16
Said	8:30:55	Qasem	8:32:23
Aqel	8:31:03	Ali Salim	8:32:30
Mohamed	8:31:09	Mohammed Husen	8:32:38
Salim Ahmed	8:31:12	Alwi	8:32:45
Khaled	8:31:14	Abdo	8:32:58
Fahd	8:31:18	Hamed Salim	8:33:02
Said Ali	8:31:23	Suhil Ali	8:33:06
Mohammed Almari	8:31:25		

employed. The researcher created a questionnaire, uploaded it to Google Models, and then sent the link to teachers and other people to get their opinions on smart attendance systems and gauge whether they should be used as the foundation for conventional attendance registration systems. The results of the second question, which asked respondents if they had ever heard of the smart attendance system: 72.2% had, compared to 27.8% who had not. The respondents also agreed with the idea of applying the attendance system to schools.

5 Conclusion and Limitations

In Oman and elsewhere, handprints, paper, and pencils make school attendance difficult. Traditional systems take time; therefore, registering all students takes time. Fast, accurate facial recognition decreases acting attendance compared to previous technologies. Passive facial recognition and identification are conceivable. Face recognition technology is still developing to detect facial emotions, surroundings, and lighting. For limitation, in Omani cases, more picture collections are needed to avoid inaccurate results. Different *kumma* and headscarf styles might also confuse attendance results. Other limitations are such as teachers needing to be exposed more to how to take the image of the students to reduce the number of failed data. It is important for schools to make sure that students follow the guidelines for school attire and guide teachers to use this technology.

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Sustainable Development of Batik Industry: A Literature Review

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Abstract. Although the contribution of the Indonesian batik industry is quite significant, its activities also lead to environmental damage. There is thus a need to develop procedures and tools to achieve sustainability and Green Industry Standards. Before doing so, it is important to conduct a systematic literature review regarding this topic. This study investigates the existing research and debates relevant to sustainability in the batik sector. Therefore, this study provides an understanding of responsible batik consumption and production activities. After reviewing 42 papers from 593 generated results, the batik production aspect is the most dominant aspect analyzed by the papers, with production waste being the most-discussed topic. There are opportunities to update the research on the batik production aspect, enrich the discussion about the organization and marketing aspects, and begin to examine the finance-related aspect regarding the sustainable batik theme.

Keywords: sustainability · batik · Green Industry Standards

1 Introduction

The United Nations has emphasized the concept of sustainable development. This includes SDG 12 (Sustainable Development Goal 12), which focuses on responsible consumption and production activities [1]. Unfortunately, the implementation of SDG 12 in developing countries, including Indonesia, is still very slow and not yet comprehensive. This can be seen from the lack of information on the implementation of SDG 12, specifically in the batik industry.

Batik industry, as part of the creative economy, contributes significantly to the Indonesian economy by employing 200 thousand people in 47 thousand registered business units and recorded exports of USD 532.7 million in 2020 [2]. However, as a world cultural heritage recognized by UNESCO (United Nations Educational, Scientific, and Cultural Organization) since 2019 [3], batik also contributes to environmental damage, especially water and air pollution, due to inefficient production processes and resource utilization [4, 5]. One kilogram of batik can produce up to 125 L of wastewater containing cancer-causing chemicals because it is disposed of directly into rivers without being treated first [6]. This endangers the health of the surrounding community that uses the river water [5, 7]. Therefore, research to make the batik industry more sustainable is urgently needed currently.

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Although the Centre for Handicrafts and Batik has established the “Green Industry Standard” for the batik industry, as stated in [8], not a single batik producer has been able to fulfill this standard and obtain certification. To answer this problem, there is a need to develop procedures to achieve the Green Industry Standard for the batik industry. The processes in batik production start from stamping to washing process [9]. Before designing the procedure, it is important to conduct a literature review on the topic. Hence, this study investigates the existing research and debates relevant to sustainability in the batik sector. This study provides an understanding of responsible batik consumption and production activities.

2 Materials and Methods

The green industry is one of the objectives of industrial operations, as stipulated in Article 3 of Indonesian Law No. 3 in 2014 concerning industry [10]. To balance industrial expansion with the maintenance of environmental functions and to benefit the community, the green industry places a high priority on efficiency and effectiveness in the sustainable use of resources. The Ministry of Industry offers green industry certification services to businesses that have benefited society, the economy, and the environment by using resources wisely and employing environmentally friendly manufacturing techniques in an effort to promote the development of the green industry. The certification facilitation intends to inspire the sector to intensify efforts in the direction of the green industry. Of course, the requirements outlined in the Green Industry Standards must be met by the industries that want green industry standards (GIS). For several industry groups, the Ministry of Industry is creating GIS. Regulation of the Minister of Industry Number 39 for 2019 mandates GIS for the batik sector [8].

A systematic literature review was conducted for this study, which includes a “snapshot” of the state of knowledge over a specific period. As it offers fresh perspectives, it enhances narrative reviews [11]. This study uses scientific articles from 2017 to 2022 (August 25, 2022). It is hereby considered an extension of the [12] conducted study, which performed a 10-year search from 2008 to 2017, discovering 82 articles on sustainable batik manufacturing issues. Systematic reviews are intended to be updated frequently to look for new evidence and have the goal of monitoring and capturing emerging knowledge within a particular research topic [11]. Clarity, internal validity, research transparency and governance are all improved by a comprehensive literature review. It also increases communication among academics about the theoretical underpinnings of a study (auditability). The current study employs Boolean logic to select pertinent material for this study by properly combining search phrases. The AND, OR, and NOT Boolean operators were utilized.

The initial step of the systematic review was locating academic papers using the keywords “sustainable” AND “batik.” The literature search was done on an electronic database, and this review chose ProQuest. Business information can be found on ProQuest in a variety of formats, including scholarly journals, dissertations, company profiles, industry profiles, and market-specific trade news. The database offers access to around 11,000 full-text scientific articles from top publishers worldwide. ProQuest is used by more than 26,000 libraries in more than 150 countries, 98% of the top 400 colleges in the world rely on it, more than 130 million students and researchers can use it, and it partners with more than 9,000 publishers and content suppliers.

The types of sources selected were scholarly journals and conference papers and proceedings. These were chosen because of their nature, i.e., they were reviewed, either via single-blind peer review or double-blind peer review. The publishing dates of the article ranged from 1 January 2017 to 25 August 2022. After setting these search limitations, 593 results were generated, which were then sorted by relevance. To make sure that prospectively relevant articles were selected, the authors manually screened all the 30 pages available. After manual screening that focused on the title and abstract, 46 prospective articles were found. Following that, each article was examined to ensure content relevance.

3 Results

After a careful reading of the 46 articles, four articles were unable to go to the next process. The relevant articles left included 42 results. The first of these four articles discusses the preservation, standardization, and information technology 4.0 in the context of batik to ensure marketing competitiveness during the COVID-19 era [13]. The sole production-related topic covered in this article is the methods used for melting and drying colors to expedite production. The second article compares Champa and Batik Lasem from the 15th to the 19th century [14]. This study mostly analyses motif creation, and the author creates four acculturation motifs. The third one examines how to sustain batik SMEs' businesses [15]. This study shows that business scale, market access capacity, and financial capacity influence the competitiveness level of batik SMEs. The last article excluded from the further review is a study about rural batik tourism in Banyuwangi [16]. This study examines the use of the community-based tourism (CBT) approach to develop a tourism village.

Based on the type of source among the 42 results, there are more conference papers and proceedings (27) than scholarly journals (15). The sources were published between 2017 and 2022. Year after year, the number of papers on the sustainability of batik production fluctuated. For the year 2017, this review found only one paper. There are five papers from the year 2018, two papers from the year 2019, 10 papers from the year 2020, 20 papers from the year 2021, and four papers from the year 2022, until August. It can be observed that 2021 is the year with the greatest number of papers, followed by 2020 and 2018.

Analyzing the types of papers across the publishing timespan reveals that 2021 was the year with the most conference and journal papers, with 14 conference papers and 6, respectively. The detailed distribution of paper types across the period under consideration can be seen in Table 1.

The authors classified the 42 articles that were further examined into four management aspects: production, organization, marketing, and finance. More specifically, the production aspect was divided into four categories: materials, dyeing, waste, and the full process. This produced seven categories in total. In the materials sub-category of the production aspect, there are four studies [17–20]. There are eight studies included in the dyeing sub-category [21–28]. Moreover, 15 studies are included in the waste

Table 1. Distribution of Paper Types Per Year

Year	Conference	Journal
2022	1	3
2021	14	6
2020	7	3
2019	1	1
2018	4	1
2017	–	1

sub-category [29–43]. This sub-category has the most papers among all the categories. The last sub-category of the production aspect is the full process, and it consists of six studies, which were conducted by [9, 44–48].

Furthermore, the organization category consists of seven studies [49–55]. Lastly, the category that has the fewest articles is the marketing category. It consists of only two studies [56, 57]. Unfortunately, there is no study in the finance-related category. To summarize the distribution of the papers based on the analysis category, Table 2 presents the details. It can be observed that the majority of the papers discuss the production aspect. In particular, batik production waste is the most discussed topic, with 15 papers, followed by dyeing with eight papers, the full production process with six papers, and materials with four papers.

Table 2. Distribution of Paper Per Category

Production: Materials	Production: Dyeing	Production: Waste	Production: Full process	Organization	Marketing	Finance
4	8	15	6	7	2	0

When the papers' categories are compared across the time the papers were published, the studies of production-related aspects show an increasing trend from 2019 to 2021. It is expected that the increasing trend will be achieved at the end of 2022 and beyond. The detailed distribution of the papers' categories across the period of publication can be seen in Table 3.

In these 42 papers, only two countries are examined: Indonesia and Malaysia. This is understandable since batik is popular in both countries. However, the studies predominantly focus on the Indonesian context. There are 35 papers whose study locations are in Indonesia, while only 7 studies focus on the Malaysian context.

Table 3. Distribution of Paper's Category Per Year

Year	Production: Materials	Production: Dyeing	Production: Waste	Production: Full process	Organization	Marketing
2022	–	–	1	1	2	–
2021	3	5	6	2	2	2
2020	1	3	3	1	2	–
2019	–	–	2	–	–	–
2018	–	–	3	1	1	–
2017	–	–	–	1	–	–

4 Discussion

In the materials sub-category of the production aspect, it was found that the current materials used to manufacture batik are more environmentally friendly. For example, in 2014, the use of copper stamps began to be replaced by wastepaper stamps [19]. Besides complying with the GIS (Green Industry Standard), this innovation also lowers the cost. Another action is discussed by [20], who gives ideas for producing block batik using bamboo. The usage of water as a material for batik production that complies with the GIS is highlighted by [18]. Lastly, [17] investigated the use of tamarind paste, or gutta, as a sustainable resource that serves as wax during the creation of batik. Although some studies have shown the utilization of materials that align with the GIS, the composition ratio for this utilization should also be explored.

In the dyeing sub-category of the production aspect, it was found that most of the papers analyze the alternative materials for dyes rather than discussing GIS-compliant dyeing processes. There are five papers focusing on the dyeing material. The first is [21], who mentions wood waste as a source of batik dyes that can produce safer and more eco-friendly dyes than synthetic ones. [26] analyses the waste of some local plants for use as natural dyes. [27] investigate the use of Bayat clay to save money and reduce production waste. [25] investigate the enormous potential of coconut fiber as a source of natural dyes for batik. Lastly, the study by [28] finds that biomass wood waste can be utilized as batik dyes. There are three more papers that focus on the dyeing process. [23] place a strong emphasis on the use of natural dyes to promote eco-friendly dyeing, increase knowledge of it, and expose people to the practice. [22] investigate how the batik technique affects the color and durability of the dyed materials. Lastly, [24] discovers that the use of environmental catalysts in the natural dyeing process encourages the use of eco-friendly chain processes for regional textile production.

In the waste sub-category of the production aspect, the 15 papers are divided into four major issues, namely adding material to the wastewater, conducting processes for the wastewater process, the importance of wastewater management, and the condition of the wastewater. Adding material to wastewater is the most discussed issue and is described in seven papers. The adding material to wastewater issue is analyzed by [33], who explored the addition of bacteria to the wastewater. [39] measures the Tyndall effect after using papaya seeds in the wastewater. [36] applies cationic surfactant-modified Mengkuang leaves to batik wastewater. [38] uses phytoremediation to treat wastewater. Kenaf is used in wastewater [32]. [41] uses immobilized Trichodermaviride in wastewater. Lastly, [40] uses rice husks and Canna indica plants in the batik wastewater treatment process.

Furthermore, conducting processes for the wastewater process is the second-most discussed issue and is covered in five papers. The issue of the conducting process in the batik wastewater process is discussed by [31], who analyses the visible light irradiation, [35] focuses on the right wastewater treatment system, while [34] proposes electro-coagulation as a method in the first step of the wastewater process. [37] analyses the decrease in the external resistor value of the wastewater process, and [29] proposes a photodegradation process to treat wastewater.

Only two papers study the importance of wastewater management. First, [30] examines the need for batik wastewater treatment and the roles of government, society, and ba-tik industry players. Second, [43] analyses the priorities in wastewater management. The last issue is the condition of wastewater. This issue is only addressed in a study [42] which shows that the flow of batik waste affects water quality.

Moving to the next sub-category, six papers are included in the full process sub-category of the production aspect. [46] looks at how batik is made and how batik businesspeople see the environment. [48] captures the process of Mega Mendung batik as well as its eco-promotion. [45] demonstrates how green business practices may be implemented at all stages of the batik production process. A useful approach for locating non-value-added operations in the manufacture of natural dye batik utilizing a lean manufacturing system is provided by [9]. [47] assesses that cleaner production uptake could significantly reduce the environmental impact. Lastly, [44] proposes alternatives to increase the energy efficiency of the production of stamped batik.

In addition, seven papers address the organizational aspect. First, [49] identifies the barriers faced by batik SMEs that hamper more sustainable batik. [55] investigates how environmental commitment affects the small batik industry's adoption of the circular economy favorably and importantly. [50] explores sustainability-oriented innovation (SOI) in a batik cultural village. [54] discusses the implementation of open innovation by some batik SMEs. [51] creates a brand-new evaluation method with four main components: company characterization, business model description, analytic input and output, and readiness area for the batik company. [53] discovers that economic sustainability has a significant and positive impact on the environmental sustainability of batik SMEs. Lastly, [52] suggests a dynamic evaluation strategy for the batik industry's sustainable supply chain management. Moreover, there are only two papers on the marketing-related aspect. First, [57] discovers that natural color batik artisans or ecopreneurs need strong green values to succeed in their line of work. Second, [56] discovers that knowledge and attitudes about green products have a beneficial impact on the intention to buy green batik products created from natural substances.

Although this study is considered an extension of [12] in terms of the publication year of the papers reviewed, this study does not solely focus on the production process of batik but also spotlights other aspects of management, such as organization and marketing. This study also enhances the results by analyzing the papers based on the location of their respective studies. This will help to map the level of concentration during the research.

5 Conclusion

A search for the theme of sustainable batik returned 42 papers. Based on the type of source, conference papers, and proceedings are more dominant than journals. There is a fluctuating amount of research on the sustainability of batik production year by year. It can be observed that 2021 is the year with the greatest number of papers, although the number of papers in 2022 and later can still increase.

Most of the papers analyze the batik production aspect, with production waste being the most discussed topic. While the marketing-related aspect is the least discussed, no paper discusses the finance-related aspect. The location of the research is still primarily in Indonesia. This is especially significant considering UNESCO's designation of Indonesian batik as a World Cultural Heritage in 2019. Specifically, the most discussed location is Central Java, a province that has been analyzed in 13 papers. For further study, there are opportunities to update the progress of the research on the aspects of batik production, enrich the discussion about the organization and marketing aspects, and initiate an examination of the finance-related aspect regarding the sustainable batik theme. It is anticipated that the study will be carried out outside the province of Central Java based on its location. Therefore, the data for the comprehensive sustainable batik study will be gathered from different areas in Indonesia.

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Comparison Between Boundary Color Method and Haar Cascade Classifier Applied on Sheep Detection and Quantification on a Live Video Streaming for a Quadcopter UAV

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Abstract. This paper compares two methods applied to a system for detecting and quantifying sheep in live video frames captured by unmanned aerial vehicles (UAVs). The proposed system consists of a UAV equipped with a wireless streaming video system that transmits video frames to a base station. These video frames are then processed using two digital image processing approaches: the boundary color method and the Haar cascade classifier. Both methods are implemented in Python 3 with the OpenCV library and employ morphological operations and feature-classifying algorithms to detect patterns and objects in the video source. Both methods have proven effective in detecting and quantifying sheep images under various lighting conditions and at different distances between the UAV and the sheep. However, the boundary color method demonstrates greater robustness in outdoor environments.

Keywords: Sheep Detection · Object Quantification · OpenCV · Haar-Cascade · UAV

1 Introduction

Applying pattern recognition techniques to quickly evaluate a large volume of information in videos by detecting objects is an essential field of research. In recent decades, Unmanned Aerial Vehicles (UAVs) have garnered significant attention from industrial communities and academics due to their high mobility, low cost, and versatile services [1]. UAVs can easily carry onboard devices and electronic modules for navigation, data acquisition, and transmission of relevant information to a ground-based station for specific purposes, including agricultural management [2], marine mammal monitoring [3],

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medical evacuation, and military applications [4]. In agriculture, the use of aerial imagery from UAhas proven to be a more convenient and cost-effective method for detecting and counting sheep, thereby facilitating livestock monitoring [5–8].

Considering the performance achieved in monitoring, techniques using deep neural networks yield the best results. In [9], they achieve recognition on 50-pixel images with a maximum accuracy of 97.8%. In [10], monitoring is carried out at distances of 80 m and 120 m, resulting in accuracy levels of up to 98.58%. However, it takes approximately 3 s to process each frame, which can be a limitation in some cases. Drones can reduce labor costs by providing efficient real-time sheep monitoring, covering large areas quickly, and offering location and movement information.

The extracted frames are captured by a drone camera and automatically analyzed using object detection and segmentation techniques, which differentiate the background and foreground. These techniques are proposed by Low-Lee-Khor in [11], and the object recognition method used is the Haar Cascade classifier proposed by Viola-Jones [12]. The algorithms are developed using the Python programming language and tools such as OpenCV. A quadcopter UAV model, the DJI Phantom Pro V2, carries a built-in camera that transmits video streams to a base station on the ground. The video streaming tests were performed at a rate of 30 frames per second. Video processing techniques were implemented on a laptop PC with an Intel i7 processor running at 2.70 GHz. In [13], the authors summarized some functional tests of detection methods implemented in the system. The results presented in this work demonstrate that automated image processing techniques offer clear advantages for assessing a large volume of video sources. These sources can be generated during UAV-based inspections to detect, recognize patterns or objects, and quantify potential targets in different environments. Manual techniques are time-consuming and yield less accurate results. The project starts by discussing the detection methods, followed by the implementation of the methods, which involves conducting tests. Subsequently, the results are presented alongside the conclusions.

2 Method for Object Detection for UAV

2.1 Object Detection with Boundary Color Method

Digital image processing uses an image that transforms and manipulates through mathematical operations to get specific features or patterns in the digital image. Color formats are designed for different purposes, such as RGB and CMYK, used mainly for print, and HSV, mostly used in graphics software like OpenCV. The transformation from RGB to HSV facilitates processing by computer programs, such as OpenCV. In this approach, for processing images uses transformation, segmentation, and morphological operations [14]. The linear algorithms proposed to find the convex hull of a polygon simple in linear time find a polynomial called P of n vertices (each vertex represented by coordinates) and are currently implemented in digital image processing programs such as OpenCV.

2.2 Haar Cascade Classifier Method

Paul Viola and Michael J. Jones developed this method, and is well known for its accuracy and fast face detection [15]. Also, it can be customized to detect a desired object. This method presents a way of combining increasingly complex classifiers, incrementing them in a cascade that allows regions of the image background to be quickly discarded if the object is not in the image. The Haar Cascade method is a fast face detection algorithm (at the time, 15 times faster than similar ones). Compared with current algorithms and other modifications, it still presents excellent results and is used and implemented in digital cameras to detect faces, eyes, and smiles.

2.3 UAV Aerial Robots

The development of air vehicles has brought further improvements in future models and prototypes. The principle of operation of quadcopters is using four engines to power the drive, balancing the thrust forces. The quadrotor highlights the pushing forces acting on the drone frame. For adequate control, a mathematical model, system dynamics, microcontrollers, and position and angle sensors, such as an electronic gyroscope and accelerometer, are needed, aiming to achieve stability in the air [16].

3 Method Implementation and Algorithms

Methods Implementation and Algorithms The proposed system adopts two techniques commonly used in streaming video applications to UAV [17]. The first method is the boundary color, which consists of detecting part of the geometric objects to extract the object from video frames. The second method is the Haar Cascade classifier, which detects custom objects and patterns, such as faces, human bodies, and objects of different characteristics concerning its main features.

3.1 Boundary Color Method

This method detects geometric objects, considering their color, from live video. The numerical composition of colors detects whether it is an RGB color space or an HSV color space. To use this method, gray color is chosen and gets its values in both the RGB and HSV; because RGB is not the suitable color space for detection, it is preferable to use the HSV color space. This one method selects a color and geometric shape, in this case, a circle. The entire process is described in the flowchart, as shown in Fig. 1. This method requires performing some actions on primary morphological features in the object. To perform the detection, it is necessary for the object's color to be extracted, eroded, and dilated to highlight the shapes. An example of detected sheep is shown in Fig. 2. All analysis and detection processes are performed in a streaming video source.

3.2 Boundary Color Method

To deploy this method in the proposed system, it was necessary to create a Haar Cascade classifier using a database generated using sheep captured images digitally with a camera drone and a cell phone, with 1:1 scale and in grayscale images (see Fig. 3). The photos were arranged in different positions and various scenes of lighting to have many variations of the images and perform flexible object and pattern recognition. All the data collected is stored primarily in the picture with many features. The entire execution process is shown in the flowchart of the Fig. 4.

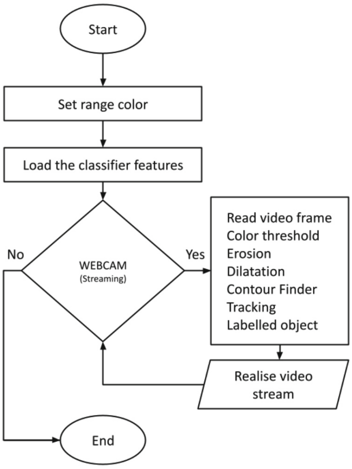
Start
Set range color
Load the classifier features
No
WEBCAM
(Streaming)
Yes
Read video frame
Color threshold
Erosion
Dilatation
Contour Finder
Tracking
Labelled object
Realise video stream
End

Fig. 1. Flow diagram of the Boundary Color method illustrates the actions by which the detection process is carried out to detect standard objects.

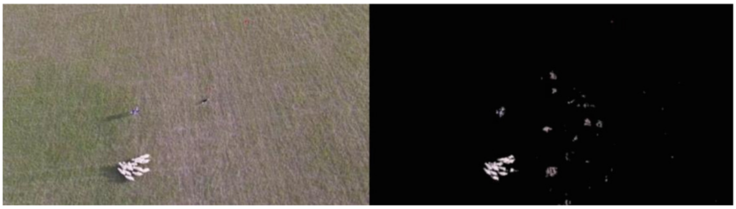

Fig. 2. Detected sheep using Boundary Color method.

3.3 Live Video Capture from UAV

A quadcopter UAV DJI Phantom pro v2 model carries a built-in camera, which transmits video streaming to a base on the ground. The test is performed on a group of 07 sheep in a pasture field with a camera and a view from a height of 25 m. The drone has an autonomy of approximately 30 min. The video source is 640 x 480 resolution at 30 frames per second. Video processing techniques have been implemented on a laptop PC with an Intel i7 processor at 2.70 GHz.

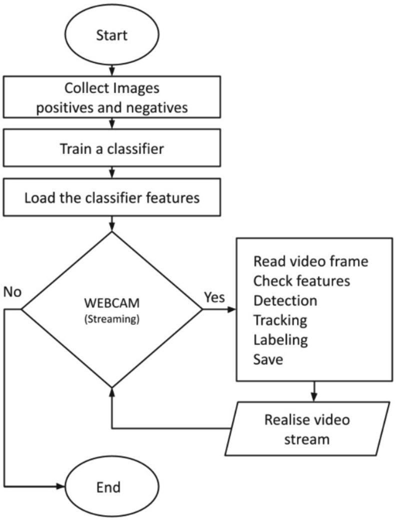
Start
Collect Images positives and negatives
Train a classifier
Load the classifier features
WEBCAM (Streaming)
No
Yes
Read video frame
Check features
Detection
Tracking
Labeling
Save
Realise video stream
End

Fig. 3. Haar Cascade Flow Diagram. This flowchart illustrates the actions by which the detection process is carried out when using the second pattern detection method.

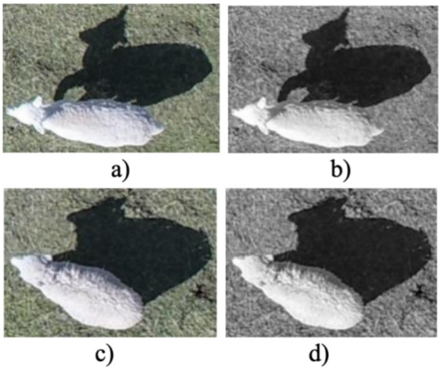

Fig. 4. Sheep captured images digitally. (a) e (c) Original images, (b) e (d) Grayscale images.

4 Experimental Results and Comparisons

4.1 Sheep Detection and Quantification with Boundary Color Method

By identifying the colors, it was determined that the color range of the sheep is between: - Lower Hue: 70 - Lower Saturation:0 - Lower Value: 135 - Upper Hue: 175 - Upper Saturation: 255 - Upper Value: 255. These adjusted values in the color-limiting algorithm identify the sheep. Results are shown of the tests in a few moments. In all tests performed, the objective of detecting the sheep on the ground was successfully reached. After detection, the quantization of the sheep is performed. Figures 5(a) and 5(b) show the result of the detection and quantization process of the 07 sheep and the group with the highest number of sheep, respectively.

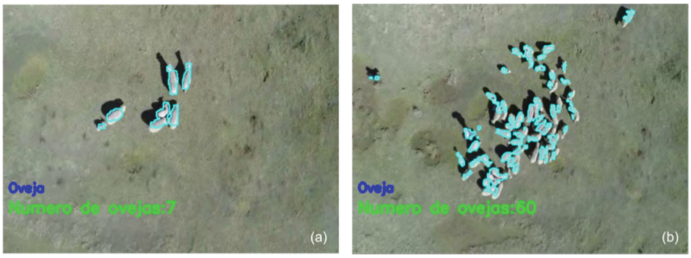

Fig. 5. Sheep detection by Boundary Color Method. a) Detection and Quantification of 07 sheep. b) Detection and Quantification up to 60 sheeps detected.

4.2 Sheep Detection and Quantification with Haar Cascade Classifier

The image samples examined a set of 40 sheep on a grassland, including adult females, males, and lambs. The samples are videos that capture the main sheep body from which a sheep image contains features such as the ears, sheep head, belly shape, and sheep shadow. These are the main morphological features (see Fig. 6). To train a Haar Cascade classifier with a pattern that is made up of the main sheep features in a picture, a picture resolution is decreased to test feature quality (see Fig. 7). Considering the pattern (Fig. 6), and pictures resized (Fig. 7).

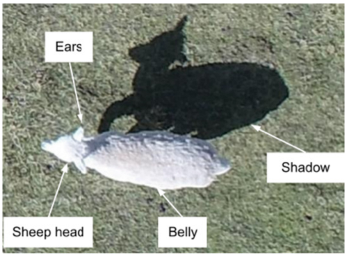

Fig. 6. Main feature sample (medium-sized sheep from the Puno region, Peru).

For training a haar classifier classifier, positive images has been used with less blur. Positive images of 32x32 pixels keep the feature pattern. The amount of collected raw samples is 2000, of which 200 positive images and 200 negative images were carefully selected to train the classifier with the best quality and clear features (see Fig. 7). From 15 stages, the classifier starts to recognize the pattern. The detection experiments were performed with a video capture at a height of 25 m. In Fig. 8 it can be seen some results of sheep detection and quantization using the Haar Cascade method.

The detection experiments were performed with a video capture at a height of 25 m. In Fig. 8 it can be seen some results of sheep detection and quantization using the Haar Cas- cade method. The comparison of both methods shows that the detection of sheep can be by detection and identification by the color and shading of the sheep. Aside from the morphological and body patterns of the sheep, there are some differences in the methods when they are executed in a streaming video source. Figure 9 and 11 show

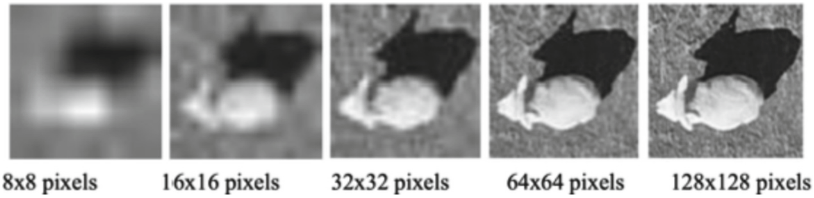

Fig. 7. Resized sample images (1 cm by 1 cm). This pixel reduction exposes the main features affected.

examples of detection when video captures, are performed at different heights from the ground, using Boundary color and Haar Cascade methods, respectively. In Table 1, the comparison is presented in the four scenarios, where the Boundary color method will have an error of 5%; this will have a precision of 95% of performance.

The detection experiments were performed with video captured at a height of 25 m. In Fig. 8, some results of sheep detection and quantification using the Haar Cascade method can be seen. The comparison of both methods shows that sheep detection can be achieved through color and shading identification. In addition to the morphological and body patterns of the sheep, there are some differences in the methods when they are executed on a streaming video source. Figure 9 shows examples of detection when video captures are performed at different heights from the ground, using the Boundary Color and Haar Cascade methods, respectively. Table 1 presents a comparison in four scenarios, where the Boundary Color method has an error rate of 5%, resulting in a performance precision of 95%.

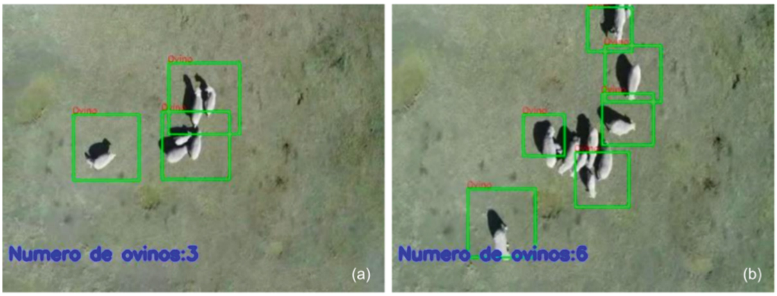

Fig. 8. Sheep detection by Haar Cascade Classifier. a) Detection and Quantification of 07 sheep. b) Detection and Quantification of more quantity sheep.

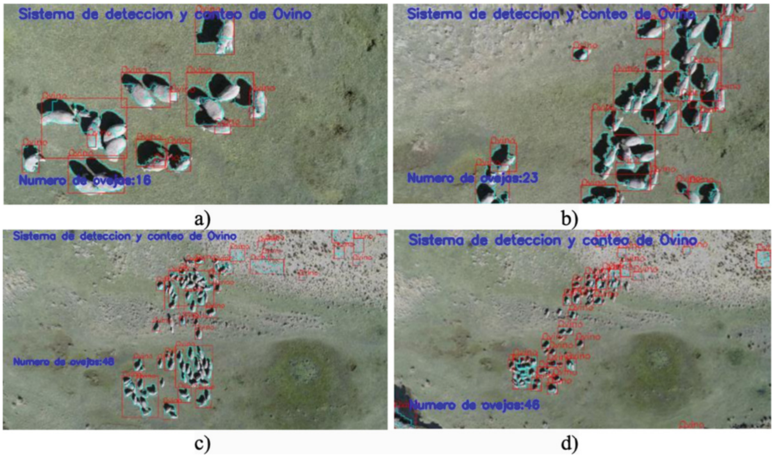
Sistema de deteccion y conteo de Ovino
Numero de ovejas:16
a)
Sistema de deteccion y conteo de Ovino
Numero de ovejas:23
b)
Sistema de deteccion y conteo de Ovino
Numero de ovejas:48
c)
Sistema de deteccion y conteo de Ovino
Numero de ovejas:46
d)

Fig. 9. Detection using the Boundary color with a video capture at a height of: a) 25m b) 50 m c) 75 m and d) 100 m.

Table 1. Comparison of method 1 and 2 under different scenarios.

Scenario	Visual	Method 1	Method 2	Error 1	Error 2
8x8	17	16	10	5%	41.17%
16x16	45	12	17	73.33%	62.22%
32x32	85	31	24	63%	71.76%
64x64	70	46	15	34.28%	78.57%

5 Conclusions

Both methods proved to be valid for specific types of patterns and objects under different conditions. The first tests using the Boundary Color method show rapid detection and accuracy and are quick and easy to implement. Due to being outdoors in strong sunlight and with the built-in webcam in the UAV, there is a limitation in the detection performance due to the camera's distance from the object and the brightness product of the light source. It achieves an accuracy of approximately 95% in the best test scenarios. Haar Cascade classifiers that have been trained with more than 20 stages took time to generate an XML file with the default features. Despite the references attributing to these classifiers an excellent performance in object detection in an indoor environment, it was found that under the conditions of the experiments carried out in an outdoor environment, it showed a limited performance in sheep detection and recognition.

Upon analyzing the performance of both methods, it is concluded that the proposed system, which employs the Boundary Color method, demonstrates greater robustness when compared to the Haar-Cascade classifier, especially in outdoor detection processes. Furthermore, detection can be performed from a video sequence of 30 frames per second with a resolution of 640x480, allowing for an acceptable computational cost and achieving good performance in the detection process. The proposed system offers a simple and efficient implementation option for object-tracking issues using a UAV. Future research will address limitations in outdoor operations, with an updated industrial camera, and integrate machine learning techniques for efficient object recognition and tracking with minimal computer processing power.

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Digital Transformation of the Banking System: Challenges and Technological Leadership

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Abstract. The problematic reality in the current context of the traditional banking system is the lack of efficiency, accessibility and security faced by customers. Long queues, limited opening hours and cumbersome procedures at physical branches pose barriers for users, who find it difficult to access financial services conveniently and quickly. Faced with this problematic, digitization of the banking system has been proposed as a solution to address these challenges and improve the financial customer experience. The present research focuses on analyzing the important aspects about the digitization of the banking system written in the scientific literature between the years 2019 and 2023. The Prisma methodology was used, and the databases searched were ScienceDirect, Scopus and Scielo. Twenty-two articles were reviewed, following inclusion criteria such as publication between 2019 and 2023, languages in Spanish, English or Portuguese and open access. The results obtained indicate that the most used database is Sciencedirect and the year with the highest number of publications was 2022. Also, the digitization of the banking system helps to offer better and more secure services to customers. In addition, specific areas covered by this digitization include data, cybersecurity, accessibility, and inclusion. In conclusion, the digital transformation of the banking system has significantly improved the customer experience and paved the way for a more efficient, accessible, and secure financial landscape.

Keywords: Digitalization · banking system · technology · cybersecurity

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1 Introduction

The transformation of the banking system in the digital era has brought about significant changes in how banks operate and how customers interact with them. Technological advancements have enabled customers to carry out online transactions and access banking services from anywhere and at any time, thereby increasing efficiency and convenience in managing their finances [1–4].

Nevertheless, the transformation towards digitalization brings challenges. The sustainability and reputation of banking institutions increasingly rely on information security and cybersecurity. In an increasingly digital world vulnerable to sophisticated cyberattacks, it is crucial to protect customers' personal and financial information. As a result, banks must implement reliable information protection systems and strengthen their security measures to ensure the confidentiality and integrity of transactions. The operations, reputation, and sustainability of a company depend on information security and cybersecurity, especially in a digital environment [5–8].

The digitalization of the banking system also brings about the need for adjustments in traditional banking. It is crucial to take into account that there are individuals who are unbanked or have limited access to banking services [9–11]. Therefore, it is necessary to analyze the factors that influence their decision to adopt mobile banking services [12]. Promoting financial inclusion and providing solutions tailored to the needs of all population segments are essential in this context. It is essential to promote financial inclusion and offer solutions tailored to the needs of all population segments.

The present research focuses on analyzing the important aspects about the digitization of the banking system, written in the scientific literature between the years 2019 and 2023. The objective is to gather existing information on the topic, classify scientific evidence, evaluate how digitalization affects operational efficiency and customer satisfaction, identify trends and challenges, and analyze best practices and strategies implemented by banking institutions. This study provides an update on the state of knowledge in the field, highlighting the benefits and challenges of digitalization, and will enable the identification of areas for improvement and opportunities to drive innovation in the banking sector.

2 Methodology

A comprehensive analysis was performed by means of a systematic review based on the adaptation of the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) protocol [13]. The evidence found in research related to banking and the financial system in terms of production, innovation and organization was examined and summarized.

For the search, the following keywords were used: "Banking system", "Digitalization", "Technology" and "Cybersecurity". Twenty-two articles were systematized following inclusion criteria such as publication between the years 2019 and 2023, availability in Spanish, English or Portuguese, open access and addressing the topic of digitization of the banking system. This collection of articles provides a solid basis for the analysis of information related to the digital transformation of the banking sector.

3 Results

After searching several databases, as shown in Fig. 1, 22 articles were obtained that met the established guidelines. The articles came from ScienceDirect, Scielo and Scopus. In addition, maximum efficiency was achieved by eliminating duplicate articles and those that did not directly answer the research question. These papers are summarized in Table 1.

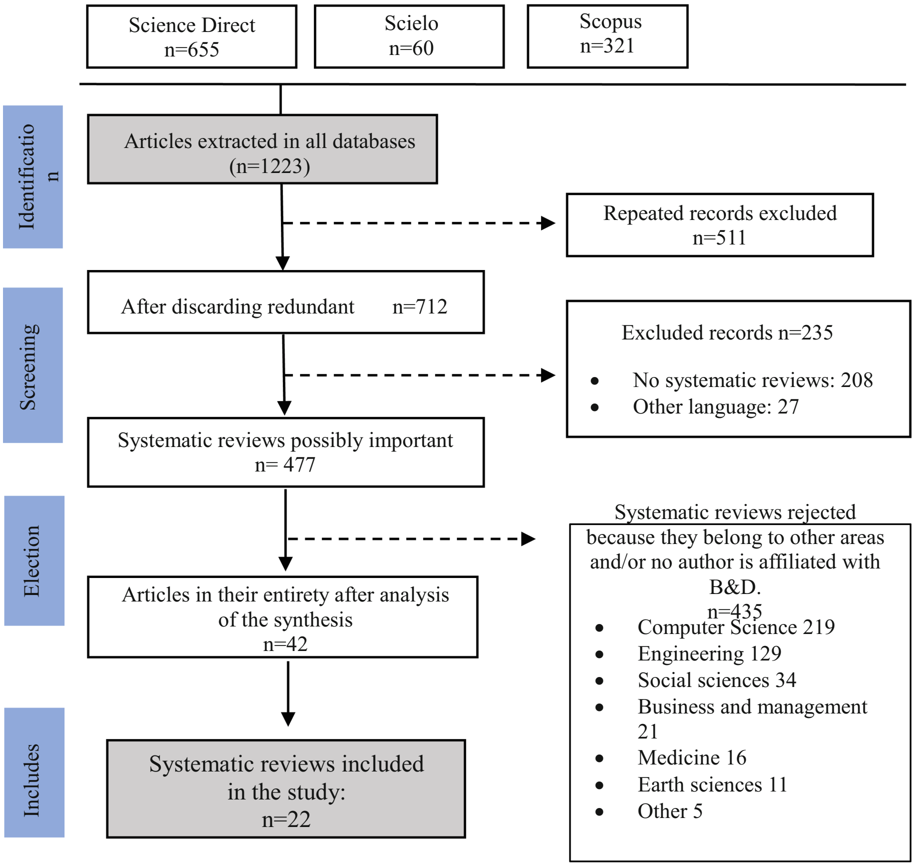
Science Direct n=655
Scielo n=60
Scopus n=321
Identification
Articles extracted in all databases (n=1223)
Repeated records excluded n=511
Screening
After discarding redundant n=712
Excluded records n=235
• No systematic reviews: 208
• Other language: 27
Systematic reviews possibly important n= 477
Election
Systematic reviews rejected because they belong to other areas and/or no author is affiliated with B&D. n=435
• Computer Science 219
• Engineering 129
• Social sciences 34
• Business and management 21
• Medicine 16
• Earth sciences 11
• Other 5
Articles in their entirety after analysis of the synthesis n=42
Includes
Systematic reviews included in the study: n=22

Fig. 1. Prism Diagram of the article systematization process

The different databases used in the systematic review are shown in Fig. 2. Of the 22 scientific articles used, 10 were obtained from Science Direct, 10 from Scopus and 2 from Scielo, the latter two having the lowest percentage of use in the review.

Among the 22 articles used for the systematic review, Fig. 3 shows that the majority were published in the year 2022, with a total of 10 articles. There were 6 articles from 2023 and 3 articles from 2021, while the number of articles from 2019 and 2020 was relatively lower.

Table 1. Representation of scientific articles selected from the databases.

Nº	Data base	Title	Year	Country
1	Scopus	Digitization model for costs and operating times reduction in Peruvian Banks	2022	France
2	Scopus	Digital transformation of commercial banks in China: Measurement, progress and impact	2023	China
3	ScienceDirect	The impact of fintech and banks M&A on Acquirer's performance: A strategic win or loss?	2022	Pakistan
4	Scopus	Central bank digital currencies: An agenda for future research	2022	United Kingdom
5	ScienceDirect	Recalibrating the Banking Sector with Blockchain Technology for Effective Anti-Money Laundering Compliances by Banks	2023	India
6	ScienceDirect	The Effect of Digital Channel Migration, Automation and Centralization on the Efficiency of Operational Staff of Bank Branches	2019	Turkey
7	Scopus	Fintech in the time of COVID-19: Technological adoption during crises	2022	Switzerland
8	Scopus	The impact of the FinTech revolution on the future of banking: Opportunities and risks	2022	United Kingdom
9	ScienceDirect	Digital Transformation and Strategy in the Banking Sector: Evaluating the Acceptance Rate of E-Services	2021	Greece
10	ScienceDirect	Curbing credit corruption in China: The role of FinTech	2023	China
11	Scielo	Can Fintech Foster Competition in the Banking System in Latin America and the Caribbean?	2022	Colombia
12	ScienceDirect	Banking the unbanked. Constitutive rules and the institutionalization of mobile payment systems in Nigeria	2023	United Kingdom
13	Scielo	Digital transformation and the emergence of the Fintech sector: Systematic literature review	2022	Spain
14	ScienceDirect	Banking Information Resource Cybersecurity System Modeling	2022	Ukraine
15	ScienceDirect	Impact analysis of peer-to-peer Fintech in Vietnam's banking industry	2022	China
16	ScienceDirect	The effects on innovation from financial sector development: Evidence from developing countries	2019	France

(*continued*)

Table 1. (*continued*)

Nº	Data base	Title	Year	Country
17	ScienceDirect	Impact of digitization in banking services on customer habits	2022	India
18	Scopus	Mobile money as a driver of digital financial inclusion	2023	Finland
19	Scopus	Chatbots or me? Consumers’ switching between human agents and conversational agents	2023	China
20	Scopus	Banking Digitalization: (Re)Thinking Strategies and Trends Using Problem Structuring Methods	2020	Portugal
21	Scopus	Leveraging financial inclusion through technology-enabled services innovation: A case of economic development in India	2021	India
22	Scopus	Fintech in the time of COVID-19: Technological adoption during crises	2021	Switzerland

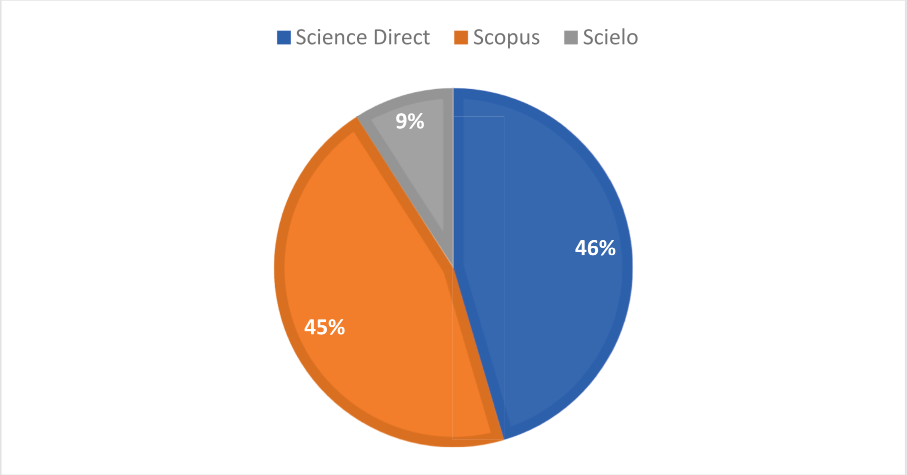

Fig. 2. Articles per database

4 Discussion

The digitalization of the banking system has generated a significant impact in the financial sector, opening new opportunities and challenges. Several key subthemes in this transformation deserve special attention [14, 15].

If more individuals and businesses have access to financial services, then an environment conducive to innovation is created. Financial inclusion expands the potential customer base for financial institutions [16, 17].

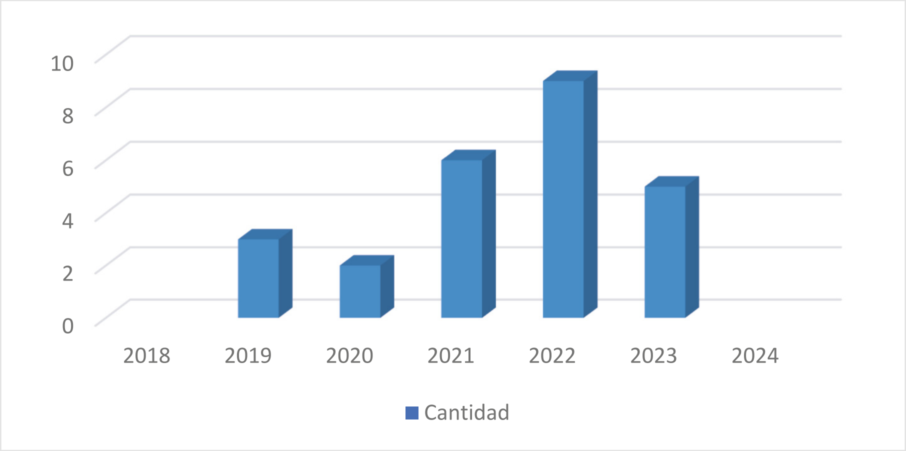

Fig. 3. Year-wise distribution of articles

Fintech companies, technology-focused enterprises providing financial solutions, have emerged in the financial landscape with disruptive innovations. Their agile approach and ability to offer financial services through digital platforms have revolutionized the way users interact with relevant entities [18]. Fintechs have introduced a wide range of products and services such as mobile payments, peer-to-peer lending, automated financial advice, and more [19].

As digitization advances, cybersecurity becomes a critical factor. Online data transfer and financial transactions make banking systems vulnerable to cyber-attacks, which is why banks must prioritize the implementation of robust cybersecurity measures that ensure data privacy and integrity. This includes adopting strong authentication technologies, data encryption, continuous threat monitoring and fostering a culture of trust awareness throughout the organization. Collaborating with cybersecurity experts and staying up to date on the latest trends and attack techniques is also essential to protecting financial assets and customer trust.

Additionally, blockchain has emerged as a promising technology in the context of banking digitization by using distributed and encrypted records, blockchain offers a transparent and secure system for conducting and tracking transactions. Its ability to eliminate intermediaries and provide an immutable ledger can improve efficiency and reduce costs in the banking system. While the widespread adoption of blockchain in the industry still faces regulatory and interoperability challenges, banks have explored specific use cases such as international payments and digital identity management. As the technology evolves and hurdles are overcome, banks could further leverage blockchain's potential to increase transaction efficiency and strengthen trust in the banking system [20].

Legal regulations play a crucial role in the protection of users' financial data and in the fight against fraud, the implementation of new data protection and security standards, such as the General Data Protection Regulation (GDPR) in the European Union, establishes clear rules on how personal information should be treated and the responsibility of banking institutions to safeguard data immunity and privacy of customer data [21].

On the one hand, it is argued that cybersecurity is a top priority in digital banking transformation. By adopting strong cybersecurity measures, banks can minimize the risks of cyberattacks and safeguard the integrity of the financial system. Encrypting data, implementing multi-factor authentication, and constantly monitoring threats are examples of practices that enhance online security. By investing in cybersecurity, banks demonstrate their commitment to protecting users' confidential information and ensure trust in the digital services offered. However, there is a contradictory perspective that poses the challenge of finding the right balance between security and customer experience [22]. Digitalization has enabled greater availability and accessibility of financial services for customers. Thanks to digital channels such as mobile apps and online services, users can transact and access information anytime and from anywhere [23]. As the shift towards digital channels progresses, there is a risk of losing the human and personalized aspect of the bank-customer interaction, where the lack of direct contact can create a sense of distance and disconnection, which could affect customer trust and satisfaction.

The increasing computerization of society and the rise of confidential information flows have led to the need for information security in various spheres of public activity. This is because any process in financial, industrial, political, or social spheres is directly related to information resources and the use of information technology. The practical implementation of the method described in the article enables the prediction of the cybersecurity state of banks and contributes to the implementation of necessary mechanisms to prevent, protect, and control access to appropriate levels of network infrastructure [24].

Adoption of Digital Technologies by Banks

Online and mobile banking have enabled customers to access their accounts and perform financial transactions from the comfort of their homes or on the go, as there is no need to physically go to a bank branch to perform basic operations such as balance inquiries, fund transfers or bill payments. Moreover, mobile applications offer additional functionalities such as real-time notifications, personalized financial management services, and the ability to make mobile payments using technologies such as NFC (Near Field Communication).

According to [25, 26], the adoption of digital technologies in banking has led to improved customer service. as banks have implemented chatbots and artificial intelligence systems to respond quickly to customer queries. According to [27–29], these systems are designed to provide accurate answers and solutions to frequently asked questions, thus improving efficiency and reducing waiting times. In addition, digital communication channels, such as email or online messaging, enable faster and more convenient communication between customers and bank representatives.

However, despite the obvious advantages of adopting digital technologies, challenges and concerns also arise. One of the main challenges is cybersecurity. As banks store and process large amounts of sensitive financial information, it is crucial to implement robust security measures to protect customer data and prevent potential cyber-attacks.

5 Conclusion

In conclusion, based on the information gathered, it can be defined that most of the articles found are current, as every year the banking system is increasingly adopting digitalization due to the numerous benefits it offers. Through this research, we have been able to explore the different areas in which digitalization is employed in the banking system, going beyond the technological aspect that improves the user experience for regular customers, as it also aims to achieve the inclusion of the unbanked population.

Finally, we have learned how digitization helps improve the security of our data within the banking system, making it more difficult for systems to be compromised and reducing the risk of cyber theft. However, despite the rapid progress of digitization, its implementation in the banking system has been relatively slow.

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Instinctive Decision Support Amid VUCA

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Abstract. As the current Industrial Society is getting close to its end, we need to design and develop a new society for the next generation. If we remember that in old days, we enjoyed the process of making our dreams come true. Only humans can think about the future and we enjoyed being a human. In these days, process was valuable. We enjoyed challenging. Challenge was the core and mainspring of all human activities. However, gradually we started to put value on products and technology. And it brought the Industrial Revolution. To produce products effectively, Division of Labor was introduced. Thus, we started to work for others. Until then, we worked for ourselves. Humans obtain the maximum happiness and feeling of achievement when we do the job internally motivated and self-determined. Thus, although we enjoyed rich supply of products, our heart was not fully satisfied. And the development of the industrial society produced many issues. Excessive use of energy is one for example. If we go further ahead along the line of product - centric society, human world may collapse. But if we self-sustain ourselves and enjoy "self" society, such concern will disappear and we can enjoy actualizing ourselves. VUCA is getting wide attention these days. Environments and situations become so complex and complicated. So, if we can make technologies as simple as possible, so that everybody can enjoy challenging. Then, we can have a self-sustaining and self-satisfying society and have a bright future.

Keywords: VUCA · Decision Support · Instinct · Analog

1 Introduction

As we know well, our society shifts with time from one society to another, as shown in Fig. 1.

The world 1.0 in this figure indicates the Industrial Society since the Industrial Revolution.

World 0.0 is the society before the Industrial Revolution. In these days, we all were trying to make the most of the characteristics of humans, i.e. we, humans, only can think about the future. Thus, we were challenging to make our dreams come true. In fact, challenge is the core and mainspring of all human activities. What mattered was the process, not the result. And we are different from person to person. We wished to actualize ourselves. In other words, we were trying to establish the world of "Self".

Maslow clarified the human needs [1], (Fig. 2).

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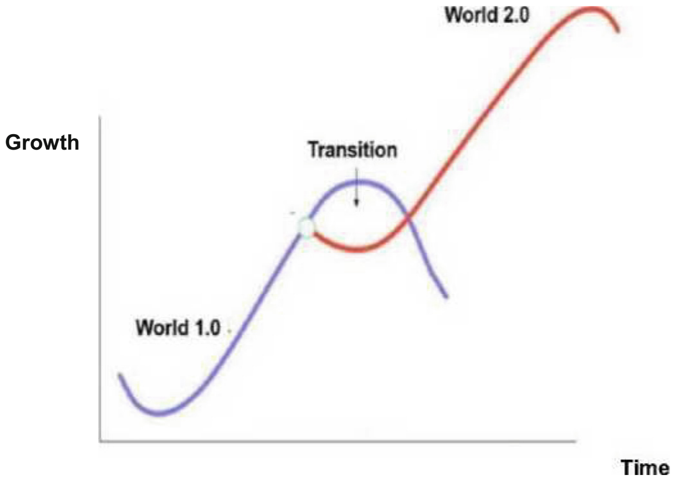

Fig. 1. Growth curve

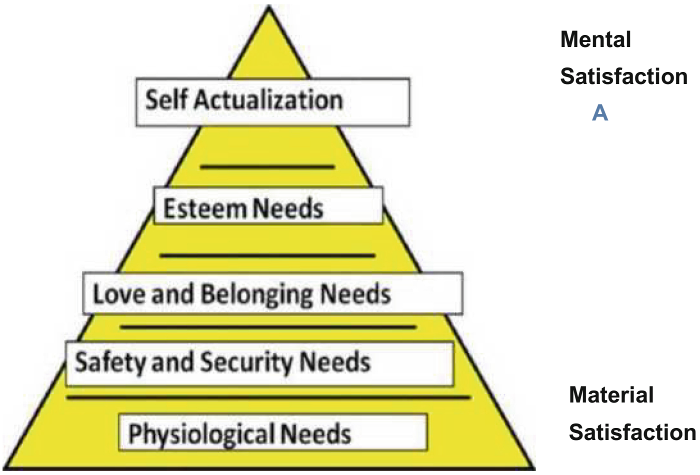
Mental
Satisfaction
A
Self Actualization
Esteem Needs
Love and Belonging Needs
Safety and Security Needs
Physiological Needs
Material
Satisfaction

Fig. 2. Maslow’s human needs

At first, we wanted to satisfy our material needs, such as food and home. We are no more different from other living things. But with time, our needs shift from material to mental and at the final stage, we look for “self-actualization”. In other words, we try to build a world of our own. As human are different from person to person, Thus, this increased diversity. That is why the human world expanded so much.

This world, world 0.0, is a world of engineering. We enjoyed the process of challenging. But gradually, we became aware of the benefits of technology. In other words, we began to question “How”. How we can improve our technologies became important. This led us to the Industrial Revolution and it brought us the Industrial Society, which is product-focused. The Industrial Society introduced "Division of Labor" to product products effectively. This changed our life completely. Until then, we worked for ourselves. But since then, we started to work for others.

As Maslow points out, we would like to actualize ourselves. In fact, Maslow's paper is titled "Human Motivation". He clarified our needs from the standpoint of motivation. And we should remember that emotion and motivation come from the same Latin word "Moreover", i.e., "movement". That is why living things are called "creatures". We create movement to survive.

The Industrial Revolution realize a rich supply of products. But about 40 years after Maslow, Deci and Ryan proposed Self-Determination Theory (SDT) [2] and made it clear that we get the maximum happiness and the feeling of achievement, when we the job, which is internally motivated and self-determined. No external rewards can provide this level of happiness and the feeling of achievement. Therefore, although we have enjoyed the rich supply of products, we have been working for others. So, we have not enjoyed this highest happiness and the feeling of achievement.

As the Industrial Society is getting close to its end, we need to develop the next society. The Industrial Revolution was realized in mid-19th century. And it took about 100 years to realize the Industrial Society, we enjoyed this society in the mid-20th century. And now it is getting close to its end. So, many issues are emerging, such as excessive use of energy, etc. But on the other hand, new buds have begun to appear.

2 Changing Real World

The real word is changing rapidly (Fig. 3).

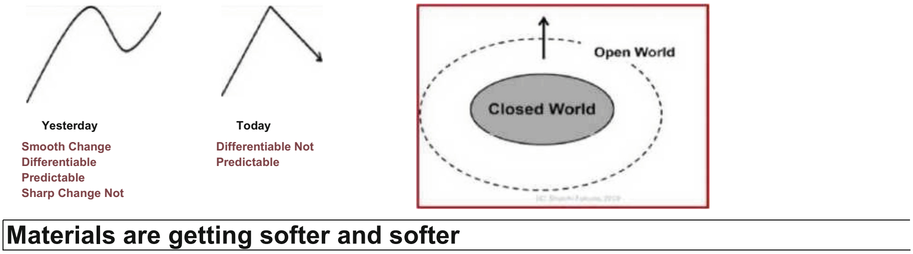

Fig. 3. Changing real world

There were changes yesterday. But change we could differentiate them and could predict the future. But today changes are sharp. So we cannot differentiate them. We cannot predict the future.

And the world is expanding rapidly. Our living space was small and closed with boundary. But today, boundaries disappear and our world becomes open.

The biggest change is materials are getting softer and softer with the progress of material engineering. Until recently, when we see the product, we understand what is and how we should handle it. And we can do that even from a distance. But today, direct interaction with the product becomes necessary. If you try to pick it up, but if it does not work, you need to scoop it.

3 VUCA

The word 'VUCA' is getting wide attention these days. But we have to remember that it was in 1985 when Warren and Nanus published the leadership book on VUCA [3].

Interestingly enough, exactly the same year Deci and Ryan published Self-Determination Theory (SDT). SDT proved that we humans get the maximum happiness and the feeling of achievement, when we do the job internally motivated and self-determined. And they pointed out no external rewards can provide this level of happiness and the feeling of achievement. Further, they also pointed out this is very important from the standpoint of growth. In other words, we would like to actualize "Self" to grow. We would like to confirm how much progress we have made. Growth and evolution are basically the same. We grow and our species evolve to go further ahead with the changing environments and situations. Why VUCA and SDT was published in 1985, Presumably, people realized the Industrial Society the Industrial Revolution led us to is working for others and we cannot receive the maximum happiness and the feeling of achievement we are supposed to enjoy. Technology development in the mid-19th century brought us the mid-20th century Industrial Society. Indeed, we could enjoy products. But in this framework, we are regarded as consumers. CX (Customer Experience) was discussed in these days, too. But it is to know how much satisfaction consumers get. But we are essentially customers, not consumer.

Brand industry clearly illustrate this change. They thought if the product is good, then their customers are happy. But today, they tell us how they produce their goods. Process becomes important. They realized how process is important for customers.

4 Brigolage

The French word Brigolage means to create from a diverse range of available things. In English, it is DIY (Do It Yourself). But DIY and Brigolage are different. DIY means just 'Do It Yourself.' Brigolage, however, means to use your resources to the maximum. Your resources are limited, but if you look at them from a different viewpoint. You can use your resources to create a new world. In short, current technology is used to improve technology in other words, going deeper and deeper is the current technology. But Brigolage reminds us that we can use technology to go wider and wider. Then, from the business point of view, we can develop new markets.

We have been discussing CX (Customer Experience) as product consumers, but if we introduce the idea of Brigolage, we can really discuss CX from the standpoint of Customers'.

As this is the paper for Business, I will not discuss how technologies can be utilized for realizing 'Brigolage' in detail. You can find the details in [3]. The idea is to use instinct. Since the New World is an unexperienced world, it is exploration. And in exploration, we need to use our resources to full extent. But in essence, it is an unexperienced world, what we have is instinct. That is the only resource we have. Thus, how we can utilize instinct is very important.

If we introduce 'Reservoir Computing (RC)' we can introduce micro technologies and we can make sensors and actuators extremely small. And we can make them part of our body. In short, our instinct is enhanced. The current technology is developed on the idea that sensors and actuators work outside of humans and sensors detect signals and actuators are mobilized which can process these signals. So, this is sequential processing.

But to code with the rapidly changing environments and situations, simultaneous processing is called for.

If we introduce RC, we can process information Real Time. Thus, we can respond to the context in real time and we can enjoy creating new worlds. i.e., we can enjoy the world of Brigolage. If you are interest, please visit [4]. It is a technical paper and technical details are described.

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The Use of Quick Response Code Indonesian Standard (QRIS) in Jakarta: Are Usefulness and Resistance to Technology Stronger Than Perceived Security and Technological Anxiety?

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Abstract. The Quick Response Code Indonesian Standard (QRIS) was introduced in Indonesia with the goal of making it a standard non-cash payment system that everyone can use and recognize. However, the conflict between advantages and fear of usage, such as erroneous transactions and data theft, continues to plague users in non-cash transactions. On the other hand, users in big city like Jakarta, with their rapid pace of knowledge absorption and tremendous social impact, may find these concerns to be unfounded. Based on this, the purpose of this study is to examine the behavioral drivers of QRIS users' desire to use the system, as well as to explain whether the utility of technology and resistance to technology more powerful reasons can be than fear in utilizing this non-cash payment method. Using 208 individuals, this study was able to demonstrate that technology usability aspects and aversion to technology are more important than technology anxiety and security views. QRIS gives more benefits to users of non-cash payment methods in metropolitan cities than the difficulty, discomfort, or fear of utilizing it. The usage of a research region that only covers one city and the use of participant criteria that can be made more specific for future studies are both limitations of this study.

Keywords: QRIS · Behavioral Intention · Usefulness

1 Introduction

The Quick Response Code Indonesian Standard (QRIS) was introduced in Indonesia with the goal of making it a standard non-cash payment system that everyone can use and recognize. However, achieving this desirable aim will not be simple. Indonesians, with their different educational and economic backgrounds, might both help and hinder the acceptance of QRIS as a widely recognized non-cash payment option. The use of non-cash transactions has started before, for example in the use of non-cash banking transactions [1], credit cards [2], public transportation [3], and mobile payments [4].

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Existing studies also give different colors to the behavioral determinants of the use of non-cash transaction technology. Existing research also paints a diverse picture of the behavioral factors of non-cash transaction technology use. When performing non-cash transactions, customers face a contradiction between advantages and fear of usage, such as erroneous purchases and data theft. On the other hand, consumers in metropolitan centers like Jakarta, with their rapid pace of knowledge absorption and tremendous social impact, may be able to overcome these anxieties. As a result, this must be researched further. Thus, the purpose of this study is to examine the behavioral drivers of users' desire to use QRIS while also explaining if technological usefulness and aversion to technology bigger variables might be than fear in adopting this non-cash payment method.

2 Literature Review and Hypotheses Development

Along with the advancement of technology, like QRIS, consumers are given the option to experience it based on their comfort level. This is consistent with the idea of technological resistance, which states that with technical breakthroughs that are believed to benefit society, there is a requirement for a learning process to use these modern goods [5, 6]. Resistance to technology, like its influence on transaction usage behavior [7], will be directly connected to QRIS usage behavior from several perspectives, such as discomfort of use, which produces usage anxiety [8, 9]. Thus, in this scenario, resistance to technology might be both favorable and negative in terms of appraisal. This is what gives rise to the following hypotheses:

H1: Resistant to technology significantly affects behavioral intention
H2: Resistant to technology which moderated by technology anxiety significantly affects behavioral intention

The utility of adopting technology such as QRIS is supposed to benefit its users. In accordance with the definition of technological usefulness, which is described as media that is helpful to its users in terms of boosting productivity, effectiveness, making life simpler or more practical, and delivering advantages [1–3]. As a result, it is not unexpected that the utility of technology would be intimately tied to user behavior [4]. However, the QRIS payment method has no major influence on users with a sales background [5]. This lack of influence is then rendered ineffective in terms of employing this non-cash payment method, hence it must be investigated further by positing the following hypotheses:

H3: Technology usefulness significantly affects behavioral intention
H4: Technology usefulness which moderated by technology anxiety significantly affects behavioral intention

Anxiety is a type of fear that arises in response to a condition, which in this case is very likely to cause a certain level of stress [4, 15, 16]. Anxiety is also linked to the scenario of utilizing or making mistakes with a computer in terms of technology [17–19]. Anxiety is thought to have a negative relationship with perceived ease of use when it comes to technology use, both directly and indirectly. These explanations are then combined to form the following hypothesis:

H5: Technology anxiety significantly affects behavioral intention

In this context, behavioral intention is defined as a plan for usage in the near or far future [10, 12, 20, 21]. In terms of QRIS, the ease of use of this non-cash payment option will be sufficient to develop a strong desire to utilize it. Several essential elements impact behavioral intention, such as the user's capacity to give supporting and suitable tools, the advantages acquired, or the sense of trust built [14]. Based on the description of the hypotheses' evolution provided above, this study offers the conceptual framework depicted in Fig. 1 below:

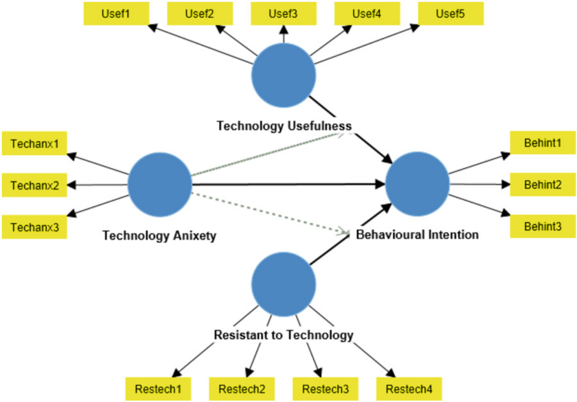
Usef1
Usef2
Usef3
Usef4
Usef5
Technology Usefulness
Techanx1
Techanx2
Techanx3
Technology Anixety
Behint1
Behint2
Behint3
Behavioural Intention
Resistant to Technology
Restech1
Restech2
Restech3
Restech4

Fig. 1. Conceptual framework

3 Methods

The users of QRIS in Jakarta were used as participants for this study. This location was chosen because it is regarded as a typical city in terms of the availability of channels or items compatible with the usage of QRIS. Aside from that, major cities such as Jakarta have been identified as having individuals with high purchasing habits [22–24]. This research employs a survey using a questionnaire produced on a Likert scale of 1 (strongly disagree) to 5 (strongly agree) utilizing criteria such as QRIS users in Jakarta, various ages, and diverse occupations. The study's sample size was 208 people. This figure takes into consideration the sample size criteria by multiplying the total indicator by five for the minimum sample size and ten for the maximum sample size [25–28]. This quantitative study employs Partial Least Square-Structural Equation Modeling (PLS-SEM) analysis using SmartPLS 4.0. As stated in Table 1, a total of 15 indicators from four variables were employed.

4 Results and Discussion

There were 118 women (58.73%) and 90 males (43.27%) in this research. In terms of age, the participants in this study were dominated by those aged 26 years, with 125 (60.10%). This was followed by individuals aged 27–43 years, with 69 (33.17%), and those aged

Table 1. Operational Variable

Variable	Item	Code
Technology usefulness [10–12, 14, 20]	QRIS helps boost productivity and performance	Usef1
	The adoption of QRIS can improve job efficiency	Usef2
	Using QRIS simplifies financial transactions (both receiving and donating money)	Usef3
	The usage of QRIS in transaction operations is profitable and beneficial	Usef4
	The application of QRIS is more practical or straightforward	Usef5
Resistance to technology [5, 6, 14]	Have an interest in learning more about QRIS development	Restech1
	The use of QRIS has raised people's living standards	Restech2
	Feel at ease when utilizing QRIS	Restech3
	Interested in learning more about additional QRIS products and services	Restech4
Technology anxiety [8, 14]	I was apprehensive to utilize QRIS because I was concerned about transaction problems	Techanx1
	Feeling compelled or uneasy about using QRIS?	Techanx2
	I was hesitant to use QRIS	Techanx3
Behavioral intention [10, 12, 20]	In the future, you intend to utilize the QRIS payment method to complete transactions	Behint1
	I'm hoping to be able to use the QRIS payment mechanism to conduct necessary transactions	Behint2
	Plan to utilize the QRIS payment mechanism regularly in transactions	Behint3

>43 years, with 14 (6.73%). When it comes to jobs, this study was dominated by private employees with 76 (36.54%) and students with 63 (30.29%). Entrepreneurs came in second with 27 participants (12.98%), followed by public servants with 24 participants (11.54%), and retirees with 18 participants (8.65%). With 166 participants (79.81%), the most common use of utilizing QRIS was to purchase daily meals or drinks. This was

followed by transportation services for 23 (11.06%) individuals and monthly household expenses for 19 (9.13%) participants.

The PLS algorithm test is used in this study to assess the reliability and validity of constructs and research items, as indicated in Table 2. In this study, dependability is determined by the outcomes of composite reliability (CR) and Cronbach's alpha (CA), both of which must be more than 0.7. Furthermore, the results of outer loading (OL), which must be larger than 0.7, and the average variance extracted, which must be greater than 0.5, are used to assess validity [29–31]. Based on the findings, it is possible to conclude that all of the items and variables in this study are trustworthy and valid.

Table 2. Reliability and Validity Tests

Variable	Item	OL	CA	CR	AVE
Technology usefulness	Usef1	0.812	0.921	0.926	0.761
	Usef2	0.858			
	Usef3	0.900			
	Usef4	0.885			
	Usef5	0.904			
Resistance to technology	Restech1	0.880	0.883	0.885	0.741
	Restech2	0.888			
	Restech3	0.840			
	Restech4	0.833			
Technology anxiety	Techanx1	0.906	0.827	0.884	0.737
	Techanx2	0.825			
	Techanx3	0.842			
Behavioral intention	Behint1	0.899	0.914	0.914	0.853
	Behint2	0.930			
	Behint3	0.940			

In this investigation, bootstrapping is used to determine if the hypothesis is accepted or rejected. The findings collected to define the test for each hypothesis are shown in Table 3. The P result is used to make this conclusion, which is then compared to 0.05. Hypothesis 1 has a P value of 0.000 (0.05), indicating that resistance to technology has a substantial impact on behavioral intention, or H1 is accepted. Furthermore, the P value for Hypothesis 2 is 0.719 (>0.05), indicating that resistance to technology, as modulated by technological anxiety, has no effect on behavioral intention. In other words, H2 is not accepted. H3 is acceptable because P = 0.000 (0.05) explains that the utility of technology has a substantial impact on behavioral intention. The p value for hypothesis 4 is 0.780 (>0.05), indicating that technology usefulness, which is tempered by technology anxiety, does not substantially alter behavioral intention (H4 is rejected).

The P value for the fifth hypothesis is 0.448 (>0.05), indicating that technological anxiety has no effect on behavioral intention.

Table 3. Hypothesis Test

Hypothesis	STDEV	T statistics	P values	Remark
H1	0.063	10.592	0.000	H1 accepted
H2	0.073	0.360	0.719	H2 rejected
H3	0.067	3.584	0.000	H3 accepted
H4	0.076	0.280	0.780	H4 rejected
H5	0.045	0.759	0.448	H5 rejected

Usefulness and Resistance to Technology are Stronger

The use of QRIS in this study was favorably appreciated, particularly by users in major cities such as Jakarta. This explains why the employment of technology in the form of non-cash payment methods through QR Code for participants in this study may be seen as a viable alternative with potential benefits for its users. This may also be described by the things that comprise technology's usefulness, which are practical (Usef5) and give transactional convenience (Usef3). This appears to be corroborated by the large number of channels or retailers who have implemented the QRIS payment mechanism. This is also consistent with the spirit of QRIS's core mission, which is to become a common non-cash payment option in Indonesia. In terms of utility, this study coincides with earlier studies that achieved comparable results [8, 10, 11, 32]. However, some studies do not discover the same benefits, particularly when the user is not an individual [14].

This study also revealed that aversion to technology is greater than anxiety and imagined security. The existence of QRIS as a non-cash payment mechanism was well received by research participants. The participants believed that the use of QRIS may enhance many people's levels of life (Restech 2), which was followed by their awareness and willingness to learn more about the usage of QRIS (Restech 1). The usage of QRIS in this situation was described so that participants would not be concerned of its abuse or data theft. Looking at the profiles of the participants in this survey, the most common purpose of utilizing QRIS is for minor transactions such as buying food or beverages daily. The findings of this study support the findings of previous research, which indicates that while technology aids in the daily lives of its users, resistance to technology emerges [6]. On the one hand, our findings complement previous research that found that perceived security had little effect on behavioral intention [8, 14, 32].

5 Conclusion, Limitation, and Recommendation

This study was successful in demonstrating that variables such as technology utility and aversion to technology can be more influential than technology anxiety and perceived security in the adoption of QRIS in Jakarta. QRIS gives more benefits to users of non-cash payment methods in metropolitan cities than the difficulty, discomfort, or fear of utilizing it. In this scenario, QRIS differs from the usage of mobile banking technologies, which appears to cause more worry or panic. QRIS has gradually gained acceptance in major cities since its inception since it offers more beneficial benefits.

The usage of research regions that only use one city limits the scope of this study. The usage of many large cities, for example, can improve the comparability of study outcomes. Aside from that, future study should examine using more particular participant criteria, such as certain generations or occupations.

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Impulse Buying in E-Commerce: A Comprehensive Literature Review and Research Prospects

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Abstract. In the context of contemporary e-commerce, a notable proportion of sales can be ascribed to consumers' impulsive purchasing behavior, with scholars positing that approximately 20% of online retail sales are a direct consequence of such impulsive tendencies. These statistics underscore the burgeoning importance of impulse buying within the global retail landscape. As a result, scholarly attention has been directed towards this phenomenon, with researchers adopting diverse perspectives and employing various conceptual frameworks and methodological approaches in their investigations. Notwithstanding the numerous studies that have probed into impulsive buying behavior, a discernible lack of consensus and cohesion persists in the research findings concerning the factors that influence this behavior. This fragmentation and inconclusiveness hinder a comprehensive grasp of the subject matter. Thus, there arises a pressing need to consolidate the extant body of literature pertaining to impulsive buying in the online retail domain to chart a course for future research endeavors. This study endeavors to conduct an exhaustive review of prior seminal research works addressing this subject. Our systematic examination encompasses a total of 183 academic publications featured in 70 scholarly journals, spanning the period from 1950 to 2021. Through this methodical survey, we dissect the content of these research endeavors to delineate the domain and thematic underpinnings of these studies. In doing so, the present investigation elucidates potential avenues for a more comprehensive comprehension of impulsive buying, thereby offering invaluable insights for both academics and practitioners in charting the course for future research initiatives in the field of impulse purchasing.

Keywords: Impulse Buying · Online Retail · Consumer Behavior · Retail Industry · Systematic Evaluation · Academic Journals · Shopping Behavior · Impulse Purchase

1 Introduction

Contemporary literature has established that online commerce, mobile commerce and social commerce are the new normal and growing at ever-increasing pace (Bashar et al., 2022). Moreover, the affordable availability of internet access provides the consumers

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with accessibility and flexibility of shopping online round the clock at anytime from anywhere, they can explore web stores, compare alternatives by reading reviews and make purchase in a single click (Bashar et al., 2022). The implementation of many new technologies such as new online based shopping platforms has greatly facilitated the shopping experience for ordinary customers (Dekimpe et al., 2020; Sheth, 2021). As a result, the act of recreational, impulsive, and excessive purchase has become both pleasurable and easily accessible. Therefore, the phenomenon of impulse buying has garnered significant attention from both scholars and professionals alike. Impulse buying is a phenomenon that has been defined by researchers as the act of making a purchase in a spontaneous and unplanned manner, without deliberate contemplation and a sudden desire to buy (Zheng et al., 2019). A well planned and regular purchasing behaviors are primarily affected by utilitarian considerations, whereas impulsive buying is characterized by high-arousal emotions and hedonic reasons (Dekimpe et al., 2020; Sheth, 202;1 Chen et al., 2020; Chen, Ku, & Yeh, 2019a). It is instrumental for the marketers to understand the activities and behavior of consumers in online shopping environment, which enables them to efficiently design unique selling propositions to attract, engage and persuade them for online impulse buying (Bashar et al., 2022).

In contemporary retail business, a significant number of sales can be attributed to impulsive buying (Zhang et al., 2020; Ahmed et al., 2020). In the United States, online firms create an annual profit of $17.78 billion alone from impulsive purchases, with consumers on average spending $5400 per year in shape of impulse buying (Tran, 2019). The COVID-19 pandemic resulted in a significant increase in impulsive consumer behavior related to shopping. According to recent polls, there has been an observed 18% increase in the average monthly expenditure of American consumers on impulsive purchases since the onset of the epidemic (Keenan, 2021; Li Cain, 2020). In spite of the adverse consequences of the COVID-19 pandemic on the worldwide economy, scholars assert that approximately 20% of sales in the online retail industry can be attributed to impulsive buying behavior (Repko, 2020).

The aforementioned statistics indicate a growing significance of impulse purchasing within the worldwide retail sector. Therefore, the phenomenon of impulse buying has got attention from scholars, who have approached the topic from various viewpoints and utilized distinct conceptualizations and methodologies. Despite the existence of several studies investigating impulsive buying, the current body of literature is characterized by a significant degree of fragmentation (Li et al., 2021). Academics from several research disciplines have conducted investigations on impulsive buying (Tran, 2019). However, the research findings pertaining to factors influencing impulse buying behavior remain inconclusive and fragmented, impeding a comprehensive comprehension of the subject matter.

Furthermore, scholars studying impulse buying have utilized a wide array of foundational theories, suggesting that the theoretical perspectives in this field are fragmented and yet in the process of further development. Hence, the amalgamation of many theories and models employed in the study of impulse buying would contribute to the advancement of scholarly writing in this domain. Ultimately, the transfer of understanding from offline traditional store setting to other newly developed technological online channels (ecommerce, mobile commerce & social commerce) is not conclusive and easily generalizable. Therefore, it is necessary to consolidate the existing literature of impulse purchase behavior on online platforms in order to determine the direction of future study.

The existing fragmentation within the literature on impulse buying might be addressed with a thorough examination of this field and a comprehensive evaluation of current scenarios. The scope of the research will be enhanced by integrating many aspects that influence impulse buying, examining the theoretical frameworks utilized in existing literature, and exploring distinct sub-domains that investigate impulse buying on various online platforms. Subsequently, few scholars have done review of the existing literatures and have reported the various frameworks that have been used over the period, its outcomes and future research directions (Bashar et al., 2022). Few of the recent studies attempted to describe the current state of research on online impulse buying behavior, focused on theoretical foundation, research methodology, research context and factors influencing online impulse buying (Bashar et al., 2022).

Therefore, it is imperative to conduct a comprehensive review of the existing body of research on impulse buying in order to evaluate its progress and determine potential areas for future investigation in this field (Paul & Criado, 2020). Hence, it is recommended to perform a comprehensive review of the available literature in order to comprehend the growing and scattered information within a specific subject of impulse buying. A structured review is a comprehensive analysis of existing literature that examines theories, contexts, characteristics, constructs and methodologies. According to Paul and Criado (2020), the structured review aims to provide specific recommendations for future research in order to progress a particular domain of interest. Hence, the utilization of the structured review deemed suitable for the purpose of condensing and methodically assessing the existing body of research within the realm of impulse buying (Li et al., 2021; Chan et al., 2017).

Several studies of systematic literature review have been conducted on the phenomenon of impulse purchase throughout the previous years. However, these studies possess a limited focus and fail to comprehensively integrate the existing body of research on impulsive buying in terms of publishing years, underpinning theories, and conceptual frameworks. Therefore, the current systematic reviews lack an updated and comprehensive synthesis of the literature on impulse purchase. The absence of an updated and comprehensive systematic literature review on impulsive buying necessitates the undertaking of a review to offer a contemporary and comprehensive synthesis of existing research on impulse buying.

Hence, the chief objective of current study is conducting a comprehensive analysis of the available body of literature on impulsive buying, with the intention of identifying areas that have not been adequately addressed, potential avenues for further investigation, and future objectives for research in this field. This comprehensive review presents a synthesis of research on impulse buying from a marketing standpoint, encompassing its latest developments in ecommerce, social commerce and mobile commerce. The current work encompasses three distinct research areas. The primary aim is to consolidate the existing body of research on impulse purchase and analyze its evolution across the years. The second purpose of this study is to present a conceptual framework that is derived from a synthesis of the existing literature. The ultimate aim is to establish potential routes for future scholarly investigations on the phenomenon of impulse purchase.

The present review holds both theoretical and practical value. In an academic context, the text highlights the progression of research on impulse purchase behavior, including a comprehensive analysis of the existing literature in terms of theoretical frameworks, geographical contexts, subject areas, scholarly publications, and research procedures. Furthermore, this study presents a proposed integrated conceptual framework that is derived from a comprehensive synthesis of existing literature. The framework illustrates the factors that precede and influence impulsive buying behavior, as well as the mechanisms that mediate this conduct. The systematic literature review effectively identifies areas that have been missed in the research on impulse buying and offers valuable guidance for further advancing research in this field. This research offers practical implications for online firms, practitioners and advertising managers in order to efficiently stimulate spontaneous sales and adjust to current advancements in the ecommerce sector.

The subsequent section of this work is organized in the following manner. The subsequent part delineates the methods utilized in this study endeavor. The following section, known as the findings and discussion part, provides a comprehensive overview of the existing literature on impulse purchase. Subsequently, this paper presents forthcoming avenues for research, which are subsequently followed by an examination of the theoretical and practical consequences, culminating in a conclusion.

2 Literature Review

The primary objective of the current systematic literature review is to methodically analyze and integrate existing literature within a certain field, with the aim of identifying gaps in knowledge and proposing potential avenues for future research (Paul & Criado, 2020). The present study aims to conduct a comprehensive analysis of the existing body of literature on impulse buying behavior of online customers. By employing this systematic literature review technique, this review seeks to synthesize the available research, identify any gaps in the current knowledge, and recommend potential avenues for future research. The present study adheres to the domain-based method, wherein it amalgamates and expands upon scholarly works within a certain subject area (Paul and Criado 2020). According to Paul and Criado (2020), most of the business and marketing reviews tend to focus on specific domains and a structured reviews involve the synthesis of existing research using commonly employed methods, theories, and structures.

The utilization of chosen methodology is regarded as a superior and dependable approach to consolidating previous research findings. This method adheres strictly to predetermined rules and employs scientific techniques that are both replicable and unambiguous (Paul & Criado, 2020). In addition, systematic literature review is a very efficient approach for evaluating the prevailing knowledge and pinpointing areas that require further investigation within a certain research field, thereby enabling researchers to propose potential avenues for future research. Therefore, employing the structured systematic review has been considered as a suitable methodology for consolidating existing body of knowledge on customers' impulse purchase.

The structured systematic review approach is employed to conduct a comprehensive examination of the existing body of literature pertaining to impulse buying. The process of selecting a topic holds significant importance in the creation of a literature review that has a profound impact (Paul & Criado, 2020). Focusing on a specific area is not recommended unless it offers novel contributions or presents a research plan, regardless of its recent publication. Based on a search conducted on Google Scholar, a total of 14 literature studies were found in the field of impulse buying.

Among these 14 studies included, six of these studies can be classified as narrative literature reviews characterized by a limited focus. Mathur's (2019) recent narrative review focused on the concept and antecedents of impulse buying, drawing from a limited sample of only 19 research studies on this topic. Moreover, among the 14 review publications, it is worth noting that four of them employed a meta-analysis methodology. The study undertaken by Paul et al. (2022) also performed a meta-analysis encompassing 33 quantitative articles. The objective of their research was to ascertain the prevalent antecedents that contribute to customers' inclination towards impulse purchasing. Nevertheless, it is important to note that a meta-analysis and a structured systematic review are distinct methodologies. However, the both of them involve the examination of a body of prior research. However, the former involves the synthesis of past findings, whilst the other involves a evaluation of existing empirical studies. The rest of the four studies consist of systematic reviews, nevertheless, it is worth noting that two of them have a narrower focus, specifically examining the literature on impulse buying within the realms of ecommerce and social commerce.

Two studies have been conducted with a primary emphasis on customer impulse buying perspective, but the breadth of these papers is limited. Xiao and Nicholson (2013) conducted a comprehensive literature analysis with the aim of identifying the important constructs leading to customer impulse purchasing behavior as well as the possible outcomes associated with this behavior. The study conducted an analysis of 183 peer-reviewed journal publications that were published from 1940 to 2011, indicating that the findings may no longer be relevant and updated. Since 2011, a considerable body of literature has emerged, indicating substantial advancements in the field of impulsive purchase research. Therefore, it fails to offer a contemporary and comprehensive integration of scholarly works about impulse purchase.

Mandolfo and Lamberti (2021) conducted a systematic review that focused exclusively on the research methodologies employed in the body of literature pertaining to impulse buying. Their investigation involved an examination of 54 journal articles that were published between the years 1982 and 2020. Despite the recent nature of Mandolfo and Lamberti's (2021) analysis, they have not presented a comprehensive synthesis of the current state of impulsive buying literature. Specifically, the review conducted by the authors focuses solely on the methodologies employed in the existing body of literature. Nevertheless, it is imperative for a structured systematic review to effectively amalgamate the used underpinning theories, constructs and settings employed within the given area (Paul & Rosado-Serrano, 2019). Consequently, there is currently a lack of a contemporary and comprehensive organized systematic review on the topic of impulsive buying, leading to a condition of uncertainty and inconclusiveness in the existing body of research.

2.1 Selection of Databases and Conducting Article Searches

In accordance with the scholarly review articles published in reputable journals, the online databases Scopus and Web of Science were chosen for the purpose of conducting a comprehensive search for pertinent literature. In addition, we employed various academic databases such as Google Scholar, Sage, Emerald, EBSCOhost, Science Direct, Springer, JSTOR, Taylor & Francis and ProQuest to conduct a comprehensive search and verify that no pertinent research papers were overlooked.

2.2 Selection of Keywords

In this section, we will discuss the process of selecting appropriate keywords for academic research. Keywords have a crucial role in facilitating the discovery and retrieval of relevant scholarly articles. The methodology employed in this review adhered to the approach proposed by Talwar et al. (2020) for the identification of relevant and important keywords in the context of article retrieval. Consequently, as an initial measure, the search was conducted on the Google Scholar platform utilizing the keyword "impulse buying." Subsequently, the papers encompassing the initial 100 outcomes were acquired and evaluated to develop an revised set of keywords. The updated keywords were gathered and employed to conduct a comprehensive search for pertinent scholarly articles across all available databases. Therefore, this review covered publications that contained the specified keywords. The inclusion and exclusion criteria, which will be elaborated on in the next section, were carefully considered.

2.3 Selection of Journals and Criteria for Inclusion/Exclusion

In order to identify pertinent scholarly papers for this literature analysis, specific criteria for inclusion and exclusion were established (Paul & Rosado-Serrano, 2019). In order to be considered for inclusion in this review, an article must meet the following criteria: (1) It should be an academic publication, (2) contain English language, (3) it should have been published in a peer-reviewed journal (4) it should primarily address the topic of impulse buying. The preliminary exploration of designated databases utilizing predetermined keywords resulted in a cumulative count of 1971 academic papers. The initial stage involved the elimination of duplicate papers. In this context, duplicate papers refer to the additional copies of articles that have been downloaded multiple times. Therefore, a total of 535 research papers were eliminated. Subsequently, a set of inclusion and exclusion criteria was utilized to assess the remaining 1436 publications. The initial criterion involved the exclusion of non-academic literature. 64 non-scholarly work refers to publications that are not found in academic sources such as newspapers, blogs, and trade journals were excluded.

Additionally, only research papers that were in English language had been taken into account. Therefore, a total of 157 papers that were authored in languages other than the designated language were excluded from the analysis. The third criterion pertained to the requirement that a study be published in a publication that employs a peer-review process. Hence, a total of 548 publications that were published in non-peer-reviewed journals were excluded, resulting in a remaining count of 667 papers within the database.

Subsequently, an evaluation was conducted to determine if a study places emphasis on the phenomenon of impulse buying, in accordance with the fourth criterion. Hence, a total of 63 studies out of the remaining 667 were deemed ineligible for inclusion in the evaluation due to their lack of emphasis on impulse buying. A total of 604 articles were evaluated for the quality of the journal based on the final criterion. As a result, a total of 421 manuscripts were excluded from publication in high-quality journals, leading to the retention of 183 research papers. This systematic evaluation aims to consolidate a total of 183 scholarly publications that were published in 70 academic journals over the period from 1950 to 2021.

2.4 Discussions

First phase in the systematic literature review method entails categorizing the publications based on their year of publication. The utilization of a period-based allocation of scholarly articles within a specific field enables us to analyze the progression of a research subject throughout a given timeframe. Furthermore, it aids in the identification and monitoring of advancements in scholarly literature. The inaugural scholarly publication on the phenomenon of impulse buying was introduced in 1950 by Clover (1950). Consequently, the evaluation encompasses articles that have been published from the year 1950 to 2021.

The research on customer impulse buying behavior first surfaced in academic literature over 70 years ago. However, research on this area was limited for the next several years and just a small number of articles surfaced during the next 50 years. This resulted in a publishing rate of approximately one paper per three years throughout that period. During the initial years of the new millennium, there was a notable increase in research focused on impulse buying, as evidenced by the publication of 27 papers between 2000 and 2010. The abrupt shift towards a more favorable trajectory might be the result of rapid improvements in technology and development in philosophy of free market economy in numerous nations around the globe. These factors have significantly amplified the prevalence and frequency of impulsive purchasing behaviors (Vohs & Faber, 2007). The immense acceptance of online shopping platforms has led to a substantial increase in scholarly investigations on this subject from 2010 to 2021. A total of 144 papers were published throughout this period, averaging 12 publications per year. A total of 33 novel papers on impulse buying were published in the year 2021, representing the most quantity of research conducted in this field since its inception. Moreover, because of the global COVID-19 pandemic and the subsequent implementation of lockdown measures worldwide, there has been a notable surge in online impulsive purchasing across several product domains. This trend has resulted in the emergence of novel research findings, as evidenced by the study conducted by Chiu et al. (2021). In general, the significant increase in the related research studies on impulsive buying indicates a growing range of research avenues within this particular field of study.

2.5 Scholarly Publications

In the subsequent phase of this synthesis, an analysis was conducted on journals that have published studies pertaining to the topic of interest. Journal of Retailing and Consumer Services was emerged as the leading publication in the field of impulse buying, having published the largest quantity of papers on this topic, specifically 20 articles. This substantial contribution represents almost 11% of the overall research conducted in this subject. The Journal of Business Research and the International Journal of Information Management were two prominent academic journals, each featuring a collection of eight articles. These journals rank second and third, respectively, in terms of the quantity of publications they have produced. Additionally, this evaluation systematically classified the 70 publications that have been published in different other high ranked journals.

Subsequently, an analysis was conducted on the most often referenced recent studies on impulse purchase. According to Xiang et al. (2016), their article has received the maximum number of citations, specifically 350. According to scholarly literature, the study conducted by Chan et al. (2017) holds the second highest number of citations (274) among recent articles in this field. It is closely followed by the work authored by Chen et al. (2016), which has garnered 234 citations. In relation to annual citations, Zheng et al. (2019) ranks first, accumulating an average of 73 citations per year. Following closely behind is Xiang et al. (2016), which receives an average of 70 citations per year. Based on these results, it has been evident that the study of Xiang et al. (2016) holds the maximum level of influence in the field of modern research on impulse buying.

This section of the study aims to consolidate the information regarding the countries in which the academic studies were conducted. This research employed a selection criterion that exclusively included empirical publications for the purpose of conducting a thorough review of the research environment. The data, namely the sample, was obtained from a specific country. A total of eleven empirical investigations were conducted across various nations, primarily with the aim of investigating cultural disparities or gaining insights into global patterns. Therefore, these publications encompassed several countries from which the data were gathered. Among the 183 scholarly publications that were assessed, 17 conceptual studies were identified, resulting in a total of 166 empirical studies that were included for final evaluation. A total number of 33 countries were identified where these empirical studies have been carried out. The United States conducted the largest number of investigations, with a total of 46, followed by China with 28 research and Taiwan with 21 studies. 12 studies on the said topic was conducted in India, 10 in United Kingdom, 7 in South Korea, 5 each in Canada, Germany, Hongkong, Malaysia and Pakistan, 4 studies each in Singapore, Sweden and Vietnam, 3 studies each in France, Italy and Netherland, 2 studies each were conducted in Norway and Turkey, the rest of the studies were conducted in different other countries.

2.6 Research Design and Data Collection

A large number of studies conducted on this topic have been utilized survey-based approach (where data was collected through structured questionnaire) or an experimental design (121 studies and 44 studies respectively). Previous literature on impulse buying encompasses a limited number of qualitative studies (four papers) as well as mixed-method studies (five papers). In this field, it is noteworthy that a total of nine conceptual papers have been published, although the number of review papers specifically focused on impulse buying amounts to five and three meta-analyses have been published.

Subsequently, the present review undertook an examination of the sample employed in the context of impulsive purchase research. Previous research on impulse purchase has included two main sample groups: the general consumer population and students. Non-student samples are frequently employed in survey-based research, as seen by the inclusion of such samples in 91 papers. A total of 30 research employing survey-based methodologies utilized samples consisting of students. In the context of experimental investigations, it is shown that student samples are more frequently employed compared to consumer samples (30 research paper and 14 research papers respectively).

2.7 Theoretical Frameworks

Additionally, the current study has integrated various underpinning theories and research models that have been employed in selected studies of customer impulse buying. The Stimulus-Organism-Response framework was utilized by a significant number of the papers (28) on impulse buying. The Big Five Model has been examined in six research, while Hofstede's cultural dimensions theory has been investigated in 5 studies. Similarly, Regulatory focus theory was used by five studies, Latent state-trait theory was utilized by three studies, Construal level theory was also used by three studies and Flow theory have each been the subject of two studies. The field of impulse buying research is continuously evolving and advancing in terms of theoretical views. The subsequent section provides a concise elucidation of the often-employed theoretical frameworks.

The Stimulus-Organism-Response (SOR) framework, often known as the S-O-R framework, is a theoretical model used in psychology to understand the relationship between stimuli, organisms and response of various individuals or groups. The Stimulus-Organism-reaction (S-O-R) framework, initially proposed by Mehrabian and Russell in 1974 and later expanded upon by Jacoby in 2002, suggests that an environmental signal, referred to as a stimulus, has the potential to impact internal state of a customer, widely known as the organism, ultimately leading to some behavioral reaction. The S-O-R framework was utilized by researchers to investigate impulsive purchase behavior in both offline (traditional store setting) and online (ecommerce settings). Based on the S-O-R framework, several studies discovered that external stimuli characterized by pleasure and arousal in consumers (hedonic emotions), acting as organisms. Consequently, these feelings stimulate impulse purchase behavior as a response.

The Big Five Model (BFM) presents a framework consisting of five unique characteristics of personality. According to McCrae and John (1992) these five characteristics are extraversion, conscientiousness, agreeableness openness to experience and neuroticism. Based on the findings of the BFM, it can be inferred that all individuals exhibit the aforementioned traits, but with varying degrees of intensity for each feature (Leong et al., 2017). Based on the findings of previous studies (Badgaiyan & Verma, 2014; Thompson & Prendergast, 2015), it has been shown that individuals with low levels of conscientiousness and high levels of extraversion tend to have a greater tendency towards impulsive purchasing behavior. In addition, impulsive shoppers are characterized by high levels of openness to experience and neuroticism traits, as indicated by previous research (Olsen et al., 2016; Miao et al., 2019).

The cultural dimensions theory, as proposed by Hofstede et al. (2005), asserts that the values and behavior of individuals are influenced by their country culture. Hofstede et al. (2005) have identified four distinct characteristics of cultural diversity, namely Power Distance, Uncertainty Avoidance, Individualism/Collectivism, and Masculinity/Femininity. Numerous studies in consumer research continuously indicate that culture exerts a significant influence on a customers' impulsive purchasing (Czarnecka et al., 2020).

Regulatory focus theory is a novel framework for understanding goal pursuit. According to this theory, individuals exhibit approach or avoidance behaviors depending on their self-regulatory orientation, which may be categorized as either promotion-focused or prevention-focused (Higgins, 1997). Persons that are promotion-focused are motivated by positive results and strive for achievement and personal improvement. On the other hand, prevention-focused persons prioritize security and concentrate on avoiding negative results in his/her life (Verplanken & Sato, 2011). Based on the theoretical framework of Regulatory emphasis Theory (RFT), individuals with a promotion emphasis are more likely to engage in impulsive buying and have higher levels of post-purchase satisfaction. Conversely, individuals with a prevention focus tend to inhibit impulse buying activity.

The existing body of research indicates that impulse purchase behavior is influenced by the psychological space that exists between a buyer and his desired product (Vonkeman et al., 2017). In their seminal work, Liberman et al. (2007) put out the construal level theory (CLT), which posits that a significant psychological gap between an individual and an item result in the formation of an abstract perception (referred to as high-level construal) of said thing. On the other hand, according to Liberman et al. (2007), when an object is psychologically closer to an individual, it results in a more specific and detailed impression of that object. Based on the central limit theorem (CLT), an study discovered that online store cues had the ability to replicate a genuine shopping experience by virtue of their interactive nature and vivid presentation (Vonkeman et al., 2017). This replication leads to a reduction in the amount of construal, evokes an emotive state within the consumer, and ultimately generates an impulsive behavior.

The latent state-trait (LST) hypothesis posits that the individual conduct has been influenced by external environmental conditions (referred to as states), individual characteristics (referred to as traits), and the interplay between these two constructs. The utilization of LST has been observed in studies on customer impulsive purchasing behavior, namely in the domains of online shopping and social commerce (Wells et al., 2011; Li, et al., 2021; Chen et al., 2016;). According to research, it has been demonstrated that the quality of a website, which can be considered an environmental characteristic, has the ability to induce impulse buying (Wells et al., 2011). This effect is further influenced by the level of consumer impulsiveness, which is an individual attribute.

As per flow theory, when individuals are actively involved in some activity, these individuals have the potential to reach a state of flow. This state is characterized by the experience of pleasant emotions, such as enjoyment, and a diminished sense of self-awareness (Jackson & Marsh, 1996). In his study, Koufaris (2002) proposed that shopping delight plays a significant role in facilitating the purchasing process. Based on the theoretical framework of flow, Huang (2016) conducted a study which revealed that individuals who derive pleasure from engaging with an online shopping platform may encounter positive affective states and temporal distortion. Consequently, this heightened state of engagement can result in greater exposure to marketing stimuli and an inclination towards impulsive purchasing behavior.

2.8 Important Variables

The existing body of literature identifies five broad categories of factors that contribute to impulse buying. These categories include marketing mix variables, store-related factors, socio-demographic factors, customer-related factors and online peer influence (Cakanlar & Nguyen, 2019; Miao et al., 2019; Wu et al., 2021; Hashmi et al., 2020; Nghia et al., 2021; Zafar et al., 2020; Bandyopadhyay et al., 2021; Li, et al., 2021; Katakam et al., 2021). The potential influence of emotional responses, such as affect, arousal, enjoyment, and pleasure, pre-purchase considerations, specifically influence the urge to buy impulsively (Zafar et al., 2020; Hashmi et al., 2020; Zhu et al., 2020; Wu et al., 2021; Zhang et al., 2021; Yi & Jai, 2020).

2.9 Factors Related to Customers

There are three consumer-related factors identified in the literature on impulse buying that serve as precursors to impulse buying behavior. The subsequent sections provide a more detailed explanation of these variables. Numerous studies have established a correlation between the tendency to engage in impulse buying and certain characteristics exhibited by consumers. Personality traits constitute the fundamental consumer attributes. The Big Five Model has been utilized by researchers to investigate the impact of personality factors on impulse purchase behavior. Previous studies have indicated that certain personality traits, namely low conscientiousness, openness to experience, neuroticism and extraversion have been found to be significant predictors of impulse purchase behavior. In addition, the characteristics of materialism and emotional intelligence have been found to be significant predictors of impulsive buying behavior among consumers.

Self-regulation is an additional consumer-oriented component that influences impulsive purchasing behavior. One prevalent factor contributing to impulsive buying behavior is the consumer's lack of resistance against purchasing temptations and their limited ability to exercise self-control (Baumeister, 2002). According to De Ridder and Gillebaart (2017), the capacity for self-control enables individuals to effectively reject immediate desires and instead direct their attention towards achieving long-term objectives. According to recent studies, individuals with lower levels of self-control were more prone to impulsive buying (Sun et al., 2021; Xu et al., 2020).

The presence of consumer resources has been identified as a strong indicator of customer impulsive purchasing behavior (Krishna et al., 2021). The buying power of a consumer is influenced by the budget allocated for a shopping trip, and a higher budget has the potential to elicit pleasant feelings that may lead to impulsive purchasing (Chang et al., 2014). According to previous research, it was evident that individuals who possess disposable income are more inclined to encounter happy emotions and engage in spontaneous buying behavior (Beatty & Ferrell, 1998; Chang et al., 2014).

Demographic characteristics have been widely recognized as significant determinants of impulse purchase, as evidenced in the existing literature. Research indicates that there exists a negative correlation between age and impulse buying behavior, whereby older individuals demonstrate a decreased propensity for engaging in impulsive purchases. Existing research indicates that gender plays a significant role in influencing impulse buying behaviors, as studies have consistently found that female shoppers have a higher propensity for impulsive purchases.

The tendency for individuals and populations to engage in impulsive buying is influenced by cultural factors, such as ethnicity. Consequently, scholars have undertaken an examination of the significance of the cultural domain suggested by Hofstede within this particular framework. This model indicates that individuals who exhibit collectivist tendencies are more inclined to engage in impulsive buying behavior (Lee & Kacen, 2008). The phenomenon of impulsive buying is influenced by individualism in certain cultural contexts, such as Vietnam (Miao et al., 2019).

The phenomenon of impulse purchase behavior is significantly influenced by normative and interpersonal factors, as evidenced by the research conducted by Katakam et al. (2021) and Peck & Childers (2006). Normative influence can be defined as the impact of social norms on an individual's behavior, as these norms establish the expected behavioral standards that individuals are expected to adhere to (Rook & Fisher, 1995). According to previous research conducted by Chih et al. (2012) and Miao (2011), it has been observed that a favorable normative assessment has the potential to enhance impulsive purchase tendencies among consumers. This effect is attributed to the activation of positive emotions experienced by individuals. According to Styvén et al. (2017), those who see the internet as a suitable platform for engaging in fashion-related buying activities exhibit a higher propensity to engage in impulsive online purchases.

According to Kacen et al. (2012), there are several product-related aspects that significantly influence impulse buying behavior. These factors include the type of product, its features, packaging, and pricing. According to Chen and Wang (2016) and Okada (2005), products can be classified into two categories: hedonic, which are designed to provide a delightful experience, and utilitarian, which aim to deliver functional benefits. According to previous research (Chen & Wang, 2016; Kacen et al., 2012), there is a higher propensity for consumers to make impulsive purchases when it comes to hedonic products. Accordingly, previous studies have identified several factors that contribute to impulse buying behavior, including product features, appealing packaging and competitive pricing (Kimiagari & Malafe, 2021).

Retailers have the ability to capture consumer attention and stimulate impulsive purchasing behavior through the implementation of sales promotion initiatives. Promotions that offer instant rewards to consumers have been found to be particularly efficacious in stimulating impulsive purchasing behavior (Luo et al., 2021; Chen & Wang, 2016). According to Dawson and Kim (2010), free shipping has been found to be an effective stimulus for impulsive buying behavior. Similarly, Chen and Wang (2016) have demonstrated that cash return incentives can similarly elicit such activity.

The phenomenon of impulse buying is notably impacted by the in-store environment under the control of retailers (Katakam et al., 2021). The ambiance of a store elicits impulsive purchasing behavior by evoking pleasant feelings such as pleasure, enjoyment of shopping, and hedonic reasons among customers (Nghia et al., 2021). The arrangement of the outlet, the quality of lighting, the degree of crowding and the availability of employees help collectively contribute to establishing a conducive environment for impulse purchasing (Mohan et al., 2013).

Within the realm of online commerce, the various components and layout of an e-store play a significant role in promoting and enabling impulsive purchasing behavior. It has been established that the caliber of a website has a significant impact on impulsive buying behavior. According to Parboteeah et al. (2009), shopping websites offer users task-relevant and mood-relevant indications. The influence of impulse buying is affected by task-relevant cues such as navigation quality and convenience of use (Kimiagari & Malafe, 2021; Xiang et al., 2016). The aesthetic attractiveness of a website and the presence of fast-paced music have been found to elicit impulsive buying behavior by inducing feelings of pleasure and arousal among customers when they engage in online shopping (Zhang et al., 2020).

According to recent studies conducted by Ampadu et al. (2022) and Chen, Lu, et al. (2019b), it has been observed that online reviews have the potential to elicit impulsive purchasing tendencies while individuals engage in browsing activities. Additionally, Xu et al. (2020) argue that positive affect is heightened by high-quality reviews that are deemed very valuable by consumers and originate from reliable sources. This heightened positive affect can then lead to impulsive buying behavior. According to previous studies, it has been observed that online evaluations with a prominent hedonic message tend to have a greater impact on stimulating impulse purchase behavior compared to reviews that primarily focus on utilitarian information. When perusing various online shopping channels, individuals are prone to encountering and engaging with diverse social cues, which can subsequently lead to impulsive purchasing behaviors (Zafar et al., 2020). The presence of various options like posts and comments on various shopping platforms might foster a sense of connection among shoppers, so eliciting pleasurable and arousing feelings and ultimately resulting in impulsive purchasing behavior. In addition, it has been shown that endorsements by digital celebrities on social media platforms have the potential to stimulate impulsive purchasing behavior among young people when engaging in hedonic purchasing behavior (Vazquez et al., 2020; Chen, Kassas, & Gao, 2021c; Zafar, et al., 2021a).

3 Impulse Buying Research Domains

Currently, there has been a growing interest in the study of impulsive buying, driven by advancements in technology and marketing strategies on a global scale. The phenomenon of impulse buying has been extensively examined within two primary realms of scholarly literature: the traditional offline store and the domain of online shopping.

3.1 Impulse Buying in Traditional Stores

The initial investigation in the realm of traditional retailing was undertaken by Clover (1950), who examined the impact of holiday sales on customers' impulse buying, focusing on specific business and product categories. Nevertheless, previous studies have identified certain limitations in the first study conducted on impulse buying. Specifically, the conceptualization and assessment of impulse buying were found to be inadequately developed in previous studies. Therefore, this particular field of study has experienced a prolonged period of stagnation and neglect spanning several decades. During the early 2000s, there was a notable rise in marketing strategies and technological advancements, which subsequently resulted in a higher prevalence of impulse buying behavior. This resurgence of interest in the field of research pertaining to impulse buying was observed. In a recent study by Hashmi et al. (2020), the authors examined the phenomenon of impulsive buying within the context of traditional retailing.

3.2 Impulse Buying in Online Environment

The advent of the internet and digital technology has given rise to a novel area of inquiry within the field of impulse buying, specifically focusing on impulsive buying behavior in the context of online retail environments. The phenomenon of online impulse buying has attracted the interest of scholars owing to its distinct characteristics when compared to conventional impulse buying.

3.3 Electronic Commerce

According to Chevalier (2021), the total value of world online sales in 2020 surpassed the level of US$ 4.28 trillion. According to Stern (2021), around 40% of online sales is defined as impulsive buying. Moreover, Johnson (2018) estimates that a significant proportion of millennials, approximately 80%, engage in frequent impulsive online purchases. The sub-domain of online impulse buying that has received the most attention in academic research is impulsive buying in e-commerce, with a total of 30 studies conducted on this topic.

3.4 Social Commerce

Social media platforms are extensively utilized by retailers for their marketing endeavors. For example, according to Guttman (2020), a significant majority of firms, specifically 86.3%, using Facebook as a platform for carrying out their marketing endeavors. The practice of conducting retail activities on social networking platforms is commonly referred to as "social commerce" or "s-commerce" in academic literature. S-commerce is currently seeing significant expansion, as seen by the notable growth in US sales within this domain. Specifically, the sales in this sector have witnessed a substantial increase of 34.8% in the year 2021, resulting in a noteworthy yearly sale of $36.09 billion. The investigation of impulsive purchasing behavior within the setting of social commerce commenced in recent years, initiated by Chen et al.'s (2016) research. Their study explored the impact of Facebook adverts and likes on the stimulation of impulsive purchase. Zafar, Qiu, Shahzad, and colleagues (2021a) conducted a recent study examining the impact of bundle deals and customer posted reviews on impulsive purchasing behavior using social networking platforms.

3.5 Mobile Commerce

According to Coppola (2021), a significant proportion of retail website visits in 2019, specifically 65%, were attributed to online consumers who accessed these websites through their smartphones. Furthermore, out of these visits, approximately 46% resulted in the placement of an order. According to Chen and Yao (2018), the advent of mobile commerce, or m-commerce, has enhanced consumer flexibility in shopping activities and created additional opportunities for impulse purchase. Nevertheless, there has been a limited amount of study conducted on impulse buying within the setting of mobile commerce, as indicated by the identification of only 13 studies in this review. The latest scholarly publication within this specific field of study has examined the impact of customers' hedonic and utilitarian motives on impulsive purchasing behavior in mobile commerce environment (Yang et al., 2021).

4 Directions for Future Research

In this section, we will discuss potential avenues for future research in order to further advance our understanding of the subject matter. The evaluation of previous literature has revealed potential areas for future research. These areas have been classified using the TCCM framework, which has been borrowed from the work of Paul and Rosado-Serrano (2019). The TCCM paradigm has gained significant traction in the academic community as a means of structuring and guiding future research endeavours within the context of systematic literature review publications included in esteemed scholarly journals (Billore & Anisimova, 2021).

4.1 Development of Theoretical Frameworks

There remains a notable absence of attention in the existing literature towards several potentially fruitful theoretical ideas, which warrant further exploration in future research endeavours. Cue utilisation theory is an example of a theoretical perspective. This theory suggests that consumers acquire both extrinsic and intrinsic information about a product and analyse it collectively in order to assess the product's quality and ultimately make a purchasing decision. For example, in situations when customers are not familiar with a particular product, they tend to give higher importance to cues that are easily accessible, such as social cues. Additionally, they rely on extrinsic cues that are offered by online retailers. Therefore, an analysis of the relationship between external and internal signals influencing impulsive buying can be conducted by applying the principles of cue utilisation theory. Another theoretical approach is derived from a research inquiry conducted by Ku et al. (2005), which examined the phenomenon of excessive spending in live auction settings in the light of competitive arousal model. According to Wu et al. (2021), promotional communications that highlight the limited availability of a product or offer can potentially influence customers in a comparable manner, resulting in heightened instances of impulsive purchasing. For instance, when retailers emphasise the limited availability of a product, they may elicit a sense of competition among consumers and incite impulsive buying behavior. The literature review demonstrates that arousal has a significant role as a mediator in the occurrence of impulsive buying behavior (Wu et al., 2021).

4.2 Context Selection

Research on impulse purchase behavior was undertaken in a total of 33 nations. Among the empirical articles examined, it was found that 28% of them gathered their data within the United States, whereas 17% conducted their data collection in China, and 13% in Taiwan. Therefore, a significant proportion (specifically, 58%) of the existing scholarly literature about impulsive buying relies on data obtained only from participants in these three nations, raising concerns about the extent to which the findings may be applied to other contexts. Hence, it is recommended that future studies investigate the phenomenon of impulse buying in additional developed and developing nations that have not been adequately represented in the existing literature on this topic. Hence, it is imperative for scholarly investigations to scrutinise the phenomenon in rising domains of mobile commerce and social commerce. Therefore, it is recommended that future study should priorities the aforementioned scenarios.

4.3 Online Sales Promotion

According to recent studies conducted by Luo et al. (2021) and Miao et al. (2019), it has been established that sales promotions have the ability to induce impulsive purchasing behavior within the context of typical retail settings. In a recent study, an investigation was undertaken to explore the impact of online bundle offers on the occurrence of impulse buying (Zafar et al., 2021b). However, there is a lack of research on several major sales methods employed in the realm of e-commerce that have yet to be examined within the context of impulse buying. The extent of scholarly coverage on the utilisation of scarcity promotions by internet businesses is limited. Illustrative instances of scarcity promotional strategies that warrant scrutiny within the realm of online impulsive buying encompass flash sales including countdown timers and the availability of limited-edition merchandise. The examination of strategies that involve the implementation of time-constrained complimentary shipping, such as next-day delivery for purchases made within a specific timeframe, as well as the provision of assured free returns, is deemed worthy of exploration. An analysis of the aforementioned strategies and other online promotional methods would offer pragmatic advice to marketers and e-retailers seeking to stimulate impulsive buying behavior.

4.4 Research Methodologies

According to previous discussion, the majority of studies on impulse buying have mostly utilized quantitative research methodologies, with 162 out of 183 papers employing this approach. The presence of qualitative studies in this particular study subject is notably limited, as our review has only identified a total of four articles. However, it should be noted that qualitative research is characterised by its inductive and exploratory nature, allowing for a comprehensive comprehension of a newly developing phenomena Therefore, it is recommended that future study employ qualitative methodologies in order to investigate new factors that influence impulse buying within the setting of social commerce.

Moreover, the utilization of mixed-method design in the investigation of impulse buying has received limited attention. Researchers have the ability to investigate a novel phenomenon through the utilization of a qualitative methodology, afterwards corroborating their findings by the application of a quantitative strategy. Researchers have the option to utilize qualitative research methods in order to investigate the elements that enhance impulsive buying. Hence, it is suggested that future research endeavors can provide valuable insights through the utilization of a comprehensive approach that combines qualitative and quantitative research methodologies.

4.5 Theoretical and Practical Implications

This section discusses the potential implications of the research findings in both theoretical and practical contexts. This review yields several theoretical consequences. The present study undertook a systematic review to synthesise the existing body of literature on impulsive buying, with a specific focus on analysing the evolution of research in this area through time. This review provides an analysis of the development of the concept and the present state of research on impulse purchase. This review highlights the fragmented nature of impulsive buying research, which can be attributed to its shift from a conventional retail setting to various online platforms, such as e-commerce, s-commerce, and m-commerce. Therefore, it can be argued that the existing body of research on impulse buying is currently in a state of ongoing development and lacks coherence, thus highlighting the necessity for a comprehensive and consolidated systematic literature review that encompasses the latest advancements in the field.

Furthermore, an elaborate conceptual framework has been established by an extensive synthesis of existing research, wherein the factors preceding and influencing impulse buying behavior were thoroughly examined. While there have been some prior studies conducted on impulse buying, such as the works of Mandolfo and Lamberti (2021) and Xiao and Nicholson (2013), these studies lack a thorough conceptual framework similar to the one proposed in our research. Therefore, this conceptual framework represents the initial scholarly endeavor to consolidate the often-examined variables within the impulsive buying literature into a unified model.

This review has successfully discovered previously neglected aspects within the field of impulsive purchase research and has put forth concrete suggestions for future research endeavors. The advent of newly developed platforms like social commerce and other contemporary advancements has significantly transformed the manner in which consumers engage in impulsive online purchases. The exploration of potential future study directions proposed by this review will contribute to the advancement of scholarly understanding of impulse buying. This review conducted an analysis to identify the precise elements that contribute to impulse purchases. Furthermore, the review delved into the significance of these factors in relation to impulse purchases. When formulating marketing, promotional, or advertising initiatives, practitioners aiming to stimulate spontaneous purchases should consider the following elements.

The literature also posits that impulsive buying is influenced by store-related characteristics that are relevant to both online and offline shopping channels. It is worth noting that design features of e-commerce platforms have a significant impact on consumer behavior in terms of impulse purchase. Therefore, it is imperative for online merchants to prioritize the optimization of their web stores, ensuring user-friendly navigation and a delightful browsing experience. The act of seamlessly browsing through web stores has been found to elicit pleasant emotions, including pleasure and a state of flow. These positive emotions, in turn, can stimulate impulse buying behavior. Furthermore, it is imperative to ensure that the checkout system in these online platforms is designed to facilitate a seamless and effortless experience for shoppers, hence enabling them to successfully complete their purchases. For example, it is recommended that online retailers provide the option for users to make purchases without the need for registration. Additionally, it is advisable for these web stores to cater to buyers' chosen payment methods and streamline the checkout process in order to minimize the likelihood of consumers altering their decisions and abandoning their virtual shopping carts.

The research review further indicates that online peer influence is a significant predictor of impulse purchase behavior in the context of e-commerce. Therefore, internet reviews serve as a potent social influence instrument inside the marketer's repertoire. In order to enhance impulse purchases, internet companies have the option to utilize consumer reviews. For example, e-commerce platforms have the capability to enable online consumers to sort and categorize digital evaluations according to their personal preferences, such as displaying the most highly rated and recently submitted reviews. Moreover, e-commerce shops have the capability to provide customers with the opportunity to provide more extensive and detailed textual content in their online reviews. Additionally, they can actively encourage shoppers to enhance their product feedback by incorporating visual elements such as photographs and videos.

This research has successfully highlighted the growth of social and mobile commerce, as well as the growing use of these platforms by impulse shoppers. This trend presents a significant opportunity for marketers and merchants to capitalize on. E-commerce companies could use these emerging trends and capitalize on the potential of social networking platforms to stimulate and encourage impulsive online purchasing behavior. In order to augment their digital footprint, shops have the opportunity to optimize their online visibility on Facebook and Instagram.

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Role of Tunisian Private Universities in Developing Community Leaders

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Abstract. Tunisian private universities (TPU) should play a crucial role in developing community leadership as they contribute to the quality of education and social responsibility. The paper aims to shine a light on the importance of TPU for launching leadership programs and taking a role in developing community leaders. Also, it aims to encourage the creation of leadership development programs to support the training and development of leaders at all levels, with a focus on community, and cover both the public and private sectors. Leadership programs seek to create a generational shift in leadership in Tunisia by producing students with well-developed skills that can thrive in various sectors of the economy. By adopting the descriptive approach and depending on secondary resources, the paper maps a framework for these programs that should address the components and curriculum, the promotion of critical thinking and innovation, and the challenges of developing leadership among communities and students. Additionally, leadership development has been associated with higher employee engagement and retention rates, which are linked to increased productivity, lower absenteeism rates, and increased commitment to the organization. Thus, TPU's leadership development programs are essential for societal, organizational, and individual careers.

Keywords: Leadership · Community Leaders · Private University · Tunisia

1 Introduction

Tunisia is undergoing significant transformational reforms in various sectors (African Development Bank Group, 2012). Transformation requires effective leadership; it is critical for countries to achieve sustainable and inclusive economic growth (Kauzya, 2020). Yemiscigil, Born & Ling (2023), highlights the need for countries to invest in developing leadership skills, particularly in the areas of strategic thinking, innovation, and collaboration. Tunisia has made significant strides in recent years to improve its higher education system, with efforts to increase enrolment, retention, and graduation rates. Despite the progress, the country still faces challenges in developing its human capital, especially in terms of producing leaders who can drive socioeconomic development, innovation, and transformational change (Saadaoui, Saadaoui, & Chtourou, 2023).

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The importance of developing leadership skills is a key factor in achieving sustainable development. To gain these leadership skills, the aim is to create a national leadership development program to support the training and development of leaders at all levels (Asghar, 2010). Despite the progress made by Tunisia in the area of leadership development, still a need for further investment in developing human capital to bridge the skills gaps, develop leadership at all levels, and invest in research and development to drive innovation (European Training Foundation, 2021). Public universities have played a role in developing various levels of leaders, including national and local leaders, while private academic institutions have not yet launched that leadership role (Rybnicek et al., 2019). Tunisian private universities (TPU) need to develop these leadership programs to play a critical role in building such leaders. Universities are the primary institutions responsible for educating and preparing students for leadership roles in various sectors. Also, universities have an important role in developing communities and their organizations. The universities, therefore, need to align their curriculum, teaching, learning, research, and services to develop leadership competencies among students and local communities (Sousa & Sousa, 2020).

Tunisia, a country that is unstable with multiple conflicts, needs to overcome political and legislative polarization to build an effective reform system for improving institutional public administration capacities and enhancing government leadership (Jouin & Rajhi, 2021). Leadership is demanded at the national and local levels by government and community institutions. The higher education sector in Tunisia is not an exception, and the government of Tunisia has been making significant efforts to reform the higher education sector in the country. One of the most notable reforms is the introduction of private university education in Tunisia. TPU has grown significantly over the past few years, and this has led to a notable shift in the higher education sector in the country. TPU has become essential in developing the leadership skills of students in the country (Buckner, 2016).

Universities have a critical role in developing leaders who can drive social and economic growth in a country. Academic institutions should provide an environment that encourages critical thinking, innovation, and problem-solving (Miranda, 2023). Universities are not only responsible for imparting knowledge but also for teaching their students how to become responsible and accountable citizens. They nurture the potential of future leaders by providing them with the necessary resources, networks, and mentorship opportunities that they need to succeed (Maureen & Stanley, 2022; Kapur, 2022).

Through various academic programs, universities equip students with the skills they need to take on leadership positions. The introduction of programs such as entrepreneurship and leadership ensure that students learn how to apply their innovative ideas and take risks that ultimately benefit society. Students are also provided with mentorship programs where they are paired with successful businesspeople as mentors to guide them in learning how to solve complex business problems. Such collaborations help students develop a better understanding of the business world, thus preparing them for positions of leadership in the future. In addition, universities are supposed to offer extracurricular activities that serve as a platform for students to build their leadership skills. Clubs, societies, and sports teams provide students with opportunities to work as a team towards achieving a common goal. These activities go a long way in developing students' communication, networking, and problem-solving skills, building their self-confidence, and exposing them to different cultures and values (Kapur, 2022).

The paper aims to shine a light on the importance of TPU for launching leadership programs and taking a role in developing community leaders. The paper sets up as follows: private universities & leadership programs is covered in Sect. 2, Sect. 3 research methods, Sect. 4 covers leadership development program, Sect. 5 suggests a framework for leadership programs, then followed by a conclusion and recommendations.

2 Private Universities and Leadership Programs

The section presents literature review.

2.1 Tunisia Private Universities

TPU faces several challenges; two obstacles are illustrated by previous literature: it established late competition with neighbouring countries such as Morocco. Also, Tunisia's private institutes do not receive governmental funds, so they are not considered elite universities compared with some neighbouring countries' universities, for example, Al-Akhawayn University (Buckner, 2016). Keeping a distance from government funds has double edges: on the one hand, it signals academic freedom, and on the other, it has a shortage of funds, which might limit the provision of community services and leadership development programs (Adesoji, 2022).

By providing students with knowledge, resources, and mentorship programs, the universities act as incubators for the future leaders of Tunisia. By investing in students' leadership capabilities, universities help prepare young people to take on the challenges that face their country today and in the future.

With regards to leadership development and its role in society, it sounds like academicians in private universities are in contradiction, undergoing a kind of internal crisis, and struggling among different philosophical and systemic systems ranging from the past to the present (Mullin, 2022). Leadership development reaches the area of private universities duties towards community development and services offered to them, including community leadership development. However, there is a shortage of research on the role of Tunisian universities in developing leaders.

Private higher education has spread over North Africa; it is a preferred model in development discourse and was pushed by major actors (Buckner, 2016). Currently, about 300,000 students are enrolled in higher education institutions, and about 19 private universities operate in Tunis (STATISTA, 2023), with two views of private universities: chasing profit or playing an essential role in the development of society, including the economy. Regardless of the view, the research should not get into this debate; rather, it should focus on the role of universities in developing leaders. It's kind of an exploratory study because it's based on quantitative approaches. Tunisia's higher education system is described as a modern system that "moves to a new certification structure, adapted from the Bologna European model of higher education." (Kherigi et al., 2020:01). Although the system still faces challenges and needs to be improved, it should pay attention to quality and policy, but this research focuses on leadership development.

2.2 Existing of Leadership Programs

TPU does not have programs in leadership development. Reviewing the literature suggested that ten leadership programs are run by nongovernmental organizations and local associations. As a result, TPU should play a development role. Leadership development programs are essential for any organization; private universities have this opportunity as they enjoy a scope or level of freedom that government institutions do not have. Developing real leaders is not an easy job; it requires allowing participants to think outside the box, explore various perspectives, build their own beliefs, find their strategies, and so on, to be independent in their thinking (Awashreh, 2023). O'Neill (2023), has reached the conclusion that many universities have become increasingly Neo-liberalized in their ideology and action. This will have an effect on universities roles, especially private universities, in tackling their mission in societies and developing community leaders.

Leadership development has been widely researched and debated over the past century. It has undergone a significant evolution with changing business environments and paradigms of leadership. The objective of this literature review is to provide a comprehensive overview of leadership development and its impact on organizations (Subhaktiyasa, Jampel, & Dantes, 2023). Previous research indicates that TPU has put significant effort into developing leadership skills in its students. This is achieved through various leadership development programs that aim to enhance soft skills such as communication, problem-solving, critical thinking, and decision-making. The leadership development programs at Tunisian private universities are tailored to meet the needs of the students. Students at private universities in Tunisia are provided with opportunities to engage in extracurricular activities such as student government, clubs, and societies. The extracurricular activities provide students with avenues to develop their leadership skills in various contexts (Mefteh, 2021).

TPU recognizes the importance of developing leadership skills in students and, as such, has made leadership development programs a priority. These programs are aimed at creating a generational shift in leadership in Tunisia by producing students with well-developed leadership skills that can thrive in various sectors of the economy (Buckner, 2016). Thus, leadership development programs at private universities in Tunisia have become essential. It is essential for society, their organizations, and individuals' careers.

Leadership development can be traced back to the early 1900s, when scholars explored different theories of leadership. The trait theory, introduced by Stogdill (1948), suggested that leaders possess certain innate traits such as intelligence, decisiveness, and honesty. The Skills Theory, introduced by Katz (1955), suggested that leadership was a set of skills that could be learned and developed.

3 Research Methodology

For the research methods, the paper adopts a descriptive approach by using secondary data—data that exists in the literature and various related government and private electronic websites—for the purpose of determining the existing leadership programs, online search has carried out by the researcher to know what kind of programs are existing at TPU. The usage of this method is due to the limitations of gathering data from the field. Also, as the purpose is to shed light on a topic and encourage academician Tunisians working in private universities to conduct the research, the existing data in the secondary sources is analysed by reading, grouping, and synthesising.

4 Leadership Development Programs

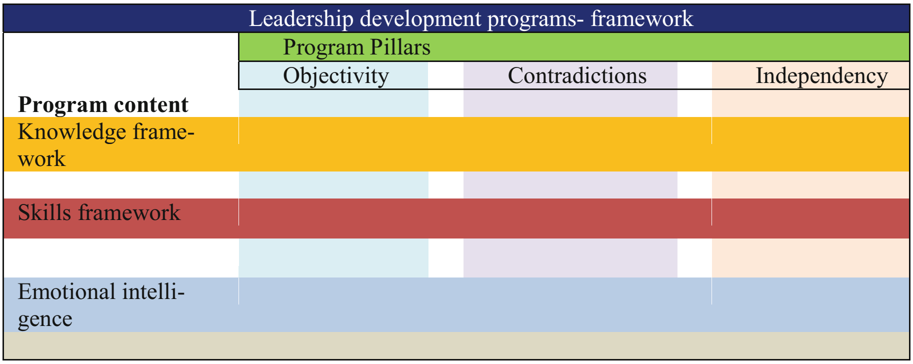
Leadership development has undergone significant changes over the past century. From the trait theory to the skills theory to the current experiential learning models, leadership development has evolved to meet the changing needs of the business environment. Leadership development has been shown to have a significant impact on organizational outcomes such as employee engagement, organizational performance, and retention. However, challenges such as the lack of a unified definition of leadership and ensuring alignment with organizational objectives remain (Awashreh, 2021).

Leadership development has become a key focus for organizations in the Middle East in recent years as they seek to develop a new generation of leaders that can drive growth and innovation. In this literature review, we will examine some of the major studies on leadership development in the Middle East and their insights into the challenges and opportunities facing organizations (Awashreh, 2020). In terms of effectiveness of leadership development programs in the Middle East, it finds that while participants reported a high degree of satisfaction with their leadership development programs, there were significant gaps between the skills and knowledge they acquired and the competencies that are required for effective leadership in the region. The study suggests that there is a need for greater alignment between leadership development programs and the specific requirements of the Middle Eastern context (Al-Lamki et al., 2018). In addition, and within the context of challenges, the role of mentoring plays a key role in developing leadership skills, particularly in areas such as networking, communication, and emotional intelligence. However, further challenges relative to mentors who were able to provide effective guidance and support, particularly for those in junior roles or in industries that are dominated by men (AlJabri et al., 2019). Religious values play a significant role in shaping leadership behaviour, particularly in areas such as ethical decision-making and social responsibility. Religious values have an effect over leadership development process and programs and should treat it in a smart way (Sheikh et al., 2017).

There is a need for leadership development programs to incorporate these values into their curriculum to better align with the cultural norms and expectations of the region. In Tunisian contexts, culture might be more closed to leadership development than religion, so it’s a hint to focus on society’s cultural values. Examining the impact of cultural values on leadership development, such as individualism, collectivism, and hierarchy, shows that leadership development programs need to take these values into account when designing their initiatives (Farhadi et al., 2018). The next section suggested a framework for private universities to use to take a part in develop leadership among communities.

5 Framework

Developing framework for leadership programs and their curriculum should promote critical thinking and innovation within the vision of developing communities and people's careers. Innovation and critical thinking can be included in the framework by considering the below framework: program pillars. (Awashreh, 2020) A framework for leadership programs is shown in Fig. 1 below. This framework is adaptable and appropriate for all forms of political, community, and governmental organizations, and it is compatible with all types of organizational units, their duties, and the responsibilities of their staff.



Leadership development programs- framework			
	Program Pillars		
	Objectivity	Contradictions	Independency
Program content			
Knowledge framework			
Skills framework			
Emotional intelligence			

Fig. 1. Leadership development programs-framework. Source: Author

The above framework suggests that the program pillars should interact at all levels of needed knowledge and skills. Without objectivity, contradictions, and in-dependency, its impossible to promote critical thinking, thinking out of the box and innovation (Awashreh, 2020). To implement the framework, innovative techniques are used. Leadership development techniques have evolved over time with the advent of technology and globalization. Traditional classroom methods such as lectures, readings, and case studies have been complemented by experiential learning methods such as simulations, role-playing, and action learning. Leadership development programs have also expanded to include coaching and mentoring, peer learning, and self-reflection (Awashreh, 2020).

Leadership development has been shown to have a significant impact on organizational outcomes such as employee engagement, organizational performance, and retention. The link between leadership development and organizational performance has been established through several studies (CIPD, 2016). Organizations that invest in leadership development programs have been found to have higher productivity, better innovation, and stronger financial performance. Leadership development has also been associated with higher employee engagement and retention rates. Engaged employees are more likely to be productive, exhibit lower absenteeism rates, and have a higher level of commitment to the organization (Baldoni, 2013).

One main challenge in leadership development is the lack of a unified definition of leadership. Different scholars have proposed different theories of leadership, and organizations may have varying definitions of what constitutes good leadership. Another challenge is ensuring that leadership development programs are aligned with organizational goals and strategies. Programs that are not tied to the organization's objectives may not yield the desired outcomes (Awashreh, 2020).

TPU should play a role in developing national and local leaders. This is part of their development role as higher education institutions and also part of their social responsibility. Gaps are exiting Tunisian private universities, and they should get out of their closed roles. Regardless of the challenges they are facing, such as a shortage of funds, limited revenue, and further logistical challenges, this is an example of education institutions in the region facing similar challenges (Alzyoud & Bani-Hani, 2015). The study will contribute to the literature on leadership development in the context of developing countries.

The role of PTU in developing community leaders can be enhanced through the implementation of various initiatives. Private universities can establish leadership programs and courses that focus on developing essential leadership skills among students. These programs can include practical training, workshops, and mentorship opportunities with experienced professionals from different sectors (Moldoveanu & Narayandas, 2019). PTU can collaborate with local community organizations and NGOs to create community-based learning projects. These projects will allow students to apply their theoretical knowledge in real-life community settings, fostering their understanding of community needs and developing their leadership abilities. Additionally, PTU can organize regular networking events and panel discussions that bring together students, alumni, and successful community leaders. These events can facilitate knowledge sharing and mentorship and inspire students to engage in community development activities (Daycho et. al., 2023).

6 Conclusion

In conclusion, the paper highlighted the importance of Tunisian private universities engaging in leadership development for ongoing economic and social development, as well as the need for programs that are tailored to the specific cultural and contextual requirements of the region. By focusing on areas such as independence, objectivity, innovation, and thinking outside the box, culture values can develop a new generation of leaders that are better equipped to drive growth and innovation in Tunisia and the Middle East. Due to the shortage on practical studies on how Tunisian private universities should take apart in developing leadership among community. This paper has suggested a framework passed on promoting innovation and critical thinking at all levels of knowledge and skills, which can used for developing community leaders.

Recommendations

To effectively play their role in developing community leaders, Tunisian Private Universities should consider the following recommendations:

- Incorporate leadership skills into the curriculum: Private universities should revamp their curriculum to include courses specifically designed to develop leadership skills. These courses could cover topics such as teamwork, communication, decision-making, and ethical leadership.
- Foster partnerships with community organizations: Private universities should actively seek partnerships with local community organizations and NGOs. These collaborations can provide students with practical experiences that enhance their understanding of community needs, as well as opportunities to apply their leadership skills in real-life situations.
- Create a mentorship program: Private universities can establish mentorship programs that match students with experienced community leaders. This mentorship will provide students with guidance and advice, enabling them to acquire valuable insights from successful leaders and potentially expand their networks.
- Encourage community engagement: Private universities should encourage and support students in participating in community engagement activities. They can provide financial assistance, resources, and recognition to students who initiate and lead community projects, creating a culture of active citizenship.
- Establish an alumni network: Private universities should establish an active alumni network that connects successful graduates who have gone on to become community leaders. This network can provide ongoing support, mentorship, and serve as a platform for knowledge transfer and collaboration.

By implementing these initiatives and recommendations, Tunisian Private Universities can significantly contribute to the development of competent and ethical community leaders, ultimately benefiting society.

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Open Environmental and Climate Data Initiatives in Somalia: An Analytical Exploration into Policy Frameworks and Digital Platforms

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Abstract. The pressing nature of addressing climate change and environmental concerns has brought attention to the necessity of Open Environmental and Climate Data (OE&CD), especially in nations that are highly vulnerable to these risks. This research examines the initiatives and regulations of the OE&CD projects in Somalia, which experiences multiple environmental vulnerabilities. By employing qualitative (Documentary and Web Content) research analysis on ministries in Somalia, this research aimed to delineate the landscape of OE&CD projects, ascertain the level of data accessibility and evaluate the government's dedication to promoting data openness. The results indicate an early phase of OE&CD initiatives in Somalia. Despite implementing the Open Government Initiative in 2018, there continues to be a noticeable need for up-to-date, easily available, and user-friendly environmental and climatic datasets. Furthermore, there exists a significant disparity between the government's professed commitment to transparency and the tangible accessibility of data. The study also highlights the need for comprehensive national policies that particularly target OE&CD, which is in stark contrast to the country's significant climate vulnerabilities. The study's recommendations propose the implementation of direct stakeholder interactions, technical capacity building, public awareness initiatives, and policy reforms as means to strengthen OE&CD practices inside the country.

Keywords: Open Environmental and Climate Data · Environmental and Climate Change · Developing Country · Somalia

1 Introduction

Environmental protection and climate change have been identified as one of the critical categories for which datasets to be freely available. To combat climate change, the world needs to take more urgent and ambitious measures. Seventy-one (71) nations have committed to achieving net-zero emissions by the middle of the century [1]. However, achieving decarbonisation and responding to climate change would include fundamental adjustments to the business production of goods and services as well as consumer consumption and behaviour. In this connection, the issues that climate change presents for decision-makers make the open government principles of transparency, accountability, and participation particularly crucial.

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The crisis has forced local governments to be more open in their administration of public resources. The catastrophic events that have a true global impact on livelihoods (for instance, the Fukushima nuclear radiation disaster [2], the Earthquake in Indonesia [3], and the COVID-19 health crisis [4]) triggered the economies to make decisions to publicise environmental and climate (E&C) data through technology-enabled platforms. The publishing and use of E&C data is widely regarded as a mechanism to enhance the level of cooperation within the field of E&C management. Moreover, the decision to make the E&C data open is based on the premises that it has the potential to hike up transparency, fight corruption, hold the public officials answerable, and expedite decision-making processes for both governmental bodies and people, enabling them to enhance their catastrophe preparedness and response capabilities within a reduced timeframe [5]. They emphasised that openness facilitates the establishment of connections that transcend organisational borders and functions. Despite political and social motives, open environmental and climate data (OE&CD) has resulted in a significant rise of almost four times in the yearly number of publications (i.e. less than 400 from 1986 and 1999 to 1600 in 2017) [6].

Developing and least-developed countries such as Somalia are the most vulnerable countries to climate change consequences, as Somalia has been declared "environmentally vulnerable" by the IFRC [7]. With a total score of 24, Somalia is ranked 159th in the Open Data Inventory Report 2022 [8]. Moreover, according to the World Justice Project, Somalia is nowhere in the global picture that has taken open government initiative [9] and is publishing E&C datasets accordingly. Although opening up and reusing E&C data have become essential for advancing knowledge in the E&C field/science, publicising E&C data and facilitating its reuse are still in their infancy as socio-technical innovations [10]. Thus, the scholarship to present the current and complete landscape of OE&CD projects and policies in Somalia is currently lacking. Accordingly, the purpose of this research is to investigate the current landscape of OE&CD projects and policies in Somalia. In this study, our focus is on answering the following research question.

What is the current landscape of OE&CD projects and policies in Somalia?

Our main research question is divided into two sub-questions, which are: 1- Is there an adequate initiative for supporting the collection, release, and use of E&C data? 2- Do existing in-country E&C initiatives have a robust open data focus? An investigation of OE&CD projects and policies in Somalia will provide a better understanding of the current landscape of publishing and use of E&C data in large quantities. For this purpose, documentary and web content analysis have been performed, and the above questions have been answered in the Result Section.

2 Literature Review

2.1 Open Government and Open Data

Organisations implement the philosophy of open data to accomplish new demands of society regarding data accessibility freely. OKFN defines open data as "data that can be freely used, re-used and redistributed by anyone - subject only, at most, to the requirement to attribute and share-alike" [11]. Open (Government) Data has gained traction speedily after taking the open government initiatives by Barack Obama's administration and the UK government. The data is any data that is in the form of images, texts, documentaries, policy documents, reports, satellite photographs, maps, genome, can be from any department or organisation, and related to any discipline like geography, science, economics, finance, or statistics and so on [12].

OGD is, specifically, termed as a new process or development within electronic government that can lead to recursive interactions between existing social structures and new technology to cause uncertainty [13–15]. OGD has its most direct impact on the access to information that is related to the government. This impact becomes immediately effective once the data are released to some degree since it immediately affects the re-utilization of data [12]. However, the use of data is bound to the condition of how and to what extent data are published, which represents its level of openness and the consumers' willingness to participate in such an effort. In addition to open access to information, the open government movement supports transparency through the proactive release of "open by default" government data. The second most level of impact of OGD is on transparency. The increased transparency achieved by publishing a large amount of government data also has a strong effect on public administration in the way that accountability within the public sector increases. Long-term interactions with the government's open data portals promote not only transparency and accountability but also democracy [16]. Open data availability offers new dimensions of creating knowledge by mixing and matching strategies, which in turn leads to effective decision-making [17].

2.2 Environmental and Climate Change

Environmental and climate (E&C) change is one of the biggest concerns of this century since it threatens everyone's health and well-being by threatening the economy. Global warming, rising temperatures, and rainfall variability undermine sustainable economic growth, lowering living standards and livelihoods [18]. Climate change affects countries' economic production by reducing agriculture-related output, labour productivity, and energy usage. The negative impacts of E&C change have been observed in developing countries, particularly in agriculture-based economies, to meet the expanding demands of the population for crop products [18, 19]. Moreover, changes in climate and environment frequently impact residential areas and contribute to the destruction of aquatic biodiversity and ecosystems [20]. In this respect, research scholarship emphasised the need and motivations of open E&C data (OE&CD) (e.g., Landsat data, participatory budgeting, water data, health data, weather data, geospatial data, life sciences data and so on) as a driving force in order to meet the challenges of and fight the E&C change [20–25].

Access to E&C data openly is crucial for promoting data-driven decision-making, user-centric service design, and evidence-based policies. Open E&C data has proven its value during the COVID-19 pandemic by supporting crisis responses and enhancing resilience through improved communication and services [26]. Similarly, open data can play a vital role in climate policymaking and promoting transparency. By providing reliable, standardised, and timely data, stakeholders from various sectors can collaboratively monitor and address climate change vulnerabilities.

2.3 OE&CD Initiatives: A Worldview

Although organisations around the world are developing comprehensive dedicated open data platforms to open non-personal data in maps and machine-readable formats related to every field of life, such as environment, education, finance, government budgets, census, and so on, purpose-built OE&CD platforms or infrastructures for effective E&C governance are also developed which both the government organisations as well as the public can use. In Argentina, SEDICI and OMLP data repositories were created after the flood disaster occurrence in 2013 in the city of La Plata to leverage flood-disaster data publication and use, data compilation, organisation, and dissemination by the scientific communities so that it can be used for different E&C management activities [27]. In the United States, OnTheMap for Emergency Management is a web-based tool that provides real-time flood-affected areas and incorporates updates according to the needs of public administrations [5]. In China, a national OGD platform to acquire and share spatial data has been developed so that timely coordination and assistance on E&C change can be enabled [3]. The Open Cities Kathmandu project has been launched by the World Bank to build disaster risk and seismic resilience models by collecting school and buildings data in Kathmandu Valley [28]. An international, freely and easily accessible data repository and management platform, that is, environmental data initiative (EDI), was also developed not only for the understanding of complex E&C processes and changes but also for rocketing transparency, uplifting collaboration, and reproducing the authentic results [10]. Several OE&CD platforms were projected in the study conducted by Peters and Zeeb [22] and Li, Zhao, Murray, Song and Zhang [3], focusing on health-related research data for environmental reporting, health monitoring, and robust decision-making. Whereas open (government) data rotates around 10 principles or criteria [22], OE&CD is based on 4 principles of findable, accessible, interoperable, and reusable, also known as FAIR principles [10].

3 Method

Similar to other analytical approaches utilised in qualitative research, document analysis necessitates the thorough examination and interpretation of data to extract significance, enhance comprehension, and cultivate empirical knowledge. The documents consist of textual content and photos that have been captured without any direct involvement from a researcher. According to Atkinson and Coffey [29], papers can be seen as "social facts" that are generated, exchanged, and utilised in socially structured manners. A diverse range of documents can be utilised for systematic review within the context of a study. The range of documents encompassed in this category comprises journals, rules and regulations, policy documents, organisational or institutional reports, survey data, and various public records (online and offline). Although the main issue with documentary analysis is related to the documents' veracity and sample size, there are several advantages: efficiency and cost-effectiveness, availability, unobtrusiveness, and non-reactiveness [30].

In our research, we also conducted Web Content Analysis (WCA) to gather evidence on the E&C policies and initiatives in Somalia along with the level of data provided by them since the national portals of Somalia were the greatest way to investigate OE&CD

initiatives in the Horn of Africa's nations. In order to examine the nature and extent of E&C data platforms, we utilised online sources. Thus, in order to fulfil our objectives, we consulted the online E&C data initiatives of Somalia, where data assets are available freely, as well as other pertinent internet sources that were applicable to our research inquiry. The process of documentary and content analysis enables individuals to search for documents with the help of desk research [31]. Documentary analysis and WCA are not such methods that have been adopted in this study for the first time; several other studies employed these methods in the context of open data [32, 33] and the E&C domain as well [34]. National OE&CD portals of Somalia were studied during the July 01, 2023 and September 30, 2023 period. Moreover, a WCA of twenty-seven (27) ministries of Somalia, including the website of Parliament, was made.

3.1 Somalia: A Background

Somalia is situated in the easternmost region of the Horn of Africa, traversed by the equator in its southern territory. It boasts the most extensive coastline among all African countries, characterised by a warm desert environment in the northern region and a semi-arid climate in the southern region. The climate of the Horn of Africa is influenced by the fluctuating sea-surface temperatures of the Indian Ocean and the El Niño-Southern Oscillation (ENSO) phenomenon [35]. Somalia has a notable vulnerability to the impacts of climate change and extreme meteorological phenomena, including prolonged droughts, sudden and intense floods, unpredictable precipitation patterns, disturbances in monsoon cycles, powerful winds, cyclonic disturbances, as well as sandstorms and dust storms. These E&C crises resulted in a staggering loss of human life, with an estimated 260,000 individuals (half of whom were children under the age of five) believed to have perished in Somalia alone as a result of famine and food insecurity [7]. Over the course of the past 25 years, Somalia has experienced a multitude of extreme weather phenomena. Somalia is among one of the 10 countries with the most people affected by E&C changes in 2020–2021 [36]. Somalia holds the 8th position in receiving aid from international organisations [7]. According to Warsame, Sheik-Ali, Barre and Ahmed [19], this sector plays a substantial role in the Somali economy, accounting for 93% of the nation's overall export profits.

4 Findings

In 2018, the Open Government Initiative was undertaken by the FRoS. It is a national platform of FRoS, accessible at http://data.gov.so/, which aims to make government information available to the public, hold public officials answerable to the public, promote democratic governance in public policy matters, and fight corruption. The portal views government datasets (data/information with metadata) as a transformative force, offering solutions and fostering creativity and innovation. By utilising a "search" function, it becomes possible to do searches within data sets. In total, there exist 8 datasets which are segregated with respect to ministries, topics, and formats. Currently, the accessible file format is limited to only three (3) options, namely CSV, PDF, and XLS/XLSX. Furthermore, there have been no recent updates or additions made to the existing data sets. Unfortunately, the ministries have not published or updated datasets after September 2018. On one side, one of the greatest features of Somalia's OGI is that stakeholders can request data from government organisations by filling out an online form. However, on the other side, no requests for the data from the users have been recorded so far. Moreover, no datasets regarding open contracting are available on the OGI portal, though the links are provided. The OGI portal also supports multilingual (i.e. English and Soomaali languages only).

Among the provided datasets, two (2) datasets are publicised only related to environmental and climate change by the Ministry of Planning. It is also noteworthy to mention that no actual datasets are available on the OGI portal. Overall, there are gaps found in the availability of datasets by public organisations in FRoS. Further, the available datasets need to be updated and in need of enhancements in terms of incorporating current updates, formats, and indexes for data analytics. Typically, datasets are commonly found in PDF forms, which cannot be utilised for subsequent statistical analysis. All the datasets are freely available for download and use under the Creative Commons Attribution license. The content analysis found that 261 downloads have been performed on the provided datasets, whereas these datasets have been viewed 3436 times as of October 01, 2023.

A web content analysis found that the Websites of twenty-one (21) out of 27 ministries support multilingual features (i.e. English and Soomaali only). Moreover, the analysis did not find any data in machine-readable format except static information by the public sector organisations (i.e., ministries and their underlying departments) in the form of reports, project listings, rules and regulations, policy documents, tenders, picture gallery, forms, acts, laws, strategies, and news and announcements. Even the Ministry of Communication and Technology, where the people are technology-aware and technically sound, kept data private. The WCA also revealed that the FRoS is so far struggling to improve Web 2.0 instead of Web 3.0, where the government uses advanced technologies, e.g., Semantic Web and Artificial Intelligence. Moreover, the transition or transformation from e-government to open government (o-government) is taking place very slowly.

Although FRoS launched a Web-based Open Government Initiative, it has yet to establish national-level policies that address Open Government or OE&CD from a national standpoint. The same approach has also been adopted by some other countries, such as Singapore [37], even without joining the Open Government Partnership [38]. However, the WCA found that Somalia Water and Land Information Management (SWALIM) is an initiative to open E&C datasets and maps undertaken under the umbrella of the Food and Agriculture Organization (FAO) of the United Nations, a partnered organisation of the Ministry of Environment and Climate Change (Table 1). We also analysed that each country in the Horn of Africa has its environmental protection authority or agency responsible for environmental governance and conservation efforts. For example, Ethiopia has the Ethiopian Environmental Protection Authority (https://www.epa.gov.et/). In contrast, Somalia has two ministries: (1) the Ministry of Energy and Water Resources, which has an environmental department as well, and (2) the Ministry of Environment and Climate Change (Table 1). In addition, international organisations such as RCMRD and HoA-REC&N, as well as NGOs such as SOGPA and Bareedo, were also working on open government and E&C domains.

Table 1. OE&CD Platforms in Somalia

1975	https://rcmrd.org/en/	Regional Center for Mapping of Resources for Development (RCMRD)	RCMRD is an intergovernmental organisation serving Eastern and Southern Africa, including the Horn of Africa, to support environmental monitoring, land use planning, and natural resource management
2002	http://www.faoswalim.org/	Somalia Water and Land Information Management (SWALIM)	The SWALIM project has been carried out as a sequence of goals and activities leading to the independence of certain Somali institutions in the generation and management of information pertaining to natural resources
2006	https://hoarec.org/about-us/about-hoarecn/	Horn of Africa Regional Environment Centre and Network (HoA-REC&N)	HoA-REC&N is a network of universities and research institutions in the Horn of Africa region to promote environmental conservation, capacity building, and advocacy
2015	https://bareedo.org/	Bareedo Platform for Democracy, Digital Rights, and Open Government	Founded in 2015, the youth-led, non-governmental Bareedo Platform Somalia is committed to advancing democratic institutions, inclusive and participatory society, open governance, and digital rights

(*continued*)

Table 1. (*continued*)

2018	https://www.data.gov.so/	Somalia Open Government Initiative Portal	The Open Government Initiative Somalia was developed to modernise data and information distribution, achieve sustainable development goals, combat corruption, and promote openness and accountability at all levels
2019	https://www.sogpa.org/who-we-are/about	Somali Greenpeace Association (SOGPA)	The Somali Greenpeace Association (SOGPA) is a non-profit civil society organisation established in 2019 with the aim of addressing climate change, environmental issues, food security, and empowering youth in Somalia
2022	https://moecc.gov.so/	Ministry of Environment and Climate Change (MoECC)	The MoECC is to protect, conserve and restore the environment of Somalia in order to improve and maintain the quality of life of its citizens through sustainable development

In addition to analysis of digital open government and E&C platforms, we also performed documentary and content analysis on open government and climate change policies. Our analysis exhibits that Somalia has demonstrated notable advancements in the formulation of policies and establishment of institutional frameworks pertaining to E&C change and natural resource management [39], thus attaining a newfound state of stability. The presence of policies and regulatory frameworks represents a positive progression, albeit with persisting implementation obstacles at both the Federal and State levels.

According to Article 32 of Somalia's Provisional Constitution, individuals possess the entitlement to access information that is under the custody of the state [40]. Furthermore, it is mandated that the Federal Parliament is responsible for enacting legislation that safeguards this right to access information. Nevertheless, Somalia currently needs the necessary legal or policy framework to effectively enable the realisation of the right to access information and o-government within its borders.

5 Discussion and Implications

The multifaceted issues experienced in 2020, such as COVID-19, encompassing economic, social, environmental, and health dimensions, surely entail significant costs. Simultaneously, these circumstances offer a prospect for fostering sustainable and democratic practices, as well as enhancing community resilience through the transition towards an environmentally friendly economy [41]. In this connection, the importance of opening up Somalia's E&C data through technology-enabled infrastructures increases to a large extent since it is among the top 10 countries with the most people affected by E&C changes in 2020–2021 [36]. Moreover, the OE&CD's significance has also increased due to the increasing impacts of climate-related environmental change, as seasons and weather phenomena are becoming more difficult to predict [35]. However, on the contrary, the claims of FRoS towards transparency and opening of E&C datasets seem invalid or superstitious, as per documentary and content analysis. Furthermore, the utilisation of datasets cannot be made. Accordingly, the value from the provided datasets cannot be derived if the public administrations in Somalia are not publishing E&C datasets freely. Therefore, it is imperative that the Somali Government takes genuine initiatives and demonstrates a strong commitment to making E&C datasets accessible to the public. The FRoS should establish a systematic approach in identifying and prioritising key datasets that can be made publicly available as open data, with the aim of bolstering efforts towards climate action.

The Directive on Open Government should be made and updated subsequently to clearly identify datasets that can support federal government departments in the timely release of high-value data and information. Although Somalia holds the 8th position in receiving aid from international organisations [7], the development of open government and climate change is equal to nothing [1, 11, 41]. The FRoS needs to prioritise investments in climate-related projects and publicising E&C datasets freely and user engagement accordingly in order to improve resilience and equity. Moreover, the researchers should also publish the data for the public good [19]. There is no doubt that there is clarity among government policy- and decision-makers in Somalia around E&C risks; they should also need to adopt a more proactive approach towards OE&CD initiatives than to respond since ICTs helped in delivering greater clarity and support for mitigation and adaptation plans.

6 Conclusion, Limitations, and Future Directions

The examination of the present state of Open Environmental and Climate Data (OE&CD) initiatives and regulations in Somalia provides valuable observations regarding the status of open data governance within the nation. Although the FRoS has made attempts to promote transparency and open governance, such as the introduction of the Open Government Initiative in 2018, there needs to be more advancement in ensuring the widespread availability of essential environmental and climate data. The successful management and reduction of E&C risks need proactive actions, with a particular emphasis on the availability of relevant data that is both accessible and transparent. The need for more progress in Somalia's transition towards transparent governance in the face of E&C

change challenges is noteworthy when compared to other countries globally. The study focused mostly on the analysis of web content and documentaries, thereby omitting direct involvement with stakeholders. This limited our ability to gain a deeper understanding of the problems and motives underlying the current state of OE&CD in Somalia. The study was limited to the utilisation of data and platforms that were accessible until September 2023. Due to the potential for policy and digital platform evolution, it is important to acknowledge that our current conclusions may only partially encompass future shifts or recent advancements that occur beyond the period under consideration. The study extensively relied on digital sources and publicly available documents. In instances when the government or pertinent institutions possess undisclosed internal policies or datasets that have not been made accessible to the public, our research outcomes would fail to capture these valuable insights. Future research efforts should focus on actively involving key stakeholders in the field of OE&CD implementation, including the FRoS, non-governmental organisations, and local communities. This approach would enable researchers to obtain a thorough comprehension of the obstacles hindering the adoption of OE&CD and explore potential strategies to overcome these challenges. An examination of adjacent nations in the Horn of Africa through a cross-country comparison can provide useful insights into the most effective approaches, obstacles, and tactics in the field of open data. This is particularly significant due to the common environmental and climatic issues experienced in the region.

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Sentiment Analysis on Google Play Store User Reviews of Digital Bank Applications in Indonesia

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Abstract. Digital payment platforms are increasingly essential in everyday life to support payment activities as well as buying and selling. The increase in the use of digital payment modes has resulted in a wide variety of sentiments given by users through the Google Play Store platform. This study aims to determine whether digital banks in Indonesia are sufficient, meet customer demands, and are relevant. The study uses sentiment analysis on user reviews from the Google Play Store to evaluate the accuracy and effectiveness of the Random Forest Classifier and Support Vector Machine Classifier algorithms.

The results show that both algorithms achieve high accuracy, with the SVM method slightly outperforming the Random Forest approach. The study also reveals that user sentiment towards digital banking services is positive, with users expressing gratitude for user-friendly functions, services, apps, and quick user experiences. However, negative sentiment is expressed toward complicated systems and regulations. The study suggests that digital banks should pay more attention to customer feedback and adjust the quality of their services and products accordingly.

Keywords: User Reviews · Digital Bank · Google Play Store · Sentiment Analysis

1 Introduction

Due to our fast-paced and connected society, digital banking applications have a significant role in our everyday lives. The emergence of digital bank applications, which offer various conveniences with fast, easy, and safe access to various financial services and complement traditional transactions that require us to visit a branch, has significantly changed how people interact with the banking industry in recent years.

The surge in demand for digital payment and banking services has ignited a competitive race among prominent providers to establish their own cutting-edge platforms. This palpable shift is substantiated by the substantial growth witnessed in Indonesia's digital banking sector. As per data sourced from Bank Indonesia, the aggregate value of

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digital banking transactions soared to a staggering IDR 4,944.1 trillion by March 2023 [7], reflecting an impressive annual growth rate of 9.88%.

This upward trajectory is further corroborated by the comprehensive statistics provided by katadata.co.id, as illustrated in Fig. 1 depicting the values of digital banking transactions. This visual representation unmistakably outlines a consistent annual growth pattern, underscoring the increasing prominence of digital banking services in Indonesia's financial landscape.

While the value of digital banking transactions experienced a temporary dip in April 2023, registering a 20.1% decrease compared to the same period in 2022 and an 11.8% decline compared to March 2023 (month-to-month/mom), it is imperative to contextualize this short-term fluctuation within the broader trend. When viewed over a span of five years, the data reveals a remarkable upswing. In April 2023, the total value of digital banking transactions on a national scale had surged by an impressive 158% compared to the corresponding period in 2018 [8]. This exponential growth speaks volumes about the evolving financial landscape in Indonesia and underscores the pivotal role that digital banking services play in shaping the country's economic trajectory.

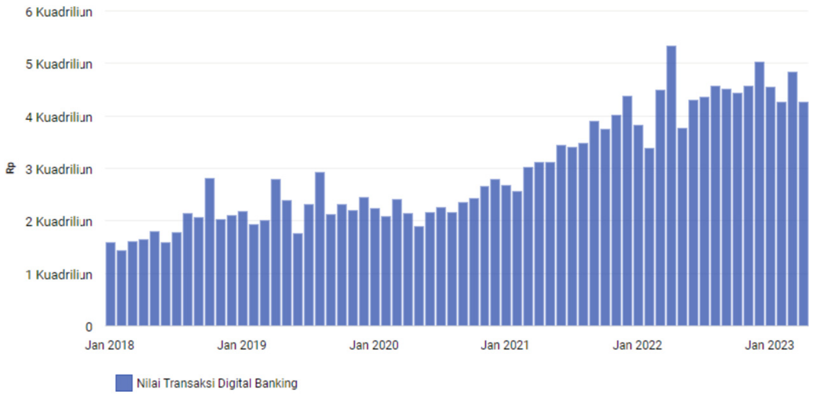


Fig. 1. Digital Banking Transaction

Considering the information presented, it becomes evident that the general public, particularly those who utilize digital banking applications available on the Google Play Store platform, has a diverse range of opinions and sentiments to express. To delve deeper into these sentiments, this study employs the technique of text mining to extract valuable insights from the voices of the general populace.

In a previous research endeavor conducted by Bonny et al. (2022) [2], the multinomial Naive Bayes approach emerged as a standout performer in terms of accuracy. This particular algorithm had previously demonstrated exceptional capabilities in a sentiment analysis study centered on mobile applications for women's protection. The findings from this prior study yielded an impressive accuracy rate of 85.42%, surpassing the performance of all other methods employed. This precedent underscores the potential of the Multinomial Naive Bayes algorithm to deliver highly accurate sentiment analysis results, providing a solid foundation for our current research.

Furthermore, Mahmud et al. (2022) [3] conducted a sentiment analysis study focusing on user evaluations of ride-sharing mobile applications within the Google Play Store environment. Their research showcased the prowess of alternative algorithms, including CNN, LSTM, and DistilBERT, in achieving remarkable accuracy rates. DistilBERT, in particular, stood out with an extraordinary accuracy rate of 98.84%. These findings highlight the capacity of advanced algorithms to excel in sentiment analysis tasks, reaffirming the importance of exploring different approaches for our current study.

Against this backdrop, our study aims to ascertain whether digital banking in Indonesia effectively meets user demands and remains relevant in today's dynamic landscape. Additionally, we seek to evaluate the accuracy and efficacy of two distinct classifier algorithms, namely the Random Forest Classifier and the Support Vector Machine Classifier, in analyzing sentiment parameters within the Digital Bank Application Classifier.

By leveraging the experiences and expertise demonstrated in previous studies, we hope to shed light on the sentiment landscape surrounding digital banking in Indonesia. This research endeavor not only holds the potential to provide valuable insights for the banking industry but also contributes to the broader understanding of how sentiment analysis can be harnessed to enhance the user experience within the digital banking sector.

The following is the structure of the paper: Sect. 2 presents an overview of relevant literature about digital marketing and machine learning algorithms. Section 3 explains the steps taken in data mining, while Sect. 4 presents the results of data mining that has been carried out according to the steps in the methodology. Section 5 of our article serves as our conclusion and suggestions for future digital marketing.

2 Literature Study

2.1 Digital Banking

Essentially, digital banking combines online and mobile banking services under one roof. While mobile banking refers to using an app to access many of the same banking features via mobile devices like smartphones or tablets, online banking refers to using the Internet to access banking operations and services from a bank's website [1]. Digital banking does not force customers to visit a Bank to register or do other services. Many people are turning to digital banking because of the ease of access, such as the history of digital bank transactions and control access to digital banking services, the benefit that digital bank services carry, and trust in the banking services for the quality of the transactions delivered [10].

In Indonesia, there has been an impressive rise in digital payments of up to 300% from 2018 to 2019, and it continues to increase, with 150 million transactions recorded in 2021, which is 24% more than the amount in 2020 [9]. The data indicates that digital payment usage has significantly increased and is constantly rising. Several digital banks are currently operating in Indonesia, such as Jago Bank, SeaBank, Blu by BCA, Line Bank, Bank Jenius, and NeoBank.

2.2 Random Forest Classifier

The random forest is built on the techniques of bagging, randomizing outputs, and random subspace excusing boosting. It belongs to the algorithm family that uses the decision tree as an individual predictor. The random forest method, which can accurately categorize large amounts of data, is one of the best classification techniques. It is an ensemble learning technique for classification and regression that builds many decision trees during the training phase and outputs the class representing the mean of the classes produced by the individual trees [4]. Random forests maintain high accuracy while avoiding overfitting issues due to using randomization techniques during training and averaging predictions from the ensemble of trees. This makes random forests well-suited for complex problems involving a large number of input variables [5].

2.3 Support Vector Machine Classifier

The Support Vector Machine methodology, which uses statistical classification, maximizes the distance between the instances and the separation hyper-plane [4]. In two-dimensional space, this hyper-plane is nothing more than a line. The total number of features and attributes in the dataset, N, is used to plot each dataset item using SVM in an N-dimensional space. Then, the data should be divided using the ideal hyperplane [6]. Both classification and regression problems may be solved with it. It was also regarded as the best text categorization technique.

3 Methodology

3.1 Data Collection

Researchers used the Google Play Store Python module to extract data from March 1 through July 20 by extracting ratings 1 through 2 stars and ratings 4–5 stars. Researchers do not take 3 stars because they are considered a neutral value that has no impact on the study done.

3.2 Identification

The identification stage is a crucial phase in which the author identifies the problems, objectives, and expectations to be addressed through the execution of this research, based on public opinions on the Twitter platform. During this stage, we conduct research and literature studies to select appropriate algorithms and problem-solving approaches. Subsequently, the author determines the solutions and future aspirations.

3.3 Pre-processing

Pre-processing is required to remove irrelevant, distracting, and unhelpful terms from the classifier model. This stage is divided into multiple steps, including tokenization, case-folding, text cleaning, and stop-word removal:

Case Folding

In the first preprocessing stage, all phrases are changed to lowercase letters.

Text Cleansing

In the second stage, eliminate numerals, non-ASCII special words, and invisible spaces.

Tokenization

At this point, all phrases are broken up into words known as tokens.

Stop-Word Removal

At this point, meaningless stopwords are eliminated. By concentrating on words that are more educational and significant, stop words are intended to be eliminated in order to increase the effectiveness and quality of text analysis.

Lemmatization

At this point, Suffixed terms are now changed back to their original forms with the same meaning.

4 Result

Reviews from Bank Y, Bank Z, and Banks X totaling 5499 each were taken from the Google Play Store and processed. As seen in the following explanation, researchers create sentiment classifications with positive, neutral, and negative ratings for each digital bank:

4.1 Bank X

Table 1 shows an average precision of 84%, recall of 81%, F1-Score of 83%, and accuracy percentage of 89% obtained using the Classifier Report SVM. An average precision of 83%, recall of 81%, F1-Score of 82%, and accuracy percentage of 88% were attained using the Random Forest Classifier. The SVM method outperforms the Random Forest approach by 1%. 818 positive reviews were collected expressing good sentiments and 227 negative reviews, as shown in Table 2.

Positive reviews frequently include compliments on Bank's X features. Words like "bagus", "mantap", "mudah", and "baik" indicate positive reviews. On the other side, as stated by "login", "masuk", "gagal", "ribet", and "daftar", 72 negative reviews were gathered from individuals who had trouble login into their accounts or had unsuccessful transactions, as the Fig. 2.

4.2 Bank Y

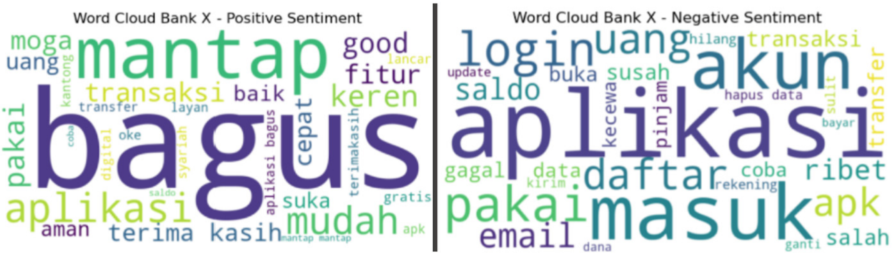
Based on the data categorization results on digital Bank Y. Researchers collected data using the Support Vector Machine and Random Forest methods and found that the two algorithms' outputs were not significantly different regarding the overall sentiment (Tables 3 and 4). Whereas the confusion matrix for the SVM method produced 990 positive and 30 negative sentiments, the confusion matrix for the random forest technique

Table 1. Positive and Negative Results of Bank X

Positive					
Algorithm	Accuracy	Precision	Recall	F1-Score	Support
SVM	89%	91%	94%	93%	818
Random Forest	88%	91%	94%	92%	818
Negative					
Algorithm	Accuracy	Precision	Recall	F1-Score	Support
SVM	89%	78%	68%	73%	227
Random Forest	88%	75%	68%	71%	227

Table 2. Sentiment Result of Bank X

SVM		
	Positive	Negative
True Positive	773	155
True Negative	72	45
Random Forest		
	Positive	Negative
True Positive	773	155
True Negative	72	45



Word Cloud Bank X - Positive Sentiment

Word Cloud Bank X - Negative Sentiment

Fig. 2. Word Cloud Bank X

produced 986 positive and 30 negative sentiments (Table 4). The two algorithms' average accuracy, according to testing done with Python tools, is 95%, as shown in Table 3.

Based on the sentiment results obtained from feedback from users of the Google Play Store app and the result of analysis using the SVM algorithm and Random Forest, the results indicate that the results will be shown in the form of a word cloud, which is a Python module in order to display existing sentiment.

Table 3. Positive and Negative Results of Bank Y

Positive					
Algorithm	Accuracy	Precision	Recall	F1-Score	Support
SVM	95%	96%	99%	98%	999
Random Forest	95%	96%	99%	97%	818
Negative					
Algorithm	Accuracy	Precision	Recall	F1-Score	Support
SVM	95%	77%	42%	55%	71
Random Forest	95%	73%	45%	56%	227

Table 4. Sentiment Result of Bank Y

SVM		
	Positive	Negative
True Positive	990	9
True Negative	41	30
Random Forest		
	Positive	Negative
True Positive	986	13
True Negative	41	30

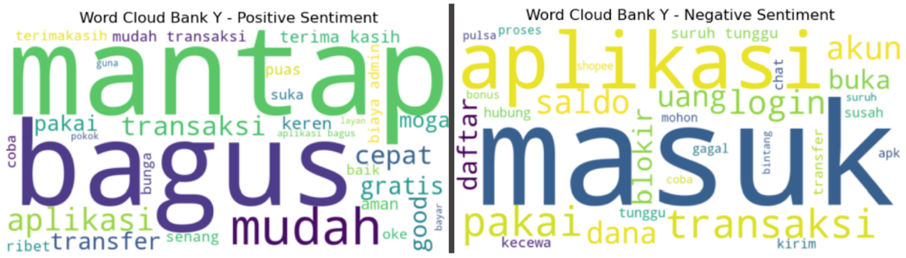

Word Cloud Bank Y - Positive Sentiment
mantap
bagus
mudah
transaksi
terima kasih
terimakasih
mudah transaksi
pakai
cepat
gratis
aplikasi
transfer
keren
moga
good
biaya admin
puas
suka
guna
pokok
coba
bunga
baik
aman
ribet
senang
oke
bayar
layan
aplikasi bagus
Word Cloud Bank Y - Negative Sentiment
aplikasi
masuk
akun
buka
saldo
uang
login
daftar
blokir
pakai
dana
transaksi
pulsa
proses
suruh tunggu
shopee
chat
bonus
hubung
mohon
gagal
suruh
susah
apk
bintang
transfer
coba
tunggu
kecewa
kirim

Fig. 3. Word Cloud Bank Y

Based on Fig. 3, show some positive sentiment words in the form "mantap", "bagus", and "mudah". Whereas in the negative sentiment from the word cloud, negative sentiment words were found in the form of "aplikasi", "masuk", "blokir", "kecewa", "gagal" etc.

4.3 Bank Z

Researchers used two algorithms, Support Vector Machine (SVM) and Random Forest, to assess sentiment based on the outcomes of data classification on digital bank Z (Tables 5 and 6). The analysis results demonstrate that the two methods produce a nearly identical image. For instance, the confusion matrix for the SVM method has 498 positive sentiment data and 337 harmful sentiment data. In contrast, the confusion matrix for the Random Forest approach contains 513 positive sentiment data and 320 negative sentiment data (Table 6). An average accuracy of 82% was found for the two methods after testing with python tools (Table 5).

Table 5. Positive and Negative Results of Bank Z

Positive					
Algorithm	Accuracy	Precision	Recall	F1-Score	Support
SVM	82%	88%	82%	85%	607
Random Forest	82%	88%	83%	84%	607
Negative					
Algorithm	Accuracy	Precision	Recall	F1-Score	Support
SVM	82%	76%	83%	79%	408
Random Forest	82%	76%	80%	78%	408

Table 6. Sentiment Result of Bank Z

SVM		
	Positive	Negative
True Positive	498	109
True Negative	71	337
Random Forest		
	Positive	Negative
True Positive	513	94
True Negative	88	320

The user sentiment from the Google Play Store application tends to be positive, as seen by the degree of positive sentiment, according to the sentiment findings gathered from user reviews on the Google Play Store application. It is clear from Fig. 4 that "mantap", "keren", "terima", "kasih", "mudah" and other words with pleasant connotations are among those that are used. Meanwhile, on the negative sentiment from the word cloud, there are words like "susah", "salah", "ribet", "kecewa", "gagal", and a few other words.

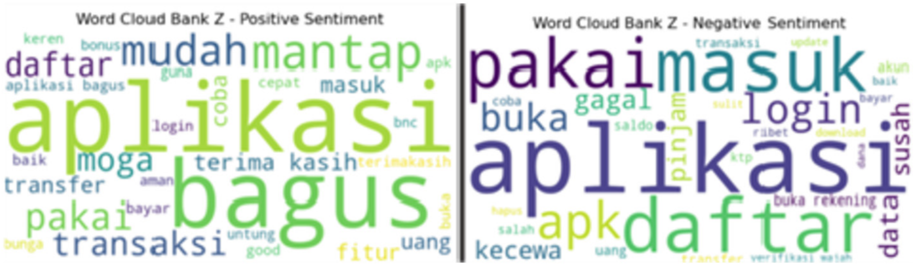


Fig. 4. Word Cloud Bank Z

5 Conclusion

In Indonesia, the quick growth of digital banking has significantly impacted daily life. In order to enhance their services, numerous businesses are investing in digital banking platforms. The main goal of this sentiment research is to determine if digital banking is sufficient, satisfies demands, and is relevant for users in Indonesia on the Google Play Store. The examination of classifier models revealed that SVM and Random Forest performed equally well at predicting sentiment. Of the three banks mentioned above, Bank Y had the most outstanding performance, scoring 95%, 86%, 71%, and 76% for accuracy, precision, recall, and F1 scores, respectively. According to the sentiment analysis results, Bank Y has the highest accuracy value (95%), followed by Bank X (88%) and Bank Z (82%). Based on the accuracy obtained, most banks have a reasonably high accuracy, which indicates satisfaction with the services provided.

Positive sentiments are expressed in gratitude for user-friendly functions, services, apps, and quick user experiences. As for negative sentiment, it appears as complaints about the difficult user experience while utilizing complicated systems and regulations. Based on the findings of this study, digital banks should pay more attention to customer feedback and adjust the quality of their services and products.

To extend this research, future work could apply other machine learning algorithm performance like Naïve Bayes, Neural Networks (CNN), Logistic Regression, Convolutional Neural Networks or Recurrent Neural Networks for classifying sentiment and compare their performance to the current Random Forest and SVM methods. Additionally, aspect-based sentiment analysis could be performed to understand attitudes toward specific features of the digital banking apps, rather than overall sentiment. Furthermore, reviews could be categorized by demographic factors like age, location, profession to enable comparison of sentiment across different user profiles. This could better inform efforts to improve digital banking apps and align them with the preferences of diverse customer segments. Also, use more advanced NLP technique in the preprocessing used basic techniques like tokenization and stopword removal. Further research could employ more advanced NLP such as tagging, named entity recognition, word embeddings, etc.

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Advanced Machine Learning Techniques for Precise Lung Cancer Detection from CT Scans

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Abstract. Using a hybrid machine learning model that takes into account Convolutional Neural Networks (CNN), Support Vector Machines (SVM), and Gradient Boosting methods, this research proposes a complete strategy for the early diagnosis of lung cancer. Due to the similarity in structure between healthy and sick lung tissues, diagnosing lung cancer is a difficult process, making automated technologies necessary to aid radiologists. Several datasets are used, with CT scans being the primary emphasis, and preprocessing methods such noise reduction, normalization, and lung segmentation are examined to improve picture quality for the purpose of detecting lung cancer. To precisely pinpoint lung nodules within CT scan pictures, CNNs are used in the segmentation step. Using visual feature extraction as input, SVM acts as a classification tool to distinguish between malignant and benign situations. Predicting lung cancer risk using patient data, such as medical records and genetic characteristics, is done with the use of gradient boosting algorithms like XGBoost and LightGBM. Nodule form, mean intensity, standard deviation intensity, and skewness are all part of the data that must be extracted in order to complete this stage. Principal Component Analysis (PCA) may help in feature selection, which in turn improves model interpretability and decreases over fitting. For all-inclusive lung cancer prediction, the suggested approach merges findings from Convolutional Neural Networks, Support Vector Machines, and Gradient Boosting models. The experimental findings support the efficiency of this strategy, which makes use of ensemble models, transfer learning, and feature selection to boost accuracy. The article highlights the importance of image processing and machine learning in detecting lung cancer early, which has the potential to greatly reduce deaths caused by the disease.

Keywords: Lung Cancer Detection · Convolutional Neural Networks · Support Vector Machine · Gradient Boosting · Medical Image Processing · Early Diagnosis

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1 Introduction

The strong foe that is lung cancer in the field of oncology continues to be a major obstacle in the way of achieving optimal global health. Nearly 10 million people will lose their lives to cancer in 2020, making it the sixth largest cause of death globally. Breast, lung, colon, rectal, and prostate cancers are among the most frequent types of the disease. Tobacco use, obesity, alcohol usage, inadequate eating of fruits and vegetables, and insufficient exercise all contribute to around a third of all cancer-related fatalities. About 30% of cancer incidences in poor and lower-middle income nations are caused by viruses including human papillomavirus (HPV) and hepatitis. If caught and treated quickly, many forms of cancer are curable. Lung cancer is one of the most common and deadly forms of cancer in the world due to its extensive network of causal variables, numerous histological subtypes, and complex genetic foundations. It is also one of the most preventable forms of cancer. In spite of advances in medical knowledge, the prognosis for many lung cancer patients continues to be discouraging. As a result, there is a pressing and ongoing need for study to investigate the complex interplay of factors that contribute to the development of this illness. In recent years, a significant amount of development has taken place in terms of comprehending the etiology and pathophysiology of lung cancer. The discovery of several risk factors, including as exposure to cigarette smoke and environmental contaminants, genetic predisposition, and developing molecular triggers, has offered essential insights into the delicate interaction of genetic and environmental variables that contribute to the development of this condition. In addition, the development of precision medicine has made tailored therapy methods possible, which show promise for improving treatment results. Cancer is an umbrella word for a variety of illnesses that may manifest in almost any organ. Malignant tumors and neoplasms are other names for cancerous growths. The fast proliferation of aberrant cells is a distinguishing hallmark of cancer, and these cells have the potential to infect neighboring tissues and metastasize to other organs. Invasive metastases are the leading cause of cancer-related mortality.

The issue:

Nearly 10 million people will lose their lives to cancer in 2020 (1), making it the top cause of death globally. Breast (2.26 million instances), lung (2.21 million cases), colon/rectum (1.93 million cases), prostate (1.41 million cases), non-melanoma skin (1.20 million cases), and stomach (1.09 million cases) cancers were the most prevalent in 2020.

Lung (1.80 million fatalities), colon and rectum (916 thousand deaths), liver (830,000 deaths), stomach (769,000 deaths), and breast (685 thousand deaths) were the five most prevalent sites of cancer in the body that year. There are almost 400,000 new cases of childhood cancer every year. Cancer rates and prevalence differ among regions. Cancer of the cervix is the most frequent in 23 nations. However, difficulties still exist on a number of other fronts. The persistent prevalence of smoking in some populations, the appearance of novel carcinogenic agents, and the often asymptomatic character of early-stage lung cancer are all factors that contribute to delayed diagnosis and lower odds of effective intervention in lung cancer patients. In addition, the heterogeneity of lung cancer in terms of both its histology and its molecular profiles calls for a greater knowledge to drive the creation of targeted treatments and treatment regimens that are more successful. This study article sets out on an exhaustive trip into the world of lung cancer, with the goal of addressing important elements of the disease's epidemiology, molecular foundations, diagnostic advancements, and changing therapy techniques. This study aims to add to the expanding body of information that informs clinical practice and promotes breakthroughs in the treatment of lung cancer by combining the most recent research results and incorporating a variety of views.

2 Related Works

Meraj Talha and colleagues provide a system for lung nodule identification that combines semantic segmentation and classification with optimum features in a study published on preprints.org in 2019. By correctly detecting lung nodules and differentiating between benign and malignant instances, this study tackles the critical obstacle of early lung cancer identification. In order to extract features, the authors use a number of methods, including preprocessing, semantic segmentation, and Principal Components Analysis (PCA). They test a variety of classifiers and validation methods, eventually settling on logic boost's impressive 99.23% accuracy. This study adds to the developing field of medical image analysis and highlights the promise of cutting-edge computer tools for improving lung cancer detection [1]. The important problem of early lung cancer diagnosis using SVM classifiers in the field of biomedical image processing is tackled by Kaucha et al. (2017). The results of their research add to the expanding corpus of work targeted at enhancing the precision with which lung cancer is diagnosed. Aligning with the urgent need for early intervention in clinical practice, this study investigates the possibility of improving lung cancer detection via the use of machine learning methods and cutting-edge image processing [2]. Sathishkumar et al. 2019 article presents research on SVM and KNN algorithms for detecting lung cancer. The use of machine learning in the context of lung cancer detection is still being investigated, and our study adds to that body of knowledge. The authors explore the possibility of enhanced classification accuracy by merging SVM with KNN, providing insights into the efficacy of ensemble techniques for this crucial healthcare application. Their findings highlight the need for novel algorithmic combinations in the quest for improved lung cancer screening sensitivity [3]. Using analysis of volatile organic compounds (VOCs) in exhaled breath, Sakumura et al. (2017) investigate a novel strategy to diagnosing lung cancer. This research introduces a unique method of using the Support Vector Machine (SVM) algorithm to categorize exhaled breath samples from people with lung cancer. This study highlights the promise of quick, non-invasive diagnostic approaches that use the distinctive chemical fingerprints in exhaled air. The use of support vector machines (SVMs) as a classification tool in this setting exemplifies the adaptability of machine learning approaches to healthcare and illness detection [4].

Kancherla and Mukkamala provide a novel method for detecting lung cancer using a Support Vector Machine (SVM) based Recursive Feature Elimination technique in their 2012 study published in the Lecture Notes in Computer Science. In their research, they zero in on feature selection, a crucial step in producing reliable diagnostic results from medical picture data. This study optimizes the discrimination of lung cancer cases by using SVM and recursive feature reduction, demonstrating the importance of machine learning approaches in improving the efficacy of diagnostic systems in healthcare [5].

Comparative research on supervised neural networks for the diagnosis of lung cancer was undertaken by Roy et al. in 2019 and presented at the International Conference on Opto-Electronics and Applied Optics. This research contributes to the expanding literature on the use of artificial neural networks in the processing of medical images. The authors shed light on the potential contributions of supervised neural networks to the area of medical diagnostics by evaluating several techniques to improving the accuracy of lung cancer diagnosis [6]. Using image processing methods applied to CT scans, Nadkarni and Borkar tackle the urgent problem of lung cancer diagnosis in their presentation at the 2019 International Conference on Trends in Electronics and Informatics. This study demonstrates the importance of non-invasive diagnostic tools by highlighting the function of cutting-edge image processing techniques in the detection of lung cancer lesions. The authors' results contribute to the larger landscape of medical image analysis and early diagnosis, shedding light on the potential of image processing as an integral component of today's lung cancer detection systems [7].

Comparative research on lung cancer diagnosis using different machine learning algorithms was undertaken by R. P. R., R. A. S. Nair, and V. G., and presented at the 2019 IEEE International Conference on Electrical, Computer, and Communication Technologies. This research adds to the growing body of work investigating the potential of machine learning approaches to the detection of lung cancer. The authors compare and contrast a variety of algorithms, offering light on their performance and appropriateness and revealing how they may be used to improve the accuracy and efficiency of lung cancer detection systems [8]. Using whole slide histopathology pictures, ari et al. describe a convolutional neural network (CNN)-based method to lung cancer diagnosis in their work given at the 2019 International Conference on Smart and Sustainable Technologies. To diagnose lung cancer at the microscopic level, this study represents a major step forward in the use of deep learning in histopathological investigation. The authors use CNNs to show that automating the detection process in histopathology is possible, highlighting the potential of AI-driven solutions to improve the precision and timeliness of lung cancer diagnosis [9]. Using a convolutional neural network (CNN) trained with the AlexNet dataset, Agarwal, Patni, and D propose a method for detecting and classifying lung cancer at the 2021 International Conference on Communication and Electronics Systems. Using the robust capabilities of the AlexNet architecture, this study demonstrates a cutting-edge implementation of deep learning for the purpose of diagnosing lung cancer. Contributing to the continuing attempts to bring AI-driven solutions to medical imaging and illness diagnosis, the authors investigate the feasibility of using CNNs to improve the accuracy of lung cancer detection and classification [10]. Recently, Joshua E.S.N., M. Chakkravarthy, and D. Bhattacharyya presented a unique technique to lung cancer diagnosis employing an improved Grad-CAM++ method in conjunction with 3D Convolutional Neural Networks (CNN). This study focuses on the use of 3D convolutional neural networks and cutting-edge visualization methods to enhance the readability and precision of lung cancer diagnoses. To address the continued need for better diagnostic tools, the authors use Grad-CAM++ and 3D CNN class activation to demonstrate the potential for improved localization and diagnosis of malignant areas in medical imaging [11]. Jena and George offer a novel method for detecting lung cancer in its earliest stages. Their article will appear in the "International Journal of Imaging

Systems and Technology" in 2020. The research centers on a KNG-CNN classification method applied to morphological features extracted from CT scans. By using the unique morphological traits found in medical photos, this study highlights the merging of modern image processing and deep learning to give a possible path for early lung cancer identification. The use of KNG-CNN demonstrates the potential for enhancing accuracy and efficiency in the early detection of lung cancer [12]. A deep learning method using Convolutional Neural Networks (CNNs) to identify lung cancer is presented by Praveena et al. in their paper for the 2022 International Conference on Communication and Electronics Systems. This work showcases the continued development of deep learning methods in medical imaging and disease detection by providing a modern example of how CNNs might be used in the context of lung cancer diagnosis. The authors investigate how convolutional neural networks (CNNs) may be used to improve lung cancer diagnosis, a step toward the development of AI-driven healthcare solutions [13].

Using a Dilated Convolutional Neural Network (CNN) with VGG16 architecture, Lu et al. suggest a novel method for detecting lung cancer, as presented at the 2021 International Conference on Signal Processing and Machine Learning. In the context of lung cancer detection, this work demonstrates how deep learning approaches may be combined with a proven CNN model, VGG16. The authors highlight the possibility for improved feature extraction from medical pictures by adding dilated convolutions, which contributes to the continued improvement of AI-driven solutions in healthcare. In order to improve the accuracy and efficiency of lung cancer diagnosis, CNN-based approaches are being explored in this study [14]. Khumancha, Barai, and Rao offer a Convolutional Neural Network (CNN)-based method for lung cancer identification from CT images in their work given at the 2019 International Conference on Computing, Communication, and Networking Technologies. The findings of this study highlight the potential of deep learning methods for use in medical imaging, notably in the detection of lung cancer. The authors investigate how convolutional neural networks (CNNs) may be used to improve lung cancer detection systems' interpretability and accuracy, adding to the growing field of AI-driven healthcare solutions. The importance of CNNs for CT-based lung cancer diagnosis is highlighted in this work [15]. In their 2022 review article for SN COMPUT. SCI., Gumma et al. provide a thorough introduction to Convolutional Neural Network (CNN) based approaches for detecting lung cancer. This report is a helpful resource since it summarizes the current status of deep learning's potential in diagnosing lung cancer. The authors go into the history of CNN-based systems, discussing the many different approaches, structures, and developments that have taken place in this field. Their study provides a thorough grasp of how deep learning methods are transforming lung cancer diagnosis, which will help researchers and clinicians keep up with the most recent advances in the field [16]. Tejaswini et al. offer a Convolutional Neural Network (CNN) architecture tailored to lung cancer detection in their work given at the 2022 IEEE International Conference on Communication Systems and Network Technologies. This research shows how deep learning methods are improving medical imaging and illness detection all the time. The authors propose a new CNN architecture that might improve the accuracy and efficiency of lung cancer detection systems. The importance of specialized CNN architectures for medical applications like lung cancer detection was highlighted by their study [17].

Phankokkruad presents a novel ensemble transfer learning method for detecting lung cancer in their work to be presented at the 2021 International Conference on Data Science & Information Technology. This research is a prime example of how transfer learning may be used with ensemble methods to improve diagnostic accuracy in medical imaging. The authors show how to improve the effectiveness and efficiency of lung cancer detection systems by using transfer learning. The importance of ensemble techniques in the quest for improved accuracy and reliability in lung cancer detection was highlighted by their study [18]. Using Convolutional Neural Network (CNN) models, Chen et al. 2021 IEEE International Conference on Computer Science, Electronic Information Engineering, and Intelligent Control Technology contribute lung cancer detection from pathological photos. This study demonstrates the importance of deep learning methods for analyzing medical images and diagnosing diseases. The scientists' use of CNNs to show the feasibility of automated lung cancer identification from pathology pictures is encouraging, as it points to the progress that can be made by relying on AI-driven solutions for accurate and prompt diagnosis in healthcare [19]. Presenting their work at the 2022 IEEE Mysore Sub Section International Conference, Biradar et al. demonstrate a 2D Convolutional Neural Network (CNN) method for identifying and categorizing lung cancer. This research demonstrates the ongoing development of deep learning methods for use in medical imaging, and in particular, the accurate identification of lung cancer. The authors show how 2D CNNs may be used to improve lung cancer detection systems' precision and performance. Contributing to the continuing efforts to enhance AI-driven solutions in healthcare, this study highlights the significance of 2D CNN models in the context of medical picture processing [20].

Existing Methodology

When not detected in its earlier stages, lung cancer is a very dangerous illness. On the other hand, because the nodules of lung cancer vary in size and form, it might be difficult to diagnose the disease in its early stages. Radiologists rely on automated technologies because they provide more accurate opinions. It is difficult to automate the identification of damaged lung nodules since healthy and diseased tissues have similar shapes. This makes it difficult to differentiate between the two. Throughout the years, a number of different expert systems have been created, all of which assist radiologists in accurately diagnosing lung cancer. In this research, we have developed a framework for accurately detecting lungs cancer in order to identify the nodules as either benign or malignant.

The picture collection from the Lung picture Database Consortium (also known as LIDC-IDRI) is used in the testing of the proposed framework since it represents a portion of the publically accessible dataset. During the pre-processing step, we removed noise and added filtering to the data. In addition, the adaptive thresholding approach, also known as OTSU, and semantic segmentation are used in order to make a precise diagnosis of unhealthy lung nodules. Utilizing principal component analysis as the method of data collection, a total of 13 nodule characteristics were determined. In addition to this, the performance of the categorization is used to choose the four most useful characteristics. During the phase devoted to classification, a total of nine distinct classifiers are used for the purpose of the experiment. Based on empirical research, it has been determined that the suggested system outperforms previous methods and offers an accuracy of 99.23% by using a logit boost classifier. Subsequent paragraphs, however, are indented.

In a study published in the ‘International Journal of Imaging Systems and Technology’ in 2021, Guo et al. provide a novel computer-assisted method for detecting lung cancer. Their approach uses a metaheuristic combination of convolutional neural network (CNN) and feature-based classifiers. This research exemplifies a novel strategy for diagnosing lung cancer that combines deep learning with conventional feature-based approaches. Integrating metaheuristics offers a viable path toward improving the accuracy and efficiency of lung cancer detection systems, and the authors give insights into maximizing the performance of these classifiers [22]. In a 2020 article published in the journal Cancer Metastasis Reviews, Thakur et al. provide a thorough evaluation of several approaches of detecting and categorizing lung cancer. This publication is a helpful reference since it provides an overview of current research and diagnostic methods for lung cancer. To better comprehend the dynamic landscape of lung cancer diagnosis, the authors provide insights into the different detection and classification strategies, emphasizing the strengths and limits of each. Their efforts help professionals in the field of healthcare research and practice keep up with recent innovations and difficulties in the field [21]. In a study published in the ‘International Journal of Imaging Systems and Technology’ in 2021, Guo et al. provide a novel computer-assisted method for detecting lung cancer. Their approach uses a metaheuristic combination of convolutional neural network (CNN) and feature-based classifiers.

3 Proposed System

This proposed system incorporates a hybrid machine learning model to detect lung cancer in the human body. The machine learning algorithms employed are Convolutional Neural Network (CNN), Support Vector Machine (SVM) and Gradient boosting algorithm. This machine learning model is trained with the datasets in order to predict the possibility of lung cancer. Figure 1 shows the conventional system for detecting Lung Cancer, which involves many processing stages.

3.1 Data Collection

Several datasets are used in the prediction of lung cancer depending on the research goal. The most common source of data for lung cancer detection is CT scan. The Lung Image Database Consortium and Image Database Resource Initiative (LIDC-IDRI) includes CT scans of the chest with lung nodule annotations made by the radiologists. The National Cancer Institute (NCI) and The Cancer Imaging Archive (TCIA) are also public repositories which include large scale datasets of CT scans that are utilized in the training of the machine learning model for the prediction of lung cancer.

3.2 Image Preprocessing

Several pre-processing techniques have been employed to generate computed topographic images that are more enhanced. The techniques used in the preprocessing of CT scan are noise reduction, normalization and lung segmentation. Median filtering or

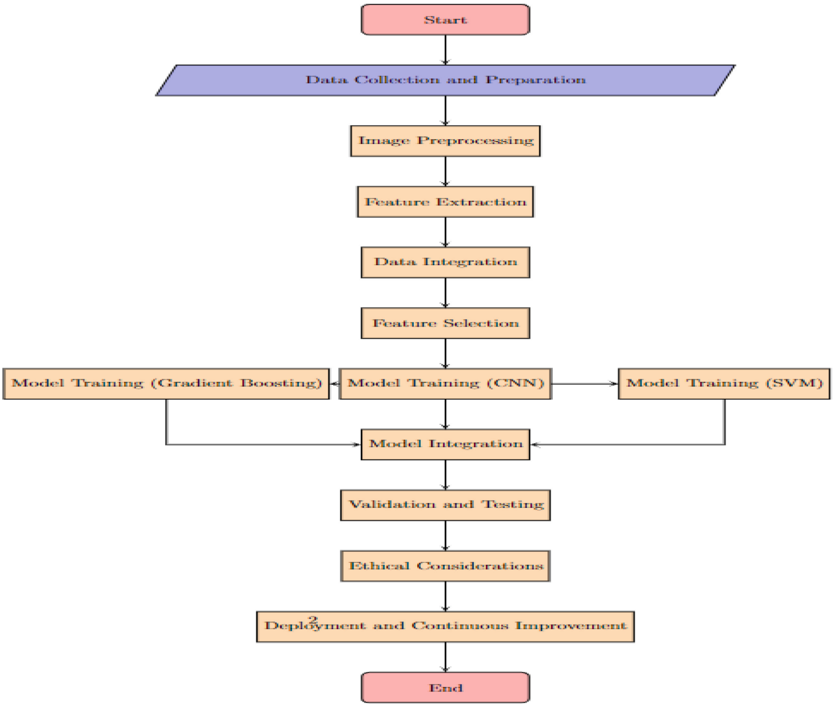

Start
Data Collection and Preparation
Image Preprocessing
Feature Extraction
Data Integration
Feature Selection
Model Training (Gradient Boosting)
Model Training (CNN)
Model Training (SVM)
Model Integration
Validation and Testing
Ethical Considerations
Deployment and Continuous Improvement
End

Fig. 1. The conventional system for detecting Lung Cancer involves many processing stages.

Gaussian smoothing is the most common noise reduction techniques utilized to eliminate the noise from the CT scan images. It enhances the signal to noise ratio in the CT images. Normalization techniques are employed to adjust the intensity values of the CT scan images to remove any variation in the brightness or contrast. Lung segmentation is a critical step in preprocessing, which involves separating the lung images from the rest of the structures in the chest, such as the ribs and spine, and it also removes the unwanted regions.

3.3 Segmentation

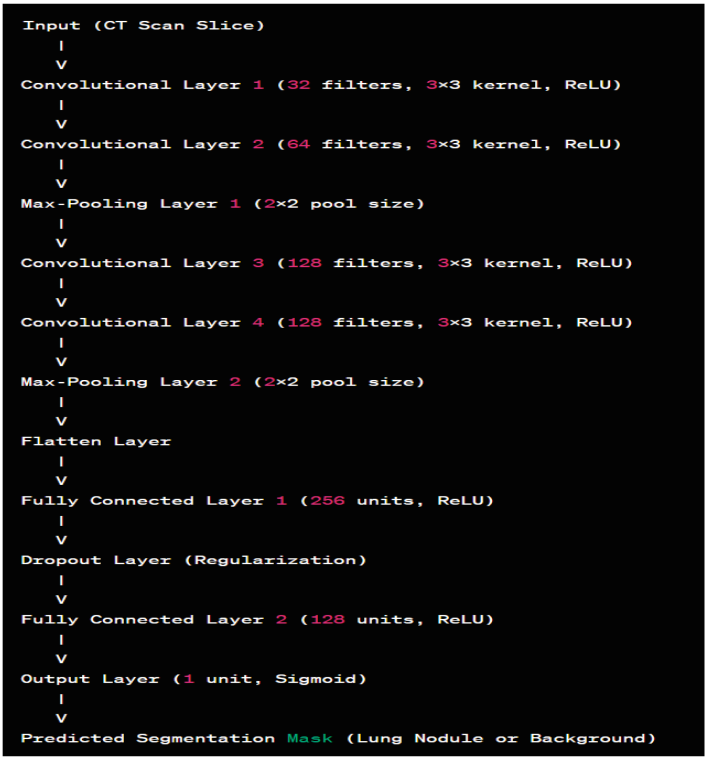
Convolutional Neural Network (CNN).

Convolution Neural Network (CNN) is a deep learning algorithm that is effective in identifying the lung nodules or lung regions within the CT scan Imaging. In the context of lung nodule segmentation, CNN can be trained to identify the location and shape of lung nodules in the CT scan. This involves training the CNN on a dataset of annotated CT scan images, where the network learns to identify the features that are indicative of lung nodules. Once trained, the CNN can be used to segment lung nodules in new CT scans. Figure 2 shows the Architecture of CNN for lung nodule segmentation.

$$h(x, y) = f((w * I)(x, y) + b) \tag{1}$$

where:

h(x, y) is the output at position (x, y) in the feature map
f is the activation function
w is the convolution kernel
I is the input image
b is the bias term



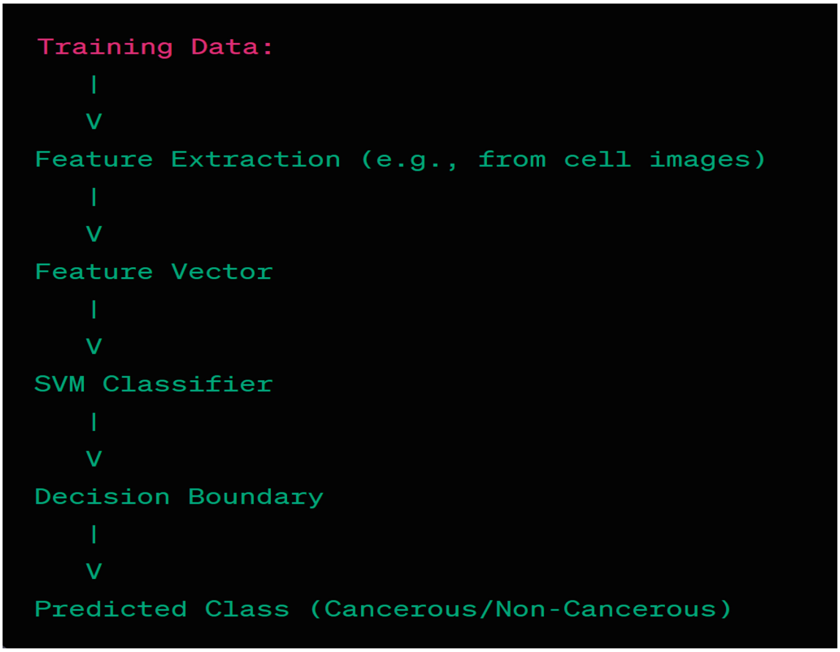
```
Input (CT Scan Slice)
   |
   V
Convolutional Layer 1 (32 filters, 3x3 kernel, ReLU)
   |
   V
Convolutional Layer 2 (64 filters, 3x3 kernel, ReLU)
   |
   V
Max-Pooling Layer 1 (2x2 pool size)
   |
   V
Convolutional Layer 3 (128 filters, 3x3 kernel, ReLU)
   |
   V
Convolutional Layer 4 (128 filters, 3x3 kernel, ReLU)
   |
   V
Max-Pooling Layer 2 (2x2 pool size)
   |
   V
Flatten Layer
   |
   V
Fully Connected Layer 1 (256 units, ReLU)
   |
   V
Dropout Layer (Regularization)
   |
   V
Fully Connected Layer 2 (128 units, ReLU)
   |
   V
Output Layer (1 unit, Sigmoid)
   |
   V
Predicted Segmentation Mask (Lung Nodule or Background)
```

Fig. 2. Architecture of CNN for lung nodule segmentation.

Support Vector Machine (SVM)

Support Vector Machine (SVM) algorithm is used as a classification tool to differentiate between the malignant and benign cases based on the extracted features from the CT scan images. Train the model with the dataset that includes the medical imaging reports and CT scans. Preprocess the data and extract only the relevant features that are required to detect the cancerous and non-cancerous cells. The features that can be concentrated are shape, structure, and intensity-based traits which indicate the physical characteristics of lung nodules or other pertinent structures. Based on the category of data and the issue at hand, pick an appropriate SVM variation, for instance a linear Support Vector Machine or a kernel SVM. When working with non-linearly separable data, kernel

SVMs are frequently preferred. Train the model with the dataset with the extracted features as the input to predict whether the cells are malignant or benign. The optimal hyper plane produced in hyper parameter tuning differentiates between the cancerous and non-cancerous cells in the lungs. SVMs are frequently employed in computer-aided diagnostic (CAD) systems to aid radiologist's spot potentially malignant areas in images of the body, resulting in earlier identification and better patient outcomes (See Fig. 3).

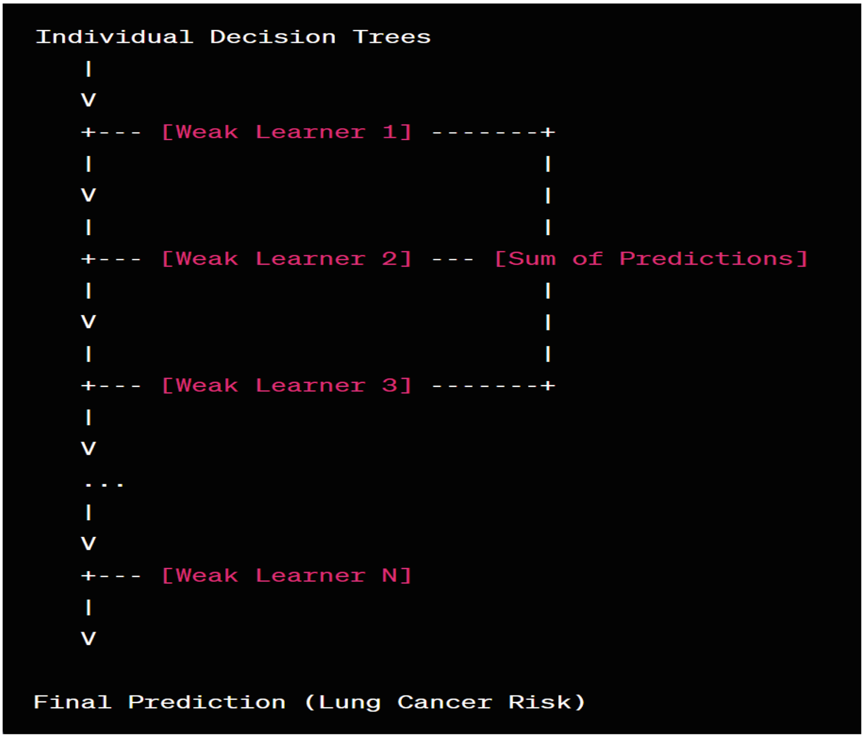


```
Training Data:
   |
   V
Feature Extraction (e.g., from cell images)
   |
   V
Feature Vector
   |
   V
SVM Classifier
   |
   V
Decision Boundary
   |
   V
Predicted Class (Cancerous/Non-Cancerous)
```

Fig. 3. Architecture of SVM predicting cancerous/non-cancerous cells.

Gradient Boosting Algorithm

In gradient boosting algorithm, XGBoost or LightGBM are employed to handle the tabular patient data like medical records, genetic variables, smoking habits etc. These algorithms can combine data from a variety of sources to forecast lung cancer. It can predict the risk of lung cancer based on various characteristics and factors. Dataset is collected that includes relevant features and labels. The labels would specify whether or not each person in the information being collected has received a lung cancer diagnosis. The dataset is preprocessed and cleaned from missing data, normalizing numerical features and encoding categorical variables to assure consistent data quality. Extract the significant features from the dataset, potentially including medical records, diagnostic reports and CT scan images to predict lung cancer. The best characteristics are identified by incorporating feature engineering. After training the dataset, the best gradient boosting model is selected for classification of the lung cancer prediction. Hyper parameter tuning is done to attain the highest predicted performance. This may entail adjusting the learning pace, maximal tree depth, and the quantity of trees within the combination, and other factors. This model also analyses the important features that influence the risk of lung cancer. Based on a variety of variables and data sources, gradient boosting may serve as a highly effective method for forecasting likelihood of developing lung cancer. When used on medical datasets, it excels at capturing complicated correlations in the data as well as generating precise predictions (Fig. 4).



```
Individual Decision Trees
     |
     V
     +--- [Weak Learner 1] -------+
     |                            |
     V                            |
     |                            |
     +--- [Weak Learner 2] --- [Sum of Predictions]
     |                            |
     V                            |
     |                            |
     +--- [Weak Learner 3] -------+
     |
     V
    ...
     |
     V
     +--- [Weak Learner N]
     |
     V

Final Prediction (Lung Cancer Risk)
```

Fig. 4. Architecture of Gradient Boosting algorithm in predicting the risk of lung cancer.

3.4 Feature Extraction

Feature extraction is a critical and crucial step in the prediction of lung cancer. Lung nodule is extracted by utilizing medical imaging such as CT scans and other diagnostic records. The nodules are quantified by the extracted features, and this information can be employed as input to train machine learning algorithms for prediction. The shape of the nodule can be extracted as an important feature. The mean intensity, standard deviation intensity and skewness are also significant features that are considered. The lung nodule location is the most crucial factor to be taken into account for the detection of lung cancer.

3.5 Feature Selection

Feature selection is employed in building predictive models for prediction of lung cancer as it promotes interpretability, decreases over fitting, and helps to improve model performance. Choosing the most useful aspects is crucial when predicting lung cancer because there are many different potential features. Principal Component Analysis (PCA) has been used to extract the features in the feature extraction phase. The feature extraction phase included the extraction of various distinct features using the technique of principal component analysis (PCA). Size is a crucial characteristic in the feature selection process (Fig. 5).

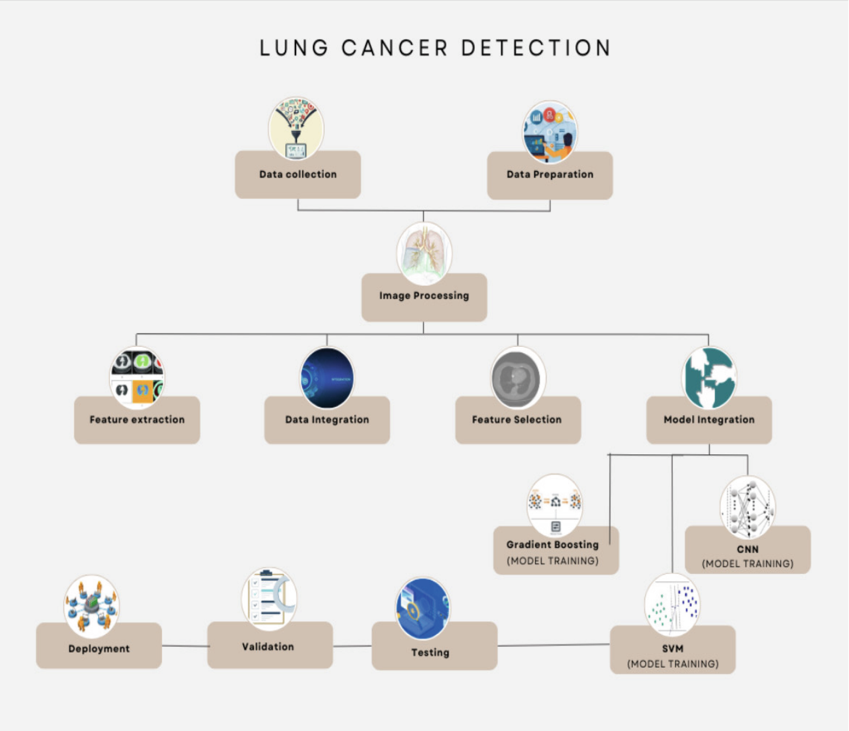

LUNG CANCER DETECTION
Data collection
Data Preparation
Image Processing
Feature extraction
Data Integration
Feature Selection
Model Integration
Gradient Boosting (MODEL TRAINING)
CNN (MODEL TRAINING)
Deployment
Validation
Testing
SVM (MODEL TRAINING)

Fig. 5. Represents the Architecture of the proposed work.

Algorithm:

Step 1: Get CT scan pictures and medical reports about them from places like LIDC-IDRI and TCIA. Make sure the records are clean and accurate by checking and cleaning them.
Step 2: Remove flaws from CT scan pictures by using noise reduction methods like median filtering or Gaussian smoothing. Normalize the image's color and contrast to get rid of

any differences. Do lung segmentation to separate parts of the lungs from things like the ribs and spine.
Step 3: Pull out the important parts of the CT scan pictures, such as the shape of the mass, the average intensity, the standard deviation intensity, and the skewness. Measure the features of a cluster and store them as feature vectors.
Step 4: Combine the image-based traits with information about the patient, such as medical records, genetic information, and whether or not they smoke.
Step 5: Use methods for selecting traits, like Principal Component Analysis (PCA), to find the most useful ones. By choosing a group of traits, you can make it easier to understand the model and reduce over fitting.
Step 6: Use the CT scan pictures that have already been cleaned up to train a Convolutional Neural Network (CNN). Mark the training data with the forms and places of lung nodules. Adjust the CNN's hyper parameters so that node segmentation is correct.
Step 7: Use the chosen traits to train a Support Vector Machine (SVM) to tell whether a tumor is cancerous or not. To train the SVM model, you need to use labeled data that shows how nodules are categorized. Based on the information, choose the right type of SVM (e.g., linear or kernel SVM).
Step 8: Use Gradient Boosting algorithms like XGBoost or LightGBM to predict the risk of lung cancer based on information about the patient. Fine-tune hyper parameters like learning rate and tree depth to get the best model results.
Step 9: Add the results of the CNN, SVM, and Gradient Boosting models together to make a single structure for making predictions. Make a plan for how to combine the results, like using weighted averaging or ensemble methods.
Step 10: Use a different test sample to judge how well the combined model works. Use cross-validation to figure out how reliable and useful a model is.
Step 11: Deal with issues of ethics and privacy that have to do with patient data and medical images.

Make sure you are following the rules and laws for healthcare.
Step 12: Use the method to find lung cancer in a practical setting with the help of doctors and nurses. Update the system regularly with new information and retrain the models so they can adapt to changing conditions and get more accurate over time.

4 Result and Discussion

Many studies have employed CNNs to detect lung cancer. To differentiate carcinogenic from non-cancerous lung anomalies in chest X-rays and CT scans, neural networks are commonly used. Binary or multiclass classification of anomalies is the main focus of these applications. CNNs have been widely used in lung tumor segmentation as well as classification. This use case uses CNNs to precisely identify and define lung tumor boundaries, helping doctors make accurate diagnosis and create effective treatment strategies. These technologies can also detect and evaluate minute lung tissue changes that may indicate early cancer development. In medical research, lung nodule detection is important. CT scan nodules are identified and assessed using CNN models. This procedure is critical to understanding these nodules' malignancy risk. Additionally, CNNs can extract important information from lung images. These derived features work well with typical machine learning classifiers. Combining CNNs and classical classifiers has improved lung image detection accuracy. Research often uses data augmentation to make models more robust to picture quality and patient-specific variables. They commonly use Convolutional Neural Networks. Transfer learning is popular in deep learning, especially for computer vision problems. It uses pre-trained CNNs from large datasets like Image Net. These pre-trained models can detect lung cancer by fine-tunin (Fig. 6).

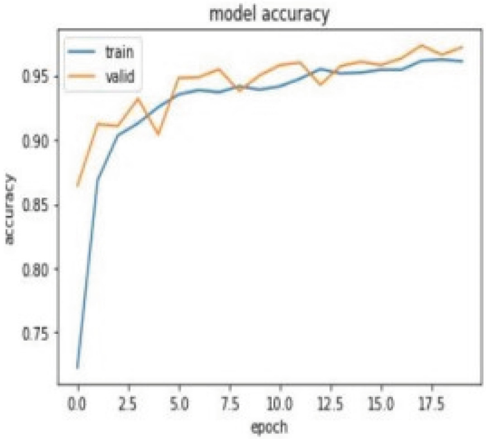


Fig. 6. Plot of Model Accuracy vs. Epoch for Training and Validation Image.

Transfer learning in lung cancer detection lets researchers exploits CNNs' image data knowledge and representations. This strategy takes advantage of the fact that CNNs trained on large-scale datasets have already learned to extract important features from images. These models can detect lung cancer patterns and irregularities by fine-tuning on lung cancer datasets. Transfer learning lets researchers use pre-trained CNNs' vast picture dataset knowledge. This method saves computational resources and training time and improves lung cancer detection models. Ensemble models are used in computer vision and other fields to increase model performance. Ensemble models use numerous CNNs to reduce model biases and improve performance. This method uses the diversity of the constituent models to make more accurate predictions. The ensemble model combines CNN predictions using voting or averaging to make a final prediction. Ensemble models outperform solo CNN models due to this collaborative approach. Enhancing CNN model interpretability is also gaining attention. Attention processes and gradient-based visualization are being used to identify image regions that influence the model's decision-making. Several image analysis studies have used clinical data including patient histories and demographics to construct lung cancer detection and evaluation models. The discipline has extensively studied convolutional neural networks (CNNs) in lung cancer diagnosis. This complete technique has improved detection accuracy, efficiency, and interpretability. Thus, medical imaging diagnosis and treatment have improved (Figs. 7 and 8).

The increased global concern over cancer-related deaths, particularly lung cancer, has highlighted the importance of early detection research methods. Lung cancer accounts

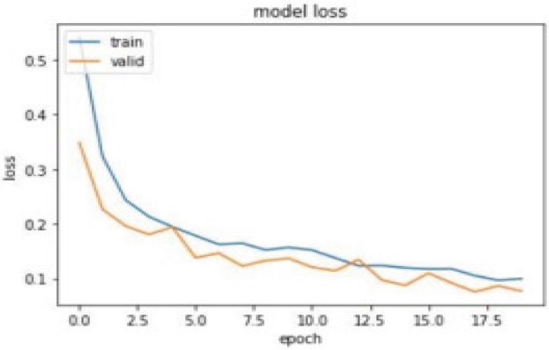


Fig. 7. Plot of Model Loss vs. Epoch for Training and Validation Images.

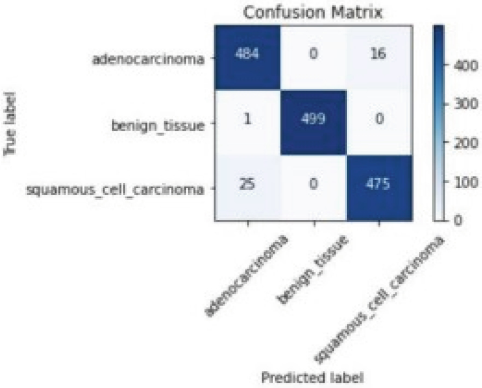


Fig. 8. Confusion Matrix of Different Image Categories for Validation Images.

for most cancer deaths worldwide, making it a major public health issue. This issue requires the development and implementation of more advanced diagnostic methods. The research has advanced with CT scans, which provide detailed information on tumor development and distribution. CT scans can provide precise insights into tumor growth and progression, surpassing other diagnostic methods. Medical imaging and cancer detection researchers use a multifaceted approach. The research begins with image preprocessing to improve CT scans. This critical stage commonly uses median filters to minimize noise and improve image clarity. Medical imaging analysis uses picture segmentation to accurately detect and describe regions of interest, primarily lung tumors. For tumor boundary demarcation, mathematical morphological techniques are useful. Geometric features including area, perimeter, and eccentricity are calculated after tumor region identification. A Support Vector Machine (SVM) classifier determines whether an anomaly is cancerous or benign. SVM classifier deployment yields a comprehensive and robust lung cancer detection approach in CT scans. Image processing and machine learning algorithms are promise for early-stage lung cancer identification. This combination could significantly reduce lung cancer fatalities (Figs. 9a and b).

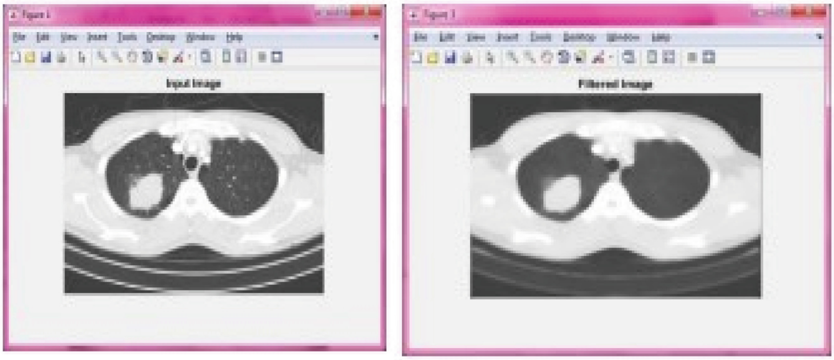

File Edit View Insert Tools Desktop Window Help
Input Image
File Edit View Insert Tools Desktop Window Help
Filtered Image

Fig. 9 **a** Original image. **b** Filtered image

During the segmentation stage, the input image undergoes a process of division into multiple constituent parts, thereby yielding the desired region of interest (ROI) for subsequent stages. The extraction of the desired region of interest (ROI) is achieved through the utilization of a technique known as morphological operations, which relies on the application of a structuring element. Subsequently, this resultant output is employed as a mask to isolate and extract the tumor region from the scanned computed tomography (CT) image.

Upon analysis of the data obtained subsequent to the process of segmentation, it has been determined that the region of interest corresponds to the presence of a tumor. In the context of our investigation, it is imperative to ascertain the various geometrical attributes, namely area, perimeter, and eccentricity. These aforementioned features are subsequently transmitted to the classifier as inputs, with the ultimate objective of substantiating the classification of cancer as either malignant or benign. Following the process of feature extraction, the subsequent step involves the utilization of the Support Vector Machine (SVM) classifier to discern the nature of the CT scan images, specifically whether they exhibit characteristics indicative of malignancy or benignity.

Upon the completion of the classification process, the resultant output is subsequently conveyed and visually presented on the liquid crystal display (LCD) module, employing the Arduino Uno microcontroller board (Fig. 10).

The input computed tomography (CT) images undergo a process of block division, wherein they are partitioned into smaller units. Subsequently, the blocks that do not contain relevant information and are deemed non-informative are eliminated, thereby facilitating subsequent pre-processing procedures. The elimination of undesired artifacts and noise within the CT scan images is undertaken with the objective of enhancing the textural fidelity pertaining to the nodules. The nonlinear anisotropic diffusion filter is employed to effectively eliminate undesired artifacts. The provided input image, sourced from the dataset, has undergone preprocessing through the utilization of an

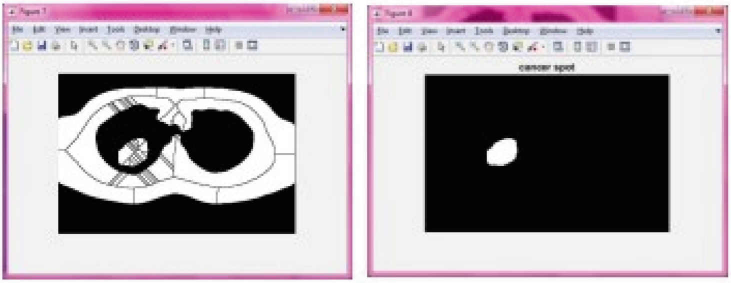


Fig. 9(c). Segmented image.

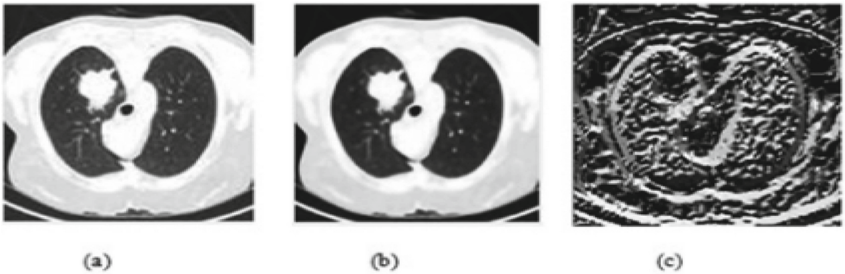


Fig. 10(a). (a) Input CT image, (b) Preprocessed image using anisotropic nonlinear diffusion filter, (c) Texture features.

anisotropic nonlinear diffusion filter. Additionally, the proposed research has facilitated the extraction of texture features from the aforementioned input image. Upon examination, it becomes evident that the application of the anisotropic nonlinear diffusion filter effectively mitigates noise while concurrently augmenting the image's textural attributes. This methodology facilitates the extraction of features in a more optimal manner, thereby enabling their subsequent analysis to be conducted with greater precision and depth. The quantification of the efficacy of the employed pre-processing technique is accomplished through the computation of the Peak Signal-to-Noise (PSNR) ratio. The Peak Signal-to-Noise Ratio (PSNR) is widely acknowledged as the predominant metric employed for evaluating the effectiveness of DE noised or compressed images. The mean Peak Signal-to-Noise Ratio (PSNR) achieved in the present study amounts to 34.56 decibels (dB) (Fig. 10c).

In order to ascertain the efficacy of the random walker method in enhancing segmentation performance, we proceed to delineate and extract the boundaries of the pulmonary nodules through the utilization of said method. The lung nodule CT images that have undergone pre-processing are subsequently inputted into the segmentation block, wherein the primary objective is to extract the delineations of the nodules. In the present study, the utilization of the random walker methodology is contemplated. Figure depicts the original CT image, the ground truth standard, and the outcome of the segmentation process. The efficacy of the random walker method in accurately segmenting small and micro nodules for subsequent processing is evident.

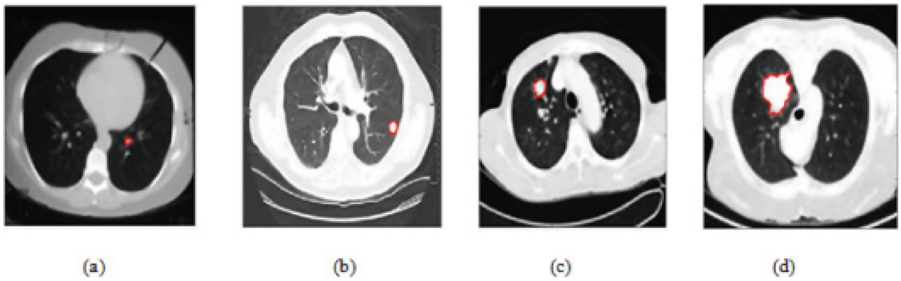
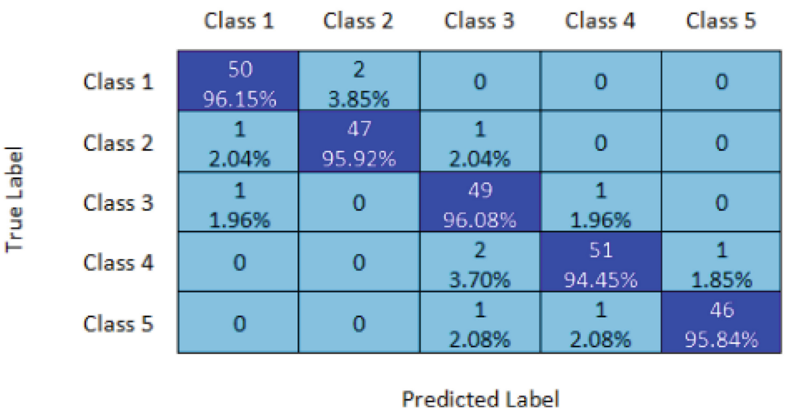


Fig. 10(b). (a) Boundary of benign class 1 nodule, (b) Boundary of benign class 2 nodule, (c) Boundary of malignant class 4 nodule, (d) Boundary of malignant class 5 nodule.

The segment that is concealed denotes the specific nodule that is being contemplated for the purpose of analysis (Fig. 10c).



True Label \ Predicted Label	Class 1	Class 2	Class 3	Class 4	Class 5
Class 1	50 96.15%	2 3.85%	0	0	0
Class 2	1 2.04%	47 95.92%	1 2.04%	0	0
Class 3	1 1.96%	0	49 96.08%	1 1.96%	0
Class 4	0	0	2 3.70%	51 94.45%	1 1.85%
Class 5	0	0	1 2.08%	1 2.08%	46 95.84%

Fig. 10(c). Confusion matrix of the proposed modified gradient boosting classifier

The proposed modified gradient boosting classifier has been trained and tested using the provided dataset. The complete dataset is partitioned into a ratio of 75:25, with 75% allocated for training purposes and 25% reserved for the validation of the proposed classifier. Among the corpus of 1018 CT scan images, a total of 764 have been employed for the purpose of training the classifier model that has been put forth. The remaining subset of 254 images, on the other hand, has been designated for the validation of the aforementioned model.

The proposed method generates a confusion matrix to classify the test dataset into various classes, namely benign class 1 nodule, benign class 2 nodules, non-nodules class 3, malignant class 4 nodules, and malignant class 5 nodule. This matrix is visually represented in Fig. 9(c).

5 Discussion

In this scholarly endeavor, a novel adaptation of the gradient boosting classifier was put forth with the aim of discerning pulmonary nodules and categorizing them into three distinct classes: benign, malignant, or non-nodule. The CT scan images acquired from the LIDC-IDRI dataset underwent pre-processing procedures aimed at artifact removal through the application of an anisotropic nonlinear diffusion filter. This particular approach yielded a peak signal-to-noise ratio (PSNR) of 34.56 decibels (dB), as observed. The demonstrated results substantiate the effectiveness of the employed pre-processing technique. The utilization of the random walker technique was employed in order to extract the delineations of the pulmonary nodules from the pre-processed computed tomography (CT) scan images. The examination of the ground truth standard and the segmented result acquired through the random walker method was subjected to analysis utilizing the Dice Similarity Coefficient (DSC) and the Jaccard Similarity Coefficient (JSC), yielding values of 0.979 ± 0.011 and 0.877 ± 0.008, correspondingly. The veracity of the proposed research was juxtaposed with established methodologies, namely the graph cut method, watershed method, 3D U-Net [36], and 3D FCN [37]. Upon careful examination as shown in Fig. 1, it becomes evident that the application of the random walker method for pulmonary segmentation has yielded superior results in terms of Dice Similarity Coefficient (DSC) and Jaccard Similarity Coefficient (JSC) when compared to alternative methodologies currently in existence. The primary contribution of the proposed research lies in its ability to effectively segment the suitable region of the pulmonary nodule across various cases. The proposed modified gradient boosting classifier was trained and tested using the LBP filter and steerable Riesz wavelet coefficients to extract texture features from the segmented image. The utilization of steerable Riesz wavelet functions facilitates the steering of said functions towards the direction of the local gradient energy. This particular approach proves to be more apt for the purpose of analyzing and processing the intricate texture present within CT images. The performance evaluation of the proposed classifier was conducted by employing metrics such as ROC accuracy, precision, recall, and F1 score.

6 Conclusion

The proposed system for lung cancer detection entails a comprehensive and advanced approach that integrates a multitude of machine learning algorithms and techniques in order to enhance the precision and effectiveness of lung cancer prediction. The system utilizes Convolutional Neural Networks (CNN) to perform lung nodule segmentation on CT scans. It employs Support Vector Machines (SVM) to classify cases as either malignant or benign, using extracted features. Additionally, Gradient Boosting algorithms such as XGBoost or LightGBM are employed to analyze patient data and make predictions regarding the risk of lung cancer. The data collection process leverages publicly accessible datasets, namely the Lung Image Database Consortium and Image Database Resource Initiative (LIDC-IDRI) and The Cancer Imaging Archive (TCIA), encompassing CT scans and medical reports. The application of image preprocessing techniques, such as noise reduction, normalization, and lung segmentation, serves to optimize the quality and precision of the input data. Feature extraction is an integral component within the system, wherein pertinent data derived from CT scans and diagnostic records is quantified for the purpose of training machine learning models. In order to enhance the accuracy of prediction, various features are extracted to characterize lung nodules. These features include nodule shape, mean intensity, standard deviation intensity, and skewness. Feature selection is a crucial step in the data analysis process. It involves utilizing techniques such as Principal Component Analysis (PCA) to identify the most informative features. This aids in enhancing the interpretability and generalization of the model.

The proposed system exhibits significant potential in the realm of early lung cancer detection, thereby facilitating healthcare professionals in the accurate diagnosis and efficacious treatment of this life-threatening ailment. The system synergistically combines the advantageous aspects of multiple machine learning methodologies and effectively exploits a wide array of data resources to enhance the precision of prognostications, thereby potentially safeguarding human lives via prompt intervention and therapeutic measures.

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Public Bicycle in the Context of Sustainable Mobility

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Abstract. Getting around the city, especially during rush hours, is a big challenge for many people. It often takes several dozen minutes to go through the home-work-home section. Congestions and their negative effects are an integral part of travel. Modern cities, in order to cope with the growing number of urban inhabitants, must evolve, looking for solutions that will meet the upcoming challenges. These solutions should be long-term, with a perspective of at least several dozen years. It is important to properly plan urban space, which will take into account the need to develop pedestrian and bicycle infrastructure. The challenges of the 21st century also include further, often uncontrolled development of cities, growing air pollution and lack of physical activity of residents. Following the example of European cities, Polish city authorities should follow trends such as the sharing economy and electromobility. City dwellers are increasingly using light electric vehicles to travel short distances. These include bicycles and electric bicycles. The main advantages of bicycles include that they take up less space when moving and parking, they are one of the fastest means of transport in the city on a door-to-door basis, and electric bicycles can compete with a passenger car for last mile speed. The bicycle is also seen as one of the main elements of sustainable urban mobility.

Keywords: public bicycle · sustainable mobility · shared mobility

1 Introduction

City bike systems implemented in cities are finding more and more supporters who use bikes mainly for short distances. Today, the bicycle can be considered an element of the urban transport system [1, 2]. The organization of bicycle transport in cities includes the creation of special traffic zones and the creation of the so-called city bike rentals that can serve both city residents and tourists [3]. It is indicated that city bikes have a great potential for increasing mobility services, which is why city authorities strive to develop urban bicycle systems [4]. The arrangement of bicycles and their stations is carefully selected and matched to the colors typical of the city or its surroundings, in order to skillfully integrate the city bicycle rental system into the urban space. These assumptions should be prepared and taken into account at the stage of planning the assumptions for the overall strategy of transport operation in cities, and local governments, which are responsible for shaping transport policy in these spaces, are responsible for their proper preparation [5].

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The implementation of city bike systems also makes it possible to counteract climate change, change the urban transport system and change energy consumption and save resources. Cycling is a friendly means of transport on road surfaces, it is a way to express an active and healthy lifestyle, conscious of ecology. Bicycles influence the development of green areas in cities and provide freedom of movement without having to adapt to travel schedules. City bikes improve the quality of life of city residents, complement and integrate public transport in cities and are an alternative means of transport for tourism. In addition, electric bicycles can be a way to overcome barriers that make it difficult for residents to cycle, such as: long distances (allowing them to cover longer distances with the same effort compared to conventional bicycles), natural obstacles: hills and wind, limited load capacity (allowing the transport of goods heavier than traditional bicycles and traditional cargo bicycles; this is an advantage for people shopping by bicycle and for companies delivering e.g. food in the city), the development of higher speeds [6]. Electric bikes enable mobility for groups of people who were previously excluded and could not ride a traditional bike due to their physical condition.

2 Public Bicycle as an Additional Means of Transport in the City

The way to achieve the goal contained in both the National Urban Policy 2023 and the White Paper (goal: planning and conducting comprehensive activities aimed at changing the communication behavior of residents, as well as providing high-quality urban mobility services, while managing resources economically) is ensuring an efficient public transport system in urbanized areas. The result of these activities should be a reduction in the share of individual motorization in cities or a complete abandonment of owning a passenger car in favor of using shared means of transport. An institutional condition that is an advantage and at the same time favors the implementation of mobility balancing strategies in cities is the popularization by local governments of shared means of transport, such as bicycles [7].

Issues such as generations and operating models are closely related to the concept of city bikes. Technological solutions that enable bike rental and return are called generations. The operating model determines how the system is used and the place where bicycles can be rented and returned. First generation systems were launched in Amsterdam by the Provo movement in 1965. Bicycles painted white were placed in various parts of the city, which was intended to draw the attention of the then local government authorities, mainly to the problem of congestion. Bicycles could be rented and returned anywhere, but this initiative was quickly ended by the introduction of laws under which unsecured bicycles were considered abandoned and therefore cleaned up by city services [8]. First generation systems are no longer available on a mass scale.

Second generation bicycles were introduced in the 1990s [9]. The most important action that distinguished this system from the first generation was the introduction of a small deposit for renting a bicycle in the form of a coin that released the clasp (a solution previously used in shopping carts). Specific places for renting and returning bicycles were created, but the length of the user's bicycle rental was beyond the operator's control. Still, as in the case of the first generation, the identity of the people renting the bike was unknown.

Third generation city bikes are a city bike system based on IT solutions. These bicycles are distinguished by color, design and advertising, often their colors are adapted to the colors characteristic of a given city or area. The docking stations are equipped with a terminal with an interface that operates the system. The stations are often powered by electricity and equipped with electric locks. Renting and returning a bike is possible via the mobile application or using a special card.

The 4th generation of city bikes are multimodal systems that respond to demand. The bikes are equipped with an on-board computer. They can be operated via a mobile application downloaded to the phone. It is also possible to rent an electric bike. Bikes for rent can be searched in the app and can also be left anywhere after use (no docking stations required). The bikes have built-in wheel locks. The bicycle redistribution system is flexible, but the costs of maintaining the system and purchasing bicycles are much higher than, for example, in the case of third-generation bicycles.

The feature that distinguishes the fourth generation from the third generation is the departure from the idea of a smart docking station - that is, a docking station for picking up and returning bicycles, towards “smart bikes” (bikes with built-in identification, rental, locking and return systems). The role of the docking station is taken over by the bike itself, equipped with an electric lock and multi-system electronic supervision in real time. The role of the rental terminal in the 3rd generation docking station is partly taken over by a smartphone with Internet access, and partly by an active rental panel built into the bike of the 4th generation system and powered by a battery. The literature increasingly mentions the next, 5th generation, which includes electrically assisted bicycles [10].

Contemporary system solutions that combine space and transport planning are aimed at increasing the use of bicycles as a means of transport. The popularity of bicycles, including electric ones, is not decreasing, and the number of people traveling by this means of transport will continue to increase. Moreover, each journey by bicycle instead of by car contributes to significant savings and benefits both for the individual and for society as a whole.

3 Materials and Methods

In order to conduct a detailed analysis and learn about the transport decisions of urban transport users, it is necessary to conduct research on consumer behavior. A detailed analysis will provide the necessary knowledge to make transport decisions on the supply and demand sides. For this purpose, an advanced methodological apparatus developed in market and consumption research as well as in marketing analyzes is used. According to M. Ben-Akiva and S. Lerman, choices can be considered the result of a sequential decision-making process that includes stages such as: defining the choice problem, generating alternatives, assessing the attributes of each alternative, selecting and applying the choice [11].

The publication uses dynamics indicators that determine the ratio of the level of a phenomenon in the examined period to the level of a phenomenon in another period, the so-called basic period (e.g. increase in the length of bicycle paths in 2011–2021), structure indicators that determine the ratio of part of the community to the entire community (e.g. share of the length of bicycle paths in individual voivodeships to the total length of bicycle paths in Poland) and intensity indicators – present the ratio of two different numbers or statistical values, presenting one phenomenon against the background of another that is logically related to it.

4 Results

Moving around urban agglomerations is becoming more and more difficult, which is why various alternative solutions are emerging, including renting a city bike. New sources of financing have emerged, which have enabled the implementation of innovative infrastructure solutions that can be used by city bike users. One of the elements that influences the behavior of consumers using urban bicycle systems is the condition of bicycle infrastructure in Poland. Figure 1 shows the length of bicycle paths in Poland in 2011–2021. You can notice a systematic increase in the length of bicycle paths, which in 2021 amounted to 18,509.9 km (an increase of 1,255.3 km).

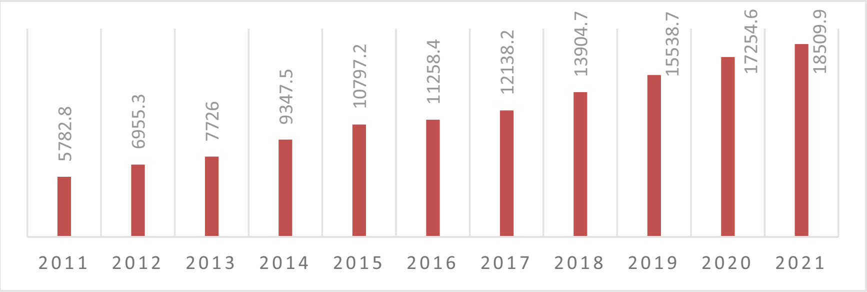

Fig. 1. Length of bicycle paths in Poland in 2011–2021 [km]

The expansion of bicycle paths is an additional incentive for residents to use this means of transport. This additionally leads to an increase in the share of bicycle transport in the city's transport system, which in turn improves air quality in cities, mobilizes society to increase physical activity, and ultimately reduces traffic in the city and reduces the number of road accidents. The dynamic construction of bicycle routes is also the result of the investment of European funds from the regional program for 2014–2020.

The leader in terms of the length of bicycle paths in Poland in 2021 was the Masovian Voivodeship (Fig. 2). The voivodeship in which the capital of Poland is located has 2,709.8 km of bicycle routes. The next places are taken by the Greater Poland Voivodeship (2,338.7 km) and the Pomeranian Voivodeship (1,549.9 km). The voivodeship with the shortest bicycle routes is the Świętokrzyskie Voivodeship (418.8 km), the Opole Voivodeship (582.3 km) and the Podkarpackie Voivodeship (719.3 km).

It should be noted that 2020 is the first year in which society in Poland felt the effects of the COVID-19 pandemic, which created both new threats and previously unforeseen challenges for the functioning of urban transport systems. Radical mobility restrictions introduced in many countries in various regions of the world, including Poland, have resulted in a significant decline in population mobility.

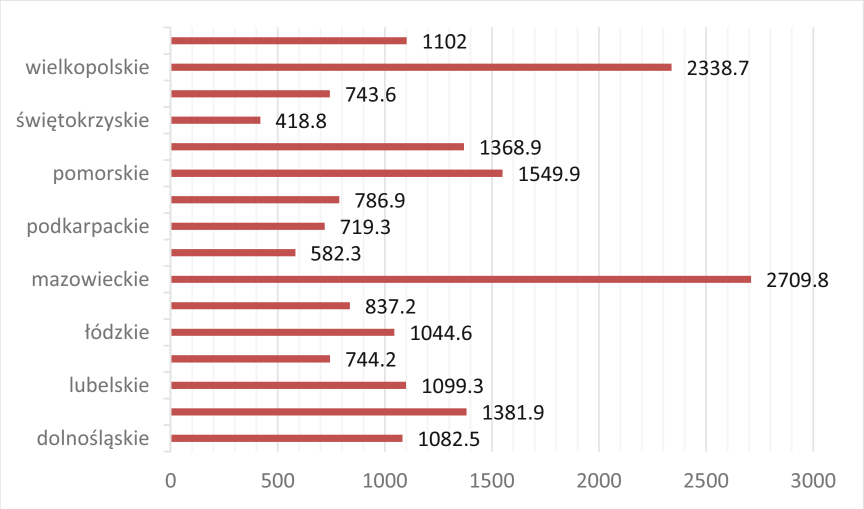

Fig. 2. Length of bicycle paths in individual voivodeships in Poland in 2021 [km]

Data from the Central Statistical Office show that in 2021 as many as 61.6% of Poles ride a bike. This bicycle can be a privately owned vehicle, but it can also be a shared bicycle, functioning as an urban bicycle system and supporting the city's transport system. In the Market Research Future report, the size of the global bicycle market was valued at USD 68.17 billion in 2021, and by 2030 it is expected to be worth USD 116.55 billion [9]. The growing popularity of two bicycles is the result of the modernization and expansion of bicycle infrastructure, as well as restrictions introduced during the COVID-19 pandemic, when the bicycle became a more attractive means of transport than the bus or tram because the bicycle allowed maintaining social distance. Other advantages include the ability to move quickly, pro-environmental activities (less exhaust fumes, less pollution) and improved physical condition.

Despite the pandemic, further investments were made in Warsaw aimed at building further bicycle routes, thanks to which in 2021 the length of the bicycle network in the capital exceeded 700 km and as of December 31, 2021 amounted to 710 km (Fig. 3).

As shown in Fig. 3, bicycle paths constitute the largest share - 72.7% of the total structure of bicycle routes marked with road signs. This is followed by shared paths for bicycles and pedestrians - 11.3%, streets with counter-traffic - 8.1%, bicycle lanes - 7.2%, and finally contra-lanes - 0.7%. Interest in the Warsaw city bike Ve-turilo in 2021 remained at a level similar to 2020 (bikes were rented a total of over 3 million times).

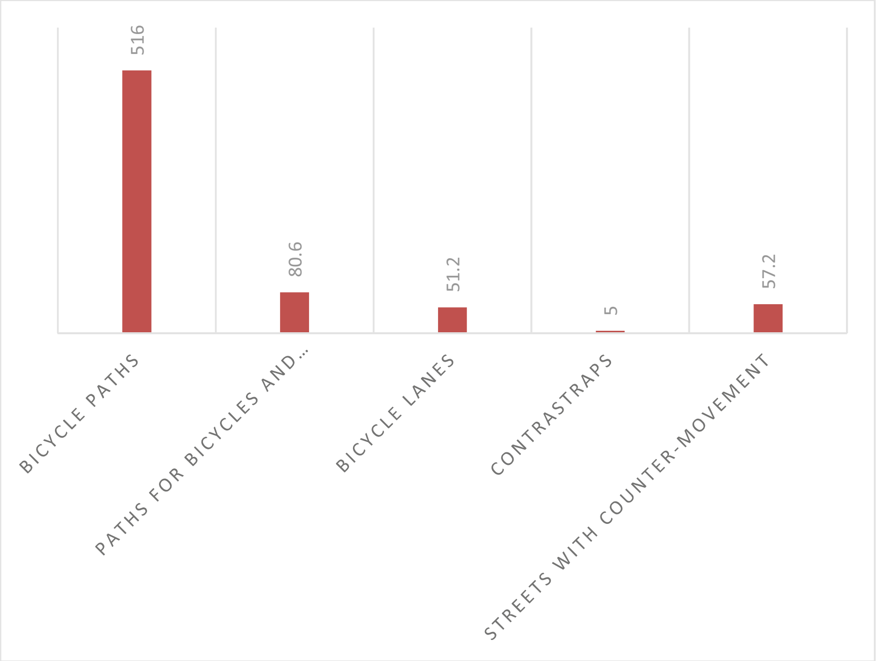

Fig. 3. Structure of bicycle routes in Warsaw in 2021 [km]

5 Discussion

More and more often, Polish cities encourage everyday journeys using a city bike. Tasks related to operating the city bike system in Poland concern access to the regional, municipal and city bike systems, depending on the calendar year. Most often, the bicycle operates in the summer season due to the fact that in the winter season there are certain restrictions related to weather conditions, however, this is not a rule, as there are known cases of urban bicycle systems operating throughout the year. Other restrictions include clothing, usually related to the position held in the workplace and the necessary infrastructure in the workplace. Therefore, priority challenges for Polish city bike systems can be identified, which concern the following elements:

- changes in the mentality and habits of residents,
- ensuring conditions for flexible and easy installation of the system,
- supervision with the ability to track bicycles in real time,
- possibility of using the latest mobile solutions (smartphones, applications, NFC technology),
- stability of the technological platform,
- optimization of bicycle allocation.

In order to take on the above challenges, it is necessary to select an appropriate operator (contractor), i.e. a private entity that will handle the operation of the bicycle system, at the initial stage of designing a city bike system for a given city/agglomeration.

It is also worth mentioning the benefits of using bicycles (not only system ones). These estimates are provided by the European Cyclists' Federation for the European Union [12]:

- reduction of CO2 emissions: EUR 0.6–5.6 billion,
- reduction of air pollution: EUR 0.435 billion,
- noise reduction: EUR 0.3 billion,
- fuel savings: EUR 4 billion,
- longer and healthier life: EUR 73 billion,
- reduced sickness absence at work: EUR 5 billion,
- development of the bicycle market and related benefits: EUR 13.2 billion,
- development of bicycle tourism: EUR 44 billion,
- congestion reduction: EUR 6.8 billion,
- savings on the costs of construction and maintenance of road infrastructure for motor vehicles – EUR 2.9 billion.

The presented benefits of using a bicycle are based on three dimensions of sustainable development: environmental, economic and social. They concern issues such as: environment (climate), business, social issues, energy (resources), technology, mobility, health, time (space) and cultural diversity.

6 Conclusions

With the increase in prosperity, industrial development and globalization progress, consumer behavior patterns and their various decisions regarding the forms, means and methods of satisfying transport needs are changing rapidly. Urban transport has become one of the most important services of a developed society. The growing demand for human mobility, motivated mainly by the spatial diversity of locations to which people need access, makes the choice of means of transport very important for every developed country.

Changing the communication behavior of city residents towards the use of urban bicycle systems can lead to significant savings and benefits, both for the user and the environment. An important aspect are the factors determining these behaviors, such as: residents' responsibility for the natural environment and the desire to reduce the negative impact on the quality of life (no noise and pollution), protection of buildings, including historic ones, and vegetation, avoiding traffic congestion in the city center, or savings economic. City dwellers are also looking for ways to supplement public transport on the first and last mile sections, so city bikes can be an ally of public transport.

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Trends in EV Charging Stations Infrastructure Development in Poland

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Abstract. Environmental issues and the need to reduce the consumption of fossil fuels have become a leading element of the contemporary socioeconomic policy of the European Union. One of the tools for implementing pro-environmental policy aimed at reducing the share of greenhouse gas emissions by the transport sector is the replacement of the combustion engine with an electric drive. Electric vehicles have a much smaller carbon footprint and are much less energy-intensive than combustion vehicles. However, a wider scale of use of electric vehicles in the realities of modern economies is determined by the charging stations infrastructure, characterised by specific features that can ensure smooth and uninterrupted operation of the BEV vehicle.

The purpose of the article is to identify the development trends in charging stations infrastructure in Poland. Based on data characterising the current state of development of charging stations infrastructure in Poland, a diagnosis of its development trends was made, along with an attempt to identify potential threats.

Keywords: battery electric vehicles (BEVs) · EV charging stations · zero-emission transport · sustainability

1 Introduction

In July 2021 The European Commission announced the "Fit for 55" climate package, setting ambitious CO2 reduction targets within the European Union. By the climate goals adopted in the document, by 2030 CO2 emissions are planned to be reduced by at least 55% compared to 1990. In turn, by 2050, the European Union intends to achieve net zero CO2 emissions and become the first climate-neutral continent [1].

The announced package, called the European Green Deal, is a pillar of energy transformation and directly addresses the urgent need to decarbonise road transport. According to data at the end of 2022 global CO2 emissions from the transport sector amounted to almost 8 Gt, of which road transport was responsible for 74% of this value [2]. The scale of the negative impact of the transport sector on the natural environment justifies the transport decarbonization strategy announced by the European Union, based on a paradigm shift in the type of propulsion of vehicles involved in road traffic and a transition from traditional drives (powered by liquid fuels) to zero-emission drives (BEV).

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However, the electrification of transport is a complex process that requires the simultaneous consideration of many complementary technologies that need to be used to achieve zero-emission mobility. One of them is the infrastructure of EV charging stations, which ensures the comfort and efficiency of using BEVs.

The purpose of the article is to identify the development trends in charging stations infrastructure in Poland. Based on data characterising the current state of development of charging stations infrastructure in Poland, a diagnosis of development trends will be carried out, with a simultaneous attempt to identify potential threats in the subject of the article.

2 The Importance of EV Charging Stations for Transport Electrification

Electric vehicles (BEV) and charging stations infrastructure should be treated as intrinsically complementary to each other and should be used to determine the effectiveness of the implementation of the concept of decarbonisation of the transport sector. Previous scientific research has proven that the lack of availability of charging stations infrastructure is a key barrier to the dissemination of electric vehicles [3–6]. A characteristic feature of BEVs is their limited range, understood as the distance that can be covered, which is determined by the battery capacity of a given vehicle. There is no doubt that the distance that can be covered with a fully charged battery is much shorter than the distance that can be covered with a full tank of fuel (as is the case with classic vehicles powered by an internal combustion engine). Therefore, to maintain smooth and uninterrupted mobility, the use of a BEV vehicle requires access to the charging stations infrastructure allowing the vehicle to be recharged. Additionally, referring to the above-mentioned comparison, BEV to combustion vehicles - it should be emphasised that the time necessary to recharge a BEV is much longer than refuelling gasoline. The circumstances limit the functionality of electric vehicles and constitute a significant barrier to consumer purchasing decisions on the BEV market [7, 8]. Therefore, it should be concluded that a large infrastructure of publicly available electric vehicle charging stations - both in terms of their number and their appropriate geographical distribution - will significantly eliminate barriers and contribute to smoothing and balancing the share of alternative means of transport (combustion-powered vehicles versus electric vehicles) [9].

In addition to the mentioned capacity of the BEV battery, the factor determining the smooth use of an electric vehicle is the time necessary to recharge the battery powering the vehicle. This, in turn, depends on the type of current supplying the charging station and the technology used. In practice, two solutions are most common. The first is based on alternating current with an output power of up to 43 kW. This type of charging occurs in the case of charging stations called AC (alternating-current) stations, and their characteristic feature is an indirect way of charging the vehicle's battery: alternating current from the station goes to the rectifier with which the vehicle is equipped, whose role is to convert alternating current into direct current, which then charges the vehicle's battery. The second BEV charging model is vehicle charging with direct current with an output power of up to 350 kW. This type of charging occurs in the case of DC stations (direct current), and its characteristic feature is the direct method of charging the battery, from the charging station to the vehicle battery [9].

The differences between the BEV charging models significantly affect the time required to charge the battery (Table 1). Fast charging stations (DC) offer the ability to charge the vehicle much faster than AC stations. Thus, the fast charging (DC) formula reduces anxiety about the available range and allows for a relatively smooth trip in a BEV. Using DC stations, it becomes possible to travel with electric vehicles over long distances, with short stops to recharge the vehicle [9, 10].

Table 1. BEV charging models and time to charge

Charger type and speed	Power rating	Approximate time to charge*
AC – single-phase (slow)	3–7 kW	7–16 h
AC – three-phase (normal)	11–22 kW	2–4 h
DC (fast)	50–100 kW	30–40 min
DC (ultra-fast)	$>$100 kW	$<$20 min
AC – single-phase (slow)	3–7 kW	7–16 h

It is important to note that with the development of technology for driving electric vehicles (e.g., an increase in the capacity of installed batteries), AC stations will be less and less useful in meeting the needs of BEV users. A larger battery capacity determines a longer vehicle charging time and there is no doubt that a fully charged battery will be desirable (to use the full functionality of the vehicle illustrated by its range). As a consequence, it can be assumed that the expected direction of future development of the infrastructure of publicly available charging stations will be to base the charging model on direct current (DC).

It is also worth highlighting that the full implementation of the concept of decarbonisation of the transport sector through electrification of the drive requires that the energy that powers electric vehicles come from renewable sources [11, 12]. Otherwise, the greenhouse effect resulting from the replacement of the combustion drive with an electric drive will not be fully achieved, and the scale of its occurrence will only be limited.

3 EV Charging Stations in Poland in 2019–2023

Before analysing the development of the charging stations market in Poland, it should be noted that decarbonisation and electrification of road transport is a global phenomenon. In 2022, electric vehicle sales exceeded 10 million units, and up to 14% of global car sales were electric vehicles, which means a significant increase in BEV sales. Therefore, it should be noted that in 2021 the share of BEVs in global car sales was estimated at 9%, and in 2020 it was less than 5% [13].

In Poland, there is also a growing interest in electric vehicles (Fig. 1). As of the end of the second quarter of 2023, there were 84.691 electric vehicles registered in Poland the dominant part of which were passenger cars (80.323 vehicles, 95% of the total). Between 2019 and 2023 the average quarterly growth rate of the number of electric vehicles fluctuated around 18%, as a result of which at the end of the second quarter of 2023 the number of electric vehicles was sixteen times higher compared to the beginning of 2019 and 64% higher compared to the same period in 2022 [14].

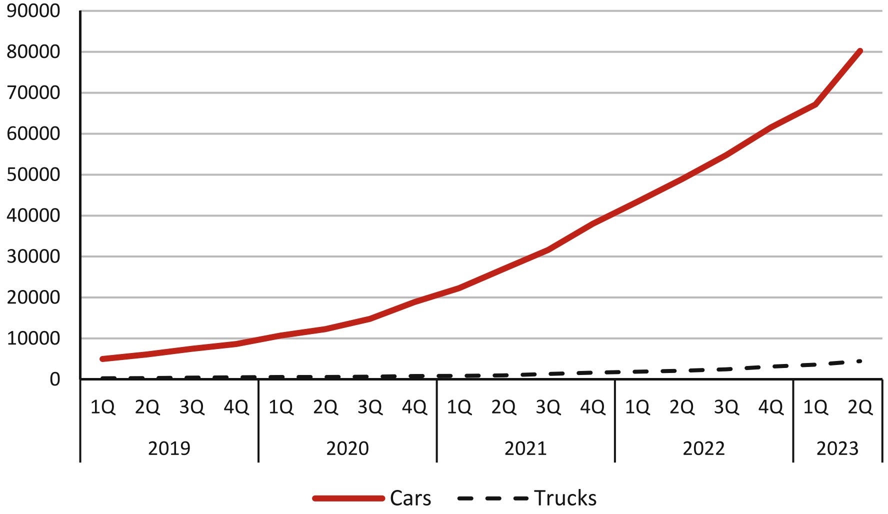

Fig. 1. The number of electric vehicles (cars and trucks) in Poland in the 1Q2019-2Q2023 period (as at the end of the period) [14]

Parallel to the electric vehicles, the infrastructure of publicly available charging stations is developing in Poland (Fig. 2). At the end of the second quarter of 2023, there were 2.885 publicly available charging stations in Poland, offering a total of 5.709 charging points. In the period under consideration, the average quarterly growth rate of the number of publicly available charging stations is 10% (quarter by quarter), and the dominant type of station is alternating-current (AC) charging stations with a power of less than or equal to 22 kW. Direct current (DC) charging stations constitute only 31% of the total number of publicly available charging stations operating at the end of Q2 2023.

To assess market saturation with the infrastructure of publicly available charging stations, it is worth referring to the ratio showing the number of electric vehicles per charging point or station. The value of the above-mentioned indicators estimated for the years 2019–2023 shows an increasing trend - the number of vehicles per station and charging point increases from quarter to quarter (Fig. 2). The illustrated phenomenon is the result of the disproportionate dynamics of the development of the electric vehicle market and the development of the infrastructure of publicly available charging stations. Consequently, at the end of Q2 2023, there were 15 electric vehicles per charging point in Poland.

The last notable feature that characterises charging stations is their location. As of the end of Q2 2023, there was only 1 city in Poland with the number of charging stations

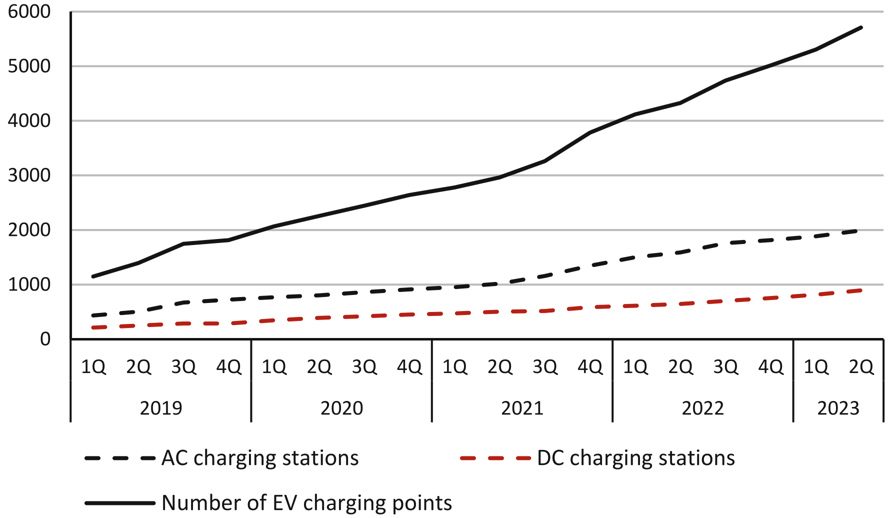

Fig. 2. The number of EV charging stations and EV charging points in Poland in the period (as at the end of the period) [14]

exceeding 300 (Warsaw). In two cities, the number of charging stations was in the range of 100–150 stations (Gdansk and Katowice), while in eight cities the number of chargers was in the range of 50–100 units (Krakow, Szczecin, Poznan, Wroclaw, Olsztyn, Torun, Sosnowiec, Lodz). It turns out that almost half of the charging stations operating in the Polish economy were built in 11 cities [14].

4 Conclusions

Certainly, the electrification of road transport is a contemporary development trend in the transport sector. The gradual electrification of road transport has a significant impact on the burden of pollutants emitted into the atmosphere, contributing to improving air quality and the protection of the living conditions and health of local communities, especially those concentrated in urban agglomerations. Nevertheless, full implementation of the concept of decarbonization in transport requires ensuring appropriate conditions for the correct and effective replacement of the combustion engine with an electric drive. This involves providing a vast infrastructure of publicly available charging stations, both in terms of quantity and space.

Despite a relatively short history of operation, the infrastructure of public charging stations in Poland is developing quite dynamically, and based on the collected material, current development trends in this process can be identified.

First of all, it can be seen that the dynamics of the increase in the number of charging points do not follow the process of electrification of the vehicle fleet, which is progressing much faster. During the period covered by the analysis, the number of electric vehicles per charging point tripled (from 5 to 15). The continuation of this trend, especially given the ban on the sale of combustion-powered vehicles, may mean a shortage of charging stations from the perspective of the needs of their users.

Another feature can be noticed by analyzing the structure of publicly available charging stations from the point of view of the power offered. In Poland, there is a tendency to build AC charging stations, which during the analysis period permanently represent a 70% share in the entire infrastructure of publicly available charging stations. The dominant share of free charging stations, combined with the above-mentioned potential market shortage of stations, only deepens the problem of the availability of charging points in the future. Furthermore, it should be noted that the continuation of the development of the said infrastructure with the dominant share of AC stations may be considered contrary to the direction of technological progress. After all, the market offer for electric vehicles is gradually expanding and the main area of interest of market participants is the increasing range of an electric vehicles. The achievement of this effect is possible only due to the increased battery capacity, resulting in a longer vehicle charging time [9].

The third area in which a certain feature is noticed concerns the location of publicly available charging stations. Almost half of all charging stations are located in 11 urban areas. The observed circumstances indicate a relatively small geographical distribution of charging stations. The poorly developed infrastructure of public charging stations in spatial terms, in turn, determines difficulties in the form of disruption of the smooth operation of electric vehicles in everyday traffic, but also constitutes a barrier to covering longer distances and reduces the tourist attractiveness of Poland.

The presented problems certainly do not exhaust the essence of the issue. They are only an attempt to diagnose the current state of development of the infrastructure of publicly available charging stations in Poland, indicating development trends and possible dysfunctional areas that pose potential barriers to further development. The dynamics of changes taking place in transport are so fast that the need to eliminate the above-mentioned problems should be treated not as a possibility but as a high necessity.

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Innovative Methods in Warehouse Management A Comprehensive Review

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Abstract. This comprehensive review article examines innovative methods in warehouse management to address the challenges posed by omni-channel logistics in multi-channel retailing. The article focuses on three key areas: developing strategies and solutions to adapt warehouse operations and design, integrating IoT technology into warehouse management systems, and utilizing RFID technology in warehouse operations. The results of this review offer knowledge, for researchers in the realm of warehouse management.

Keywords: Innovative Methods · Warehouse Management · Energy Sector · Developing Strategies

1 Introduction

This chapter aims to address the challenges of omni-channel logistics in warehouse management by exploring innovative methods in three key areas: developing strategies and solutions, integrating IoT technology, and utilizing RFID technology. By addressing the research inquiries this study adds to our comprehension of the issue offers insights for researchers, in the realm of warehouse management [1].

In the first area, the article delves into the need for developing strategies and solutions that effectively meet the challenges of omni-channel logistics. The rise of multi-channel retailing has necessitated the adaptation and optimization of warehouse operations to cater to the demands of multiple channels. By following best practices, such as cross-channel optimization, warehouse managers can reduce waste, improve operational and distribution performance, and enhance overall business performance [2]. This research focuses on the importance of cross-channel optimization as an opportunity for improving supply chain performance and reducing costs.

The second area of focus is the integration of IoT technology into warehouse management systems. Incorporating IoT technology offers potential benefits such as enhanced visibility, speed, efficiency, and inventory management [3]. Real-time visibility allows for better tracking and monitoring of inventory, leading to improved decision-making and reduced operational costs. The article emphasizes the importance of implementing IoT technologies to provide real-time visibility, increase speed and efficiency, and prevent inventory shortages and counterfeiting.

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The third area examines the utilization of RFID technology in warehouse operations. RFID technology offers advantages in terms of resource management, accuracy, and customer service. It has various applications in warehouse management, including inventory tracking, order fulfillment, and asset management. This research investigates the various applications of RFID technology and discusses the development of effective methods for its implementation to optimize resource management and improve overall performance [4].

By conducting this research, we aim to contribute to the understanding of warehouse management in the context of omni-channel logistics. The research problem is important because the challenges posed by omni-channel logistics require innovative solutions to ensure efficient and effective warehouse operations [4]. Before undertaking this research, we knew that warehouse operations needed to adapt and optimize their processes to cater to the demands of multiple channels. However there hasn't been research conducted on the advancement of strategies and solutions the incorporation of IoT technology and the utilization of RFID technology, in warehouse management.

Our research improves understanding of the problem by exploring and analyzing innovative methods in warehouse management. By developing strategies and solutions, integrating IoT technology, and utilizing RFID technology, we provide insights into reducing waste, improving operational and distribution performance, and enhancing overall business performance in warehouse management. The results of this study add to what we know and provide ways to optimize warehouses in the context of omni-channel logistics [5].

2 Methods

This chapter focuses on the research methods that can be employed to investigate and analyze innovative methods in warehouse management. By utilizing appropriate research methods, researchers can gain valuable insights into developing strategies and solutions, integrating IoT technology, and utilizing RFID technology to address the challenges of omni-channel logistics [6]. This chapter aims to provide guidance on selecting and implementing research methods that can enhance our understanding of warehouse management practices.

Research Design and Methodology Selection

To effectively study innovative methods in warehouse management, researchers need to carefully consider the research design and methodology. Possible research methods that can be employed include qualitative, quantitative, and mixed methods approaches. Qualitative methods, such as interviews and observations, can provide in-depth insights into the experiences and perspectives of warehouse managers and employees [7]. Quantitative methods, such as surveys and statistical analysis, can help quantify the impact of innovative methods on warehouse performance [8]. Combined methodologies can incorporate both quantitative methods to offer a comprehension of the research issue [12].

Data Collection

Data collection is a crucial step in conducting research on innovative warehouse management methods. Depending on the research objectives and methodology, various data collection techniques can be employed. For qualitative research, interviews, focus groups, and observations can be used to gather rich and detailed data [7]. Quantitative research may involve collecting data through surveys, questionnaires, or existing databases [8]. Additionally, data related to warehouse operations, such as inventory records and performance metrics, can be collected for analysis.

Data Analysis

Once the data is collected, researchers need to analyze it to draw meaningful conclusions. Qualitative data analysis involves coding and categorizing the data to identify themes and patterns [4]. This can be done using software tools like NVivo or through manual coding techniques. Quantitative data analysis involves statistical techniques such as descriptive statistics, regression analysis, or hypothesis testing [3]. Mixed methods research may involve integrating qualitative and quantitative data through data triangulation or data transformation techniques [6].

Case Studies and Theory Building

Case studies can be a valuable research method to explore innovative warehouse management methods. By examining real-world cases, researchers can gain insights into the challenges faced by warehouse managers and the effectiveness of different strategies and technologies [8]. Case studies can also contribute to theory building by identifying patterns and relationships between variables [9]. Researchers can use theoretical frameworks, such as the Technology-Organization-Environment (TOE) framework, to guide their analysis and interpretation of the case study findings.

To ensure warehouse management it is crucial to conduct research to examine and evaluate various strategies and technologies. By using research methodologies, data collection techniques and analysis methods researchers can contribute to our understanding of warehouse management practices. Case studies, literature reviews and meta analyses play a role, in providing insights, into the obstacles and possibilities involved in implementing innovative approaches [10]. Through the application of research methods researchers can improve our knowledge of warehouse management. Contribute to the development of efficient strategies and solutions.

3 Materials

3.1 Develop Strategies and Solutions to Adapt Warehouse Operations and Design to Effectively Meet the Challenges Posed by Omni-Channel Logistics in Multi-channel Retailing

The shift to omni-hannel logistics is hampered by differences in demand patterns and a greater choice of items. The sizes of orders placed in stores and those placed online sometimes differ greatly, making it difficult to mix the two types of orders and build storage operations. As the quantity of items offered through e-commerce and online marketplaces grows, warehousing becomes more complicated, necessitating storage space and various order pickup sites [11]. Many businesses are exploring combining their channel activities in order to address these difficulties. However, the evolving nature of omni-channels and customer behavior necessitates study into how businesses handle the rising complexity in back end fulfillment and whether they want to integrate or segregate their various channels. According to research, businesses often migrate from maintaining inventories to integrating stocks for both store replenishment and online consumers [12].

Retailers require an integrated performance management strategy to avoid channel conflicts and guarantee long-term profitability. Omni channels have increased the amount of material that is reaching customers and increasing sales. Additionally, they have led to more returns. Costs have grown as a result of the handling of logistics becoming more sophisticated. It might not always bring in money or make a profit [13]. The effect of these higher flows on sustainability is still unknown. Has been a subject of debate in previous literature.

The distribution and management of returns have evolved into a complex process throughout time. Retailers now carefully plan out the delivery to destinations and dispatching sites. Choosing where to collect and ship an order requires taking into account a number of variables, including lead times, transportation costs, handling expenses, fixed operation costs, holding charges, and backorder costs. Additionally, return rules and a variety of return alternatives complicate network design [14]. Retail outlets now serve as material handling hubs in the omni- channel ecosystem.

Research indicates that utilizing selected stores as FFCs (fulfillment centers) can bring added value to retailers by allowing them to handle displays marketing efforts, customer service tasks, direct sales activities, pick-ups for customers e commerce orders along with returns processing. Grocery retailers are increasingly employing stores for order picking purposes due to online order volumes and the differences in order characteristics, between orders and store replenishment [15]. This function may have an impact on the architecture of the omni-channel network, involving an assessment of aspects such as product availability, returns, delivery alternatives, reverse flows, and inventory management across channels. To handle the difficulties of omni-channels, inventory management in networks necessitates the expansion of existing models and the adoption of novel methodologies. Planning and assigning capacity are especially difficult due to the uncertainty in demand over both long and short time periods [16].

The current literature has mostly concentrated on labor planning, ignoring variables such as storage area and equipment in relation to infrastructure and capacity. Implementing a strategy of postponing orders across locations is one method to solve capacity challenges. The rising complexity of omni-channel distribution networks necessitates the use of an integrated information system capable of successfully handling scattered orders [17]. This system helps to coordinate inventory information, improve visibility, facilitate decision making, improve service levels, and save costs. It also allows for return flow reservation, prioritizing, tracking, communication, and effective management. It is known as a distributed order management (DOM) system, and it provides a logistical solution for omni-channel operations that offers a positive experience for both merchants and customers [15]. Retail businesses now have the chance to improve both their performance and connections with customers.

3.2 The Research on Examining the Benefits and Drawbacks of Implementing Internet of Things (IoT) Technology in Warehouse Management

Research is being conducted to explore the costs and benefits that the Internet of Things (IoT) can offer to warehouse companies. An expert survey was carried out to accomplish this goal. The findings of the expert survey are presented and discussed in this section. The semi-structured expert survey approach was utilized in the study to collect data, as was mentioned in the research's earlier section. Additional questions were asked throughout the interviews in order to elicit potential answers to the survey cost issue. As a result, the experts' suggestions to deal with the costs are also described in this outcome analysis section. The conceptual model will be described in the following part based on this analysis [16].

The advantages of using IoT in warehouse companies were assessed by the study, which examined indicators like order lead time inventory accuracy, employee efficiency and return on investment. The aim was to determine the benefits that can be achieved through the implementation of IoT, in warehouse organizations. However, it was discovered after the study was completed that a few cost indicators had a favorable effect.

The poll findings indicate that one of the drivers, for digitization is the ability to have real time visibility, into a company operations and the establishment of a platform. Figure 1 shows that 95% of participants believed IoT will increase inventory accuracy.

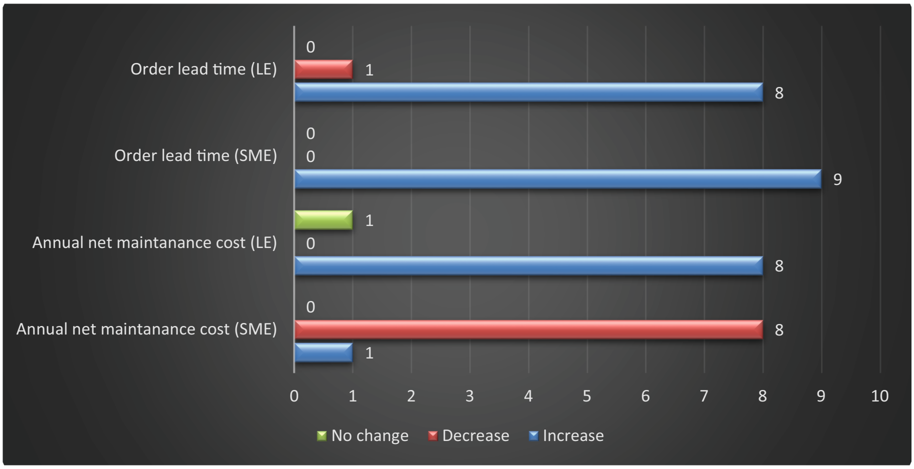

Fig. 1. Key motivations for digitization

The ability to handle a company's assets or inventory information more quickly and accurately has a substantial influence on the efficiency of corporate operations [17]. In the case of warehouse sites, a centralized system enables access to all data, including real-time view of stock information from various locations via IoT sales estimates. Although 5% of participants felt that human physical counting is required for warehouses because of the contact required, one respondent stated that their small scale warehouse still depends heavily on techniques. They have, nevertheless, lately embraced technology.

The report suggests that the implementation of IoT can have an impact, on a company sales. When the participants were questioned about the influence of the Internet of Things, on sales all of them agreed that it would indeed have an effect. Businesses can utilize IoT to assess client needs and modify their products accordingly, increasing transparency. According to experts, digitization enables businesses and customers to receive more frequent and real-time updates about shipments. The products are also shipped in better conditions thanks to remote monitoring of storage conditions for things, including humidity, temperature, and location. Such a strategy can boost revenue by developing positive relationships with both current and potential future opportunities [28] mentioned a circumstance that is comparable. In Fig. 2 we can see the responses, from participants regarding the impact of the Internet of Things (IoT) on both sales and client satisfaction in SME and LE.

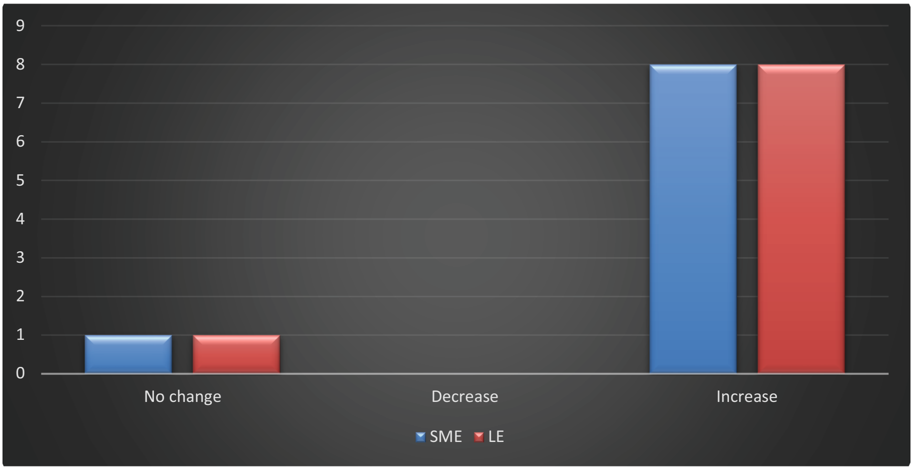

Fig. 2. IOT affection on sales and client satisfaction in SME and LE

According to the study, there was not much diversity among experts responses when it came to customer satisfaction, as seen in Fig. 2. For instance, 90% of respondents claimed IoT will boost customer satisfaction, while 10% indicated it would have no effect [16]. One respondent claimed that sensors and feedback reporting systems support the maintenance of positive customer connections and future encounters. The same strategy was suggested by [23].

All participants agreed that an IoT workplace fosters a positive work atmosphere and an engaged staff. Workforce innovation is facilitated by getting more done in less time and having more time. As a result, it results in lower costs and greater productivity at work. In both small and large businesses, the work environment of the Internet of Things (IoT) aids, in retaining employees and enhancing their morale. IoT has some social implications, according to 20% of the survey's experts, as seen in Fig. 3. They thought that people were being replaced by technology, which was taking their employment. The reactions of the remaining individuals were in consistent [22].

They held the view that technology was eliminating jobs while boosting revenue in the hope that a prosperous economy would eventually create more jobs. According to the article, deployment has a favorable effect on a company's financial performance, as well as its market value, profitability, and labor productivity[16].

Participants agree that there are significant intangible expenses connected with IoT, in addition to installation costs, for warehouse organizations [16]. For instance, the IoT eco-system's compatibility and the availability of a competent labor are both perennial problems.

Figure 3 reveals that 90% of respondents predicted a skilled labor shortage in businesses of all sizes, while only 10% stated there was a workforce available.

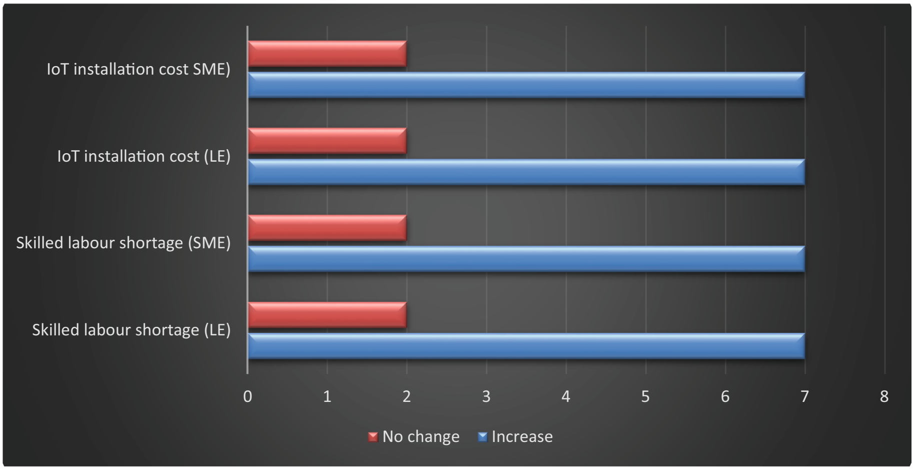

Fig. 3. Responses from participants on indicators for skilled labor shortage and installation costs in SMEs and LEs related to IoT systems

The confidentiality of personal data and sensitive information must be given top priority in the Internet of Things, all participants agreed.

It is critical, like with any investment, to plan IoT efforts before implementing them. Small firms that wish to digitize their operations with IoT must first develop a plan. According to 77% of respondents, the expenses of establishing a platform are significant for both small and large businesses, and these costs increase as the size of the organization expands. Due to unanticipated cost fluctuations, experts advise that medium-sized firms (SMEs) implement IoT gradually. For example, although 90% of experts agree that integrating IoT can lead to shorter order lead times for SMEs, 10% feel that it will have no effect on bigger enterprises' order lead times. The application of technology such as trailer tracking systems. The employment of technology like RFID, proof of delivery (PoD), and trailer tracking systems has produced results. Real-time tracking of freight locations is made possible by the trailer tracking system.

According to the survey's results, using a forklift can increase safety and help prevent accidents. Usually, it takes time for a driver to find a certain item at a warehouse. Reduced productivity may be the effect of this. However, the procedure is more effective when the PoD (Point of Delivery) system is used since information and documentation are quickly accessible. Costs for printing, shipping, petrol, and human error have decreased as a result [16]. 90% of participants believed that yearly system maintenance expenses would be affordable for businesses of all sizes. However, 10% of respondents expected medium-sized enterprises to incur higher costs. Surprisingly, comparable proportion of respondents thought that firms would not be affected. Application maintenance expenses generally vary from 1% to 5% of the application cost, according to IT professionals that deal with them [16]. When warehouse companies use platforms, they sometimes include expenditures for maintenance like as updates, patches, licenses, and certifications for devices. Participants mentioned how the Internet of Things has improved warehouse operations and reduced costs [16].

The IT specialists that were questioned think that integrating enabled maintenance in warehouse operations can save operational expenses. Smart sensor installation techniques may reduce downtime, speed up processes, and halt issues before they arise. One approach to accomplish cost reductions associated with IoT is productivity, which lowers labor costs and overhead:

- The cost of the entire asset can be minimized by cutting back on maintenance and device work,
- Energy savings,
- Costs are gradually reduced through expedited information and material flow management and optimization,
- Accurateinventory management,
- Time savings for power and heating in warehouses as well as remote monitoring of energy use.

3.3 RFID Technology Expand

RFID research in supply chain management (SCM) is advancing swiftly. RFID, being a facilitator of technology provides real time data that assists in identifying, tracking and tracing inventory, within supply chains. This enhances efficiency. Establishes an advantage that is sustainable, in the long run. RFID tags, which consist of an antenna, an IC chip, and an assembly process, are becoming increasingly widely used as a result of the swift reduction in IC chip prices and more economical assembly techniques. RFID enables over 30 billion devices and makes communication between functional domains easier. An innovative method called RFID eliminates the need, for microchips, in the transponder. Passive tags, which are affordable and don't require power are used in Ultra High Frequency (UHF) tags. These UHF tags can be categorized into two types; pure Additive Links On Line Hawaii Area (ALOHA) both of which are employed with the Gen C protocol. Pure ALOHA uses Time Division Multiple Access to reduce collisions while slotted phase enhances transmission processes. RFID technology has been utilized by a wide range of companies, including those in the production, transportation, hospitality, health, and hospitality industries.

3.3.1 RFID Applications

According to a literature review, businesses that deal with more than 1,000 different types of items may profit from the adoption of RFID technology to streamline operations. This result is reached after taking into account variables like cost effectiveness and scalability. The choice of gateways in RFID readers should be taken into account while developing RFID systems. By concentrating on certain regions, the supply process may be optimized [17]. Making choices at the corporate level about inventory planning and controlling the acquisition of materials are part of the earliest phases of using RFID [22]. It is interesting to note that there appears to be a disparity between the system's 70% recorded data and the stock count of over 350,000 units [24]. Property loss or theft costs 20% of profits. The effectiveness of supply networks is negatively impacted by ineffective inventory management presents tough obstacles for businesses trying to operate successfully. By enabling data gathering on materials, suppliers, their storage in warehouses and the transfer of completed items across supply chains, RFID technology improves inventory management. Real-time data from RFID allows for the prediction of operational peaks and troughs, which reduces waste and boosts quality. RFID helps to optimize supply chain logistics by balancing demand and supply, identifying process bottlenecks, and providing remedies [24].

In actuality, the identifying process starts with each material and item being given an RFID tag. The tag is scanned at the end of a conveyor belt after it has been made. The information gathered is subsequently sent to a database, usually one kept in the cloud. Products are further sorted at the distribution center before being sent to retailers. At the distribution center, tag readers are used to increase distribution efficiency. Sort items according to category. To detect items and update data in the corporate RFID database, similar processes are used in organizations [22]. It is now simple to follow the movement and position of the product throughout the process thanks to these readers.

The processed data may be used to enhance various functional areas and systems, as well as the management of orders in both forward and backward directions, as well as demand fulfillment. Based on the idea of radio frequency, RFID technology enables the identification of products as both fixed and moving items [24]. Access cards and electronic wallets are included in this technology for auto identification. Applications for the data collected by RFID include tool tracking, process management, and access control.

3.3.2 The Use of RFID Technology, in Managing Information, Within the Supply Chain and Implementing Automation

Technology's wide use has created new economic prospects. To develop supply chains and omni channels, for instance, retail organizations are integrating relevant technology like RFID [22]. Retail logistics organizations are using gadgets, RFID, and big data analytics to improve the performance of their route designs and deliveries. Future supply chains for manufacturers will take data management technologies into account. The learning factory, which integrates IoT for enterprise information sharing and management and makes use of a cheap RFID monitoring system [24], is an intriguing example of this. Cognitive systems have a significant role in the success of companies.These cognitive systems include information systems like security systems, RFID and IoT devices, and cyber-physical control systems [17].

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According to the findings, there is the potential to save up to 84% of the overall transportation and lag time. The other benefit is the approximately 60% decrease in time to furnish materials, which increases a supply chain's overall efficiency by about 80%. RFID is widely recognized as a global technology that offers commercial benefits and is being adopted by a variety of sectors, including urban planning, healthcare supply chains transportation management and location tracking aerospace and defense operations, tourism supply chain management, smart manufacturing [34]. The utilization of RFID enabled technologies, in applications highlights its importance in enhancing traceability within supply chains and overall business effectiveness in sectors such as agriculture and food supply chains. Regarding its benefits, supply chain management applications that use RFID-based systems are not without challenges, including managing tag collisions, customer privacy concerns, and data integration issues. Regarding logistical concerns, RFID tags have a number of security implications [34]. Operations and production issues include data management and incompatibility between suppliers' and the main company's information systems. Data-driven decisions and solutions are now required for supply chain operations including production, warehousing, transport, and distribution thanks to Industry 4.0. RFID technology and the Internet of Things have been combined to enhance RFID IoT operations utilizing automated sensing and ubiquitous computing. All parties involved in the supply chain ecosystem, such as producers, distributors, and consumers, may now access data. The availability of this data improves customer service while enhancing the tracking capabilities for process efficiency. In order to provide decision support systems that ease the transition to smart factories warehouse management, RFID IoT plays a key role in optimizing supply chain efficiency and cost effectiveness [34].

Table 1. Time before RFID implementation

Distribution center	Item (per order)	Unit	Pre-Implementation	Post-Implementation	Improvement (%)
CDC	Average Time: Between Outward and Inward	Min	88,9	16,2	81,77
	Average Time: Transaction	Sec	10	1	90
	Average Time: Transaction Retrieval	Sec	10,3	1	90,29
LDC	Average Time: Between Outward and Inward	Min	46,3	13	70,18
	Average Time: Transaction	Sec	10,4	1	90,38
	Average Time: Transaction Retrieval	Sec	10	1	90

Digital technology use is rising, which has opened up new business options for companies. One example is how retail companies use RFID and IoT devices to create flexible supply chains and omni-channels. Manufacturing facilities will set themselves apart in the upcoming years based on their knowledge of data management technology. The Internet of Things (IoT) will be used in these “learning factories” to streamline enterprise-wide information management and interchange. To achieve this, they will make use of RFID tracking devices. Human machine interfaces, automated logistics management, medical treatment, vacation supply chains, and agro food chains of supply are just a few of the industries that might benefit from these information systems [34].

These systems are based on the integration of information from various senses. RFID implementation is challenging due to the high cost of tags and adoption issues. Effective tactics include the bulk manufacture of RFID tags and detailed supply chain process modeling [34]. Cost-benefit analysis is crucial for RFID deployment because it highlights the significance of time, cost, and waste reductions. This research examines the usefulness of RFID technology, in enhancing operations and managing supply chains within the framework of Industry 4.0. It serves as an example of the benefits of implementing

Table 2. Overall optimization time

Item	Time	Without RFID	With RFID	Improvement (%)
CDC	Inward-Outward Duration	1200	146	87,83
	Shipment time	5,5	1,9	65,45
	Overall time	1205,5	147,9	87,73
LDC	Inward-Outward Duration	120	98	18,33
	Shipment time	3,1	1,3	58,06
	Overall time	123,1	99,3	19,33
Supply Chain	Inward-Outward Duration	1320	244	81,51
	Shipment time	8,6	1,2	86,04
	Overall time	1328,6	245,2	81,54

RFID, including cost reductions, stock tracking, and improved operational effectiveness. The integration of RFID and Industry 4.0 technologies can help enterprises by fostering operational excellence. Care must be taken with corporate operations, technological infrastructure, and business goals when implementing RFID technology. The study looks into potential inefficiencies in inventory management and advises using RFID to improve business operations. When supply chain flaws are addressed, overall income rises by 20% [22]. The results show that there is the potential to reduce transportation and lag time by up to 84% [24]. A supply chain's overall efficiency rises by nearly 80% as a result of the additional benefit of a 60% reduction in time to furnish supplies [17]. Numerous industries, including smart manufacturing, city planning, healthcare, transportation, and aerospace, heavily rely on RFID technology. It improves business efficiency and traceability, especially in supply chains for agriculture and food.

4 Conclusions and Discussion

In this research study, we outline a strategy for addressing the difficulties and effects of omni = channel logistics in warehousing. In order to examine how the change to omnichannel logistics would affect warehouse operations and design, we have picked 10 topics that are pertinent to the topic. Additionally, we have developed a set of research questions that explore the interconnectedness of various warehouse operations and design features with value propositions, channel management, and the physical architecture of distribution networks [12]. The links between channel strategy, network architecture, and warehouse operations must be taken into account since decisions made in one area may have long-term effects on the others. Because they facilitate the efficient movement and operation of the supply chain, warehouses have an important role in modern society. It is critical to design a system that prioritizes customer demands since future warehousing procedures are predicted to become more complicated. Internet of Things (IoT) integration may provide businesses a competitive edge in the market, according to the revolution 4.0 idea, which is gaining popularity [20].

IoT has an influence on warehouse management, including enhanced operating efficiency, inventory update precision, and excellent workmanship. Additionally, it offers benefits such as increased client satisfaction, energy saving measures, and sales success. Warehouse facilities are possible thanks to the IoT's versatility [8].

IoT implementation in warehouses entails expenditures for installation, potential data breaches, protecting confidentiality of information, and efficient data administration. The recommended method for implementing IoT in warehouse companies focuses on taking into account external advantages, warehouse operations, and related expenses. It is advised for warehouse enterprises and government agencies to choose the deployment of Internet of Things (IoT) methods to overcome challenges such a labor shortage and worries about confidentiality of information [10].

Future study should use approaches including empirical case studies, exploratory and descriptive surveys, survey studies to test hypotheses, operations research modeling, and simulations to better understand the expanding trend of omni channel warehousing. The demands of the omni-channel approach will undoubtedly put current warehousing processes to the test while stimulating development that will restore warehousing as a field of study in logistics. This agenda may be used as a planning tool for researchers working in this area and by business professionals looking into storage facility approaches to adopting omni-channel logistics [13].

The benefits of integrating IoT into warehouse management include better operating efficiency, real-time inventory precision, and maintenance capabilities [29]. RFID technology is widely adopted in warehouse management due to its ability to trace and track objects [26]. However, the adoption of IoT in warehouses also comes with costs, such as installation costs, data security breaches, data privacy, and data management [21]. Future research should focus on developing knowledge on omni-channel warehousing through various methods, including empirical case studies, surveys, and operations-research modeling and simulation [22]. Overall, the adoption of IoT and RFID technology in warehouse management can enhance efficiency and customer satisfaction, but careful consideration must be given to the associated costs and challenges [31].

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Assessment of Economic Efficiency of Transshipment Services in Seaports on the Example of Analysis of Indicators of Technical Readiness of Bulk Cranes

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Abstract. In the article, for a selected group of cranes used for handling bulk cargoes in a seaport, an evaluation of the economic efficiency of the handling services provided was carried out. The analysis was based on the designated two key technical indicators - technical readiness and technical readiness utilization. The determined values of technical readiness indicators made it possible to determine the preparation of equipment and readiness to provide handling services. In turn, technical readiness utilization rates indicated at what level the handling capacity of the equipment is being used. It has been shown that the analysis of technical readiness indicators and the use of technical readiness may constitute an indication of the need to withdraw the reloading device from operation. It was confirmed that with properly performed inspection and service activities, reloading equipment maintains a high level of technical readiness even after a long period of use, and thus ensures a high level of technical readiness utilization. Simultaneously ensuring high values of technical readiness indicators and the use of technical readiness is one of the elements that directly translates into high economic efficiency of reloading services.

Keywords: technical readiness · use of technical readiness · bulk cranes · efficiency of reloading services

1 Introduction

Commonly handled cargo in seaports is bulk cargo. The key devices used to handle this group of cargo in the vessel-quay relationship are bulk cranes. Bulk cranes, in order to ensure adequate economic efficiency of cargo handling, should, on the one hand, be in a technical condition ensuring their high technical readiness, and on the other hand, they should also be characterized by a high level of technical readiness utilization. One of the characteristics describing the performance of the system of operation of technical facilities such as equipment used for cargo handling in seaports is their readiness to carry out cargo handling tasks. The readiness to carry out such tasks is generally referred to as

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technical readiness [1–5]. Technical readiness as a feature of a system is used to analyze systems coming into operation at random times $t, t \in (t_o, t_k)$ [1, 2]. In practice, when a task arises, the personnel together with the assigned technical facilities in the specified time interval from the initial moment t_o to the final moment t_k should be provided with the opportunity to proceed and complete the task. Ensuring that a task can be started on time and completed within the stipulated time is one of the most essential features describing the operation of complex systems for the operation of technical facilities [1, 2]. In the case of handling bulk cargo, technical readiness and the use of technical readiness of devices have a significant impact on the economic efficiency of such services.

The article evaluates the technical readiness and utilization of technical readiness based on an indicator analysis for selected bulk cranes used for bulk cargo handling in a seaport.

2 Technical Readiness of Bulk Cranes

2.1 Subject of Study

The subject of the research were four bulk cranes: Tukan 1500–40, D-136, D-95 and D-158, shown in Fig. 1 and 2. Cranes were selected that differ significantly in operational and construction parameters and in their use in the field of bulk cargo reloading works. Cranes also differ significantly in their service life.

The Tukan 1500–40 crane, manufactured in 2012, is characterized by a lifting capacity of 45/25 t and an outreach of up to 40 m, which allows the handling of 600 t of cargo per hour. With its help, it is possible to realize the handling of bulk materials using a four-rope double-jaw rod gripper (Fig. 1), as well as single loads using a hook attachment and containers using a stacker.

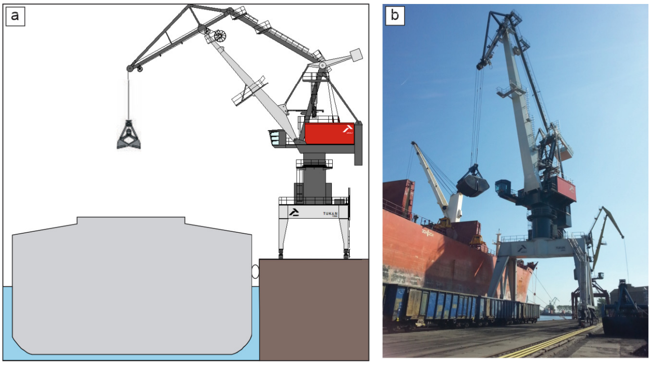

Fig. 1. TUKAN 1500–40 crane: a) diagram of bulk cargo handling, b) view of the crane in the port while unloading bulk cargo from a floating unit onto railway wagons.

The Tukan 1500–40 crane features a portal rail clearance of 14.3 m, a wheelbase of 12.5 m, an overrun buffer clearance of 20.57 m, a construction weight of 350 t and a total weight of 470 t. It is electrically powered by the portal's driving mechanism and can move on rails. Rotation of the crane is made possible by a mechanism located on the engine room platform, which rotates through an internally toothed roller turntable (RDV).

The D-136 crane has been in operation since 1970 - Fig. 2a. The lifting mechanism of this crane, together with the gripper, allows a lifting capacity of up to 10 t, the load can be lifted up to 22 m above the upper edge of the rail, and its lowering depth can be up to 12 m. In the case of this crane, lifting is carried out by means of a slip ring motor drive with controlled vibration current braking, while closing is carried out by means of a slip ring motor drive with counter current braking. The rotary mechanism of the D-136 crane and the outrigger is driven by a slip ring motor with brake control by vibrating current.

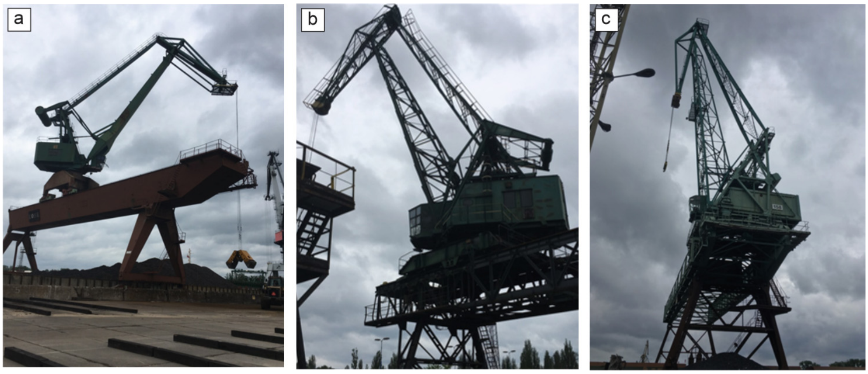

Fig. 2. Cranes for handling bulk cargo: a) D-136 crane, b) D-95 crane, c) D-158 crane.

The D-95 crane is a slewing crane with a four-section launch system - Fig. 2b. This crane is electrically powered by a portal travel mechanism and has the ability to move on rails. The lifting capacity of the device is 8 t, and the reach of the jib is from 8 to 22 m, while its span is up to 18.8 m. The total weight of the crane without the grapple is 18.66 t. The D-158 crane is a mobile platform crane with an extension boom with a maximum lowering height of 14 m - Fig. 2c. This crane has an electric drive and is made as a portal crane with a cart and a swivel column and an outreach. The system for changing the boom in a crane involves guiding the boom in an arc, which is articulated with the rotating column. The entire steel structure of the device rests on two supports located 28.9 m apart. The bridge is driven by four drive units located in the corners of the bridge supports. Each unit includes three electric motors. Descriptions of the cranes that are the subject of the research are limited to the scope of information made available by the entity operating the equipment.

2.2 Research Methodology

The research assessed technical readiness indicators and the use of technical readiness for four Tukan 1500–40, D-136, D-95 and D-158 bulk cranes.

The measure determining the readiness of the device for operation is the technical readiness index (W_{GT}) expressed as the quotient of the number of days or hours in which the reloading device was ready for operation (T_g) and the number of days or hours in which the device should perform its work (T_{pg}) operating time gross, which is described by the relationship [1–5]:

$$W_{GT} = \frac{T_g}{T_{pg}} \cdot 100\% \tag{1}$$

where:

W_{GT} – technical readiness indicator [%];

T_g – ready-to-work time [h];

T_{pg} – gross operating time of the device [h].

Readiness time (T_g) is the planned readiness time (T_{pg}) less the time when the machine is taken out of service due to technical reasons (T_r):

$$T_g = T_{pg} - T_r \tag{2}$$

where:

T_r – time of all maintenance stops [h].

The time of planned readiness for work (T_{pg}) is easiest to determine during three-shift work, which is 8760 h/year (365 days × 24 h)

$$T_{pg} = T_k - T_s \tag{3}$$

where:

T_k – observation time [h];

T_s - observation time on public holidays [h].

The technical readiness utilization rate (W_{WGT}) is the quotient of the actual net operating time of the device to the readiness time described by the formula [1–5]:

$$W_{WGT} = \frac{T_n}{T_g} \cdot 100\% \tag{4}$$

where:

W_{WGT} – technical readiness utilization rate [%];

T_n - actual net operating time of the device [h].

2.3 Calculation Results

For the selected group of equipment, based on the relationships summarized in Sect. 2.2, the operating times used to determine technical readiness and technical readiness utilization rates were determined. Consecutive months of the years from 2018 to 2023 were used for the analysis, with the data for 2023 including only the first half of the year, as observations were completed for this period.

Examples of working times for individual cranes determined for 2022 are listed in Table 1. In order to increase the readability of the table, the following symbols have been adopted: T_{n1} - actual net working time of the Tukan 1500–40 crane, T_{n2} - actual net working time of the D-136 crane, T_{n3} - actual net operating time of the D-158 crane, T_{n4} - actual net operating time of the D-95 crane, T_s - observation time on public holidays, T_{pg}- gross operating time of the devices. The consecutive months of the year constitute the ordinal number. For the remaining years, crane operating times were determined in a similar manner. In order to limit its volume, only the total operating times of the analyzed bulk cranes are listed in Table 2 for the remaining years in the article.

Table 1. Operating times of Tukan 1500–40, D-136, D158, D-95 mass cranes in the following months of 2022.

O.n	T_{n1} [h]	T_{n2} [h]	T_{n3} [h]	T_{n4} [h]	T_s [h]	T_{pg} [h]
1	456	0	456	456	12	504
2	480	0	456	456	8	480
3	480	0	528	528	8	528
4	456	0	312	312	10	480
5	504	0	0	0	10	480
6	504	0	0	0	9	504
7	504	0	432	432	10	528
8	480	456	504	504	9	528
9	480	504	96	96	8	480
10	480	480	504	504	10	552
11	456	0	480	480	10	480
12	504	0	480	480	10	456
Sum	5592	3864	4896	5712	115	6000

Table 2. Total operating times of Tukan 1500–40, D-136, D158, D-95 bulk cranes in 2018 – 2023.

Year	T_{n1} [h]	T_{n2} [h]	T_{n3} [h]	T_{n4} [h]	T_s [h]	T_{pg} [h]
2018	5592	3864	4896	5712	115	6000
2019	5640	5184	5256	5592	114	6024
2020	5880	5808	5712	5688	113	6072
2021	5736	1536	5040	5088	113	6048
2022	5784	1440	4248	5784	114	6024
2023	2928	1584	2280	2760	56	3000

Tables 3, 4, 5, 6, 7 and 8 summarize the values determining the operating time budget of the analyzed handling equipment in 2018–2023, as well as the determined values of technical readiness indicators W_{GT} [%] and technical readiness utilization W_{WGT} [%].

Table 3. Operating time budget for Tukan 1500–40, D-136, D158, D-95 bulk cranes in 2018.

Crane	Year	T_{pg} [h]	T_r [h]	T_g [h]	T_s [h]	W_{GT} [%]	W_{WGT} [%]
Tukan	2018	6000	408	5592	523	93	86
D-136			2136	3864	2251	64	29
D-158			1104	4896	1219	82	63
D-95			288	5712	403	95	90

Table 4. Operating time budget for Tukan 1500–40, D-136, D158, D-95 bulk cranes in 2019.

Crane	Year	T_{pg} [h]	T_r [h]	T_g [h]	T_s [h]	W_{GT} [%]	W_{WGT} [%]
Tukan	2019	6024	384	5640	499	93	87
D-136			840	5184	955	86	72
D-158			768	5256	883	87	75
D-95			432	5592	547	93	86

Table 5. Operating time budget for Tukan 1500–40, D-136, D158, D-95 bulk cranes in 2020.

Crane	Year	T_{pg} [h]	T_r [h]	T_g [h]	T_s [h]	W_{GT} [%]	W_{WGT} [%]
Tukan	2020	6072	192	5880	2904	97	94
D-136			264	5808	2976	96	91
D-158			360	5712	3072	94	88
D-95			384	5688	3096	94	87

Table 6. Operating time budget for Tukan 1500–40, D-136, D158, D-95 bulk cranes in 2021.

Crane	Year	T_{pg} [h]	T_r [h]	T_g [h]	T_s [h]	W_{GT} [%]	W_{WGT} [%]
Tukan	2021	6048	312	5736	3023	95	90
D-136			6264	0	8976	0	0
D-158			1008	5040	3720	83	67
D-95			384	5664	3096	94	78

Table 7. Operating time budget for Tukan 1500–40, D-136, D158, D-95 bulk cranes in 2022.

Crane	Year	T_{pg} [h]	T_r [h]	T_g [h]	T_s [h]	W_{GT} [%]	W_{WGT} [%]
Tukan	2022	6024	240	5784	2976	96	92
D-136			6480	0	9216	0	0
D-158			2232	3792	4968	63	34
D-95			240	5784	2976	96	92

Table 8. Operating time budget for Tukan 1500–40, D-136, D158, D-95 bulk cranes in 2023.

Crane	Year	T_{pg} [h]	T_r [h]	T_g [h]	T_s [h]	W_{GT} [%]	W_{WGT} [%]
Tukan	2023	3000	72	2928	1728	98	95
D-136			1704	1296	3048	43	0
D-158			720	2280	2064	76	52
D-95			240	2760	1584	92	84

3 Summary and Conclusions

The paper analyzes the technical readiness rates W_{GT} [%] and technical readiness utilization W_{WGT} [%] for four cranes used in the seaport for bulk cargo handling. The Tukan 1500–40 crane has been in operation for 11 years, other cranes have been operated for periods exceeding 40 years and even up to 50 years. In a comparative form for the analyzed devices, Fig. 3 presents the average values of W_{GT} technical readiness indicators [%] and W_{WGT} technical readiness utilization [%] for the analyzed period.

The comparison of average values shows that Tukan 1500–40 and D-95 cranes, despite significant differences in operating time, are characterized by comparable values of W_{GT} technical readiness indicators [%].The values of W_{WGT} technical readiness utilization indicators [%] are also comparable and at a high level. At a slightly lower level are the values of the determined indicators for the D-158 crane. In turn, the D-136 crane is characterized by an average indicator of technical readiness W_{GT} [%] and technical readiness utilization W_{WGT} [%] at a very low level. Figure 4 compares the average times of all maintenance downtimes T_r [h] of the analyzed bulk cranes.

The comparison of the values of W_{GT} technical readiness indicators [%] and W_{WGT} technical readiness utilization [%] with the average times of all renovation downtimes T_r [h] shows that the D-136 crane was also most often taken out of service due to failure. The downtime of the Tukan 1500–40 and D-95 cranes was the result of scheduled inspections and service work. The economic effectiveness of reloading services requires reloading devices in a state of technical readiness.

The D-136 crane has low values for both key indicators. In 2020, the crane had a W_{GT} technical readiness index [%] of 96%, with the use of W_{WGT} technical readiness

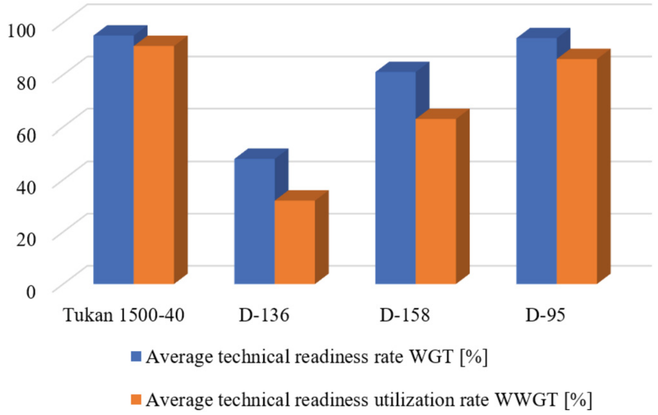

Fig. 3. Comparison of average values of W_{GT} technical readiness indicators [%] and W_{WGT} technical readiness utilization [%] of the analyzed cranes for handling bulk cargo.

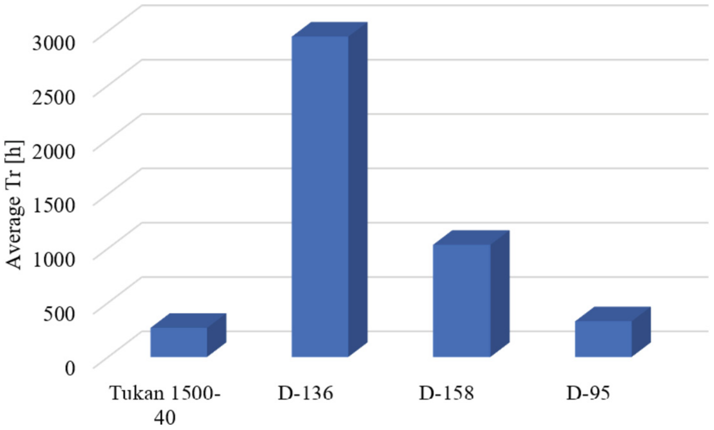

Fig. 4. Comparison of the average values of the times of all repair downtimes Tr [h] of the analyzed cranes for handling bulk loads.

[%] of 91%. In 2021 and 2022, the rates dropped to 0%. In the first half of 2023, the crane's W_{GT} [%] technical readiness rate reached 43%, but with W_{WGT} [%] technical readiness utilization at 0%. Taking into account the age of the crane and the achieved indicator values, the unit operating the equipment should consider whether it is necessary to keep the D-136 crane in a state of technical readiness, or whether it would be more economically reasonable to take the crane out of service.

In the case of the remaining cranes, the determined indicator values, especially those relating to the D-158 and D-95 cranes, confirm that they are in a state of technical readiness ensuring effective provision of reloading services. It should be noted that these cranes are operated for a similarly long period of time as the D-136 crane.

In summary, by determining the values of technical readiness indicators W_{GT} [%] and technical readiness utilization W_{WGT} [%], it is possible to indicate the most favorable operating periods with the inclusion of necessary repairs to handling equipment. In addition, it is possible to determine whether the port's repair facilities are sufficient in relation to needs, as well as confirm the need to take action on the possible decommissioning of the equipment due to technical depletion. The article shows that bulk cranes subject to proper use in the scope of inspections, regardless of the length of operation, can be characterized by high technical readiness, ensuring at the same time the possibility of achieving high utilization of technical readiness.

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Leveraging Artificial Intelligence for Enhanced Quality Management in Energy Companies: Opportunities, Challenges, and Practical Solutions

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Abstract. The search focused on articles that explored the application of AI in the energy industry, specifically in the context of quality management. The selection of articles was based on their relevance to the topic and their contribution to the understanding of opportunities, challenges, and practical solutions associated with leveraging AI in quality management for energy companies. To ensure the comprehensiveness of the literature review, a wide range of articles were considered. By analyzing and synthesizing the information from articles, this literature review provides a comprehensive overview of the theoretical background and existing research related to the application of AI in quality management for energy companies.

Keywords: Artificial Intelligence · Quality Management · Energy Sector

1 Introduction

The rapid advancement of technology has paved the way for the integration of artificial intelligence (AI) techniques in various domains, including energy demand prediction, solar radiation prediction, energy sector optimization, and cybersecurity. These applications of AI have the potential to revolutionize the way we manage and utilize energy resources, enhance the efficiency of energy systems, and safeguard critical infrastructure from cyber threats. In this paper, we will explore four specific areas where AI is being utilized: predicting energy demand using explainable artificial intelligence (XAI), solar radiation prediction using intelligence techniques, deep neural networks-based energy sector optimization for a sustainable economy, and the use of AI to defend against and detect cyber attacks [1].

Section 3.1 focuses on the prediction of energy demand using explainable artificial intelligence (XAI). Energy demand prediction plays a crucial role in ensuring the stability and reliability of energy systems. Traditional methods for energy demand prediction often rely on statistical models that may lack transparency and interpretability. However, with the advent of XAI, it is now possible to develop AI models that not only accurately predict energy demand but also provide explanations for their predictions. This allows

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stakeholders to understand the factors influencing energy demand and make informed decisions regarding energy management and resource allocation. This paper aims to explore the opportunities, challenges, and practical solutions associated with leveraging AI for enhanced quality management in energy companies [2].

In Sect. 3.2, we delve into the application of intelligence techniques for solar radiation prediction. Solar energy is a renewable and abundant source of power, and accurate prediction of solar radiation is essential for optimizing the performance of solar energy systems. By leveraging AI techniques such as machine learning and data analytics, researchers have developed models that can accurately forecast solar radiation patterns. These models enable better planning and utilization of solar energy resources, leading to increased efficiency and cost-effectiveness of solar power generation [3].

Section 3.3 explores the use of deep neural networks (DNNs) in optimizing the energy sector for a sustainable economy. DNNs are a subset of AI algorithms that mimic the structure and functioning of the human brain. By training DNNs on large datasets, researchers have been able to develop models that can optimize energy generation, distribution, and consumption [2]. These models take into account various factors such as renewable energy integration, demand response, and grid stability, with the aim of achieving a sustainable and environmentally friendly energy sector.

Lastly, Sect. 3.4 focuses on the use of AI to defend against and detect cyber attacks in the energy sector. As energy systems become increasingly interconnected and digitized, they become vulnerable to cyber threats. AI-based cybersecurity solutions offer advanced capabilities for detecting and mitigating cyber attacks [8]. These solutions leverage machine learning algorithms to analyze network traffic, identify anomalies, and detect potential threats in real-time. By employing AI in cybersecurity, energy companies can enhance their resilience against cyber attacks and protect critical infrastructure from potential disruptions [11].

In conclusion, the integration of AI techniques in energy-related applications holds great promise for improving energy management, optimizing renewable energy utilization, achieving a sustainable economy, and enhancing cybersecurity in the energy section.

The research problem is of significant importance due to several reasons. Firstly, energy companies play a crucial role in the global economy and are responsible for providing essential services. Enhancing their quality management practices can lead to improved efficiency, reliability, and customer satisfaction. Secondly, the integration of AI technologies in quality management has the potential to revolutionize the industry by enabling data-driven decision-making, predictive maintenance, and automation. Understanding the implications and benefits of AI in this context is vital for the future development and competitiveness of energy companies [13].

Research has contributed to a deeper understanding of the problem by providing empirical evidence and insights into the application of AI in quality management in energy companies. Paper gather data and analyze the impact of AI technologies on various aspects of quality management. Our findings confirm the theoretical assumptions and highlight the positive impact of AI on decision-making, operational processes, and overall performance and sustainability in energy companies. In summary, our research has expanded the knowledge and understanding of leveraging AI for enhanced quality management in energy companies [2].

2 Methods

Literature review, case studies and data analysis were conducted to gain insights into real-world examples of AI implementation in quality management for energy companies. The case studies involved in-depth analysis of energy companies that have successfully adopted AI in their quality management systems. The case studies provided valuable insights into the opportunities, challenges, and practical solutions associated with leveraging AI in quality management [3]. In addition to the literature review, case studies, data analysis techniques were employed to analyze relevant datasets related to AI implementation in quality management for energy companies. This included analyzing data regarding predicting energy, solar radiation demand and AI to defend and detect cyber attacks to identify patterns, correlations, and opportunities for improvement [2]. The data analysis provided quantitative and qualitative insights into the impact of AI on quality management in energy companies. It helped identify the effectiveness of AI in improving quality control processes, reducing energy consumption, and enhancing overall operational efficiency. By employing these materials and methods, this research provides a comprehensive and well-rounded understanding of the opportunities, challenges, and practical solutions associated with leveraging AI in quality management for energy companies.

3 Materials

3.1 Predicting Energy Demand by Explainable Artificial Intelligence (XAI)

LIME (Local Interpretable Model-Agnostic Explanations) approximates any AI model with an interpretable model to provide local explanations for individual predictions. It works by perturbing the input data and observing the changes in the output, allowing it to determine the importance of different features in the prediction (Kuzlu et al. 2020). In the context of predicting energy demand, LIME could identify which features, such as temperature or time of day, have the most influence on the prediction [8].

SHAP (Shapley Additive exPlanations) uses Shapley values from cooperative game theory to explain the contribution of each feature to the prediction. It quantifies the importance of each feature by considering all possible combinations of features and their contributions to the prediction (Kuzlu et al. 2020). In the case of energy demand prediction, SHAP could identify the relative importance of features like weather conditions, historical energy consumption, and time of year [16].

ELI5 provides explanations for regression and classification models. It helps to understand the inner workings of the models by providing feature importance scores and highlighting the contribution of each feature to the prediction (Kuzlu et al. 2020). In the context of energy demand prediction, ELI5 could identify which features, such as historical energy consumption patterns or demographic data, are most influential in determining energy demand. Research showing that predicting energy demand by explainable artificial intelligence can lead to increased efficiency, reduced reliance on non-renewable energy sources, and enhanced sustainability in the energy sector [11].

Using the LIME XAI tool, for PV forecasting helps us analyze and understand the results in a manner. When we apply LIME to explain predictions it provides the PV power output forecasting results along with each feature. As per the findings the forecasted values for PV are 0.731, 0.647 and 0.686 while the actual values are 0.774, 0.758 and 0.712 [19].

Applying the SHAP XAI tool to PV forecasting allows us to compute feature importance by averaging the magnitude of SHAP values across different instances. In our predictions we obtained values of 0.720, 0.680 and 0.690 while the actual values were recorded as 0.774, 0.758 and 0.712 respectively. Across all selected data points in these predictions all features demonstrate trends [19].

ELI5 is an XAI tool that leverages an approach based on interpreting random forest feature weights for PV forecasting analysis purposes. These weights are calculated by tracing decision paths within a tree model. Each node in a tree has an output score which determines how much a feature contributes to decision making, along that path. Moreover the intercept (often referred to as constant) represents expected value of predicted results when all features have zero impact. The predicted power generation values, for PV, in terms of accuracy are 0.717, 0.677 and 0.689 whereas the corresponding actual values are 0.774, 0.758 and 0.712 [19].

When it comes to managing the grid accurately predicting energy generation from renewable sources, like solar photovoltaic (SPV) is crucial. In a study by Patel et al. (2022) they propose an AI based recommender system that aims to minimize the difference between actual and predicted energy generation. It's likely that the recommender system developed by Patel et al. utilizes AI techniques, such as machine learning algorithms to analyze data on solar photovoltaic energy generation [17]. By training the system on this data it can understand patterns and relationships between factors like weather conditions, time of day and solar panel characteristics and how they affect energy generation. This AI powered recommender system can then use its learned knowledge to provide real time predictions of energy generation [13]. By reducing the gap between predicted energy generation the system can offer recommendations for harvesting renewable energy in smart grid systems. The incorporation of AI in recommending energy harvesting has implications, for smart grid systems as it enables better utilization of renewable sources improved grid integration and optimized energy generation.

Differences Between LIME, SHAP, ELI5, and Non-AI Methods in Terms of Explain Ability and Interpretability

Model-Agnostic Interpretations: LIME, SHAP, and ELI5 are model-agnostic, meaning they can be applied to any machine learning model, providing explanations regardless of the underlying algorithm or architecture [4]. Non-AI methods, on the other hand, may be specific to certain models or rely on domain-specific equations or rules, limiting their applicability.

Local Explanations: LIME provides locally surrogated models that explain predictions at local boundaries, allowing for explanations specific to individual instances or data points (Samek 2017). SHAP also provides local explanations by quantifying the contribution of each feature to the difference between the actual prediction and the mean prediction [4]. Non-AI methods may not provide such detailed local explanations [7].

Feature Importance: SHAP and ELI5 offer feature importance measures, such as SHAP values and feature contributions, respectively (Ribeiro et al. 2016). These measures quantify the influence of each feature on the model's predictions. Non-AI methods may not provide explicit feature importance measures [10].

Visualization: SHAP and ELI5 provide visualization techniques to aid in the interpretation of machine learning [4]. They offer visualizations such as dependence plots, summary plots, and feature importance plots. Non-AI methods may not have built-in visualization capabilities [19].

Computational Efficiency: LIME is generally faster than SHAP due to the time-consuming calculation of SHAP values [4]. This computational efficiency can be advantageous when dealing with large datasets or real-time applications. Non-AI methods may have varying computational requirements depending on the specific approach used [14].

These differences highlight the advantages of AI-based XAI methods like LIME, SHAP, and ELI5 in providing model-agnostic interpretations, local explanations, feature importance measures, visualization capabilities, and computational efficiency compared to non-AI methods.

3.2 Solar Radiation Prediction Using Intelligence Techniques

Solar radiation serves as the energy source, for photovoltaic (PV) systems. Consequently accurate forecasting of radiation plays a role in optimizing the operation of PV based power systems and grids. Various approaches have been employed for radiation forecasting broadly categorized into physics based models data driven methods and hybrid models [12]. Physics based methods encompass numerical weather prediction techniques and cloud imaging methods [13]. Statistical weather forecasting methods that employ equations to model atmospheric conditions are typically utilized for short term forecasts in the hours and days ahead; however they can be computationally expensive. The presence of clouds significantly impacts ground level radiation making cloud images from satellites or ground based sky cameras sources of information for short term predictions [15]. Data driven methods generate forecasts by leveraging models and machine learning algorithms to learn the relationship between model outputs and historical input data [1]. The accuracy of data driven models heavily relies on the quality of input data, as the chosen modeling approach. Hybrid methods aim to enhance forecasting performance by integrating data sources and modeling techniques [15]. Table 1 compares the various types of forecasting methods used. It can be observed that all kinds of methods are valuable for predicting solar irradiance.

The selection of forecasting methods relies on factors such, as the required accuracy, forecast duration and available data. Forecasting methods can be categorized into point forecasting and probabilistic forecasting based on their results. Unlike point forecasting probabilistic forecasts assign probabilities to all solar irradiance scenarios [5].

Accurate solar irradiance forecasting is crucial for the operation of photovoltaic (PV) systems and grids. Various approaches, including physics based models, data driven methods and hybrid models are employed for predicting irradiance [6]. Physics based

Table 1. Comparison the Physic ruled, Data-driven and Hybrid methods in Solar radiation prediction

Type of Methods	Modeling Method	Data Rrequired	Forecasting horizon	Remarks
Physic ruled	Satellite-to irradiance model	Satellite image	1 h–3 h ahead	Ultra-short term and short term forecasting, non-availability of cloud images limits the utilization
	Maximum corss corelation	Sky image	1 min–180 min ahead	Applicable for various forecasting horizons and the accuracy highly depends on the data quality and the designed model
Data-driven	Markov switch	Solar irradiance and clear sky index	1 min–180 min ahead	Applicable for various forecasting horizons and the accuracy highly depends on the data quality and the designed model
	Wavelet neural network	Solar irradiance and clearness index	15 min–1 h ahead	Various sources of data and different modeling methods can be integrated to improve accuracy but the data requirements and model complexity can be high

(*continued*)

Table 1. (*continued*)

Type of Methods	Modeling Method	Data Rrequired	Forecasting horizon	Remarks
Hybrid	Support vector regression	Clear sky index	1 h–6 h ahead	
	Self-organizing map, SVM and Particle swarms optimization	Solar irradiance	1 h ahead	
	Deep neural network	Satellite images and clear sky solar irradiance	1 h–6 h ahead	

methods consider the influence of clouds on irradiance through weather prediction and cloud based imaging techniques [6]. On the hand data driven methods utilize machine learning models to establish relationships, between model outputs and historical data inputs [7]. Hybrid methods combine data sources and modeling techniques to enhance forecasting performance [6]. The choice of forecasting methods depends on accuracy requirements, forecast duration and available data sources [5].

Point forecasting involves providing a value to estimate irradiance while probabilistic forecasting assigns probabilities, to various potential future solar irradiance values [7]. While energy forecasting methods are commonly used in domains there is potential to develop probabilistic forecasts for solar irradiance [9]. Artificial intelligence techniques, including machine learning and neural networks have been extensively utilized for predicting irradiance [8].

Traditional statistical models without AI may struggle with the complexity of irradiance due to its nonlinear characteristics under changing weather conditions [4]. On the hand AI based models can effectively. Model these complex relationships resulting in more accurate predictions [5].

Non AI methods may have limitations when it comes to predicting irradiance at different time intervals. For instance a study found that a particular model was not suitable, for predicting day irradiance (Jeon & Kim 2020).

AI models have shown their accuracy, in forecasting irradiance across time spans, including hourly daily averages and minute by minute intervals [15]. One of the advantages of AI models is their ability to adapt to the variability of cloud cover and other weather events that impact solar irradiance [18]. These models can effectively. Capture patterns in the data resulting in more reliable predictions. On the hand non AI methods may rely on models or equations that might not adequately account for data variability [11].

Another advantage of AI based models is their ability to integrate data sources, such as weather forecasts and IoT systems to enhance solar irradiance prediction [4]. In contrast non AI methods may face limitations when it comes to incorporating data sources, which could potentially hinder their capabilities [2].

Furthermore AI models excel in providing time or near real time predictions of irradiance [4]. This feature proves valuable for making decisions, in solar energy systems and maximizing the efficient utilization of solar resources.

Methods that do not involve AI may necessitate resources and time for making forecasts, which can pose challenges, in generating real time predictions [4]. In a irradiance prediction models based on AI have several benefits over non AI methods. They are adept, at handling complexity forecasting at time intervals adapting to the variability of data integrating data sources and providing real time predictions.

3.3 Deep Neural Networks-Based Energy Sector for a Sustainable Economy

Deep neural networks, a type of intelligence (AI) model aim to replicate the structure and functionality of the brain. These networks consist of interconnected nodes (neurons) arranged in layers. Their purpose is to process and analyze data extracting patterns and relationships. Deep neural networks are particularly effective, in handling high dimensional data making them valuable for analyzing and optimizing low carbon energy technologies.

In the field of low carbon energy technologies deep neural networks can be trained on datasets that encompass information about renewable energy sources, energy consumption patterns, weather conditions and other relevant variables. By learning from this data deep neural networks can uncover hidden patterns, correlations and dependencies that may not be easily discernible through analysis methods.

Once trained deep neural networks find applications in low carbon energy technologies. For instance they can be utilized for predicting energy demand or optimizing systems for energy generation and storage. They can also contribute to enhancing the energy efficiency of buildings or forecasting the performance of energy technologies [13].

When it comes to estimating the energy market in this context choosing an approach becomes crucial. Accurate predictions aid providers in making decisions while driving improvements, within the power sector well as advancing regional economies [7]. The majority of the worlds electricity is produced by steam turbines that utilize fossil, nuclear, biomass or geothermal fuels. Additionally gas turbines, hydro turbines, wind turbines and solar photovoltaics all play roles in generating electricity.

The adoption of DNNs and other AI technologies in the low carbon energy sector can contribute to economic development. By improving the efficiency and performance of renewable energy systems, AI can drive cost reductions, attract investments, and create job opportunities in the renewable energy industry [economic and social elements in the databases [11]. DNN methods are compared with non-ai methods in Table 2.

DNNs have the potential to revolutionize low carbon energy technologies by enabling more accurate predictions, optimization, and control of renewable energy systems [2]. They can enhance the efficiency and reliability of energy generation, storage, and distribution, leading to increased renewable energy integration and reduced carbon emissions.

Table 2. Comparison the DNN and traditional methods

Characteristic	AI	NON-AI
Automation and Efficiency	AI methods can automate tasks and processes, reducing the need for manual intervention and improving efficiency	Non-AI methods may require more manual effort and human expertise, leading to slower and less efficient processes
Learning and Improvement	AI methods can continuously learn and improve from data, allowing for iterative optimization and better performance over time	Non-AI methods may not have the ability to learn and adapt based on new information
Handling Complexity	AI methods, particularly DNNs, can handle complex patterns and relationships in data, enabling them to capture intricate features and make accurate predictions	Non-AI methods may rely on simplified models or assumptions that may not capture the full complexity of the problem
Scalability	AI methods can scale to handle large datasets and complex problems, making them suitable for applications with high-dimensional data or large-scale operations	Non-AI methods may have limitations in scalability and may struggle to handle large amounts of data or complex systems
Decision-Making and Insights	AI methods can provide data-driven insights and support decision-making by uncovering patterns and relationships in data	Non-AI methods may rely more on human judgment and expertise, which can be subjective and prone to biases

Despite their potential, DNNs face challenges in the context of low carbon energy technologies. These challenges include the need for large amounts of training data, computational resources, and expertise in developing and deploying DNN models [6]. Additionally, ensuring the interpretability and explain ability of DNN-based models is crucial for gaining trust and acceptance in the renewable energy sector.

3.4 AI to Defend and Detect Cyber Attacks

The research has extensively focused on studying jamming attacks and false data attacks, against the grid. Typically jamming attacks can be categorized into two groups; reactive jamming and active jamming. The objective of a jammer is to occupy the communication channel of its usage while a reactive jammer only operates when the channel is being utilized. One of the concerns regarding jamming attacks is their ease of execution. A recent report highlighted that a large scale cyberattack on London's energy network could result in losses of up to £111 million leading to disruptions in rail, gas and telephone networks [5]. Energy companies and power network providers have been frequently targeted by hackers in years. In 2016 a study revealed that 75% of energy companies experienced at one cyberattack within the year [7]. Moreover according to a report from the US Department of Homeland Security in 2017 over 400 intrusions were reported in US energy installations since 2011 [9]. Safeguarding energy systems against cyberattacks remains one of the concerns, for societies.

The rise of homes, internet connected appliances and advanced energy meters is transforming the way we consume energy. These technological advancements play a role, in managing energy distribution and ensuring a balance between demand and generation. However they also present opportunities for cyber attackers to exploit. From wind energy systems to vehicles and energy storage many interconnected devices are vulnerable to various adversaries such as industrial spies, cybercriminals, intelligence agencies state sponsored hackers and military cyber commands equipped with advanced capabilities [15]. To combat these threats effectively the integration of AI models proves beneficial in detecting cyber risks by analyzing false data. This analysis helps. Neutralize threats before they can cause any harm to our energy systems. Additionally AI technology enhances security by offering authentication for secure energy operations in place of traditional passwords that may be susceptible, to cybercriminals.

Numerous research studies have focused on preventing cyber attacks, including enhancing the security of IoTs through cyber measures safeguarding wide area monitoring, fortifying cyber systems, implementing transient energy based screening technology, securing industrial control systems, employing unobserved topology to counter cyber physical attacks, ensuring the safety of energy storage systems and evaluating wind farm reliability and power system stability [11].

Artificial intelligence (AI) has emerged as a powerful tool in the field of cybersecurity, both for defending against and detecting cyber-attacks. Machine learning algorithms, in particular, have been utilized to develop classification models that can effectively detect various types of cyber-attacks and intrusions [15]. These models take into account the impact of security features, making them valuable in identifying and mitigating potential threats.

Furthermore, AI-based modeling and adversarial learning have been explored as comprehensive approaches to cybersecurity intelligence and robustness. These approaches address various issues in different cyber application areas, including the detection of malware or intrusions, zero-day attacks, phishing, data breaches, cyberbullying, and other cybercrimes [9]. By leveraging AI-based techniques, cybersecurity professionals can gain insights into attacker actions and utilities, ultimately enhancing their ability to detect and prevent cyber-attacks. There are potential differences between cyberattack detection technology supported by artificial intelligence and traditional methods without the use of advanced algorithms and machine learning shown in Table 3.

Advances in AI techniques, such as machine learning and deep learning, have shown promise in improving cybersecurity capabilities. These techniques enable cybersecurity experts to counter the ever-evolving threats posed by adversaries [11]. By harnessing

Table 3. Comparison the cyberattack detection technology supported by AI and traditional methods

Characteristic	AI	NON-AI
Enhanced Detection Capabilities	AI methods, such as machine learning and deep learning, can analyze large volumes of data and identify patterns indicative of cyber-attacks For example, machine learning algorithms can learn from historical attack data to detect and classify new and emerging threats	Non-AI methods may rely on predefined rules or signatures, which can be less effective in detecting novel or sophisticated attacks
Real-time Threat Response	AI-based systems can provide real-time monitoring and response to cyber threats They can continuously analyze network traffic, system logs, and user behavior to identify anomalies and potential attacks	Non-AI methods may require manual analysis and intervention, leading to delays in detecting and responding to threats
Adaptability to Evolving Threats	Adaptability to Evolving Threats: AI methods can adapt and learn from new attack patterns, making them more resilient against evolving cyber threats. They can update their models and algorithms based on new data and emerging attack techniques	Non-AI methods may require manual updates or modifications to address new threats, which can be time-consuming and less effective
Improved Accuracy	AI methods can achieve higher accuracy in detecting cyber-attacks by leveraging advanced algorithms and models. For example, deep learning models can extract complex features and relationships from data, leading to more accurate identification of malicious activities	Non-AI methods may rely on simpler algorithms or heuristics, which may result in higher false positives or false negatives

(*continued*)

Table 3. (*continued*)

Characteristic	AI	NON-AI
Scalability	AI-based systems can scale to handle large and complex networks, making them suitable for defending against cyber attacks in large organizations or critical infrastructure. They can process and analyze vast amounts of data in parallel, enabling efficient threat detection and response	Non-AI methods may struggle to handle the scale and complexity of modern cyber environments

the capabilities of AI, experts can develop more robust defense tools and enhance their ability to respond to attacks.

The use of AI in cybersecurity also raises ethical and regulatory issues. Policy initiatives have been introduced to regulate AI in the development of medical devices, highlighting the need for accountability and compliance with data protection and cybersecurity measures [3]. The implications of data protection and cybersecurity are crucial considerations in the implementation of AI systems for cybersecurity purposes.

4 Conclusion and Discussion

In conclusion, this article has explored the opportunities, challenges, and practical solutions associated with leveraging artificial intelligence (AI) for enhanced quality management in energy companies. The four specific areas of focus were predicting energy demand using explainable artificial intelligence (XAI), solar radiation prediction using intelligence techniques, deep neural networks-based energy sector optimization for a sustainable economy, and the use of AI to defend against and detect cyber-attacks [4].

Through the examination of relevant literature and case studies, it is evident that AI has the potential to revolutionize the way energy companies manage and utilize energy resources. Predicting energy demand using XAI allows for accurate and transparent models that provide insights into the factors influencing demand. This can aid in decision-making processes related to energy production, distribution, and consumption [5].

Solar radiation prediction using intelligence techniques enables the optimization of solar energy systems by considering various factors such as weather conditions and geographical location. By leveraging AI algorithms, accurate and reliable predictions can be made, leading to improved performance and efficiency of solar energy systems [17].

Deep neural networks-based energy sector optimization offers a promising approach for achieving a sustainable economy. These models can analyze large amounts of data from various sources, such as smart meters and sensors, to optimize energy generation, distribution, and consumption in real-time. This can lead to improved energy efficiency, reduced carbon emissions, and overall sustainability [18].

Furthermore, the use of AI to defend against and detect cyber-attacks is crucial in safeguarding critical infrastructure in the energy sector. AI-based cybersecurity systems can analyze network traffic, detect anomalies, and respond to attacks in real-time, ensuring the reliability and security of energy systems [19].

However, it is important to acknowledge the challenges associated with leveraging AI in quality management for energy companies. These challenges include data privacy, algorithm bias, and ethical considerations. Addressing these challenges is essential to ensure the responsible and effective implementation of AI in the energy sector.

In conclusion, the integration of AI techniques in quality management for energy companies presents significant opportunities for enhanced efficiency, sustainability, and security. By leveraging AI in predicting energy demand, solar radiation prediction, energy sector optimization, and cybersecurity, energy companies can improve their operations, reduce costs, and contribute to a sustainable and resilient energy future.

The discussion section of this article aims to delve deeper into the opportunities, challenges, and practical solutions associated with leveraging AI for enhanced quality management in energy companies. It provides a platform to critically analyze the findings and implications of the research [19].

One of the key opportunities identified in this study is the potential for AI to optimize energy systems and improve energy efficiency. By accurately predicting energy demand and optimizing energy generation, distribution, and consumption, energy companies can reduce waste, lower costs, and contribute to a more sustainable economy. This can lead to significant environmental benefits, such as reduced carbon emissions and a decreased reliance on fossil fuels [4].

However, it is important to acknowledge the challenges that come with implementing AI in quality management for energy companies. Data privacy is a major concern, as the collection and analysis of large amounts of data raise questions about the protection of personal and sensitive information. Additionally, algorithm bias is a potential issue that needs to be addressed to ensure fair and unbiased decision-making processes [18].

Ethical considerations also play a crucial role in the implementation of AI in the energy sector. It is essential to ensure that AI systems are designed and used in a manner that aligns with ethical principles, respects human rights, and avoids discriminatory practices. Transparency and accountability are key in building trust and acceptance of AI technologies [14].

Practical solutions to these challenges include the development of robust data protection measures, the implementation of fairness and bias mitigation techniques in AI algorithms, and the establishment of ethical guidelines and regulations for AI use in the energy sector. Collaboration between energy companies, policymakers, and researchers is crucial to address these challenges and ensure the responsible and effective implementation [11].

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The Sustainable Development Paradigm as a Determinant of Information System Development Oriented to Energy Consumption Monitoring Based on Promar FM Platform

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Abstract. The sustainable development paradigm plays a significant role in achieving the balance in three main areas: economic, social and environmental. The energy issues and optimization of energy consumption is one of key element to cost savings and minimalizing the negative impact on environment, what is important for current and future generations. Improving the energy efficiency as a global priority is provided in many sectors like transport, industry, agriculture or construction.

While the construction sector is one of the largest energy consumers in the world, improving energy efficiency in buildings requires more innovative and advanced solutions. The energy efficiency is nowadays increased not only by investments in innovative technologies and energy infrastructure, applying renewable energy sources, sensors, smart energy meters but also by the information systems applications that allows to monitor and adjust the energy production and consumption. The role of IT systems is more and more important to track, report, recommend and implement more effective strategies to manage the energy sources and recommend their better utilization. Nevertheless the problem, which exists and is often underlined regards the integration of data from different sources to provide complex analysis and control. In the article is presented the approach to deliver facility management system oriented to complex analysis of energy efficiency in different contexts. The system allows to integrate and proceed the real-time data from various external units to provide multi-aspects analysis allowing for improvement the energy efficiency indicators and cost savings.

Keywords: Sustainability · sustainable development · IT system · energy monitoring system · energy efficiency

1 Introduction

The sustainable development concept is widely discussed and plays a key role in shaping the future of societies, economies and the environment [10, 18]. The approach highly influence on construction, both at the planning and designing stage, as well as at construction and buildings utilization [4, 7, 19]. To meet the challenges of sustainable

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development in architecture pro-social aspects are considered to focus on creating optimal health, aesthetic and social conditions for people to stay [4, 6]. From environmental perspective the necessity to reduce negative impact on the natural environment is implemented through the application of renewable materials, designing structures that are energy-efficient and durable and implementing modern technologies. This changes within building contribute to optimization the efficiency and costs of building functioning [11].

While the sustainable development stimulate wide spectrum of innovation in building and causes that buildings become green, sustainable and intelligent, the energy efficiency needs to be investigated as a basic concept for meeting this trends [1, 2, 4, 7, 14]. To achieve higher energy efficiency many different devices and advanced technologies are implemented within the building. It means, that the buildings are equipped with intelligent meters, sensors, thermostats, IT systems to gather different type building-related data. The wide spectrum of data coming from this tools and systems, in different formats, different presentation modes, with different detail level causes many difficulties with their processing and analysis [9, 16]. To solve this problems, the information system is proposed, which from one side enables the integration of data from external units and from other allows to monitor energy consumption, energy efficiency and energy performance to propose better and personalized strategies to facility management and resource utilization. In the article is presented the concept of platform developed by Promar, called Imperius [13], which is a complex solution that facilitate building management, with emphasis on energy monitoring, analyzing and control. There is presented the structure of the system and the effect energy efficiency optimization results with the application of the platform. The article is summarized with conclusions covering the future work of system development.

2 Problem Statement

Fact, that construction sector belongs to one of the highest energy consumers, the application of sustainable development guidelines to reduce energy consumption has a crucial meaning [3, 7]. This influence directly to the current studies on sustainable buildings, which are focused on energy, water, and carbon efficiency. From the other side the interest is put towards intelligent and digitalized tendencies and modern technologies that are designed and applied for the purpose of smart and sustainable buildings [5, 12]. The increasing number of emerging technologies affect to more dynamic development of cloud computing, big data analytics and application of artificial intelligence algorithm to better answer the energy efficiency needs and orient buildings to more sustainable ones [1, 5, 16].

Monitoring the energy efficiency is based on various technologies, systems and devices that allow collecting data on energy consumption and efficiency coming from various systems in the building. Among them the intelligent sensor, meters, IoT technologies, control systems (i.eg. lighting, water consumption), energy monitoring and management systems are applied. This devices and systems generate large amount of data, which for the purpose of analysis and management require to be collected, unified and processed to give appropriate feedback. The problems that appear concerns the variety of solutions, time needed for data collection, variety of data formats, incomplete data, outdated data, low quality data, identification of data and their inconsistency and is often the barrier to provide in-depth analysis and fast reaction. Therefore, incorporating and integrating energy-efficient features, energy-capturing technologies and smart infrastructure systems is required to work with provided data and on basis of achieved results, reduce operational energy consumption, create energy consumption patterns and optimize energy usage in short and long term [3, 9, 16, 20].

The range of analysed in the context of energy efficiency data growths, if parameters of available devices are analysed and maintenance issues are considered. The sustainable development perspective requires the conservation of possessed technologies to achieve their well performance and stable functioning [18]. Conservation measures should be adopted, monitored, reported and analysed and providing consistent policy at this field should enable access to such information like technical documentation, instructions, certifications, etc.

The huge amount of data processed implicates therefore the need to offer an integrated system, which will cover the information requirements in different aspects of building functioning and will allow to monitor and manage the energy efficiency and track and alert anomalies and disfunctions.

3 The Concept of Facility Management System to Monitor and Analysis the Energy Efficiency

3.1 The Structure and Operational Scope of the System

Increasing the energy efficiency in construction is a key element to meet the challenges of sustainable development. Focusing on delivering high-quality solutions in the energy management and optimization, smart building and IoT sector plays a significant role to decrease the energy consumption. This allows you to reduce greenhouse gas emissions, reduce building operating costs and increase user comfort. Implementing modern technologies is nowadays strongly supported by appropriate IT systems. At the market, there are available different solutions like Siemens Ecomodus [17], Schneider Electric EcoStruxure [15] or Honeywell Forge Energy Management [8], that supports the energy monitoring and optimization. Nevertheless, there is still the necessity to offer more complex systems, which allow to manage in one platform different energy sources and will take into consideration different building properties to offer tailor-made strategies for energy consumption and increasing the energy efficiency level.

The facility management system designed by Promar, called Imperius, is a solution that integrates in one environment the comprehensive information referring to different aspects of building functioning to provide efficient facility management. The system allows to reduce energy and water consumption and ensures safety and improve the operation of installations and transmission networks. Imperius is dedicated for units oriented on the IoT and smart city concept.

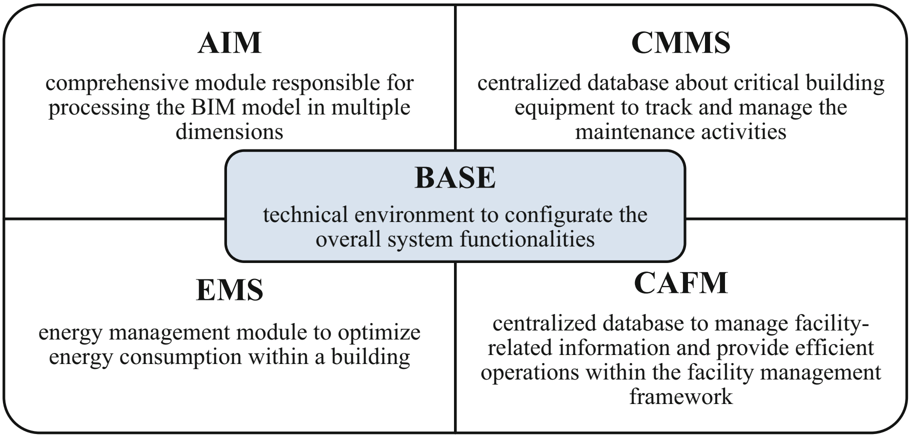
AIM
comprehensive module responsible for processing the BIM model in multiple dimensions
CMMS
centralized database about critical building equipment to track and manage the maintenance activities
BASE
technical environment to configurate the overall system functionalities
EMS
energy management module to optimize energy consumption within a building
CAFM
centralized database to manage facility-related information and provide efficient operations within the facility management framework

Fig. 1. The structure of Imperius facility management system designed by Promar

The most significant factor that distinguishes Imperius platform from other solutions available on the market is its architecture, designed to facilitate data sharing with various third-party systems. The system enables to integrate data from different devices like: IoT, LoRa, PLC, smart building modules, Smart Grid meters, etc.

The platform is built on a modular structure, utilizing microservices architecture. There are five modules distinguished to ensure wide analysis and building managerial capabilities as presented in Fig. 1. The AIM (Asset Information Model) module is responsible for processing the data coming from the BIM model. The CMMS (Computerised Maintenance Management System) gathers all data related to building equipment and allows to monitor the health, functionality and maintenance of applied devices. Within EMS (Energy Management System) functionality the energy consumption from multiple sources is analyzed and optimized to achieve better energy efficiency and cost savings. The CAFM (Computer Aided Facility Management) is built on holistic approach to proceed data is applied to manage facilities, assets, and resources, resulting in improved productivity and cost savings. The module offers a wide range of features that streamline facility management processes, enhance operational efficiency, and enable data-driven decision-making. The whole working environment is configured in BASE module. The specification of main modules capabilities is presented in Table 1.

By leveraging these collaborative capabilities coming from Imperius modules the holistic and interconnected platform is created that optimizes facility management, improves operational efficiency, enhances occupant comfort, and drives sustainable building performance. The crucial benefits that come with integrating these modules are as follows:

- Enhanced Data Accuracy and Consistency: integrating the modules ensures that data are synchronized across systems and the risk of discrepancies or errors is minimalized. This promotes data accuracy and consistency, allowing stakeholders to make informed decisions based on reliable information.

- Streamlined Workflows and Increased Productivity: the integration of modules enables streamlined workflows by automating the processes, reducing manual data entry and eliminating duplicate efforts. This automation enhances operational efficiency, saves time and increases productivity for maintenance teams, facility managers, and other stakeholders.
- Scalability and Future-Proofing: integrating modules into a single platform provides scalability and future-proofing capabilities. As organizations grow and evolve, the unified system can accommodate additional functionalities, modules, or integrations, ensuring long-term adaptability and flexibility.

Table 1. The main capabilities of Imperius modules

Module	Main capabilities
AIM	• Provides the interactive 3D visualization of building with the possibility of rotating the 3D building model, cutting in any plane, toggling visibility of floors and installations, • provides the representation of installations, • provides interactive navigation between the database and the BIM model, allowing users to switch between any element on the model and the corresponding data in the database, • enables to locate and present the building elements, • provides data about areas (spaces), including room localization and information about area and volume
CMMS	• Enables to manage the maintenance activities and technical performance of building equipment, • enables to monitor the technical condition of devices, • allows to organize maintenance processes and schedule preventive maintenance tasks, • enables to track work orders, and generate maintenance reports, • provides valuable insights into equipment performance trends and patterns, facilitating data-driven decision-making for optimizing maintenance strategies and resource allocation, • allows to prioritize maintenance tasks and allocate resources efficiently to reduce costs associated with unexpected breakdowns
EMS	• Enables to gather and integrate real-time energy data from different building systems, sensors, monitoring devices, etc • enables to track energy usage across various areas and systems within the building, • enables the analysis energy consumption patterns, identification areas of inefficiency, and recommendation of energy-saving measures • can recommend appropriate lighting levels, HVAC settings, and equipment operations, • assists the operator in making decisions to reduce energy losses and improve overall energy efficiency,

(*continued*)

Table 1. (*continued*)

Module	Main capabilities
CAFM	• facilitates energy monitoring and reporting by providing visual dashboards, reports and alerts, • enables facility managers to track energy usage and compare performance against set targets, • can anticipate upcoming occupancy changes, such as meetings, events, or office reconfigurations, and optimize energy settings accordingly • Provides support for facility management during the operational phase • assists in effectively managing space utilization within buildings, • facilitates cross-departmental and inter-employee tasks, such as office orders and transportation requests, • offers tools for room reservations, event management, and tracking employee presence in offices, • provides the description of organizational structure, rooms, equipment, documents, contracts, etc
BASE	• Enables to create personalizes dashboard including charts, images, file text, reports, indicators, • provides user and permission management tools to define access level for different modules and functionalities within the system, • establishes a reliable authentication and login environment to access the system, • enables configuration to customize and configure settings for each individual module available in the system

3.2 Optimizing the Energy Efficiency with the Use of Imperius Platform

More and more companies invest in renewable energy sources and take care about improving energy efficiency in buildings, industry and transport. Implementing an innovative and advanced technologies and systems in buildings allows to monitor conditions inside and outside the building and automatically control, react and adjust parameters to save energy. It requires the necessity to control the consumption of electricity, heating, cooling and other devices and gather real-time data to process them for more efficient utilization and adjustments to the user needs.

Imperius platform has on aim to increase the efficiency of energy consumption. To achieve this, it incorporates advanced fault detection and energy analytics capabilities, powered by artificial intelligence. The fault detection and energy analytics tool incorporates predefined indicators (Key Performance Indicators - KPIs) and efficiency metrics. In Fig. 2 is presented the personalized dashboard analyzing different aspects of energy consumption monitoring process. The indicators are dynamically programmed in the system to assess the performance of various building devices and identify potential areas for improvement. By analyzing these indicators, the platform helps to manage energy efficiency and effectively detect faults or malfunctions in building equipment and installations. The available trend analysis and space utilization allows to adjust the energy parameters to the real needs.

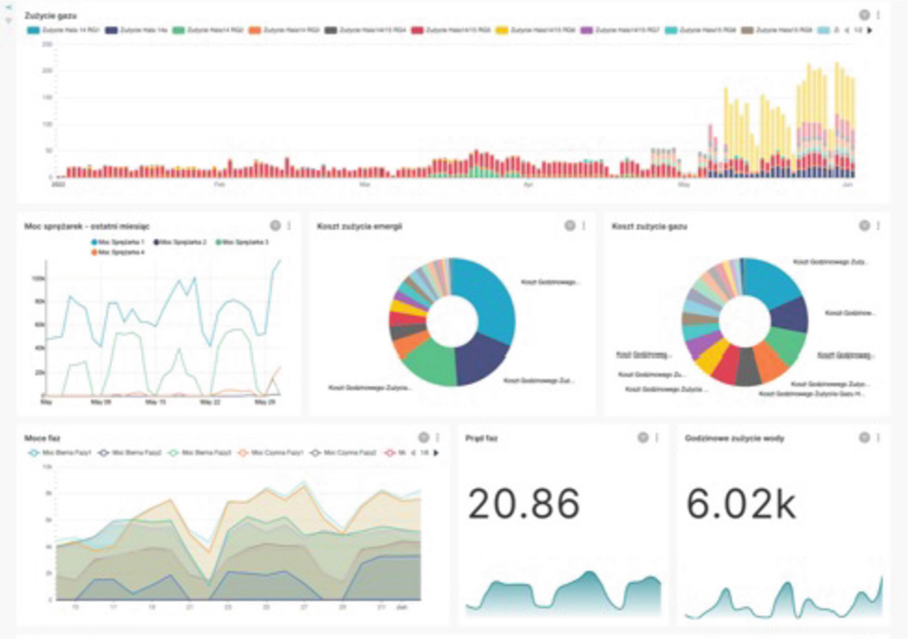

Fig. 2. Visualization of dashboard presenting the different energy aspects monitoring

There are many implementations of the system in different units, in which personalized buildings parameters and indicators are monitored and controlled in the platform. The modular architecture of the system enables to flexibly adjust its functionalities to the type of building and monitoring requirements. In Table 2 are presented some results of applications of Imperius platform to monitor the improve the energy efficiency. The realized projects and delivered feedback allowed to recommend changes in existing energy sources and modernize the already existing technologies.

The application of Imperius system to offer more effective strategies for energy utilization is nowadays conducted in more than 2500 buildings. Monitoring the operation of energy installations, controlling the operation of energy installations, supporting the control of renewable energy sources in order to maximize their efficiency, implementing fault detection algorithms, preparing the comparative and historical analyses and predicting of energy consumption in the future contributes to reducing building operating costs and ensuring accurate and efficient identification of errors and anomalies within the building systems. By gathering real-time data from different devices and third-parties systems it is possible to achieve measurable benefits and recommend appropriate reactions.

Table 2. The application of Imperius system

Unit	Range of the project	Achieved results
Warsaw city, downtown district	Implementation of the Imperius system as a global platform for 37 education units, infrastructure modernization	• Ensuring platform integration with existing devices in buildings, • Conducting remote monitoring and exploitation of building and installation, • Optimization of energy consumption, • Seasonal reports summarizing the effect of conducted activities, • Total savings in variable and fixed costs in period 2012–2018 exceed 8 million PLN, • Average annual heat cost savings of over 26%
District Courts - Opole	Implementation of Imperius system in 2 District Courts in Opole, infrastructure modernization	• Monitoring the energy consumptions in the field of heat and electricity, • Installation of reactive power compensator to optimize the energy consumption, • Analyzing real-time data to assess the efficiency of energy consumption, • Reporting the effect of conducted activities, • Average annual savings to over 75,000 PLN

(*continued*)

Table 2. (*continued*)

Unit	Range of the project	Achieved results
InDeal – Vransko (Słowenia)	Implementation of Imperius system in network's buildings, infrastructure modernization	• Ensuring platform integration with existing devices in buildings, • Application artificial intelligence algorithm to forecast demands for energy, • Analysis the utilization of energy for heating and cooling systems and fairly distribution of energy, • Balancing renewable energy source production using artificial intelligence application, • Balancing the energy consumption from biomass boiler plant and solar panel installations, • Predicting the short-term and long-term weather conditions and forthcoming need for heating and cooling, • Implementation of dynamic models to manage the operation of the heat buffer to achieve economical operation of biomass boilers in summer and during peak load in winter, • Reporting the effect of conducted activities

4 Conclusion and Future Work

Reaching the high level of sustainable buildings has become an international trend. The need for sustainable development, energy management and savings has never been more pressing. It directly influence on the role of modern technologies and information systems, which help to achieve higher level of energy efficiency.

In the article is presented the Imperius system, which allows to manage building facilities and monitor and analyze the energy consumption. The system offers many functionalities, which allow to achieve measurable benefits and save money. The complex approach to join in one environment BIM models processing, energy management system and facility management opportunities does not close the path to further development. In progress is integration of AIM module with augmented reality to offer the possibility to overlay virtual 3D models onto real-world environments and uncover building elements, which are not directly visible as well as interact with stored data in real-time. Additionally, the OCR tools will be implemented to proceed data from documents to facilitate quick addition of key parameters and specifications to the system and updating information in efficient way. Future plans include also the integration of the system with Property Management Systems to ensure the aggregation with property-related data.

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A Low-Cost Computer Vision Approach for Counting Juvenile Shrimp Using OpenCV and Smartphone

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Abstract. One of the most important tasks in growing and trading shrimp is postlarvae and juvenile shrimp counting. In Vietnam, most small-scale shrimp farms/companies today rely on manual and volumetric counting to estimate the number of postlarvae and juveniles for sale to customers. This traditional counting method is time-consuming, labor-intensive, and prone to error. Inaccurate shrimp counting not only causes economic loss to sellers and buyers but also affects production efficiency. This paper presents the design and implementation of a computer vision-based device for automatic counting of juvenile shrimp. The designed shrimp counting device were portable and low cost by taking advantages of the open-source computer vision library OpenCV and the power of now-ubiquitous smartphones. The experimental results demonstrate that the proposed counting approach can provide an average accuracy of over 96% compared to the true values. The average processing time for one counting is a few seconds. This could provide famers with a shrimp counting approach that offers acceptable accuracy, requires less time and labor cost compared to the traditional manual counting methods.

Keywords: Android studio · Computer vision · Shrimp counting · OpenCV

1 Introduction

Vietnam is one of the three countries with the largest shrimp production in the world, along with China and India [1]. According to data released by the Directorate of Fisheries in 2022, the country has over 2,000 shrimp seed farms/companies with an output of more than 160 billion shrimp/year [2]. One of the most important tasks in growing and trading shrimp is postlarvae and juvenile shrimp counting. Currently, most small-scale shrimp farms/companies rely on manual and volumetric counting to estimate the number of postlarvae and juveniles for sale to customers. The shrimp are first put into a large

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racket, and the farmer will choose a cup of the appropriate size to be able to pick up about 2,000 shrimp/cup. The shrimp are then placed in plastic bags filled with oxygen to be transported to the customers. Buyers can choose an arbitrary bag for testing. They use a small cup to pick up a few shrimp to count. On average, it takes about 30 min to count 2,000 shrimp (Fig. 1). This traditional counting method is time-consuming, labor-intensive, and prone to error. Inaccurate shrimp counting not only causes economic loss to sellers and buyers but also affects production efficiency.

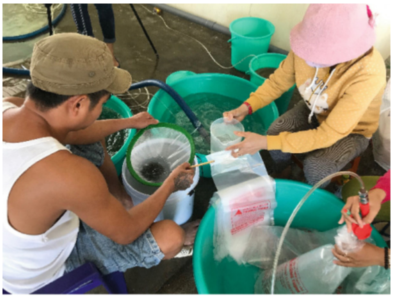


Fig. 1. Counting shrimp manually to sell to customers [3].

Several studies have been conducted to apply image recognition techniques for automated shrimp counting [4–8]. The authors in [4] introduced a computer vision-based system consisting of a computer, a 15-MP camera, and an elaborately-designed image acquisition box for counting juvenile shrimp. An automated ornamental shrimp counting system employing a Raspberry Pi Zero W kit, OpenCV library, and Cloud computing was also presented in [5]. The systems proposed in [4, 5] offered an counting accuracy of about 95%. However, these methods require complex hardware designs, so they are not convenient for deployment in practice. Recently, advanced image processing methods such as machine learning and deep learning techniques have been employed for the problem of counting postlarvae and juvenile shrimp [6–8]. In [6], the authors applied the Random Forest classification algorithm to estimate postlarvae shrimp population with an accuracy of 98.5%. Unsupervised machine learning was also used to calculate the number of ornamental shrimps with an accuracy of over 96% [7]. The authors in [8] used the deep learning method and developed a neural network model, named Shrimpseed_Net, to count shrimp seeds. This shrimp seed counting model was trained on a PC server and deployed on smartphones for use, and it can obtain a precision of 95.53%. Additionally, AI-powered portable automatic shrimp counting devices has recently become available on the market [9, 10]. AI-based shrimp counting equipment can offer improved accuracy and calculation speed compared to conventional image processing techniques. However, these advanced image recognition techniques require high-performance computing platforms, making the cost of counting devices less attractive for small-scale farms in developing countries.

In this paper, we present the design and implementation of a computer vision-based device for automatic counting of juvenile shrimp. The proposed approach leverages the power of today's popular smartphones and the open-source computer vision programming tools OpenCV [11]. This therefore offers farmers a portable, low-cost method of counting shrimp with acceptable accuracy, requiring less time and labor costs than traditional manual counting methods.

2 Methodology

2.1 System Overview

Figure 2 shows the principle diagram of the proposed computer vision system for counting juvenile shrimp. The system consists of an Android smartphone, and a plastic cylinder bucket with height of *h*, and diameters of d_1 (top) and d_2 (bottom). Juvenile shrimp are placed at the bottom of the bucket with an appropriate amount of water. Images of the shrimp are taken by a smartphone camera placed on the lid of the bucket. The location of the smartphone is determined so that the phone's camera is in the center of the lid to get the best image. The captured images are then processed by the application software developed with Android Studio (version 2021.2.1.15) [12]. The image processing algorithms are implemented in Java programming language and the OpenCV library (version 4.6.0). Shrimp counting results are displayed on smartphone's screen. An LED light can be installed on the underside of the bucket's lid to enhance lighting for photography.

2.2 Image Collection

The juvenile shrimp used in the experiment were purchased from shrimp farms in Can Tho City. A total of about 800 black tiger shrimps (*Penaeus monodon*) and 800 whiteleg shrimps (*Litopenaeus vannamei*) were used to develop the image processing algorithms. The distance between the camera and the shrimp (i.e. the bucket height) is chosen to achieve the best image quality.

2.3 Image Processing Algorithms

Figure 3 shows the flowchart of the image processing algorithms of the proposed approach. The algorithm consists of 6 processing steps: capture images from phone's camera, resize image, convert color image to grayscale one and blurring, convert image to binary one, find contours and determine ROI (region of interest), and count objects.

2.3.1 Capture Images from Camera

Since the smartphone is placed horizontally on the bucket lid, the taken image frame will be horizontally oriented, not true to the actual frame. Therefore, some control parameters in the *CameraBridgeViewBase.java* file of the OpenCV library were adjusted to obtain the appropriate image orientation.

2.3.2 Resize Image

After being taken by the phone's camera, the captured images are resized before being processed (Fig. 4). Through experimentation, the image size of 640*x*480 pixels with JPG format was chosen since it allows for fast processing speed and reasonably accurate calculation.

2.3.3 Convert Image to Grayscale and Blurring

In this step, the RGB image is converted to grayscale one using the *Imgproc.cvtColor()* function in OpenCV library. The grayscale image is then blurred to filter out noises using the *Imgproc.GaussianBlur()* function. The grayscale image applied blurring is shown in Fig. 5.

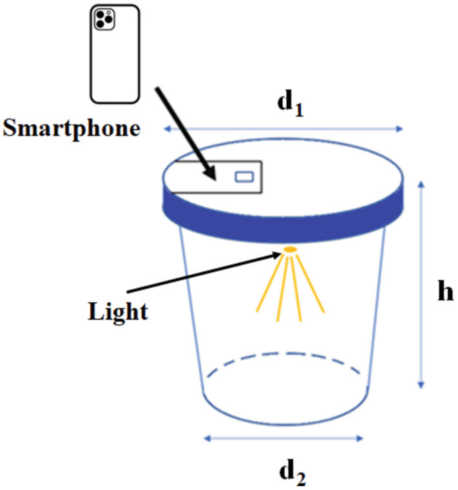


Fig. 2. Structure of the designed device for counting juvenile shrimp.

2.3.4 Convert Image to Binary

In this step, the adaptive thresholding method is applied to transform grayscale image to binary one using the *Imgproc.adaptiveThreshold()* function. Figure 6 shows the r-sults of the grayscale to binary conversion.

2.3.5 Find Contours and Determine ROI

In this step, *Imgproc.findContours()* function is applied to detect objects in the binary image. The region of interest (ROI) is the part of the image that contains shrimp. The determination of ROI also helps to reduce processing time. An ROI with rectangular shape is extracted using the *Imgproc.boundingRect()* function of OpenCV library. The results of extracting the ROI are depicted in Fig. 7.

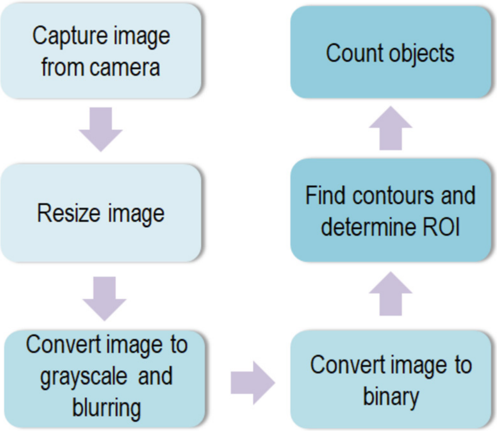
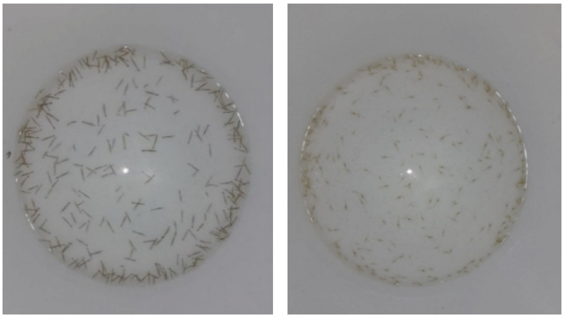
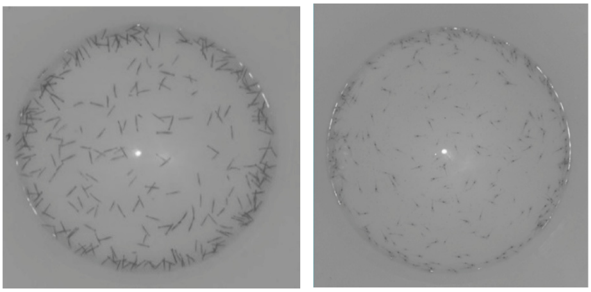

Capture image from camera
Resize image
Convert image to grayscale and blurring
Convert image to binary
Find contours and determine ROI
Count objects

Fig. 3. The flowchart of the image processing algorithm.



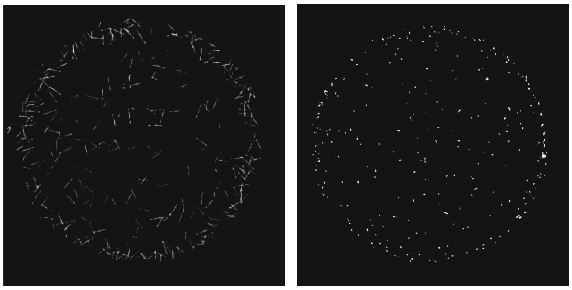
(a) (b)

Fig. 4. Images taken by phone's camera: (a) juvenile tiger shrimp and (b) whiteleg shrimp.



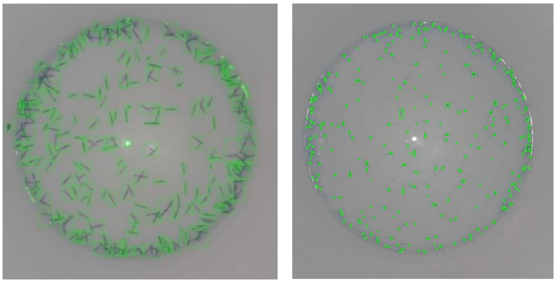
(a) (b)

Fig. 5. Images after being blurred: (a) juvenile tiger shrimp and (b) whiteleg shrimp.



(a) (b)

Fig. 6. Conversion from grayscale to binary image: (a) juvenile tiger shrimp and (b) whiteleg shrimp.



(a) (b)

Fig. 7. Determining the region of interest: (a) juvenile tiger shrimp and (b) whiteleg shrimp.

2.3.6 Count Objects

The *Imgproc.rectangle()* function is used to identify every shrimp in the image. The number of shrimp is calculated based on the number of counted rectangles. To increase counting accuracy, the number of shrimp is the average value of the calculation from 10 consecutive images taken.

3 Experimental Results

To validate the effectiveness of the proposed method, a plastic cylinder bucket having a dimension of 26 cm × 24 cm × 21 cm (h x $d1$ x $d2$) was used to build the image acquisition chamber, as shown in Fig. 8. Since the shrimp has a dark color, the inside of the bucket was painted white to easily detect the shrimp shape in the image processing algorithms. A 3-Watt white LED light was installed on the inside of the bucket lid to help maintain the quality of the captured images stable, not affected by the characteristics of the flash light on the smartphones (Fig. 8c). In this study, the shrimp counting software developed with Android Studio was installed on a Samsung Galaxy A12 smartphone [13]. An Arduino Nano kit [14], which is connected to the smartphone via a USB On-The-Go cable [15], is employed to control the operation of the LED light.

The user interfaces of the application software on smartphone are shown in Fig. 9. After starting the software, users can choose the size of juvenile shrimp to count by triggering the “Mode” switch. In this experiment, the length of the juvenile whiteleg shrimp and the juvenile tiger shrimp is 6–12 mm and 12–18 mm, respectively. The process of counting juvenile shrimp is depicted in Fig. 10. When the “Count” button is pressed, the software sends a signal to the Arduino Nano kit to turn on the LED light. After a short delay of T_1 seconds, the shrimp counting algorithm begins with taking images of the shrimp in the bucket. Determining the number of shrimp in the image is then done based on the techniques presented in the Sect. 2.3. In the next step, a delay of T_2 seconds is added before the next image is taken and processed. These tasks will continue to be performed until the capture and processing of N images is complete. In this experiment, N was chosen to be 10 to improve the accuracy of shrimp counting. In the final steps of the process, the LED light is turned off and the count result is displayed on the smartphone screen.

Shrimp counting results using the proposed approach were compared with the true values. Tables 1 and 2 show the data of true values and automated counts, average error, and accuracy of shrimp counting obtained from 750 black tiger shrimp samples and 750 whiteleg shrimp samples, respectively. The shrimp count starts with 50 samples and gradually increases to 750 samples. It can be seen that the counting error gradually increases with the number of shrimp placed in the bucket. This is because as shrimp density increases, the likelihood of shrimp overlapping also increases. In addition, when the number of shrimp exceeds a threshold value (i.e. 650 shrimp in this experiment), the counting errors of tiger shrimp are larger than those of whiteleg shrimp because the tiger shrimp are larger in size, so the probability of image overlap is also greater. Therefore, the counting error can be kept low by maintaining the number of shrimp appropriate to the size of the bucket. Besides, maintaining a suitable water level in the bucket will also help reduce cases of overlapping images leading to incorrect counting. The experimental results demonstrate that the proposed counting approach can provide an average accuracy of over 96% compared to the true values. The average processing time for one counting is a few seconds.

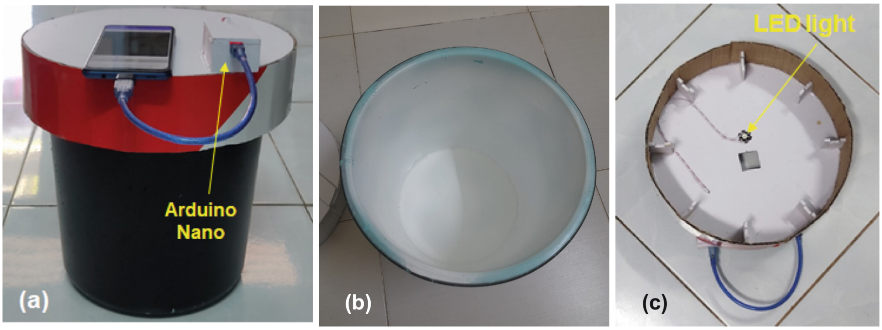
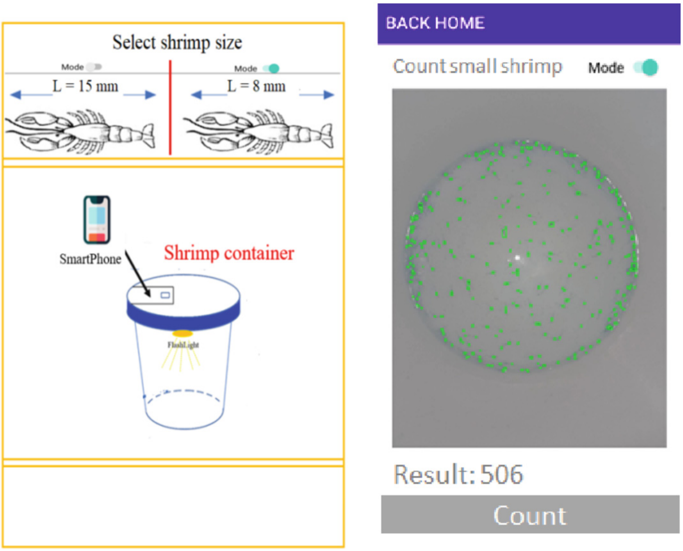


Fig. 8. The designed shrimp counting device: (a) plastic cylinder bucket; (b) inside of the bucket; (c) LED light installed on inside of the lid.


Select shrimp size
Mode
L = 15 mm
Mode
L = 8 mm
SmartPhone
Shrimp container
FlashLight
BACK HOME
Count small shrimp
Mode
Count

Result: 506

Fig. 9. User interface of the shrimp counting software.

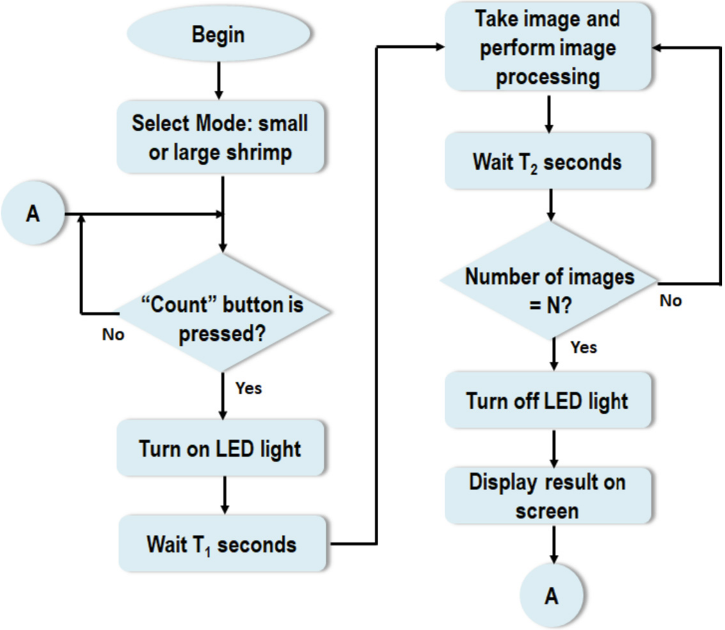

Begin
Select Mode: small or large shrimp
A
"Count" button is pressed?
No
Yes
Turn on LED light
Wait T1 seconds
Take image and perform image processing
Wait T2 seconds
Number of images = N?
No
Yes
Turn off LED light
Display result on screen
A

Fig. 10. Diagram of shrimp counting process.

4 Conclusions and Future Work

This paper presented the implementation of a computer vision - based method for automated juvenile shrimp counting. The designed shrimp counting device were port-able and low cost by taking advantages of the open-source computer vision library OpenCV and the power of now-ubiquitous smartphones. This provides famers with an automated shrimp counting approach that offers acceptable accuracy, requires less time and labor cost compared to the manual counting methods. The proposed method could be a potential alternative of shrimp counting to support shrimp industry. Our future works will focus on improving counting accuracy and the device's ability to process larger numbers of shrimp at once.

Table 1. Experimental results of counting juvenile black tiger shrimp.

No	True values, m_i	Automated counts (*averaged over 10 counts*), s_i	Error $\lvert s_i - m_i \rvert / m_i$ (%)	Accuracy (%)
1	50	49.9	0.20	99.80
2	100	98.9	1.10	98.90
3	300	294.5	1.83	98.17
4	350	345.6	1.25	98.75
5	400	396.4	0.90	99.10
6	450	435.9	3.13	96.87
7	500	479.3	4.14	95.86
8	550	527	4.18	95.82
9	600	570.1	4.98	95.02
10	650	602.6	7.29	92.71
11	700	651	7	93
12	750	700.8	6.65	93.44
Mean value			**3.55**	**96.45**

Table 2. Experimental results of counting juvenile whiteleg shrimp.

No	True values, m_i	Automated counts (*averaged over 10 counts*), s_i	Error $\lvert s_i - m_i \rvert / m_i$ (%)	Accuracy (%)
1	50	48.9	2.20	97.80
2	100	102	2	98
3	300	291.6	2.80	97.20
4	350	339.8	2.91	97.09
5	400	391.5	2.12	97.88
6	450	437.3	2.82	97.18
7	500	486.9	2.62	97.38
8	550	536.6	2.43	97.57
9	600	575.7	4.05	95.95
10	650	628.1	3.36	96.64
11	700	677.1	3.27	96.73
12	750	726.1	3.18	96.82
Mean value			**2.81**	**97.19**

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Usefulness of Design Thinking in Polish Cultural Institutions

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Abstract. The purpose of the article is to analyze the management of Polish cultural institutions in the context of design thinking - Design Thinking. As a result of the breakthrough that was the process of development of the Internet, cultural institutions faced the need to combine human resources with software and technical infrastructure, enabling them to take care of a unique, competitive experience for users of the cultural sector. The "service logic" (Service Dominant Logic) characteristic of the 21st century, assuming in its paradigm, the transformation of the recipient-customer into a prosumer, i.e. an individual who co-creates the service and has an impact on its final shape, emphasizing the tailoring of services to the needs of users has become a fact and a necessity for the continued existence of the development of Polish cultural institutions.

Keywords: Design Thinking · Polish cultural institutions · Management · IT industry

1 Introduction

According to Eurostat statistics, the cultural sector in the EU employed 8.7 million people in 2018, or 3.8% of the total workforce [1]. Cultural heritage is of vital importance to the majority of Europeans recognizing its importance and value to the communities, region and countries in which they live, and the European Union itself as a whole [2]. A key aspect for Polish cultural institutions to take full advantage of their mission and social role is to constantly improve the competence of their staff in the areas of copyright, accessibility as well as digital transformation, conducting IT projects, but above all experience, observation, research and data collection containing the current expectations of the audience, but above all the digital activation of art audiences. Creating innovative solutions, both in the institution's program and new strategies in the field of culture, and thus increasing the satisfaction of art audiences on the other side of the screen, has become a priority for the continued existence and operation of culture in all institutions around the world. During the pandemic, when many institutions made the digital transformation and moved online, "pandemic digitization was necessary - it gave neither artists nor audiences a choice, and sudden - it left no one time to prepare" [3]. Cultural institutions, broadcasting concerts, performances and meetings with Artists on the Internet, in order to improve the growth of usability, have applied new tools and techniques to customize

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cultural offerings based on customer needs analysis. The knowledge gained about the expectations of *online audiences* thanks to the information automatically gathered on the web has significantly impacted the dynamization of interaction with the audience, while enabling the creation of programs tailored to the needs of a specific customer-viewer.

Specific needs and expectations in the cultural sector make the vision of business success by achieving the basic goals of: preserving the cultural identity of the nation, ensuring equal access to culture, promoting creativity and quality cultural goods and services, ensuring cultural diversity to meet the needs and tastes of all sectors of society [4].

The first part of the article presents Polish cultural policy, the current shape of which has been shaped by the significant socio-political and economic transformations of the last three decades. The second part deals with the methodology of design thinking - design thinking, as well as the possibility of its application of principles in Polish cultural institutions. The third part focused on the future of cultural institutions in the context of design thinking and the related expectations of audiences in relation to the expansion of the new digital environment.

2 Theoretical Aspects

The cultural policy of the state can be defined as an intentional and systematic involvement in the field of culture, aimed at conscious management of the public interest, in this sector, and decision-making on all issues related to the cultural development of a given society [5]. The creation of a transparent and independent system of financing culture requires the interaction of intermediary institutions between the government and cultural creators [6], as well as the adoption and amendment of laws regulating the cultural sector in Poland[1]. Culture and the institutions that represent it are an area that is particularly sensitive and vulnerable to difficulties in political systems undergoing constant transformation, resulting from the need for independence and also the cessation of ideological control by the state [7]. In this regard, Polish cultural institutions over the past three decades have undergone many changes and transformations necessary to maintain the existence of the institution, primarily in aspects of the development of the commercial side of the cultural offer - often focused on works intended for mass audiences, not presenting high artistic quality. Changes in the environment, both economic and social, the lack of a well-established model of cultural policy that could be applied to the changed political reality [8] have forced the targeting of cultural offerings to the widest possible mass audience. A cultural offer that corresponded to the mechanisms of the free market, economies of scale and the lowest common denominator, unfortunately, contradicted the “cultural mission” performed by cultural institutions and its employees for the development of the state and its national heritage [9]. The establishment of intermediary institutions between the government and cultural representatives, such as the Polish Film Institute, the Adam Mickiewicz Institute, the National Audiovisual Institute, the Book Institute, and the National Cultural Center, contributed to the creation of a transparent funding program for institutions, while relieving the burden on local institutions [6].

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[1] The Law on Organizing and Conducting Cultural Activities was adopted as early as 1991, the Law on Copyright - in 1994.

Within the framework of support for the Polish cultural sector, *programs of the Ministry of Culture and National Heritage* are offered. *Targeted* at cultural institutions, NGOs, film institutions, schools and universities, local government units, business entities, churches and religious associations, they are primarily aimed at subsidizing project-based tasks [10]. Digitization and long-term storage of digital resources is also one of the factors in the development of the modern information society. And the creation of digital copies of Polish national heritage resources is one of the most important conditions for its preservation for future generations [11]. Within the framework of the above-mentioned needs of cultural institutions, measures were taken to digitize the resources held by Polish cultural institutions. Carrying out the digitization project required the creation of a whole system of changes at many levels of the functioning of cultural institutions, thus giving space to the usefulness of the design thinking methodology. Table 1 below shows the cost of implementing the program from 2009 to 2020.

Table 1. Costs of implementing the digitization program with possible sources of funding from 2009 to 2020

Total cost	2883 million
Funds from the state budget	2338 million
EU funds	PLN 285 million
other	260 million zlotys
Cost per digitization lab	700,000 euros

Source: [11].

Accession to the European Union has enabled Polish cultural institutions to benefit from new sources of funding for cultural activities, enriching the offer of Polish cultural institutions, which are also an excellent area of exchange in the field of art between cooperating entities. Funds available under European structures actively contribute to more effective protection and promotion of Polish cultural heritage. Cultural ventures of particular importance to culture and the protection of national heritage are awarded the Honorary Patronage of the Minister of Culture and National Heritage as a distinction [12].

The need to provide cultural diversity that responds to the needs and tastes of all sectors of society arising from the basic assumptions of the state's cultural policy [13] also required providing cultural institutions with new methods and tools to collect and analyze data, as well as rapidly prototype and test ideas and innovative solutions. Applied mainly in the commercial sector, design thinking has also found application in cultural institutions, directing the team's involvement in creating a diverse cultural offer that meets the needs of the community of art recipients, as well as attracting new ones. On the basis of the segmentation study to which the participants of culture were subjected, a division into groups was carried out according to: needs, cultural spending and ways of spending time. In conclusion, the survey found that 96% of Poles participate in culture - both institutionalized (e.g., through visits to cultural institutions) and at home (e.g., through reading, listening to cultural radio stations) - at least once a year [14]. Learning about the needs of audiences, responding to the interests and themes preferred by customers has made it possible to initiate the building of long-term relationships between cultural institutions and audiences, based on trust and empathy stemming from knowledge of the needs of customers-co-creators of public events. Based on data from the UK's DCMS[2], cultural goods - considered as part of the creative sector - are an important source of export-derived revenue, and therefore contribute to the country's economic growth [8].

The design thinking characteristic of co-creation of solutions, realizing the needs of both parties, supports not only the creation of innovations in the course of design processes of cultural institutions but significantly contributes to overall economic growth. A cultural institution, defined as a state or local government legal entity for which cultural activities are the primary statutory purpose, conducted in the form of: museums, art exhibition offices, art galleries and centers, libraries, cultural houses and centers, community centers and clubs [15], responds primarily to the needs of customers in receiving culture in the broadest sense. According to an NCK survey[3], four out of five respondents use the Internet at least once a week, and only 4% of respondents used a mobile application related to culture or sightseeing last year [16]. The systematic introduction of innovations in the aforementioned area, the interaction of cultural institutions with their customers has become a new starting point for the effective design of services that meet the requirements and expectations of the audience of the arts area. However, the introduction of changes enabled by design thinking required cultural institutions to analyze the institution's resources in terms of: disposition of an interdisciplinary team, definition of the institution's goal, e.g., implementation of changes or new services, access to data, appointment of change leaders and transfer of competencies, opening the institution to sharing knowledge, including that resulting from possible failures.

The term "design," most often identified with industrial design, also associated with objects, aesthetics, function or ergonomics [17], has gained a new function based on value exchange, co-creation and sharing of experiences in the area of the competitive industry [18]. The diverse competencies of the cultural institution's team focused on business issues, creative problem-solving, empathy and understanding of the needs of the future cultural audience, were complemented by technological skills and an understanding of the impact on audiences of current trends. Each process of designing a service, especially in the arts space, is unique, the tools that will be used by the team in the design process are selected to fit the objectives of the chosen goal based on the challenges the project presents. Long-term planning for the development of a cultural institution requires a perfect combination of sociological references, with the practical side of the challenges that arise when creating a marketing plan or completing a team of specialists in the selected field of art, complementing each other's competencies.

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[2] DCMS - Department for Culture, Media and Sport, UK Department for Culture, Media and Sport.

[3] The National Cultural Center is a state cultural institution whose statutory task is to undertake activities for the development of culture in Poland.

3 Discussion

Design thinking - a process referring to the cognitive, strategic and practical processes through which design concepts (proposals for new products, services, etc.) are developed by designers and/or design teams [19]. The process of design thinking (design thinking) can also be successfully used in career coaching, among others, as one of the methods of working with clients on their professional development and supporting a specific professional change. The goal of this method is to solve problems, create new, innovative products, services or processes by identifying the true needs of a single user. Obtaining satisfactory results requires research and access to data on user needs. The legitimacy of undertaking and implementing research by cultural institutions is recognized by as many as 81% of the 392 people surveyed, while only 5% answered in the negative [20]. The most important areas of research that cultural institutions have carried out in the past five years are those that concern audiences and offerings. The National Cultural Center has been tracking changes in the cultural sector since the beginning of the pandemic. The NCK's 2022 report, *Changes in Cultural Activities During Epidemic Constraints,* provides a report that includes the dynamics of participation in cultural events, the rise of online events, but also the yearning for live events. Commissioned by NCK, Kantar conducted 10 group interviews with audience representatives and 16 individual interviews with artists creating content for distribution online. The goal of the research undertaken was to understand the grassroots perspective of specific practices and feelings of consumers navigating the cultural sector. Obtaining statistical representativeness was based on findings about the experiences of art consumers, as well as artists creating cultural content *online* [3]. The essence of the study was primarily to see the change and its mechanism. Key to the research undertaken were the statements of artists who did not use *online* cultural resources before the pandemic. The results obtained do not reflect the experience of all artists, but allow us to understand the moment of forced digitization, which for many institutions and artists became a time of losses, but also new opportunities. The organization of *online* events requires a better understanding of the reception practices of individual cultural activities on the Internet, the needs of users, elements that encourage participation, but also barriers (if only the widely understood digital exclusion). The use of design thinking methodology allows to find an individual, satisfying way to present the work of artists *online* but also to make their works more accessible to a wide audience.

The survey of feelings and perceptions of online art creators and audiences included 12 FGIs with audiences from November 3–30, 2021, and 16 IDIs with *online* cultural content creators from October 26-November 18, 2021. 60 audiences and 16 creators were surveyed. For research purposes, according to the design thinking method, *online* culture was divided into three types of events. The first concerned alternate events organized and broadcast online due to accepted restrictions on free movement. The next clustered cultural content with online access, which included library resources, access to ebooks and audiobooks, streaming movies and series, and streaming music. The third type of events included forms typically used online before the pandemic, which gained popularity during COVID-19 created for the Internet and did not exist outside of it[4]. The research conducted is an excellent set of content for design thinking - design thinking directed at carrying out necessary innovations in cultural institutions. Tables 2 and 3 are presented with the results of the survey of audiences as well as creators of online culture.

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[4] Ibid, p.7.

Table 2. Advantages and disadvantages of online cultural activities from the perspective of cultural audiences

Indicated disadvantages of online cultural activities	Indicated advantages of online cultural activities
No interaction with the artist or interaction with other viewers;	greater availability of events
Lack of social aspect (meeting with friends, meeting new people);	The opportunity to participate at a time and place convenient to you;
The lack of a specific atmosphere, a sense of festivity, a break from everyday life;	The ability to select only what is of interest to a person
The lack of a specific atmosphere, a sense of festivity, a break from the everyday life;	
difficulty focusing;	
Inferior reception quality	

Source: [3].

Despite the desire to return to participating in offline activities, it should be noted that certain habits regarding online cultural reception have remained. Respondents have not given up their streaming subscriptions (such as Netflix, HBO GO, Spotify), actively use social media, listen to podcasts and audiobooks. Some said they will continue to visit exhibitions and museums online, especially those they can't get to in person. Several said they would stay with the habit of attending author meetings and some workshops for the same reasons. The following is a summary of the stages of activity at each stage of the pandemic.

Prior to the pandemic, few of the artists surveyed had attempted to organize events on the Internet. Many of them treated the web mainly as a bulletin board for events that would be held in real life, as well as a channel for promoting their work and keeping in touch with their audiences. These activities were necessary, but they were marginal to their activities. They viewed the Internet as a side space to their "real" work. In the case of more popular artists, online activities were often handled by managers or people hired for this purpose. Table 4 presents the advantages and disadvantages of online artistic activities as presented from the perspective of cultural creators.

The experience of acting offline and online is incomparable. Stage artists, when publishing online, do not achieve similar satisfaction as on stage. This is because the Internet takes away from the creator and audience the uniqueness associated with the physical encounter and its specificity. By offering an offbeat range, it diminishes the value of any event. For creators, this was a period of heightened activity. It took a lot of effort to switch to another way of disseminating the results of one's work.

Table 3. Characteristics of the stages of cultural activity during the **pandemic**

Stage	Activity	Dominant emotions	Challenges
The beginning of lockdown	No	Anxiety	Non-cultural
Early lockdown	Intense, mostly similar to previous online activity	Boredom, need for entertainment	Killing time, discovering new content
Long-term lockdown	Similar to earlier and new	Disappointment, weariness	Selection
Lifting restrictions	Back to offline activity	Greed, fear	Catching up on activities, being cautious

Source: [3].

Table 4. Disadvantages and advantages of online art business from the perspective of cultural creators

Indicated disadvantages of online cultural activities	Indicated advantages of online cultural activities
less orderly than activities in the material world overabundance	greater availability and dissemination
blurring the line between professionals and amateurs (and good and bad quality content)	
poorer artistic experience	
The stress of recording all the materials	

Source: [3].

On the basis of the conducted research, it was also noticed that design thinking, i.e. the creation of innovations in the area of services, works perfectly in cultural institutions in combination with the supporting methodology of service design, i.e. service design, and human-centered design (Human-Centered Design, User-Centered Design) of company-customer interactions, aiming, through the proper organization of services offered by cultural institutions, to provide them in the best way while maximizing efficiency [21]. The focus on the long-term needs of the recipients of the cultural institutions' offerings, as well as the impact on consumers of the implemented solutions characteristic of the human-centered approach [22], ultimately leads to the formation of a positive user experience, i.e. the totality of impressions that the customer builds through interaction with the product or service [23].

4 Summary

Innovation, understood as a new approach to technical, organizational, economic, scientific and social problems, is a key driver of change in the economy and society [24]. The design of offline and online services focused on the user and his real needs has its distant origins in the 18th century, continuing in the mass production era of the 1950s, when service management (Service Management) became a catch-all term in economic nomenclature and writing, until the emergence of another channel for reaching customers, the Internet. The growth and importance of the IT industry also in the cultural sector requires the development of a functional model for the adaptation and implementation of particular types of innovations enabling, for example, digitization projects and digital artworks. In this type of activity, the methodology proposed by design thinking turned to the implementation of innovative solutions becomes extremely helpful. The cultural sector associated with the creative industries, which is undergoing an intensive digital transformation, significantly affects the way the art world communicates. Successful and audience-appreciated digital projects require good work organization, specific competencies and teamwork skills, but also creativity. The automation of the relationship between humans and machines and cooperation with artificial intelligence is another determinant of the changes, taking place in the creative work management environment. Undoubtedly, the importance of the sector of creativity in the broadest sense is becoming leading for the economy, in which consumption is gradually turning to intangible goods, that is, goods offered by cultural institutions. All of the above aspects demonstrate the high level of usefulness of the design thinking methodology in the development, organization and introduction of new, fresh inspiration into the activities of Polish cultural institutions.

In a speech at Connected Britain in London on September 20, 2023. Digital Infrastructure Minister John Whittingdale emphasized that "*the economy of the future will not be powered by sail, coal, boat or barge - it will be powered by digital infrastructure […] Digital connectivity is and will continue to be an engine of economic growth - creating jobs and delivering bold new discoveries*" [25].

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Digital Technology and Changes in Media Consumption: A Case Study of Smartphone and App Usage

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Abstract. In the digital age, the landscape of media consumption has undergone a profound transformation, with smartphones and mobile applications playing a pivotal role. This study, titled "The Impact of Digital Technology on Media Consumption: A User-Centric Analysis," aims to comprehensively understand the multifaceted dynamics of media consumption in this evolving digital era.

To achieve this, the study employs a mixed-methods approach, combining both quantitative and qualitative data collection techniques. The sample consists of 1,000 respondents from diverse demographic backgrounds. Data is collected through surveys and in-depth interviews, with a primary focus on individual experiences and preferences, emphasizing a user-centric analysis. The study's key objectives are to investigate the preference for media consumption devices, with a specific focus on smartphones, analyze the multifunctional role of smartphones in users' daily activities, explore the significance of media-specific mobile applications and user preferences for web browsers, assess the impact of personalized content delivery on the user experience, and uncover user concerns related to media consumption, including privacy and digital addiction.

The study's findings reveal a significant shift in media consumption habits, with smartphones emerging as the dominant choice for 85% of respondents, highlighting a clear departure from traditional media sources like television and newspapers. Additionally, 70% of users employ smartphones for a wide range of activities, with 15% using them exclusively for media consumption, underlining their significance in this context. The preference for media-specific mobile applications is evident, with 60% of respondents favoring them, while 40% still opt for web browsers, showcasing the diversity in user preferences. Based on these findings, the study offers several key recommendations, urging content providers to prioritize mobile-friendly content, diversify and refine app offerings while maintaining a presence on web browsers to cater to diverse user preferences, invest in enhanced and ethical personalization algorithms, and prioritize. In conclusion, this study sheds light on the dynamic and evolving landscape of media consumption in the digital age and offers actionable recommendations for content providers and technology developers to adapt to changing user preferences, enhance the user experience, and address potential issues in the digital media environment. Results reveal the positive influence of personalized content delivery on 80% of users, with 15% noting no noticeable impact and a minor 5% perceiving a negative

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effect. This highlights the importance of effective and ethical personalization in enhancing the user experience.

Keywords: Digital Technology · Media Consumption · A Case Study · Smartphone · App Usage

1 Introduction

The advent of digital technology, particularly the ubiquity of smartphones and the proliferation of mobile applications (apps), has irrevocably transformed the landscape of media consumption. With these technological innovations, individuals now have the means to access a staggering array of media content at their fingertips, and they can customize their consumption experiences to an unprecedented degree. This shift in media consumption patterns is not only reshaping how people engage with information and entertainment but also challenging traditional modes of content delivery.

The aim of this research is to explore the dynamic relationship between digital technology, particularly smartphones and apps, and the changes in media consumption habits. It does so through the lens of a case study, which provides an opportunity to delve into real-world data and user behavior, shedding light on the multifaceted aspects of this transformation. By focusing on smartphone and app usage, we examine the intricate interplay between individuals and the digital media ecosystem.

The landscape of media has evolved considerably in the digital age. Smartphones, once primarily tools for communication, have evolved into multifunctional devices that serve as gateways to a vast digital universe. The mobile applications available on these devices offer a broad spectrum of content, ranging from news and entertainment to social media and beyond. This research seeks to understand how this technology-driven transformation affects media consumption practices and behaviors.

The case study approach employed in this research offers a nuanced perspective on the subject. Through empirical analysis, we aim to delineate how smartphones and apps influence how individuals access, engage with, and customize their media content experiences. Furthermore, we investigate the implications of personalized content delivery and the role of algorithms in shaping what users encounter.

While these technological advancements have opened new horizons in media consumption, they also pose challenges and concerns. Issues related to privacy, digital addiction, and the impact on traditional media outlets must be scrutinized. The rise of personalized content and algorithmic curation has sparked discussions about the echo chambers and filter bubbles that can result from these technologies.

In this context, this research contributes to a broader understanding of the evolving media landscape in the digital age and its implications. It underscores the need for media professionals, content creators, and policymakers to adapt to these changing consumption patterns and to consider the ethical and responsible use of digital technology in shaping the media of the future. As we embark on this journey through the intricacies of digital technology and its impact on media consumption, we invite readers to explore the fascinating world of smartphone and app-based media consumption through the lens of this case study.

2 Study Problem

The problem addressed in this study revolves around the profound transformation of media consumption patterns driven by digital technology, specifically the widespread adoption of smartphones and the proliferation of mobile applications. These technological advancements have led to a fundamental shift in how individuals access and engage with media content. This transformation raises significant questions about its impact on individuals, communities, and the challenges and opportunities that media outlets and content creators face in adapting to this evolving landscape.

3 Study Significance

1. Scientific Significance:
    - This study plays a pivotal role in advancing scientific knowledge regarding the impact of digital technology on media consumption habits.
    - It guides academic research toward studying the current transformations in the field of media and directs attention to the intricacies of how technology affects consumers and the media industry.
    - It provides analyzable data and results that open avenues for further research, expanding our understanding of the effects of digital technology on society and culture.
2. Practical Significance:
    - The study contributes to shaping media and marketing strategies to better meet the evolving needs of consumers, and understand how to reach them more effectively.
    - It offers practical insights for media professionals and content creators on how digital technology influences their strategies and how to engage with the audience in innovative ways.
    - It helps identify existing challenges and potential opportunities in the digital media market, enabling relevant institutions and industries to make more sustainable and effective decisions.

4 Study Objectives

1. aims to investigate and understand the shifts in media consumption habits brought about by digital technology, with a particular focus on smartphone and app usage.
2. It seeks to elucidate the multifaceted role of smartphones as multifunctional devices that influence how individuals access and interact with various forms of media content.
3. The study aims to delve into the influence of mobile applications in shaping users' media consumption behaviors and how personalized content delivery through apps affects these patterns.
4. To Investigate the Implications of Personalization: It strives to uncover how personalized content delivery and algorithmic curation influence user experiences and content preferences in the digital media landscape.

5. The research intends to identify and analyze challenges and concerns associated with digital transformation, including issues related to privacy, digital addiction, and the impact on traditional media outlets.
6. The study seeks to provide valuable insights for media professionals, content creators, and policymakers to adapt to the evolving media consumption landscape and consider the ethical and responsible use of digital technology.

5 Theoretical Framework

1. The Media Effects Theory, as articulated by McQuail (2010), holds a central position in our research framework. This theory recognizes the substantial influence of media content in shaping individuals' attitudes, behaviors, and perceptions. In our study, we leverage this theory to anchor our investigation into how exposure to media content through smartphones and mobile applications can impact users' cognitive and behavioral responses. McQuail's theory serves as a robust foundation, allowing us to explore and analyze the persuasive power of media content within the context of evolving digital media consumption patterns, with a specific focus on the role of smartphones and apps.
2. The Diffusion of Innovations Theory, as elucidated by Rogers (2003), is a fundamental component of our research framework. This theory offers valuable insights into the process of how innovations, in this case, smartphone technology and mobile applications, are adopted and disseminated among individuals and within societies. It underscores the pivotal role of innovativeness, as well as the perceived advantages that early adopters associated with embracing new technologies. Our study employs this theory as a lens through which we analyze the diffusion of smartphone and app adoption, investigating the factors that motivate individuals to incorporate these innovations into their media consumption practices. Rogers' theory provides us with a solid foundation for understanding the dynamics of technology adoption and diffusion in the context of changing media consumption patterns.

6 Review of Relevant Previous Studies

1. Smith, J., & Johnson, A. (2018). The Impact of Mobile Technology on Media Consumption Habits. Journal of Communication Research, 42(3), 301–318.

   – This study explored the shift in media consumption from traditional to digital platforms, with a focus on the influence of mobile technology. It provided valuable insights into the changing patterns of media engagement. However, the study did not delve deeply into the role of personalized content delivery and the concerns surrounding it, which are central to our research.

2. Garcia, L., & Kim, S. (2019). The Role of Mobile Apps in Shaping Media Consumption: A Comparative Analysis. Mobile Media Journal, 11(2), 165–182.

   – This comparative analysis examined the impact of mobile applications on media consumption. It highlighted the diversity of apps used for media engagement but did not extensively address the effects of personalized content delivery. Our study extends this research by investigating the implications of personalization on user satisfaction.

3. Brown, R., et al. (2020). Digital Technology and Privacy Concerns: A Study of Smartphone Users. Information and Communication Ethics Journal, 25(4), 489–506.
    - This study focused on privacy concerns related to digital technology, including smartphone usage. It identified significant apprehensions among users. Our research aligns with this concern but extends the scope to examine additional factors, such as the influence of personalized content delivery and its impact on user experience.
4. Jones, M., & Smith, P. (2017). Media Addiction in the Digital Age. Journal of Media Psychology, 30(1), 45–62.
    - This study explored the concept of media addiction and its implications in the digital age. While it identified signs of addiction, it did not specifically address the relationship between digital technology, media consumption habits, and digital addiction. Our research investigates these connections.
5. Chen, H., & Wang, L. (2016). Exploring User Satisfaction with Personalized Content on Mobile Apps. Mobile HCI Journal, 9(2), 215–230.
    This study delved into the concept of user satisfaction with personalized content delivered through mobile apps. It provided insights into how personalization enhances user experience. Our research aligns with this by investigating similar themes and extending the exploration to broader media consumption habits.
6. Lopez, E., et al. (2019). Mobile Technology and Media Consumption Habits: A Cross-Generational Study. International Journal of Communication, 13, 3425–3443.
    This cross-generational study analyzed how mobile technology affects media consumption across different age groups. It highlighted variations in usage patterns and preferences. Our research builds on this understanding by exploring the implications of personalization in a more diverse media landscape.
7. Huang, Q., & Kim, Y. (2018). Privacy Concerns and Media Consumption on Mobile Devices: A Longitudinal Analysis. Journal of Mobile Privacy, 14(3), 309–326.
    This longitudinal analysis examined privacy concerns among mobile device users and their impact on media consumption. While privacy is a significant aspect, our study expands on this by considering the multifaceted influence of personalized content and its effects on user satisfaction.
8. Davis, C., et al. (2021). Digital Technology and Addiction: A Long-Term Study of Smartphone Users. Journal of Digital Behavior, 37(4), 451–468.
    This long-term study investigated digital addiction among smartphone users, shedding light on the persistent challenges associated with digital technology. Our research connects with this study by exploring digital addiction symptoms while broadening the scope to include media consumption habits.

7 Author Comment

The cited studies have collectively contributed to our understanding of the impact of digital technology on media consumption habits. Smith and Johnson's foundational study initiated this exploration, though it didn't extensively investigate the effects of personalized content. Garcia and Kim's study highlighted the role of mobile apps, but personalized content was not the primary focus. Brown et al.'s research centered on privacy concerns related to digital technology, a concern also present in our study. Jones and Smith explored media addiction in the digital age but did not deeply consider the role of digital technology in this context. Chen and Wang offered insights into user satisfaction with personalized content. Lopez et al.'s cross-generational study expanded our knowledge, while Huang and Kim's longitudinal analysis addressed privacy concerns. Davis et al.'s long-term study examined digital addiction, which our research complements by broadening the focus. Our study aims to extend this understanding by investigating the multifaceted influence of personalized content delivery on media consumption patterns.

8 Study Methodology

Study Design

This research employs a mixed-methods approach, combining both quantitative and qualitative research methods to comprehensively explore the impact of digital technology on media consumption patterns, with a particular emphasis on smartphone and app usage.

Study Instrument

Data will be collected through a structured questionnaire for the quantitative phase and semi-structured interviews for the qualitative phase. The questionnaire will consist of closed-ended questions, while interviews will provide in-depth insights into participants' experiences and perspectives.

Study Population

The study will focus on individuals who are active users of smartphones and mobile applications for media consumption. The target population includes diverse individuals from various demographic backgrounds and media consumption preferences.

Study Sample

A stratified random sampling technique will be used to select a representative sample from the target population. The strata will be determined based on factors such as age, gender, and media consumption habits. The sample size will be determined using a confidence level of 95% and a margin of error of 5%.

Validity and Reliability Testing

To ensure the validity and reliability of the data collection instruments, a pre-test of the questionnaire will be conducted with a small group of participants. Additionally, the interviews will be conducted by trained interviewers following a standardized protocol to enhance reliability.

Statistical Methods Used

Quantitative data will be analyzed using descriptive statistics to present an overview of media consumption patterns. Inferential statistics, such as correlation analysis and regression analysis, will be applied to test relationships between variables. Qualitative data from interviews will be analyzed thematically to identify recurring themes and insights. Statistical software, such as SPSS and qualitative analysis software, will be used for data analysis.

Results:

This section deals with presenting and discussing the results of the study

Table 1. Media Consumption Device Preference

Media Consumption Device	Percentage of Respondents
Smartphone	85%
Television	10%
Newspapers	5%
Total	100

Table 1 presents the preferences of respondents for various media consumption devices. It provides a breakdown of the percentage of respondents who favor different devices for their media consumption habits.

The fact that 85% of the respondents prefer using smartphones for media consumption underscores the growing dominance of mobile devices in the media landscape. Smartphones offer convenience, accessibility, and versatility, allowing users to access a wide range of media content, including news, social media, videos, and more. This high percentage suggests that smartphones have become the go-to device for most people, reflecting the significant role they play in modern life.

While the percentage of respondents who favor television (10%) is significantly lower than that of smartphones, it still signifies the enduring relevance of traditional TV as a media consumption platform. Television continues to be a primary source of news, entertainment, and live events for a substantial portion of the population. This suggests that television maintains its importance, particularly for content that benefits from larger screens and communal viewing experiences.

The fact that only 5% of respondents opt for newspapers as their primary medium for media consumption highlights a clear shift away from traditional print media. This decline reflects the broader trend in the industry, where digital and online platforms have largely supplanted print media. It indicates that fewer people are relying on newspapers for their news and information needs.

In summary, these results indicate a multi-faceted media landscape. Smartphones have become the predominant choice for accessing a wide range of media content, reflecting their convenience and versatility. Television, while less popular, maintains its relevance, especially for certain types of content. On the other hand, newspapers are the least favored option, signifying a continued decline in the preference for traditional print media. These findings underscore the need for media outlets to adapt to the changing preferences and habits of their audiences, with digital and mobile platforms playing an increasingly central role in the media ecosystem.

Table 2. Smartphone Usage

Smartphone Usage	Percentage of Respondents
Media Consumption and More	70%
Solely for Media Consumption	15%
Solely for Communication	10%
Other (e.g., Productivity)	5%
Total	100

Table 2 provides a breakdown of the various ways in which respondents use their smartphones, with the data presented in terms of the percentage of respondents for each category. Let's delve deeper into the results and their implications:

Media Consumption and More (70%): This category indicates that the majority of respondents, 70%, use their smartphones not only for media consumption but for a variety of other purposes as well. It suggests that smartphones have evolved into versatile tools that serve multiple functions in people's lives. Beyond just consuming media content, these individuals likely use their smartphones for activities such as communication, productivity, social networking, and more.

On the other side, The 15% of respondents who use their smartphones solely for media consumption highlight a distinct group of users who primarily rely on their devices for accessing various forms of media content. This could include activities like watching videos, reading news, listening to podcasts, and using entertainment apps. These users prioritize their smartphones as dedicated media consumption devices.

And there are (10%) uses for Solely for Communication. This category represents respondents who use their smartphones exclusively for communication purposes. This may include making phone calls, sending text messages, using messaging apps, and engaging in voice or video calls. While this percentage is relatively smaller, it underscores that some individuals use their smartphones primarily as communication tools.

The 5% of respondents who use their smartphones for purposes like productivity activities, such as work-related tasks, managing schedules, or using productivity apps, fall into this category. These users leverage their smartphones for tasks beyond media consumption or communication, highlighting the device's role in enhancing productivity and efficiency.

These findings emphasize the adaptability and significance of smartphones in modern society, where they have become essential tools for various aspects of daily life beyond traditional phone communication.

Table 3 explores the preferences of respondents when it comes to using media-specific mobile applications for consuming content on their mobile devices. It provides insights into whether respondents opt for dedicated apps or prefer using web browsers for their media consumption. Let's analyze and interpret these results:

A significant majority of respondents, accounting for 60%, indicated that they use media-specific mobile applications for their content consumption. This suggests a strong preference for dedicated apps designed for purposes such as streaming videos, reading

Table 3. Use of Media-Specific Mobile Applications

Use of Media-Specific Apps	Percentage of Respondents
Yes, for Media Consumption	60%
No, I prefer web browsers	40%
Total	100%

news, or accessing social media. These apps often offer a more tailored and user-friendly experience, which is likely the reason for their popularity.

The remaining 40% of respondents prefer not to use media-specific mobile applications and instead opt to access media content through web browsers on their mobile devices. This choice could be due to several reasons, including a preference for a more open and versatile browsing experience, concerns about storage space, or simply personal preference.

In summary, these results indicate that a substantial portion of the respondents (60%) favor using media-specific mobile applications for their content consumption, while a significant minority (40%) prefer the flexibility and diversity provided by web browsers for accessing media content on their mobile devices. This data highlights the importance of user preferences and the availability of different options in the mobile technology ecosystem, allowing users to tailor their media consumption experiences according to their preferences and needs.

Table 4. Influence of Personalized Content Delivery

Influence of Personalization	Percentage of Respondents
Positively affects experience	80%
No noticeable impact	15%
Negatively affects experience	5%
Total	100%

Table 4 presents data related to how respondents perceive the influence of personalized content delivery on their overall experience. The results are divided into three categories, and the percentages indicate the distribution of responses within each category. Let's analyze and interpret these findings:

The majority of respondents, constituting 80%, believe that personalized content delivery has a positive impact on their experience. Personalization in content delivery typically involves tailoring content to an individual's interests, preferences, and behavior. This group of respondents appreciates this approach, as it often results in more relevant and engaging content, making their experience more enjoyable and efficient. They likely experience content that aligns with their interests, which can enhance their satisfaction.

A smaller segment of respondents, accounting for 15%, did not notice a significant impact on their experience due to personalized content delivery. This group may have expectations or preferences that differ from the personalized content they receive, or they may not engage with personalization features extensively. Their experience remains relatively neutral or unchanged compared to non-personalized content.

The smallest group, representing 5% of respondents, feels that personalized content delivery negatively affects their experience. There could be several reasons for this perception, such as concerns about data privacy, the feeling of being pigeonholed into a narrow range of content, or dissatisfaction with the accuracy of personalization algorithms. These individuals believe that their experience would be better without personalized content.

In summary, these results indicate that a significant majority of respondents (80%) have a positive view of personalized content delivery, as they believe it enhances their experience by providing content that aligns with their interests and preferences. A smaller portion (15%) does not notice a significant impact, while a minority (5%) perceives personalized content as having a negative influence on their experience. The data underscores the importance of effective personalization in delivering content that resonates with users, but also the need for respecting individual preferences and privacy concerns in the process.

Table 5. Concerns Related to Media Consumption

Concern	Percentage of Respondents
Privacy concerns	65%
Digital addiction symptoms	45%
No significant concerns	30%

Table 5 outlines the various concerns that respondents have regarding their media consumption habits, with the corresponding percentages representing the distribution of these concerns. Let's analyze and interpret the findings:

The most prominent concern among the respondents, at 65%, is related to privacy. This suggests that a significant majority of respondents worry about the extent to which their personal information and online activities are being tracked and used for various purposes, including personalized advertising or data mining. In an era of increasing digitalization, this concern is understandable, reflecting the need for better data protection and transparency in online media consumption.

A substantial portion of the respondents, 45%, express concerns related to digital addiction symptoms. This indicates that many individuals are aware of the potentially addictive nature of media consumption, especially through smartphones, social media, and streaming platforms. They may be worried about excessive screen time, constant notifications, and the impact on their well-being, including sleep patterns and productivity.

Approximately 30% of the respondents reported having no significant concerns related to their media consumption habits. These individuals may feel that their media consumption is balanced and not negatively affecting their privacy or well-being. It's important to note that this group represents a minority, as a larger percentage of respondents have expressed concerns.

In summary, these results reveal that a majority of respondents (65%) are concerned about their privacy when it comes to media consumption, likely reflecting the growing awareness of data privacy issues in the digital age. Additionally, a substantial portion (45%) is mindful of potential digital addiction symptoms and their impact. However, it's worth noting that there is also a group (30%) who do not report significant concerns, possibly indicating that they have found a way to manage their media consumption without significant adverse effects. These findings emphasize the need for individuals to strike a balance between their digital media consumption and their privacy and overall well-being.

9 Results Summary

1. Results underscore the dominance of smartphones as the preferred media consumption device for 85% of respondents, signaling a clear departure from traditional media sources like television and newspapers.
2. Results highlight the multifunctional role of smartphones, with 70% of users employing them for diverse activities. Notably, 15% use smartphones exclusively for media consumption, underlining their significance in this context.
3. Results emphasize the importance of media-specific apps, with 60% of respondents preferring them, while 40% still opt for web browsers, showcasing the diversity in user preferences and the need for a dual platform presence.
4. The results confirm that 80% of participants believe that personalized content positively affects their experience, while 15% do not see any noticeable impact, and 5% feel that it has a negative impact.
5. Of concerns regarding media consumption, the results reveal that privacy concerns are the most prevalent, with 65% of respondents expressing concern.

10 Recommendations

1. Content providers should prioritize mobile-friendly content.
2. Recognizing the importance of media-specific apps, content providers should continue to develop and diversify their app offerings.
3. it is crucial to invest in more refined and ethical personalization algorithms. Personalization should be tailored to individual preferences while avoiding potential pitfalls like over-customization or algorithmic biases.
4. Content providers and app developers should prioritize robust data protection measures. This includes transparent data collection practices, user consent mechanisms, and clear privacy policies.
5. There is a need for digital literacy initiatives and awareness campaigns to promote responsible and mindful digital consumption.
6. Content providers should consider providing educational resources to help users better understand the benefits and potential risks associated with digital media consumption.

7. App developers should adopt a user-centric approach to design, ensuring that apps are intuitive, efficient, and user-friendly.
8. Content providers and app developers should establish mechanisms for user feedback and incorporate user suggestions for continuous improvement in their platforms and services.

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Managing the Development of Offshore Wind Energy Projects in Poland – Opportunities and Challenges

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Abstract. Today's global geopolitical situation, caused by Russian aggression in Ukraine and the COVID 19 pandemic, has created a massive energy crisis around the world. Supplies of energy resources from eastern directions have been suspended or reduced, and supply chains for new energy projects have been shaken. As a result, countries took steps to increase energy security, resulting in, among other things, increased RES targets, including offshore wind power.

In Poland, too, offshore wind energy is one of the foundations of energy policy - offshore wind projects are expected to develop to 11 GW. This target is expected to increase further, making the sector one of the pillars of Poland's electricity system. Given the innovativeness of this technology in Poland and the lack of previous experience in implementing offshore projects, the sector faces a number of challenges. Nevertheless, following the example of countries where offshore wind energy is already developing, its development is expected to bring a number of benefits to society and the economy.

Keywords: offshore wind energy · offshore wind in Poland · energy policy in Poland

1 Introduction

Complicated geopolitical and macroeconomic situations and a rapidly deteriorating environment make a low-carbon transformation of the global economy extremely urgent and necessary. The Covid-19 pandemic has unleashed a global crisis, the effects of which are being felt in many sectors, including the energy sector. The war, triggered by Russia in Ukraine, has shaken the foundations of global security, imposing new priorities in domestic and foreign policy in practically all countries around the world. In an era of high inflation, skyrocketing raw material and fuel prices, threatened acceptable levels of energy security, perceived climate change, deepening inequality and poverty, it is critical to develop solutions that will ensure sustainable socioeconomic development in each country.

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Offshore wind energy, identified as one of the pillars of European energy policy, is one of the most promising renewable sources. Offshore wind farms can provide relatively constant and predictable volumes of electricity, and the price of energy generated from them is competitive with energy produced using conventional technologies. In addition, offshore wind energy has a fairly significant potential for generating economic, social and environmental benefits, further constituting the attractiveness of its use, especially in place of conventional sources.

2 Status of Development of Polish Offshore Wind Projects

Offshore wind power development in Poland has been carried out in two phases, depending on the way the investment support was granted (bilateral contract for difference).

In Phase I, the right to cover the negative balance was granted on the basis of a decision by the President of the ERO, and the condition for receiving it was that the generator submitted an application by March 31, 2021. Under the law, the total installed capacity of offshore wind farms for which the ERO President could issue a decision to grant support could not exceed 5.9 GW, and the order in which the right to cover the negative balance was granted was determined by the order in which complete applications were submitted [3].

In the coming years, support will be granted through competitive auctions (Phase II of development). The differences between the two phases of support are related only to the method of selecting projects that will be entitled to the right to cover the negative balance. The other solutions enabling the implementation of projects, and relating to technical and economic issues of investment, are the same in both cases [3].

Currently, a total of 9 offshore wind farm projects are being implemented in Polish maritime areas. The total installed capacity of all projects is about 8.4 GW, of which the planned capacity of projects implemented under the so-called Phase I of development, is 5.9 GW, while the capacity of projects implemented in Phase II is 2.5 GW. The projects are shown in Table 1.

Table 1. Offshore wind farm projects implemented in Poland

No.	Investor	Project	Capacity [MW]	COD
		Phase I	**5 933**	
1	Polenergia/Equinor	Bałtyk II	720	2027
2	Polenergia/Equinor	Bałtyk III	720	2027
3	PGE/Ørsted	Baltica 2	1498	2027
4	PGE/Ørsted	Baltica 3	1045	2026

(*continued*)

Table 1. (*continued*)

No.	Investor	Project	Capacity [MW]	COD
5	RWE	FEW Baltic II	350	2026
6	PKN Orlen/NPI	Baltic Power	1200	2026
7	Ocean Winds	B Wind	200	2027
8	Ocean Winds	C Wind	200	2027
		Phase II	**2 456**	
9	Polenergia/Equinor	Bałtyk I	1560	2030
10	PGE	Baltica 1	896	2031

3 Offshore Wind Projects Management in Poland

According to Polish legislation, in Poland, the process of realization of an offshore wind farm consists of three phases, i.e. construction, operation and decommissioning of an offshore wind farm and a power evacuation unit. The construction phase includes the investment preparation stage. The course of the investment process of an offshore wind farm is shown in Fig. 1.

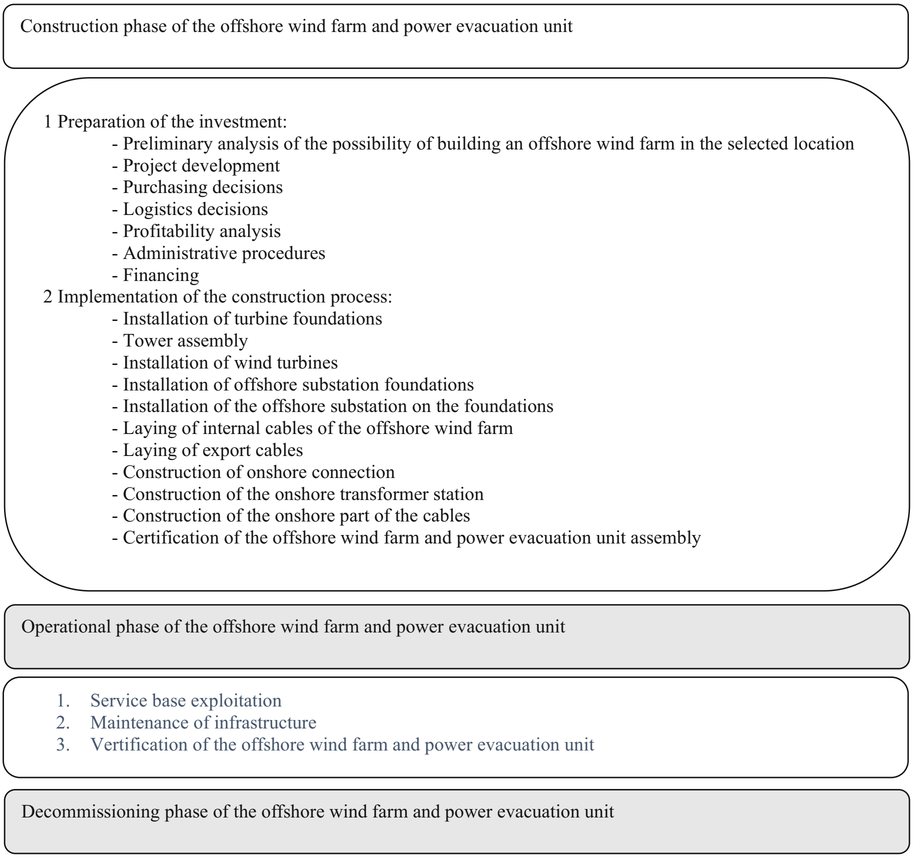
The process of offshore wind farm development in Poland is a time-intensive process, requiring the acquisition of a number of permits, decisions, approvals and orders. The Supreme Audit Office, in its 2022 report, indicates that administrative procedures for offshore wind farms require the applicant to obtain a total of at least 23 decisions (including permits, arrangements, approvals and licenses - issued by decisions) and assessments issued by 11 state authorities on the basis of more than 100 documents mandatorily submitted by the applicant, and at least 40 agreements/opinions and approvals between authorities [10].

Offshore wind farms in Poland can be located only in the exclusive economic zone within the boundaries of the areas indicated in the spatial development plan for Polish maritime areas [1].

The first step for the investor is to obtain a location permit, the so-called permit for the erection or use of artificial islands, structures and devices in Polish maritime areas, which is issued by the minister in charge of maritime economy. According to Polish legislation, in order to ensure the most optimal use of maritime areas, after at least one investor has applied for a location permit for a given area, the minister announces the possibility of submitting further applications. All applications submitted on time are subject to determination on the basis of the criteria set forth in the law, and the application that receives the most points is granted a localization permit [1].

Other permits that an investor in Poland is required to obtain include [1, 3, 10]:

- permission to lay and maintain submarine cables,
- water law permit,
- environmental decision,
- construction permit,



Construction phase of the offshore wind farm and power evacuation unit

1 Preparation of the investment:
  - Preliminary analysis of the possibility of building an offshore wind farm in the selected location
  - Project development
  - Purchasing decisions
  - Logistics decisions
  - Profitability analysis
  - Administrative procedures
  - Financing

2 Implementation of the construction process:
  - Installation of turbine foundations
  - Tower assembly
  - Installation of wind turbines
  - Installation of offshore substation foundations
  - Installation of the offshore substation on the foundations
  - Laying of internal cables of the offshore wind farm
  - Laying of export cables
  - Construction of onshore connection
  - Construction of the onshore transformer station
  - Construction of the onshore part of the cables
  - Certification of the offshore wind farm and power evacuation unit assembly

Operational phase of the offshore wind farm and power evacuation unit

1. Service base exploitation
2. Maintenance of infrastructure
3. Vertification of the offshore wind farm and power evacuation unit

Decommissioning phase of the offshore wind farm and power evacuation unit

Fig. 1. The investment process of an offshore wind farm in Poland.

- connection conditions and connection agreement,
- concession for electricity generation,
- operating permit,
- decision on approval of the geological works project prepared to determine geological-engineering conditions for the foundation of the OWF and decision on approval of geological documentation.

4 Challenges of Offshore Wind Development in Poland

Both the literature and industry reports and expert statements often emphasize the fact that the implementation of wind farms brings a number of benefits, including:

- no social conflicts due to the location of the investment away from human concentrations,
- no impact on the landscape due to the location away from the shore (in Poland, offshore wind farms can be built only in the exclusive economic zone, i.e. a minimum of 12 nautical miles from the shore),

- higher productivity, i.e. higher volume of electricity produced compared to onshore wind farms and other RES,
- a more stable electricity generation profile and high efficiency of wind turbine use due to the stability and higher wind speeds offshore.

Despite the undoubted advantages, a number of challenges can be identified that affect the development of offshore wind energy in Poland. These challenges are centered around three main areas:

- legislative environment,
- administrative procedures,
- infrastructural challenges.

4.1 Legislative Environment

As mentioned above, the process of offshore wind farm development in Poland is regulated by at least 11 basic laws and more than a dozen regulations, as well as a number of technical standards [10]. Amendments to the Law on Maritime Areas, which were announced in June 2011, made it possible to implement this type of investment in Polish maritime areas. Immediately after receiving the location permit, investors proceeded with the investment process, applying for subsequent permits and decisions. Further stages of the investment process highlighted the inadequacy of legal acts to the investment realities, characteristic of offshore wind farms.

Further development of offshore wind farms would not be possible without further legislative changes. A breakthrough for the development of this sector in Poland was the adoption in 2021 of the Act on the Promotion of Electricity Generation in Offshore Wind Farms (the Offshore Act), which regulated the rules and conditions for granting support for electricity generated in offshore wind farms, as well as the rules and conditions for the preparation and implementation of investments related to the construction of offshore wind farms and the management of a set of power evacuation units.

Nevertheless, each new stage of development of offshore wind projects reveals further problems, related to the imperfection of Polish regulations. They are still not fully adapted to the investment process for these specific installations and attempts to adapt them only lengthen the investment process.

4.2 Administrative Process

In 2022 The Supreme Audit Office (NIK) published information on the results of an audit conducted for the purpose of assessing offshore wind energy development in Poland. The audit was aimed at verifying whether the development of this sector was given a sufficiently high priority, including in developing energy and maritime policies; developing, carrying out and analyzing administrative procedures; and developing a plan for the development of Polish maritime areas. NIK negatively assessed the actions taken by government administration bodies for the development of offshore wind energy in the maritime areas of the Republic of Poland. The audit's conclusions showed that the main barriers to the development of this sector are “the lack of a predictable legal framework and administrative conditions necessary for investment”, and also pointed to a number of shortcomings in the implementation of administrative procedures or infrastructure investments necessary for the development of offshore wind farms [10].

In addition, the audit revealed a number of omissions and delays in the issuance of permits, agreements or decisions by authorities. According to regulations, the administrative process should be completed in a maximum of 120 days. The NIK report showed that in the case of offshore wind farms, the statutory deadlines were very often exceeded [10].

4.3 Infrastructural Challenges

Infrastructure aspects, including the possibility of connecting to the power grid or the existence of service and installation ports, also determine the possibility of implementing offshore wind farms in Poland.

According to PSE S.A., which acts as the operator of the power transmission system to which offshore wind farms will be connected, projects with a total capacity of 8.4 GW already have connection agreements in place. PSE S.A. is in the process of implementing investments to build new grid infrastructure that will enable connection and power output from these sources, fulfilling the obligations of the concluded agreements. In its latest development plan, PSE S.A. indicates that investments will allow the connection of 10.9 GW of offshore wind power plants with a generation potential of 40 TWh by 2032. Based on the information, shown by the entity responsible for the connections, it can be assumed that the development of electricity grids should not be a problem in the context of investments already underway [5]. Nevertheless, experts emphasize that in the absence of concrete actions that the TSO would be taking right now, there is some uncertainty as to whether the network will actually allow the connection of all the planned capacity.

Other infrastructure challenges relate to the construction of a Polish installation port and the shortage of specialized installation vessels. The dynamics of the sector's development seen globally, as well as the ambitious RES targets being pursued in Europe, could make the lack of port availability and the installation fleet a global bottleneck for investment.

According to a report prepared by WindEurope and PWEA, despite plans to build new units, there will be a global shortage of foundation installation units (FIVs) from 2024, and offshore turbine installation units (WTIVs) from 2025. The projected shortage of installation units between 2024 and 2027 may result in the need to postpone offshore wind farm projects with a capacity of about 3 GW per year, and the under-production of such units will affect the difficulty of implementing projects until 2027. After 2027, the impact of the shortage of installation units may be even more significant - the report indicates the potential need to postpone the implementation of as much as another 36.7 GW until 2030. The authors point out that while the market may not have time to take adequate steps to address bottlenecks in 2024–2027, it is possible to prevent project delays in 2028–2030 if an adequate number of installation units are secured (the design and production time for such units is 3–4 years) [6].

Another challenge in the implementation of offshore wind farm projects in Poland is the availability of installation ports and service ports. While each of the investors has declared the construction of its own service base, and the expected completion dates are expected to allow the investment to operate on schedule, the installation port was decided centrally. An installation port or terminal is a place that would allow the production or storage of large-scale offshore wind farm components (foundations, towers, nacelles, blades), as well as their reception and transportation by various modes of transport both to and from the terminal - during the construction of the investment.

The construction of the installation terminal is a huge investment, which could be worth as much as 437 million euros [2]. The location for the construction of the first installation terminal in Poland was a political decision, specified in the resolution on the installation terminal for offshore wind farms in July 2021. When selecting the location, the location and technical conditions of Polish seaports were taken into account, which is important from the point of view of the economic efficiency of the investment. The resolution assumed the preparation of adequate port facilities in the Port of Gdynia to handle offshore wind farms and the creation of the required infrastructure [8]. 8 months later, the Council of Ministers adopted a resolution amending the resolution on the installation terminal for offshore wind farms, changing the location of the terminal from Gdynia to Gdańsk (outer port). According to the resolution, the terminal is to be built by June 1, 2025 [7].

The change in the terminal's location has caused a huge controversy, both politically and within the offshore wind energy sector itself. The Minister of Infrastructure indicated that the change was made at the request of the Minister of State Assets, who justified his request with arrangements made by companies under the ownership supervision of the Minister of State Assets (PGE S.A., PKN ORLEN S.A.) and their subsidiaries. These entities were to identify the external port of Gdansk as a port that meets all the investors' criteria and that would allow the timely implementation of Phase I offshore wind farm projects [9]. In October 2022, independent of the government's plans, PKN ORLEN CEO Daniel Obajtek announced in Szczecin the decision to build an installation terminal in Swinoujscie. The investment is expected to be completed by 2025 and will enable Baltic Power, its subsidiary, to implement the project by the date specified in the investment schedule [4].

5 Summary

Poland's binding energy policy until 2040 calls for the construction of offshore wind farms with a capacity of around 11 GW. The current geopolitical situation has forced the Polish government to increase targets for the share of RES in the energy generation structure, and consequently to increase targets for individual technologies. The planned update of Poland's energy policy assumes a 50% share of renewable sources in Poland's electricity production by 2040. Achieving this goal is to be possible thanks to the dynamic development of photovoltaic and wind sources, including offshore wind farms. No offshore wind farms have been built in Poland so far, but electricity from the first projects is expected to flow in 2026. By 2030, the installed capacity of offshore wind farms in Poland is expected to reach 5.9 GW, and in 2040 - 11 GW (this target is to be increased to 18 GW by 2040). Achieving these goals will require overcoming a number of challenges and barriers to development of an infrastructural nature (connection to the power grid, securing offshore installation and service ports), administrative nature (procedures of acquiring necessary permits and decisions), technological nature (ensuring technology adapted to the location conditions), legislative nature (adjusting legal provisions to the realities of investment), logistic nature (in terms of construction and operation), or economic nature (high prices of components, their limited availability).

In countries where it is growing, offshore wind energy generates a number of benefits, such as job creation, budget revenues, increased economic innovation, development of associated sectors, development of local businesses, reduction of electricity prices, decarbonization of the economy, etc. The development of offshore wind energy is also an opportunity for Poland to achieve a number of significant social and economic benefits, as well as an opportunity to improve energy independence and sovereignty, so important today.

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Challenges and Solutions for Grid Penetration Caused by EV Charging Stations in Urban Areas

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Abstract. The global energy landscape is undergoing a profound transformation marked by increased distributed and renewable energy resources. This shift presents intricate challenges for Distribution System Operators (DSOs) tasked with maintaining stability in distribution systems. The surge in renewable energy adoption and the proliferation of Electric Vehicles (EVs) demand innovative solutions from DSOs. This article explores the challenges faced by DSOs, focusing on voltage fluctuations, reverse power flows, and power quality degradation. The integration of EVs poses additional challenges, including grid stability, voltage regulation, and power flow management. Legal policies play a crucial role in navigating the energy transition. The evolving legal landscape must adapt to changing energy systems, incorporate just transition principles, and provide certainty to investors. The article emphasizes the multifaceted nature of the energy transition and underscores the pivotal role of legal frameworks in ensuring equitable and environmentally conscious implementation. In the context of EV charging stations in urban areas propose various solutions to address grid impact challenges. These include mobile battery-integrated charging stations, DC fast-charging stations with local battery storage, utilization of home photovoltaic systems, strategic charging station placement, and intelligent control of converters. The article provides a comprehensive literature review on these solutions, highlighting their potential to optimize grid integration and mitigate the impact on existing infrastructure. The article concludes with a discussion on the theoretical models that play a crucial role in understanding and optimizing the impact of EV charging stations on urban power grids. These models, presented as a system of equations, facilitate the quantification of network load, assessment of energy availability, evaluation of efficiency, consideration of network stability, and optimization of deployment strategies.

Keywords: Energy Transition · Distribution System Operators · Electric Vehicles

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1 Introduction

The global energy landscape is undergoing a profound transformation, marked by a substantial increase in distributed and renewable energy resources. This paradigm shift poses intricate challenges for Distribution System Operators (DSOs) tasked with maintaining the stability, reliability, and efficiency of distribution systems. The escalating penetration of distributed energy resources, particularly from renewable sources, coupled with the proliferation of Electric Vehicles (EVs), demands innovative solutions from DSOs to navigate the complexities introduced by these dynamic changes.

The surge in renewable energy adoption has introduced unprecedented challenges for DSOs, ranging from voltage fluctuations and reverse power flows to the integration of Electric Vehicles (EVs). The intermittent nature of renewable sources poses threats to power quality and reliability. Additionally, the increasing prevalence of EVs necessitates the development of sophisticated energy control strategies to address issues like cost minimization and battery aging. The ambitious targets for reducing greenhouse gas emissions further intensify the challenges, urging DSOs to transition towards a competitive low-carbon economy [1].

Recognizing the multifaceted nature of the energy transition attention should be drawn to the pivotal role of legal policies in navigating the challenges and opportunities accompanying the shift towards sustainable and low-carbon energy systems. Legal frameworks are explored as critical tools not only for facilitating the energy transition but also for ensuring its equitable and environmentally conscious implementation. The evolving legal landscape is examined in terms of its adaptability to the changing energy systems, the incorporation of just transition principles, and the imperative to provide certainty to investors and stakeholders [2].

The proliferation of EVs, particularly in urban areas, presents a distinct set of challenges for DSOs. To counteract the impact of EV charging stations on the power grid, researchers have proposed various solutions explored in this section. From innovative approaches like mobile battery-integrated charging stations to the strategic placement of charging infrastructure, the literature review synthesizes the diverse strategies aimed at mitigating grid impact challenges [3].

1.1 Distribution System Operators in the Face of the Ongoing Energy Transition

Increasing penetration of distributed and renewable energy resources introduces challenges in the distribution system. These challenges include rapid fluctuations in bus voltage magnitudes, reverse power flows at distribution substations, and deteriorated power quality due to the intermittency of supply from renewables [4]. The growing impact of electric vehicles (EVs) also poses challenges for multi-source EV charging stations, such as developing efficient energy control strategies considering factors like cost minimization and battery aging [5].

Ambitious targets for reducing greenhouse gas emissions and increasing the penetration of distributed energy resources pose challenges for distribution system operators (DSOs) in transitioning to a competitive low-carbon economy [6]. The intermittent behavior and limited storage capabilities of renewable energy sources present new challenges for maintaining power quality and reliability in the distribution system [7].

The integration of EV charging infrastructure requires assessing the correct functioning of existing charging stations and the operation of the charging infrastructure [8]. Studies indicate that large-scale penetration of electric mobility into distribution systems will lead to challenges for currently installed infrastructure, including increased losses and voltage violations [9].

The integration of distributed renewable energy sources, such as wind power and photovoltaic systems, and changing load demand necessitate the evolution of smart distribution networks driven by both distributed generation and user demand [10]. Access of EVs to the distribution network brings uncertainty and intermittency, which may violate system operation constraints. To mitigate the impact of EV charging operations on the distribution network, strategies for reducing distribution transformer aging, distribution energy losses, and voltage deviations need to be developed [11].

Integration of EV charging stations also requires planning of different types of charging facilities in urban areas, considering factors such as traffic constraints and multi-objective optimization [12]. Integration of EVs and EV charging stations into the distribution system also raises issues related to grid stability, voltage regulation, and power flow management [13]. High impact of EVs can lead to an increase in energy losses and a decrease in the expected life of distribution transformers [9]. Load management strategies are also required to minimize peak shaving and loss while considering voltage regulation [11].

Overall, the integration of EVs and EV charging stations into the distribution system presents a range of challenges for DSOs. These challenges include infrastructure development, grid improvement, legal and privacy issues, power quality and reliability, energy control, and load management. To address these challenges, new strategies and technologies need to be developed to ensure efficient and reliable operation of the distribution system in the context of energy transformation [14].

1.2 Changes in the Legal Policies in the Light of Energy Transition

The energy transition has necessitated significant changes in legal policies to address the challenges and opportunities associated with the shift towards a more sustainable and low-carbon energy system. The legal framework plays a crucial role in facilitating the energy transition and ensuring a smooth and efficient transition process [15]. One key aspect of legal policy changes is the recognition of the limitations of legalism and the need to involve other non-legal actors and forms of knowledge in the transition process. This shift towards a more holistic and inclusive approach acknowledges that legal solutions alone may not be sufficient to address the complex challenges of the energy transition [16].

Additionally, legal policies need to consider the social and environmental impacts of the transition, ensuring that the rights of individuals and communities are protected throughout the process. This includes the consideration of just transition principles, which aim to ensure that the costs and benefits of the energy transition are distributed fairly and that vulnerable groups are not disproportionately affected [17]. The concept of energy justice seeks to apply justice principles to energy policy, production, consumption, and climate change. It questions the existing state of affairs and aims to address social and environmental inequalities [18].

Furthermore, the legal framework needs to provide certainty and stability to investors and stakeholders in the energy sector, encouraging long-term investments in renewable energy technologies. This requires the development of clear and consistent regulations that provide a supportive environment for renewable energy development and remove barriers to entry for new technologies [15]. The regulatory framework also needs to address the challenges posed by the integration of renewable energy sources into the grid, such as grid stability and the management of intermittent generation. This may involve the development of new regulatory mechanisms and market designs that incentivize the deployment of energy storage and demand response [19].

Moreover, the legal framework needs to adapt to the changing nature of energy systems, including the rise of decentralized energy generation and the emergence of energy communities. This may require the revision of existing regulations to accommodate new business models and ensure a level playing field for all market participants [16]. The changes in legal policies in the light of the energy transition are aimed at facilitating the deployment of renewable energy technologies, ensuring a just and equitable transition, providing regulatory certainty, and addressing the challenges posed by the evolving energy landscape [16].

In conclusion, the energy transition has necessitated significant changes in legal policies to address the challenges and opportunities associated with the shift towards a more sustainable and low-carbon energy system. The legal framework plays a crucial role in facilitating the energy transition and ensuring a smooth and efficient transition process. These legal policy changes recognize the limitations of legalism and the need to involve other non-legal actors and forms of knowledge in the transition process. Additionally, legal policies need to consider the social and environmental impacts of the transition, ensure a just transition, provide regulatory certainty, and address the challenges posed by the evolving energy landscape. The changes in legal policies are aimed at facilitating the deployment of renewable energy technologies and ensuring a just and equitable transition.

1.3 Solutions for Grid Impact Caused by EV Charging Stations in Urban Areas

The increasing grid impact caused by charging stations in urban areas has presented significant challenges for distribution system operators (DSOs) in near future. To address these challenges, researchers have explored various solutions and technologies.

One of the proposed solutions for reducing EV charging queues and costs is the use of mobile battery-integrated charging stations (MCS). Deilami & Muyeen [20] discuss the concept of MCS, which involves integrating batteries into the charging stations. This innovative approach allows the stations to store excess renewable energy and utilize it during peak charging periods, effectively reducing the strain on the grid. The authors highlight the potential of MCS to bridge the gap between high electricity costs and enhanced emissions resulting from charging EVs from the utility grid. By leveraging the stored energy in the integrated batteries, MCS can optimize the utilization of renewable energy and contribute to cost savings and reduced emissions.

Another solution proposed in the literature is the deployment of DC fast-charging stations with local battery storage. Rituraj et al. [21] present a comprehensive cost-benefit analysis of such stations, emphasizing their importance in satisfying the EV load demand in urban areas. By integrating local battery storage, these stations can provide rapid charging for EVs while reducing the strain on the grid. The authors highlight the potential of local battery storage in decoupling the peak load demand caused by EVs on the main grid, resulting in decreased connection fees and improved grid stability. The analysis conducted by demonstrates the economic feasibility and benefits of deploying DC fast-charging stations with local battery storage.

Utilizing local flexibility resources is another approach to mitigate grid challenges caused by EV charging stations. Zhu et al. [22] explore the possibility of utilizing home photovoltaic systems for charging EVs, highlighting the potential for improving self-consumption of renewable energy. By integrating EV charging with home photovoltaic systems, the authors propose a decentralized approach that reduces the reliance on the utility grid and maximizes the utilization of locally generated renewable energy. This approach not only reduces the strain on the grid but also contributes to the overall sustainability of the charging infrastructure‘s research emphasizes the importance of leveraging local flexibility resources to optimize the integration of EV charging stations into the existing power grid.

The placement of EV charging stations in urban areas is a crucial aspect of infrastructure planning. Nair et al. [23] discuss an electric vehicle charging station placement method specifically designed for urban areas. The authors consider various factors, including driving range constraints and accessibility, to optimize the placement of charging stations. By strategically locating charging stations, aim to minimize the distance between charging stations and EV users, reducing the inconvenience and potential congestion associated with EV charging. Their research highlights the importance of considering the spatial distribution of charging stations to ensure convenient access for EV owners and efficient utilization of the charging infrastructure.

The integration of large-scale EVs into utility grids presents additional challenges. Ahadi et al. [24] investigate the impacts of large-scale EV impact on low voltage distribution, power demand, voltage profile, power quality, and system adequacy. Their research emphasizes the need for a comprehensive impact analysis to ensure grid stability and reliability. By analysing the potential impacts of large-scale EV impact, provide insights into the necessary grid upgrades and management strategies to accommodate the increasing EV load. Their findings contribute to the development of sustainable and efficient strategies for managing the grid impact caused by EV charging stations.

The intelligent control of converters for EV charging stations is another area of research. Jha et al. [25] discuss the challenges of EV charging stations and highlight the growing use of distributed generators in the modern electrical grid system. They emphasize the importance of availing electricity for EV charging from sustainable sources of energy. By implementing intelligent control strategies for converters, propose a solution that optimizes the utilization of renewable energy and ensures the efficient operation of EV charging stations. Their research highlights the potential of intelligent control systems in enhancing the sustainability and grid support capabilities of EV charging infrastructure.

The deployment of charging stations should consider both the charging demand in traffic networks and the stability of the power grid. Zhao et al. [26] propose a novel methodology for charging station deployment, taking into account both factors. Their research aims to balance the load among charging stations and minimize charging waiting time through vehicle-grid communication. By considering the charging demand patterns and the grid conditions, provide a framework for optimizing the deployment of charging stations, ensuring efficient utilization of the charging infrastructure and minimizing the impact on the power grid.

A comprehensive review of EV charging technologies, standards, architectures, and converter configurations is provided by Acharige et al., [27]. The authors emphasize the importance of analysing the status of EV charging technologies to enhance charging efficiency and grid support. They discuss the dedicated converter topologies, control strategies, and compatibility with standards and grid codes for optimum operation. By providing an overview of the current state of EV charging technologies, contribute to the development of standardized and efficient charging solutions that support the integration of EVs into the power grid.

Multi-priority queuing for EV charging at public supply stations is another area of research. Propose models where vehicles communicate with the grid to convey information about their charging needs and locations. The aim is to balance the load among charging stations and minimize charging waiting time. By implementing intelligent queuing strategies, address the challenge of optimizing the utilization of charging stations and improving the charging experience for EV owners.

Finally, off-grid and hybrid charging systems are explored as comprehensive solutions for seamless, widespread, and fast charging of EVs in urban and rural areas. Rituraj et al. [21] provide a comprehensive review of off-grid and hybrid charging systems, highlighting their potential in overcoming the limitations of relying solely on the utility grid for EV charging. By integrating renewable energy sources, energy storage systems, and smart charging technologies, off-grid and hybrid charging systems offer a sustainable and reliable solution for EV charging, particularly in areas with limited grid infrastructure.

In conclusion, the research emphasizes the importance of utilizing renewable energy, integrating local generation and storage, optimizing charging station placement, implementing intelligent control strategies, and exploring off-grid and hybrid charging systems. By synthesizing these research findings, this review provides valuable insights for DSOs, policymakers, and researchers in the field of electric vehicle charging infrastructure.

2 Methods

The rapid growth of Electric Vehicle (EV) and it's charging infrastructure adoption in urban areas brings forth both opportunities and challenges for urban infrastructure, particularly the electrical grid. The increasing demand for EV charging stations necessitates a comprehensive understanding of their impact on the existing power grid. In response to this need, theoretical models play a crucial role in providing insights that can inform the planning and development of Electric Vehicle Supply Equipment (EVSE) networks.

Such models contribute to addressing challenges associated with grid impact, offering a systematic framework to analyze and optimize the deployment of EV charging infrastructure. By quantifying the load on the grid, assessing energy availability, and evaluating efficiency, these models enable planners and stakeholders to make informed decisions in the face of evolving urban landscapes. Moreover, they serve as valuable tools in devising strategies to enhance grid stability and resilience against the backdrop of increasing electric mobility.

The mathematical formula for the theoretical model can include different elements depending on the specifics of the issue being analysed. In this case, the theoretical model for the impact of electric vehicle charging stations on the power grid in urban areas can be presented as a system of equations. A general example of a mathematical formula that can be adapted to specific parameters and conditions is presented below.

General Theoretical Model:

1. Parameters:
    - S_i: Number of charging stations in area *i*.
    - P_i: Capacity of a single charging station in area *i*.
    - V_i: Number of electric vehicles in area *i*.
2. Equations:
    a. Network Load:

$$\text{Load}_i = S_i \cdot P_i$$

    b. Impact on Energy Availability:
$\text{Availability}_i = \frac{\text{Available\_Capacity}_i}{\text{Total\_Capacity}_i}$

    c. Energy Efficiency:

$$\text{Efficiency}_i = \frac{\text{Used\_Capacity}_i}{\text{Charging\_Capacity}_i}$$

    d. Network Stability:

$$\text{Stability}_i = \text{Stability\_Function}(\text{Load}_i, \text{Other\_Parameters})$$

    e. Optimal Deployment:

$$\text{Optimal\_Deployment} = \text{Optimization\_Function}(\text{Deployment\_Parameters})$$

3. Assumptions:
    - The model assumes that the number of electric vehicles is a dynamic variable dependent on time.
    - The model assumes that parameters related to charging stations can evolve over time.

It’s important to note that the above formula is just a general example of an approach to theoretical modelling. Before adapting it to a specific case, it’s crucial to precisely define the parameters, equations, and functions that best reflect the investigated issue regarding the grid impact caused by EV charging stations in urban areas.

3 Conclusion

Formidable challenges confront Distribution System Operators (DSOs) amidst the ongoing energy transition, driven by the escalating integration of distributed energy resources and Electric Vehicles (EVs). The intricate issues encompass voltage fluctuations, reverse power flows, and power quality degradation arising from the intermittent nature of renewable energy sources.

Legal policies are identified as crucial instruments shaping the trajectory of the energy transition. The evolving legal framework is seen as vital for providing stability to investors, addressing social and environmental impacts, and accommodating the dynamic nature of energy systems. The adoption of a holistic and inclusive approach, considering non-legal actors and embracing just transition principles, emerges as imperative for effective navigation through the complexities of the energy transition.

Regarding grid impact challenges posed by EV charging stations in urban locales strategies encompass mobile battery-integrated charging stations, DC fast-charging stations with local battery storage, utilization of home photovoltaic systems, strategic charging station placement, and intelligent control of converters or the off-grid and hybrid charging systems.

The theoretical model elucidated in the methods section serves as a pivotal tool for comprehending and optimizing the impact of EV charging stations on urban power grids. Rooted in a system of equations, the model facilitates the quantification of network load, assessment of energy availability, evaluation of efficiency, consideration of network stability, and optimization of deployment strategies.

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The Impact of Control of Corruption on GHG Emissions: Overview of the Five Largest Industrial Cities in Indonesia

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Abstract. This cross-sectional research concept aims to investigate the impact of corruption control on the level of greenhouse gas (GHG) emissions in Indonesia. This research used a variety of data sources, including corruption perception index, GHG data, and socio-economic indicators. Statistical analysis was used in this study to measure to what extent the control of corruption practices affecting GHG emissions in Indonesia. The findings provide empirical evidence for policy makers to design effective policies to reduce GHG emissions in Indonesia and improve the control of corruption. Overall, this research concept will play a role in deepening understanding of the relationship between efforts to control of corruption, sustainable development and environmental preservation in Indonesia.

Keywords: Control of Corruption · GHG Emissions · Sustainable Development

1 Introduction

Over the last few years, energy demand throughout the world has increased, but in Asian countries, the increase has been much faster and more significant. This increase in global energy demand has caused vulnerabilities in energy supply and accessibility problems in developing countries. The developing regions, such as Asian countries, could see a 33% increase in overall energy demand by 2040 [1]. Indonesia's progress in achieving "access to affordable, reliable, sustainable and modern energy for all," as outlined in the UN Sustainable Development Goals number 7, causes competition between the global goals of the UN SDGs and the country's political ambitions. Many countries have expressed their commitment to prioritizing using renewable energy sources. However, the extent to which these global targets influence national electricity policy depends on their political underpinnings, which can have varying impacts. In Indonesia, the transition to low-carbon energy is often hampered by the decentralization of institutions, leading to divisions in policy. However, institutional quality also attracts Foreign Direct Investment (FDI) into developing countries [2]. This growth in FDI can increase CO2 emissions, so it is important to have the right institutional framework and decision-making mechanisms to overcome environmental problems. Thus, the relationship between institutional quality and CO^2 emissions remains a major challenge in research to achieve the UN Sustainable Development Goals [3].

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Several studies verified that countries with a strong institutional framework have a greater opportunity to play a role in reducing CO^2 emissions, greenhouse gases, climate change, and improving environmental quality [4–6]. Institutional quality supports sustainable development [7] because improving institutional performance is essential in controlling and reducing pollution for economic development [8]. Other research also concludes that institutional quality has a positive impact on the growth of CO^2 emissions per capita [9] and reduces negative impacts on the environment [10]. Institutional performance is also important in linking Foreign Direct Investment (FDI) with pollution.

Climate change can harm productivity, while strong institutions help reduce its negative impact by encouraging technology adoption in developing countries[11]. Therefore, strengthening these institutions is very important to implement more effective and efficient practices, with the support of adequate regulations, laws, property rights, and corruption control to reduce pollution [12].

In recent years, many researchers have focused on the role of corruption and its relationship with economic growth and CO2 emissions. Corruption significantly impacts CO2 emissions, which are the leading cause of pollution [13]. However, corruption affects not only the process of implementing environmental policies but also the implementation and monitoring of environmental laws. In addition, theoretical analysis and empirical research show that corruption is a key factor contributing to environmental degradation because it decreases the stiffness of environmental regulation [14]. Orji et al., (2022) [15] stated that efforts to control corruption contributed positively toward economic growth in Nigeria. They found there was an increase in the level of corruption control with an increase in the growth rate of around 0.54% whilst considering other economic factors. Research by [16]–[18] discussed various aspects of the relationship between governance, energy, the environment, and economic growth, with mixed findings on the role of corruption and the quality of institutions. Some researchers argue that corruption has fatal impacts. Indeed, it can have serious consequences for health, such as reduced government budgets for health services and disruptions in medical interventions. In addition, corruption can lead to the absence of health workers [19] and motivate distrust of the health system [20].

There are several factors that inspired the writing of this paper. First, previous research has mostly focused on the factors that drive anti-corruption actions at the macro level, such as political, economic and cultural aspects [21]. However, there is an essential gap in the literature when trying to identify the factors at the firm level [22–24]. Therefore, the main aim of our research is to investigate the impact of control of corruption on corporate social and environmental behavior. By focusing on firm-level analysis, we seek to provide a more direct understanding of the variations in control of corruption commitments seen in national contexts. Second, world banks in their governance index ranking gave a minus for Indonesia's control of corruption rating from 2006 to 2021 as shown in Fig. 1.

Ali et al., (2019) [12] suggest that for developing countries, a very important step is to strengthen their institutions and ensure that they function effectively. This is because institutions that operate effectively will produce appropriate regulations and laws that can help reduce carbon emissions. According to [25], the impact of trade on environmental

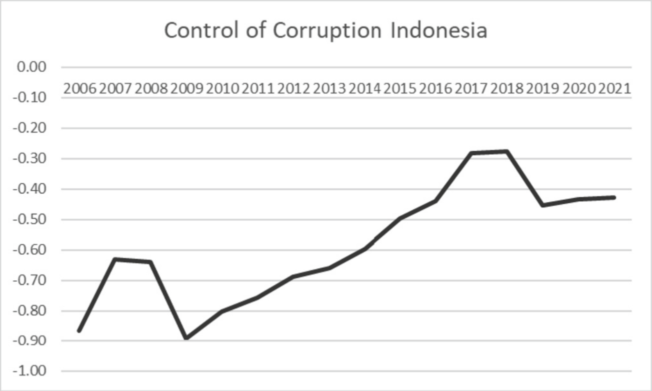

Fig. 1. World Bank Indonesia Control of Corruption Index 2022

degradation is very dependent on the institutional formation of a country. Overall, institutional quality is considered as a key factor in efforts to reduce environmental degradation in the context of economic development. A strong institutional framework is an important element in achieving high economic growth without sacrificing environmental risks, as emphasized by [8]. It is hoped that this research will further provide contributions such as; Improving environmental management, understanding the relationship between corruption and greenhouse gas emissions in Indonesia, and helping policy makers and researchers identify areas of negative impacts of corruption on the environment. These opens the door to better strategies in environmental management. For the economic benefits, it can reduce corruption, supporting sustainable environmental policies, increase the attractiveness of foreign investment and Indonesia's competitiveness in international markets. These aspects support economic growth and job creation, especially in the renewable energy sector. Moreover, by reducing corruption and encouraging sustainable environmental policies, Indonesia can improve the quality of life for all citizens, especially those most affected by climate change. As one of the largest contributors to greenhouse gas emissions, the efforts to reduce emissions in Indonesia potentially to have a global impact on climate change. Research about the impact of corruption on greenhouse gas emissions in Indonesia can contribute to the global dialogue on reducing emissions and mitigating climate change.

2 Literature Review

2.1 Legitimacy Theory

According to legitimacy theory, organizations need to ensure alignment between their business activities and societal goals to maintain operational continuity [26]. Therefore, company actions are affected by how interested parties outside the company assess the suitability of company decisions with society's expectation [27, 28]. The impact of corruption not only for the company itself, but also other organizations, markets and society. In this context, legitimacy theory provides valuable insight about why companies that actively engage in ethical, social, and environmental initiatives are more likely to adopt anti-corruption policies to strengthen their legitimacy and public image [26]. Therefore, we believe that social and cultural values reflected in CSR reports, committees and company performance play a key role in motivating corruption prevention efforts. The development and implementation of strong anti-corruption can stimulate ethical behavior and serve as a strategic tool to increase the public legitimacy of a company [29].

2.2 World Governance Indicators

The World Bank defines governance as the traditions and institutions used by state authorities. This includes the process of selecting, monitoring and replacing the government, the government's ability to formulate and implement good policies, and the level of citizens' trust in the institutions that regulate their economic and social interactions. The theory stated by [30] indicates that institutions have an important role in economic activity, not only as direct resources for productive investment, but also in influencing transaction and production costs. Therefore, institutional barriers such as lack of property rights, corruption, and political instability can potentially harm investment. Since 1996, the World Bank has released six parameters used to measure governance within a country as part of its governance indicators project, known as Worldwide Governance Indicators (WGI). These parameters include voice and accountability, political stability, government effectiveness, rule of law, regulatory quality, and corruption control.

Kaufmann et al., (2011) [31] offer a definition of governance as "traditions and institutions responsible for the implementation of government". This definition emphasizes the importance of selecting and replacing governments, the ability to design and implement quality public policies, and the level of trust placed by the state and its citizens in the institutions that oversee economic and social interactions between these institutions, citizens and the government. Institutions can also affect the environment through various policies, such as carbon taxes, feed-in tariffs, and eliminating fossil fuel subsidies [32]. Thus, the quality of institutions in a country can affect energy demand by influencing the efficiency of energy use directly or through the introduction of technologies that reduce energy use.[33] stated that the quality of institutions is an important prerequisite for maintaining environmental quality.

In addition, the quality of institutions has a significant impact on human development. Research has shown that countries with stronger institutions tend to have higher levels of human development, including better health and education. In terms of health, Rehmat et al., (2020) [34] show that the quality of institutions plays a role in increasing life expectancy and reducing infant mortality rates. Something similar occurs when using different proxies to measure the quality of institutions. Dhrifi, (2020) [35] also found that the quality of institutions has a significant impact on the relationship between spending in the health sector and infant mortality rates and plays an important role in shaping the correlation between the two.

Globally, more than 1.5 billion tons of carbon dioxide are produced by humans every year. This includes the use of fossil fuels, energy, management of water, land, air, water resources, as well as in food and energy production [36]. All these elements are a key part in the challenge of establishing a sustainable society, because they are essential components of our daily lives. The concept of sustainable development that the researcher adheres to is not only related to economic growth, but also includes social and environmental dimensions. Policies leading to sustainable development, including environmental and economic policies, have a complex background and long history. They play an important role in efforts to achieve sustainable development from economic, social, and environmental perspectives [37]. This approach is strongly bottom-up, emphasizing that a sustainable future can only be achieved if we maintain the biophysical and social conditions necessary to support economic activity and human well-being, both for current and future generations. The quality of institutions also plays an important role in reducing energy disparities between regions by setting more open market policies [38]. Efforts to reduce energy gaps, both at the national and regional levels, contribute to improving the quality of the environment because countries are interdependent through various social, economic and cultural factors.

3 Hypothesis

3.1 The Effect of Control of Corruption on GHG Emissions

As a selection tool, a culture of corruption in a company has the potential to cause errors at the corporate level, such as earnings management practices, financial fraud, and insider trading, for example, feeling under pressure to meet investor expectations, the management often tends to cheat in financial reporting to show false growth and overachieve earnings. In the context of a corrupted company, managers can use company resources, both tangible and intangible, to invest funds in projects that are not profitable and suit their personal interests. Therefore, corruption can result in increased agency cost [39]. In a different way, companies that have strong social responsibility are more likely to be motivated to reduce corruption because they are aware of its potential negative impact on society [40]. Research conducted by [22] explained that the relationship between CSR performance and corporate-related corruption risk is tested and showed a negative relationship between CSR commitment and corporate corruption risk.

In the legitimacy theory framework, as a form of non-financial information, disclosure of GHG emissions can help increase legitimacy by reducing information inequality and fulfilling the interests of stakeholders [41]. Therefore, it is very important for companies to implement anti-corruption measures to reduce corrupt practices, agency costs, financial losses, and negative impacts on reputation that arise from dishonest behavior [42, 43]. Additionally, these actions can increase employee motivation and engagement [44]. Therefore, based on existing theoretical literature and empirical findings, the hypothesis is formulated as follows:

H1: Control of corruption has a negative effect on the company's GHG emissions.

4 Research Methods and Operational Variables Definitions

This research used a case study approach where researchers conduct an in-depth examination of one case or a limited number of cases. This research method is included in the qualitative research category, which means that the emphasis is on collecting and analyzing data, where the data is not in the form of numbers or statistics, but interviews, observations and documents.

This research analyzed the relationship between company-level control of corruption and carbon emissions in 2023. The selection of the research period was purely based on the availability of data for all variables used in the research. In addition, an institutional index in terms of control of corruption was built using PCA to represent institutional quality. The construction of these indices will help us identify whether control of corruption places policy pressure on the government or performance pressure on company management. In addition, this study conducted a single indicator analysis for the control of corruption indicator. This will provide a better picture of the impact of control of corruption on GHG Emissions.

Due to the limited data regarding the role of control of corruption in affecting company emissions performance, specific primary data has an important role in providing in-depth insight into the analysis presented in this paper. The information gathering process is carried out by referring to the core question, namely what public strategies are used to support or hinder control of corruption policies in Indonesia? Primary data was collected through a series of questionnaires aimed at stakeholders involved in various renewable energy projects and initiatives in the five largest industrial countries in Indonesia,

We predict that the company's anti-corruption measures will have a positive influence on the GHG Emissions score. A high culture of corruption in a company will easily rise to more violations at the corporate level, and agents may become more selfish and unscrupulous. Therefore, it increases agency costs between management and shareholders [39, 45].

5 Variable Description

This research chose two variables to be the main focus, namely control of corruption and GHG emissions.

Control of Corruption = Reflects views on to what extent the government authorities utilize their power for personal gain, which includes acts of corruption on various scales, as well as attempts by elites and individuals to control or manipulate the state for personal gain [31].

GHG Emissions = Total company Greenhouse Gas (GHG) emissions, measured in thousands of metric tons of carbon dioxide equivalent (CO2e), calculated using a location-based approach. GHG is a type of gas that contributes to heat capture in the Earth's atmosphere, including but not limited to Carbon Dioxide (CO2), Methane, Nitrous Oxide, and other gases[46].

6 Limitations and Suggestions

Research on the relationship between Word Governance Indicators (WGI) corruption control and greenhouse gas (GHG) emissions in Indonesia using questionnaires has the following limitations: Limited Sample Size: The questionnaire only represents a small portion of the population, so the results may not reflect the population as a whole.

Uncertain Response: Not everyone who receives a questionnaire will respond, which can result in selection bias because it only represents people who are willing to answer. Subjective Self-Report: Questionnaires rely on participants' subjective reports, which can result in bias because people tend to over-report positive behavior and ignore negative behavior. Cultural Influence: Cultural factors can also influence responses to questionnaires, so the results can be influenced by social norms. Suggestions for future research: Mixed Methods Approach: Use a combined approach to quantitative and qualitative data, such as questionnaires for quantitative data and interviews with stakeholders for deeper understanding. Larger Sample Size: Use a larger sample for more representative results. Stratified Sampling: Divide the population into groups or strata, then select randomly from each stratum to ensure better representation in important variables such as age, gender, and region.

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TCO Analysis of Conventional and Electric Vehicles on the Example of Operations of the Polish Enterprise

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Abstract. The purchase of a vehicle should be based primarily on an accurate and realistic economic calculation. This means that the expenses incurred for the vehicle should be calculated on the basis of all costs that are associated with exploitation. Many people, who deciding on the choice of a particular vehicle, take into account only the purchase price of the vehicle, and overlook other important issues of exploitation. In accurately determining the profitability of a vehicle purchase, both for individuals and companies, the Total Cost of Ownership (TCO) parameter plays a major role.

TCO is all the expenses incurred by a specific user, starting from the implementation of the vehicle into the fleet (in the case of enterprises) or the purchase of the vehicle (in the case of individuals), through the operation and ending with the final disposal of the used vehicle. This model provides an estimate of the development of costs over time. TCO is beginning to have an increasing impact on consumer purchasing behavior.

Keywords: TCO · electric vehicles · company fleet

1 Theoretical Aspects of TCO

Within the decision process of a new car, financial factors are regarded as very important. Investment in the purchase of a new vehicle is always an investment with long-term economic consequences. This means that the purchase cost is only one of many other costs that owners incur in the exploitation of the car. Increasingly, private users and entrepreneurs are looking to estimate all costs associated with car ownership. TCO models are used to estimate the operating costs of vehicles.

By using TCO models, it is possible not only to determine the total cost of ownership, but also to get information about the evolution of costs over time. This makes it possible to estimate which vehicle will be more economical in the long terms, but also at what point a vehicle (with an initially higher purchase cost) will begin to generate savings due to lower operating costs. In addition, the TCO model makes it possible to determine how much the vehicle will lose in value after its lifetime.

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TCO models in the automotive sector mainly include two basic parameters. The first is all the costs of operating the vehicle incurred by the user from the time of purchase to the final sale. The second parameter is the residual value (the resale price of the vehicle). The TCO model of conventional vehicles (CV) consists of a residual value and three basic cost groups. Table 1 shows the components of the TCO model for conventional vehicles.

Table 1. Components of the TCO model for CV

TCO Model – conventional vehicles		
One-time costs	Recurring costs	Variable costs
Cost of purchase	Insurance costs	Fuel
Vehicle registration	Technical review	Service
Adaptations for exploitation	Parking and highway tolls	Car spare parts
Residual value		

Literature reveals many TCO studies on electric vehicles (EV), especially since 2008, when several car manufacturers launched their plans of mass production of electric vehicles [1]. The electric vehicle market is rapidly changing, largely because the cost of batteries has decreased dramatically over the past decade [2].

TCO of an electric $_{\text{vehicle}}$ is determined by a number of economic factors, i.e. the price of energy, the difference in insurance rates for electric vehicles, and policies to support electromobility (the existence and amount of rebates and subsidies for electric cars) [3]. Some of the costs, of course, are identical to those for conventional vehicles, but the TCO model for EVs distinguishes another, fourth group of costs (avoided costs). While electric vehicles typically have higher upfront purchase prices, they can save consumers a lot on operating expenses [4]. However, because EVs are relatively new, little hard data are available to put numbers to these claims, and most estimates in the literature are based on predicted repair and maintenance costs [5]. Table 2 shows the components of the TCO model for electric vehicles.

2 Methodology

Comparing different TCO studies should be done with care as analyses have different assumptions, input parameters and research scope. The assumption was to carry out, based on real data, a comparative analysis of the TCO of two city cars (Class B) - one electric car and one conventional car, which are in service at the analyzed enterprise.

Table 2. Components of the TCO model for EV

TCO Model – conventional vehicles			
One-time costs	Recurring costs	Variable costs	Avoided costs
Cost of purchase	Insurance costs	Electricity	Paid public parking
Vehicle registration	Technical review	Service	Saving time – bus lanes
Adaptations for exploitation	Highway tolls or car washes tolls	Car spare parts	Fees for entering Clean Transportation Zones
Cost of purchasing and installing charging stations		Charging station service	
Residual value			

Both cars were purchased by the enterprise in a similar period (Q3/Q4 2020). This is very important considering the identic regulations on the purchase and settlement of fleet vehicles. The cars selected for analysis are characterized by high construction similarity. Both models come from the same automotive concern, are built on an identical platform and have practically identical dimensions. Another important factor is that the cars selected for analysis were used for similar operations at the company, and their mileage was practically the same - about 20,000 km per car. The above factors increase the reliability of the analysis.

Estimating costs for TCO models requires a unified approach, because many of the components of the calculations change over time, including fuel and electricity costs or service costs. For TCO analysis, all possible data collected during the research work were used, as well as those monitored as part of the analyzed company's fleet management system. All costs associated with the exploitation of electric and conventional fleet cars are monitored by the company's internal fleet management system. This allowed to analyze historical data and compare, how the operational costs of electric and conventional vehicles have changed over the past years and estimate, for instance, the increase in exploitation or service costs. The TCO analysis included a period of 8 years; after this time, according to the fleet policy of the analyzed company, passenger cars are withdrawn from service and replaced with new vehicles.

3 Results and Conclusions

For the TCO analysis, the following formula was developed:

$$TCO_{(t)} = C_p - A_s - R_v + C_{chs} + A_{ic}(t) + A_{ec}(t) + A_{sc}(t) + AC_{\frac{e}{f}}(t) + A_{cr}(t) + A_{ac}(t) \tag{1}$$

C_p – cost of purchase,

A_s – amount of subsidy (depending on the variant - including or not including the subsidy),

R_v – residual value,

C_{chs} – cost of purchasing and installing charging stations (depending on the variant – Wallbox or AC charging station),

A_{ic} – annual insurance costs,

A_{ec} – annual exploitation costs,

A_{sc} – annual service costs,

$AC_{\frac{e}{f}}$ – annual electricity/fuel costs.

A_{cr} – annual cost of repairs,

A_{ac} – annual avoided costs,

Of course, in the case of a conventional car, the amount of funding, the cost of purchasing and installing a charging station and avoided costs were not included in the above formula.

Table 3 and Figs. 1, 2, 3 and 4 present a summary of the results of the comparative analysis over the entire exploitation period, taking into account several variants for electric cars that affect the TCO analysis:

- Variant I (V I) – including the subsidy system and with the cost of purchasing a wall box station,,
- Variant II (V II) – including the subsidy system and with the cost of purchasing a AC station,
- Variant III (V III) – without including the subsidy systems and with the cost of purchasing AC stations,
- Variant IV (V IV) – without including the subsidy systems and with the cost of purchasing wall box station.

Table 3. Summary of TCO results [PLN]

Vehicle		Year of exploitation							
		1	2	3	4	5	6	7	8
EV	V I	58 609	**65 344**	71 917	78 183	84 519	90 674	96 678	102 551
	V II	69 462	76 198	82 770	**89 037**	95 372	101 528	107 531	113 405
	V III	96 462	103 198	109 770	116 037	122 372	128 528	**134 531**	140 405
	V IV	85 609	92 344	98 917	105 183	**111 519**	117 674	123 678	129 551
CV		50 291	66 372	81 970	98 092	112 053	126 461	141 467	156 035

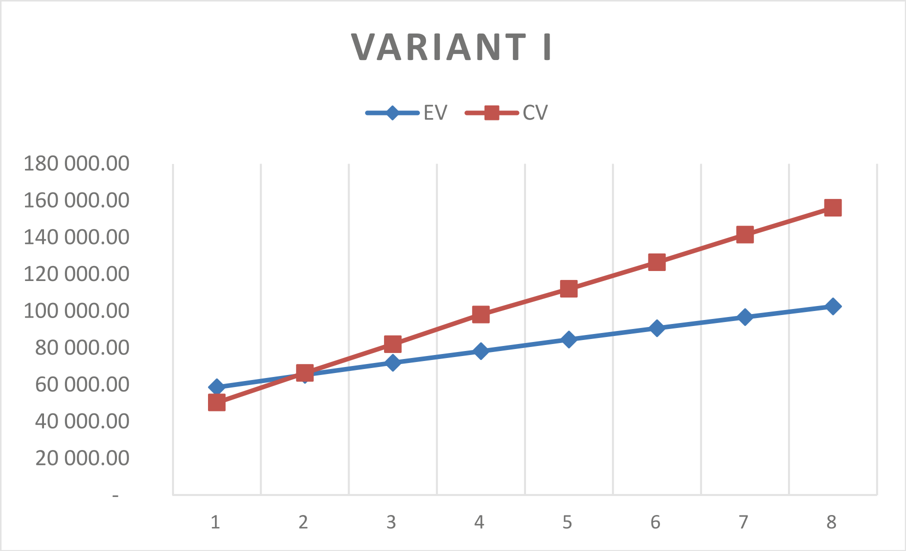

Fig. 1. Comparative results of TCO analysis in variant 1 (Source: Own Study)

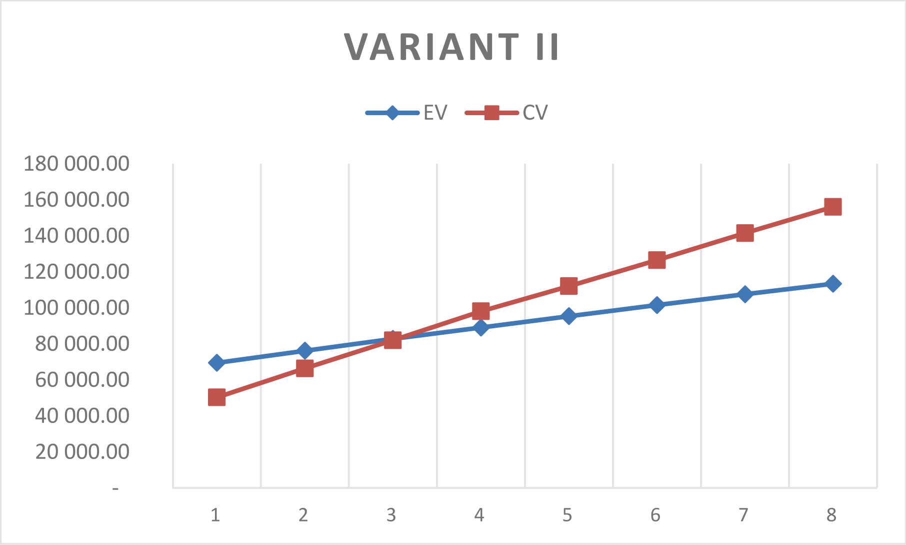

Fig. 2. Comparative results of TCO analysis in variant 2 (Source: Own Study)

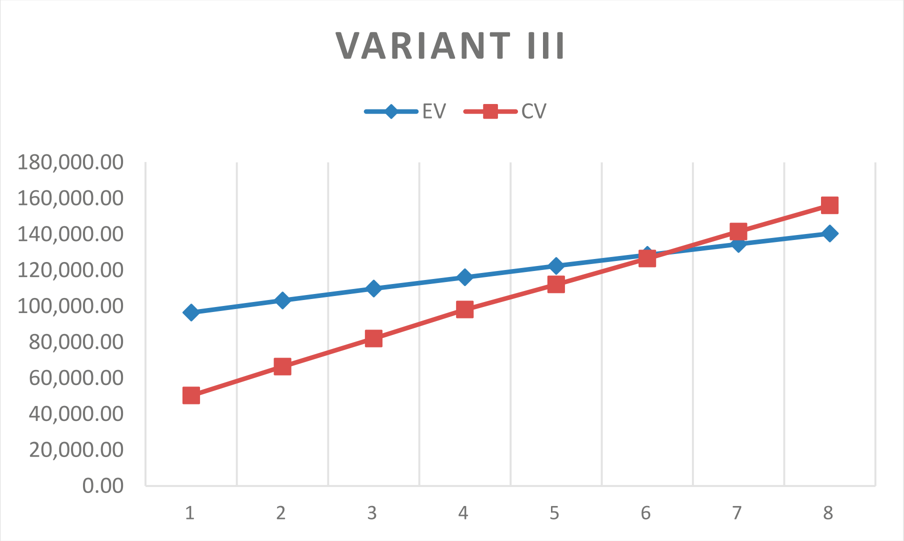

Fig. 3. Comparative results of TCO analysis in variant 3 (Source: Own Study)

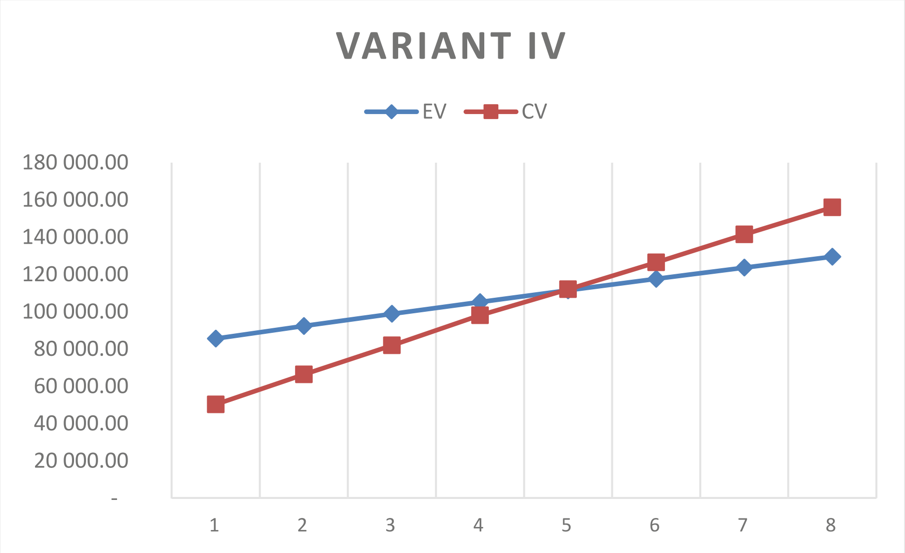

Fig. 4. Comparative results of TCO analysis in variant 4 (Source: Own Study)

4 Discussion

Although, costs for electric cars are higher at the initial stage (mainly caused by one-time expenses for the purchase of vehicles or charging infrastructure), as shown by a comprehensive TCO analysis conducted with real data and assumptions, over the 8-year operating period in each of the studied variants, the total operating costs of fleet electric cars are lower compared to conventional cars. In the analyzed variants, the TCO value for an electric car and a conventional car equalizes between the 2nd and 7th year of operation. For an electric car, the most favored variant was variant 1, which took into account the current electromobility support systems and requirements for charging infrastructure for fleet electric cars. In this variant, the TCO of a fleet electric vehicle and a conventional vehicle already equalizes before the 2nd year of exploitation. At the same time, it should be noted that this is the most probably variant for most enterprises in Poland.

Several important facts have an impact on the equalization of the TCO of electric and conventional vehicle. The first is the government's subsidy system for the purchase of a fleet of electric vehicles, which automatically reduces the difference in the purchase price of electric and conventional cars. Another important factor is that the TCO analysis has confirmed common theories about the lower operating costs of electric vehicles. Data from the analyzed company's fleet vehicle monitoring systems clearly indicated that the service costs of fleet electric vehicles are lower compared to conventional vehicles. It is also important to include avoided costs in the TCO model for electric cars. Saving time by being able to drive EVs freely in bus lanes or no fees for EVs in paid parking zones and projected clean transportation zones are factors that make a real difference in financial benefits and should always be considered in creating TCO models for fleet vehicles. In general, these findings are similar to what can be found in literature: governmental subsidies can make EVs cost efficient compared to conventional vehicles [6, 7].

A comparative TCO analysis, which assumed 4 variants related to the subsidy system and type of charging infrastructure, and took into account fleet policies at the analyzed enterprise, showed that the decision to electrify the company's fleet of passenger vehicles may be more cost-effective than the decision to exploit conventional vehicles. At the same time, it should be noted that the results of the study do not take into account many benefits that cannot be directly measured in material (monetary) form. Marketing and promotional activities related to electric car fleets and at the same time an increase in public awareness of the principles of sustainable development, can translate directly into a stronger image and position of the company in the market, and consequently - an increase in its revenue. However, other factors (styling, looks, driving sensation, relationship with the car dealer, influence from friends and family…) that cannot be included in this economic analysis also influence the final purchase decision of the consumer [8, 9].

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Young Workers on Digital Platform Work: A Review of Rights and Protection in Malaysia

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Abstract. The rise of digital labour platforms has been among the most significant changes in the world of work, a change that has transformed the global employment landscape. Digital platform work refers to work on web-based platforms and location-based apps. Although characterised by greater volatility and uncertainty, it is agreed that digital platform work is an attractive alternative to unemployment and offers flexibility to people in generating income. This current trend has certainly attracted, predominantly, young people. The growing population of young people, along with digital labour platforms that are expected to stay permanently have created both opportunities and challenges for the traditional workforce. Their employment status is often ambiguous. Workplace protections and entitlements are entirely denied. The objectives of this study are two-fold, firstly to review the rights and protection for young workers working on digital platforms and secondly, to make recommendations to improve the rights and protection for young workers working on digital platforms. This is a socio-legal research where the qualitative method is employed by putting secondary sources through content analysis and the result is analysed through thematic analysis method. Findings show that the existing laws in Malaysia do not accommodate young workers in digital platform work. The findings of this study extend the discussion on labour law protections and support decent work and economic growth as aspired through the Sustainable Development Goals.

Keywords: Digital Platform · Young Workers · Labour Rights · Platform Worker

1 Introduction

The global labour market and the nature of employment have undergone a profound upheaval as a result of the emergence of digital platforms. Job displacement occurs due to changing skills and requirement and this has caused the rise of gig economy workers. A study shows that, before the COVID-19 pandemic, 4 in 10 Malaysians joined the gig economy after leaving full time jobs (Zurich Insurance Group and Oxford University, 2020). Digital platform work refers to work on web-based platforms; where work is outsourced through an open call and location-based apps; typically to perform local,

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service-oriented tasks such as driving, running errands or cleaning houses. It is reported that over 1.4 million Malaysian job seekers and more than 20,000 Malaysian brands registered on a digital platform work app known as FastGig (Pang, 2022). However, despite the upward trend of digital labour platforms, there are significant inadequacies in the protection of rights of workers in terms of representation, compensation, job stability, social protection, working hours, and health and safety for the digital platform workers (Xu et al., 2021).

These issues are affecting the largest group of workers in digital platform work, that is the young workers. A study shows that more young persons are going into informal and 'non-standard' employment (Lin et al., 2018). A study by the International Labour Organization (2021) across sectors shows that digital platform workers are well-educated and typically below age 35. According to Lin et al. (2018), 82% of young workers who are self-employed report that they are not covered by any form of social protection due to the nature of their informal status of employment. Other than that, the low wages offered to young workers contribute to the brain drain problem in Malaysia. Based on recent statistics, Malaysia is among the countries that are highly affected by the brain drain issue and recently the number rose to 6% (Department of Statistics Malaysia, 2022). In the context of digital platform work, young workers are underpaid as the Minimum Wages Order 2012 does not cover their position.

Lack of protections for young workers while working on digital platforms has affected their interest in participating in the digital economy and increased unemployment statistics. This effect can be seen in the unemployment rates in Malaysia among young workers which are relatively high at 10.8% in 2017, 10.9% in 2018, 10.5% in 2019, 12.0% in 2020 and 11.3% in 2022 (Ministry of Human Resources, 2022). Based on the above issues, it can be observed that the current framework does not accommodate young workers in digital platform work. Hence, a clear framework for protection and rights must be established to accommodate the growing number of young workers joining digital platform work. The gig economy is featured in the 12th Malaysia Plan for 2021–2025 and the government is acting to regulate the sector to protect worker welfare. Appropriate regulations are anticipated to ensure fair competition for businesses and adequate protections for workers. Engaging with and addressing such challenges will be decisive in leveraging the potential opportunities emerging from the digital economy and labour platforms to promote decent work and advance progress towards achieving the Sustainable Development Goals.

The objectives of this study are two-fold, firstly to review the rights of and protection for young workers working in digital platform work and secondly, to make recommendations to improve the rights of and protection for young workers working on digital platforms in Malaysia. This paper starts off with a literature review of this study, followed with a discussion of research methodology adopted to achieve the objectives of this research. The next section of this paper discusses the results and findings of this study. Finally, this paper is concluded with an explanation of the contribution of this study and some recommendations to improve the protection for young digital platform workers.

2 Literature Review

2.1 The Concept of Digital Platform Workplace

The growth of digital economy has profoundly expands the employment opportunities through the use of digital technology in economic and social activities such as eCommerce, education and entertainment among individuals and business owners. There are various types of digital platforms such as media sharing platform (YouTube, Spotify), social media platform (LinkedIn, Facebook, Twitter, Instagram and TikTok), knowledge-based platform (Reddit, Quora and ChatGPT) and service-based platform (Airbnb, Foodpanda, Grab). Digital platform work emerged as a consequence of digital economy growth which connects individual who is ready to provide service and the person who request for the service through digital platform. Digital platform work refers to web-based platforms (where work is outsourced through an open call) and location-based apps (typically to perform local, service-oriented tasks such as driving, running errands or cleaning houses). Individual that work for a specific organization that provides specific services through digital platform is known as platform worker. The employment relationship which stipulates the responsibilities of the employer and the platform worker depends on the terms and conditions in the employment contract. The platform worker is paid by the organisation based on the service provided through the online platform. It is estimated that nearly 4 in 10 of Malaysian workforces would involve in digital platform works in the next 5 years (Rahim et al., 2021). The nature of digital platform workplace has blurred the line between gig workers and platform workers due to the flexibility offered in its working environment. Digital platform work offers many advantages such as working hours flexibility and work can be done remotely. However, the lack of job stability, inconsistent of salary payment, denial of insurance and benefits for platform workers had become the drawback of digital platform work.

2.2 Labour Protection for Young Workers

The International Labour Organization (2021) defines young worker as a worker who has attained the age of 15 and is below 24 years old. Nowadays, due to economic demands, more young persons are working to meet their commitments and support their family’s livelihood. Gig economy is preferred by youths for their source of income due to the freedom and control given through the digital platform work. The technological advancement in digital platforms has eased the process for those who want to offer their services without meeting the traditional employment relationship demands. Globally, young people also choose to work on digital platforms (Garben 2017; Popescu et al. 2018, Ganapathy & Deepak, 2023).

The Children and Young Persons (Employment) Act 1966 or also known as the Children and Young Persons (Employment) (Amendment) Act 2019 (‘CYPE’) which came into force on 1st February 2019 is a law that protects the labour rights of young workers in Malaysia. Young worker is defined as a worker who is aged at least 15 years old and under the age of 18 years. This definition is inconsistent with the definition of young person as defined by the Malaysian Institute of Labor Market Information and Analysis (2023) which refers to a young person as someone in the 15 to 24-year age group. Basically, the CYPE states the rights of young workers at the workplace. Young workers are not allowed to engage in any hazardous work such as construction work, work in the timber industry, offshore work, work above or near water unless with personal supervision (section 2). The CYPE also prohibits young workers from engaging in employment involving prostitution, as social escorts, in production or trade of alcoholic beverages, gambling and lottery activities, massage or reflexology activities, pornography, production and trade of drugs and other similar substances. Apart from that, in terms of working hours, young workers are not permitted to work between 8 pm to 6 am; to work for more than four consecutive hours without a period of rest of at least 30 min; to work for more than seven hours on any one day, but if the young workers are attending school, they must not work exceeding eight hours including the time which they spend attending school; to start any work on any day without having had a period of not less than 12 consecutive hours free from work. Additionally, the CYPE does not permit young workers to take part in any public entertainment work.

According to Aun (2020), among the factors that cause youth unemployment are those related with wage levels, job quality and work conditions. Another study shows that factors that cause young persons to refuse to work in the construction industry are unsafe working conditions and low wages (Mahmood et al., 2021). Young workers are at greater risk of work injuries than adult workers (Turner et al., 2022). As a result, it is reported that there is poor involvement of young workers in the Malaysian construction sector (Mahmood et al., 2021). Ab Kadir et al. (2021) state that there is a dire need to provide a standard guideline to protect the rights of young person entertainers in Malaysia as there are lacunas which might expose young persons to employer exploitation especially with regard to their working hours.

Significant inadequacies in representation, compensation, job stability, social protection, working hours, and health and safety that are observed in digital platform work (Xu et al., 2021) are also affecting young workers. The lack of awareness among young workers about their labour rights while working on digital platforms has worsened the situation and caused them to be exploited by the platform providers. According to Lin et al. (2018), 82% of young workers who are self-employed report that they are not covered by any form of social protection. As a consequence of their informal employment status, they are not entitled to social security and insurance benefits such as Employees Provident Fund (EPF) coverage, Employment Insurance System (EIS) and Social Security Organisation (SOCSO) contributions. Based on the above reviews, it can be observed that past literature on digital platform work and labour protection for young workers have been discussed widely among scholars; however, a study is yet to be conducted on digital platform work focusing on labour protection for young workers in Malaysia. Thus, this study intends to fill the gap by analysing the current regulatory framework for labour protection of young workers in Malaysia in digital platform work and recommend improvement to protect young workers from being abused and exploited.

3 Methodology

This study is based on the qualitative method using content analysis. Content analysis is used to analyse the content of text data through conventional content analysis. Conventional content analysis is where text data is directly coded and categorised (Hsieh et al., 2005). Content analysis in this study is based on the parliamentary statutes in Malaysia. There are four statutes relevant to achieving the objective of this study. These are the Children and Young Persons (Employment) (Amendment) Act 2019, Minimum Wages Order 2012, Employment Act 1955 and Trade Unions Act 1959. Apart from these statutes, other relevant government documents such as government statistics and international reports that highlight the issue of labour protection of young workers on digital platforms are also analysed in this study. Additionally, this study adopts content analysis in analysing journal articles. Articles are chosen from Scopus and Web of Science databases using the keywords ‘digital platform’, ‘young worker’ and ‘labour rights’. The result from journal articles is further refined according to the latest publication year, ranging from 2018 to 2023. The data obtained from this method is further analysed and discussed according to themes.

4 Results and Discussion

4.1 The Children and Young Persons (Employment) Act 1966

The question on whether young workers’ rights are protected in digital platform work is based on the coverage of the statute for young workers. According to the International Labour Standard, young worker is defined as a worker bearing the age of 15 years old until 24 years old (International Labour Organization, 2021). Thus, workers between the ages of 15 to 24 years are considered as a vulnerable group of workers and must be protected by specific laws. In Malaysia, there is a specific law protecting young workers’ rights at the workplace which is known as the CYPE. However, it can be observed that only a small category of young workers is covered under the CYPE when it defines young person as ‘a person who has attained the age of 15 years and under the age of 18 years’. The inconsistency of the definition of young worker between the CYPE and the International Labour Organization has caused a group of young workers to be unprotected by the CYPE. These are young workers between 19 to 24 years old. As a consequence, a young worker who is outside the scope of CYPE protection is not able to claim labour protections such as in terms of maximum working hours and limitation of types of work to be done. However, it does not mean that young workers (19 to 24) are not protected as they can still be covered under the Employment Act 1955.

In digital platform work, young workers are exposed to exploitation by employers due to their lack of work experience and knowledge of labour rights. Additionally, these workers are carrying out their work without proper supervision and remotely from the organisation. There is also a high risk of injuries for young workers compared to older workers (Nielsen et al., 2022). Despite having the freedom to choose when to perform work, a study shows that their autonomy is limited by algorithmic management of the digital platform (Laursen et al., 2021). The CYPE is inadequate in protecting young workers working on digital platforms. For instance, the CYPE allows a young worker to work in the agricultural sector, public entertainment or on any vessel between 8 pm to 6 am. Additionally, young workers are exposed to online harassment as young persons are allowed to work in the entertainment industry with permission of the Director General of Labour (section 7). Despite the recent amendments to the CYEP, there still remains a vast area where it is unregulated, outdated and sketchy. As a result, young persons are vulnerable to abuse and exploitation (Sharma, 2015).

4.2 The Employment Act 1955

The Employment Act 1955 was introduced to outline minimum employment rights for workers in Malaysia. It stipulates provisions such as on maximum working hours, holidays and leave, payment of wages, protection for female workers, termination and sexual harassment. However, young workers working on digital platforms will face challenges even when they try claiming protection under this act because of the nature of employment on digital platforms. This is because the flexibility model offered in digital platform work is conflicting with traditional employment in the current regulatory labour law framework. The uncertain law on flexible working arrangement deprives workers of the right to claim for overtime payment and causes them to work for long hours. Recently, the Malaysian parliament incorporated a provision on flexible working arrangement in the Employment Act 1955. This action is deemed as a stepping stone to embrace the digital platform as a form of workplace.

The status of workers on digital platforms as informal workers and self-employed workers has excluded them from employment rights under the Employment Act 1955. According to Sazali (2021), digital platform work is generally classified as self-employment. This becomes an issue especially if the young worker is a gig worker. The relationship between a gig worker and the platform provider under contract for service is preventing the young workers from claiming protection under the Employment Act 1955. As a consequence, they are not entitled to social security and insurance benefits as given to workers under contract of service. These benefits are in the form of contributions to the Employees Provident Fund (EPF), the Employment Insurance System (EIS) and the Social Security Organisation (SOCSO). Their social protection is only covered on an individual basis. Besides the Employment Act 1955, it is observed that the Minimum Wages Order 2012 does not cover protection for young workers. According to the International Labour Organization, there are cases of discrimination against young people in the form of minimum wage. As minimum wage is not applicable to young persons or because they are often described as interns or under apprenticeship contract, employers sometimes pay them a small allowance and sometimes they work without any payment of wages.

Furthermore, in matters regarding retrenchment, there is no legal provision under the Employment Act 1955 that can guide employers in selecting workers to be retrenched. Therefore, young workers are most likely to be retrenched due to their lack of experience and skills compared to the senior workers. Hamid et al. (2018) found that the construction industry prefers skilled workers over the age of 30 years rather than young workers. According to statistics released by the Ministry of Human Resources, 104,432 and 63,321 workers' contracts were terminated by their employers in the years 2020 and 2021, respectively (Ministry of Human Resources, 2022). Measures must be taken to protect young workers as they are more vulnerable to loss of employment as they bear the brunt of adverse effects from COVID-19 (Aun, 2020).

4.3 Rights to Form and Join Trade Unions

Trade union is defined as a group of workers representing the rights of workers in negotiating with employers, provide assistance and advise in matters relating to labour rights and playing a part in industrial actions such as strike and picket. Forming a trade union and joining union activities are important for young workers. This is because the nature of digital platform work is excluding them from traditional organisation and leaves them lacking social interactions. Young workers should join trade unions so that they will be exposed to their rights at the workplace and to get proper motivation and support from other workers in the same area of work. A study shows that early labour market experienced by young workers will increase the motivation of the young workers to join unions (Kovács, I. et al., 2017).

However, in Malaysia, young workers are facing challenges to participate in trade union activities. This is due to the issue of membership as the Trade Unions Act 1959 disqualifies persons aged 15 years old from becoming a member of a trade union. Accordingly, a member of a trade union who has not reached 18 years old shall not be entitled to vote in matters involving strikes. Thus, these lacunae are affecting the rights of young workers to exercise their freedom to associate and participate in collective bargaining. Collective bargaining is a collective action of workers represented by a trade union to negotiate with the employer to improve their employment contract. Despite digital platforms that promise autonomy and flexibility to workers, at the same time, some workers are experiencing pressure to undertake underpaid work (Pulignano, 2023) and the young workers feel that they are being unfairly treated by the algorithm of the digital platform (Laursen et al., 2021, Preethi & Verma, 2023). However, the absence of an employment relationship has disqualified digital platform workers from having the right to associate and directly the right to collective bargaining. The results of this study are summarized in Table 1.

Table 1. Legislation, Category of Worker, and Scope of Protection

Legislation	Category of Worker	Scope of Protection
The Children and Young Persons (Employment) Act 1966	• 15 to 18 years old • contract of service	Working hours, restriction in public entertainment
The Employment Act 1955	Persons under contract of service	Working hours, wages, holidays and leave, termination, female worker protection
Trade Unions Act 1959	Persons under contract of service	Formation of trade union, membership of trade union
Minimum Wages Order 2012	Persons under contract of service	Minimum wages

5 Conclusion and Recommendation

According to Sharma (2022), Malaysia must take necessary measures to ensure that its legal framework lives up to the international standard and propose the harmonisation of the definition of young persons in the CYPE and in national laws. It is recommended that the parliament changes the definition of young person under the CYPE to define a young worker as a person that has attained the age of 15 to 24 years old to align with the definition of young worker under the International Labour Organization. Next, it is recommended for the Employment Act 1955 to include the definition of the words 'platform worker' and 'gig worker' to allow these types of workers to claim protection under the Employment Act 1955 and directly claim for social protections. According to Radzi et al. (2022), gig workers are unable to form a union under the Trade Unions Act 1959; however, they can form an association under the Societies Act 1966. Thus, young workers working on digital platforms can form an association for the purpose of sharing and networking among them. In Japan, delivery workers can form a union which provides better protection for the workers (Uchiyama et al., 2022).

The government's role as a mediator to regulate and mainstream digital platform labour is crucial for industries to adopt digital platform work while also protecting the welfare of young workers. This is because a decent working environment promotes good relationships that can benefit all parties, including companies as providers and young workers as employees. Improving the existing laws will protect the rights of young workers working on digital platforms and consequently produce a harmonious industrial relations environment. This effort will pave the way for Malaysia in becoming the regional leader in digital economy and to achieve inclusive, responsible and sustainable socioeconomic development (Malaysia Digital Economy Blueprint, 2023). This study is significant as it expands the discussion of digital platform work on the rights of young workers. The findings of this study will benefit the government in its effort to develop an agile and competent digital talent base through ensuring that gig workers are covered in terms of their social protection and rights at the workplace. The findings of this study are limited to content analysis of available secondary data. Future researchers should conduct a survey focusing on young workers' rights and protection in digital platform work.

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The Rich Poor: Weakly Managed Agri-Food Supply Chains in Three Selected East African Countries

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Abstract. Economic resources are crucial for firms and nations and are considered relevant indicators for measuring wealth. These resources encompass various elements such as minerals and materials, human capital, and financial assets, all of which serve as essential inputs in generating wealth for firms and nations. These resources enable firms to initiate and sustain their business operations, contributing to wealth creation when effectively managed within the logistics process. Similarly, the wealth of nations is not solely determined by the mere availability or abundance of these resources but also by the strategic structures and processes that nations establish to enhance the value of their foundational resources. Resource-rich countries may still experience poverty and underdevelopment if their logistics operations and supply chains are poorly managed, failing to add significant value to their core resources. This study employs an integrated supply chain framework to analyze logistics operations, utilizing data from the FAO statistics database for three specific countries: Ethiopia, Sudan, and Kenya. The study focuses on exploring the livestock resources in these countries. The analysis results reveal that the presence of resources alone, without proper management through a well-integrated supply chain, does not guarantee the efficient production and delivery of outputs to consumers. This inefficiency can lead to resource wastage, ultimately perpetuating the cycle of poverty in resource-rich countries. National economic growth and improved living standards depend significantly on how a nation's resources are managed and utilized. This study offers fresh perspectives on the rich-poor disparity and highlights how inadequately managed supply chains can contribute to the persistence of poverty in nations abundant in resources.

Keywords: Rich · Poor · logistics · supply chain

1 Introduction

Economic resources are the lifeblood of corporations and nations, serving as essential yardsticks to gauge prosperity and evaluate performance. These resources encompass various components, including raw materials, human capital, and financial assets, all of

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which play pivotal roles in generating wealth for entities, be they businesses or countries. Resources, in many ways, underpin a firm's assets and a nation's affluence. Firms harness these resources to initiate their operations and perpetuate wealth creation by adding value throughout the supply chain. Within this framework, it is widely accepted that a company's competitive edge is significantly determined by its resource allocation and management, as suggested by the Resource-Based View (RBV) theory articulated by Barney in 1991.

Similarly, a nation's prosperity hinges not only on the abundance of its resources but also on its capacity to augment its value. Resource-rich developing countries often grapple with the challenge of inadequately managed agro-processing technologies, perpetuating poverty due to their inability to extract optimal value from their resource bases, as noted by Johnson et al. in 2015. Moreover, climate change looms as a formidable adversary, particularly affecting the agricultural sector, as observed by Deepa in 2023. This multifaceted challenge exacerbates resource scarcity and adds urgency to the need for sustainable resource management across the globe.

However, resource endowment or being 'rich' in resources does not guarantee staying sustainably rich in business. The supply chain model with the value chain concept implies the creation of value in such a way that it assists firms in adding wealth from the original resource base (Porter, 1985). Firms that contain physical resources, people and money should be organized to add value to enable the firm to attract more wealth to grow sustainably and exist indefinitely profitably. Continuous growth and sustainable development depend on how a firm creates and adds value to its input resources (Porter, 1985). Nations' growth and life of their citizens depend on how national resources are organized in a manner that could create additional value from the existing resource base (Nwaokoro, 2023).

Resource countries possess huge livestock populations and large sizes of uncultivated land in addition to minerals, oil, and people. Hence, they largely rely on subsistence, less value-adding agriculture. Agriculture is the main source of life for its poverty-stricken population and continues to be crucial for the world (Meijerink & Roza, 2007). Nevertheless, the focus and investment in agriculture and value-adding processing in relation to GDP is insufficient to ensure sustainable growth. Expansion of agriculture and operating in value-added activities are deemed to be potential development area as it helps to absorb the large semi-skilled labour in the sector (Memedovic & Andrew, 2009). It is also essential for a sustainable food supply (Pandy & Punchal, 2023). Besides, operating in the various stages of the supply chain enables the nation to attract many skilled and semi-skilled labour in the various parts of the chain, improving their income, which may stimulate them to stay and work in the value chain. Improving agriculture through an integrated value chain would also contribute to the growth of other sectors (Joaquin, 2010). Focus on agriculture would help nations to increase wealth and sustain development, providing better life conditions to their citizens (IFPRI 2006).

Researchers have indicated that involvement in the various stages of the supply chain contributes to improved income generation and better living standards. It will then contribute to increased GDP and growth of the nation. However, resource 'rich' nations fail to develop integrated supply chain systems for their resources and consume and deplete existing resources, leaving the next generation in debt and risk. Accordingly, most developing countries remain poor as they export raw materials or live animals. Recently, Ethiopia and Kenya have introduced modern satellite abattoirs as mechanisms to export processed meat (Aklilu, 2008).

The concept of value chain in business as a source of competitive advantage was quoted by Michael Porter, and he advised firm managers to employ the concept to sustain business competitively and keep the firm growing in wealth (Porter, 1985). The value chain concept proposes that resource abundance does not necessarily assure success, sustainable growth, and wealth creation unless those resources are managed to add value to the supply chain. This will ensure sustainable growth and development (de Vries, J. et al. 2023). The concept also applies at the macro level for nations. For instance, natural resource 'rich' African and Middle East countries are less developed. Those resource-rich countries are endowed with minerals like gold, diamond, oil, livestock, and land, but their people have the lowest standard of living. However, the underdeveloped value chains push them to supply unprocessed raw materials, affecting them to price changes in the world market (Memedovic & Andrew, 2009).

Resource 'poor' nations are innovating technologies and capital goods used to process and add value to inputs in raw or semi-processed forms. Their continuous focus on value-adding technologies enables them to exist in sustainable growth and development. A comparison of nations indicates that resource 'rich' countries are 'poor' in value-adding and resource 'poor' countries are 'rich' in value creation and addition. Hence, this study gives new perspectives on the rich-poor dichotomy and applies an integrated supply chain framework to analyze the data captured from the FAO statistics database of three countries. Livestock resources of three countries in East Africa are analyzed to indicate differences in value addition for livestock products and impact on resource use, export revenue, distribution/market performance and consumption. Ethiopia, Kenya and Sudan are considered cases for responding to the research questions.

Research Question

Understanding and applying the value chain concept would enable resources to be more useful and value added to the user. It also results in several actors participating in the chain, which consequently results in win-win relations among those actors. Accordingly, the paper is designed to answer two basic questions: (1) How does a weakly managed supply chain adversely affect a firm's/nation's sustainable economic growth? (2) What shall a firm/nation do to assure sustainable development?

Objectives of the Study

This paper tries to achieve the following two basic objectives. 1) Analyze whether inbound logistics (processing) has an effect on creating a difference in resource utilization, and 2) Investigate the added value created by processing and its effect on export. Data on cattle resources, the total population of dairy cattle and beef cattle, volume of processed milk and processed meat, and value and volume of export from three eastern African countries, Ethiopia, Kenya and Sudan, are collected and analyzed. These three countries were chosen because they are known for their cattle population, but Kenya, with a lower cattle population, has a higher processing and export market volume. The supply chain framework is used to analyze the data and identify the effect of value addition on production and market/export. The study is believed to be significant in that Ethiopia and Sudan have to take lessons from Kenya and improve the Ethiopia and Sudan have to take lessons from Kenya and improve the supply chain to improve productivity and export income from their largest cattle resource.

Organization of the paper, this paper divided into five parts, introduction is part one, literature review is part two, methodology is part three, data analysis is part four, conclusion part five.

2 Literature Review

2.1 The Supply Chain Framework and the Value Chain

Michael Porter (1985) introduced in his book ‘The Competitive Advantage the concept of the Value Chain, and the book highlighted that the activities within the organization add value to the services and products that the organization produces, and all these activities should be run at optimum level if the organization is to gain any real competitive advantage. If they are run efficiently, the value obtained should exceed the costs of running them, i.e. customers should return to the organization and transact freely and willingly. Michael Porter suggested splitting the organization into ‘primary activities’ and ‘support activities’.

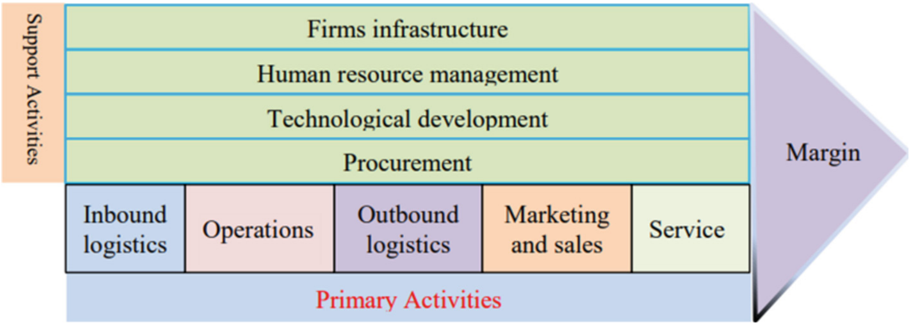

Fig. 1. The value chain concept Porter (1985)

The map of the value chain is composed of Primary activities. As shown in Fig. 1, the primary activities include inbound logistics, operations, outbound logistics, marketing, and services. Inbound logistics refers to goods obtained from the organizations’ suppliers ready to produce the end product. Operation is related to creating finished products by manufacturing or processing raw materials. It involves value-added activities as it converts raw materials to finished goods with more value to the customer, for which buyers are willing to pay more for the value added. Value is added to the product at this stage as it moves through the production line. Outbound logistics is related to making goods ready for distribution. Once the products have been manufactured, they are ready to be moved to distribution centres, wholesalers, retailers or customers. Marketing and Sales is one of the core functions responsible for availing products to consumption.

The support activities assist the primary activities in helping the organization achieve its competitive advantage. The use of technology to obtain a competitive advantage within the organization is essential. Human resource management is the other important support function in Porter's value chain map. The organization needs to recruit, train and develop the correct people for the organization if they are to succeed in their objectives. Staff will have to be motivated and paid the 'market rate' if they are to stay with the organization and add value to it over their duration of employment. Firm infrastructure is related to a well-functioning structure of relationships which enables firms to meet its objectives. Every organization needs to ensure that their finances, legal structure and management structure work efficiently and help drive the organization forward.

2.2 Supply Chain Versus Value Chain

Value chains are concerned with what the market will pay for a good or service offered for sale. Moreover, market considerations differ from country to country, region to region and have a close connection with the people's food habits and consumption patterns. Value chain management's main objectives are maximizing gross revenue and sustaining it over time. Supply chains are concerned with what it costs and how long it takes to present the goods for sale. The main objectives of supply chain management are to reduce the number of links and to reduce friction, such as bottlenecks, costs incurred, time to market, etc. (Tuoi & Son, 2023).

2.3 Weak Supply Chain Symptoms: Perspective from East Africa

The livestock sector in Eastern Africa holds considerable importance in providing off-farm work opportunities and generating money. There are several stakeholders in agri-food supply chains classified into two categories: input supply and farm-product supply. Input supply functions encompass several actors whose primary duty is to provide agricultural inputs, including equipment, medications, and extension services such as animal health, advising support, and research products. On the other hand, the farm-product supply involves actors whose primary roles are selling farm products, transportation, and post-harvest handling. In contrast, actors supplying farm products are crucial in facilitating the marketing and distribution processes, enabling farmers to sell their farm production and create revenue efficiently (Ibrahim, & Hamid, 2014).

Based on several reports and academic literature review, it is clear that the supply chain of agriculture in eastern Africa is encountering severe issues that result in the performance of the agri-food sector (World Bank, 2020; Faostat, 2021; Turley & Uzsoki, 2019; Canavari et al. 2010; ROY, 2014; Nchanji, & Lutomia, 2021). These issues include lack of infrastructure, Lack of cold chain infrastructure, Access to Inputs, limited access to finance, and Traceability and certification.

Infrastructure Deficiencies: One of the most significant challenges in Eastern Africa is the lack of adequate infrastructure. These infrastructure deficiencies also limit the ability of farmers to access information and resources necessary for improving their agricultural practices (Turley & Uzsoki, 2019).

Lack of cold chain. Integrated cold supply chain infrastructure backed up by uninterrupted electricity supply, especially for livestock (meat), dairy, and horticulture—a must for export markets—is grossly underdeveloped. The prevalent hot weather, poor post-harvest handling technologies, and a deficient road and transport system limit the consistent supply of value chains, resulting in market price volatility. Cold chain facilities are limited to Khartoum's capital, far away from the horticulture production areas (ROY, 2014).

Access to Inputs: Small-scale animal producers in the region often struggle to access quality input and modern equipment. The lack of access to inputs hinders their ability to adopt sustainable farming practices and improve their resilience to climate change.

Lack of modern technology. For the most part, value chain processing in eastern Africa is based on outdated technologies which are inefficient, wasteful, and not able to produce quality products for the domestic market, let alone for export (Shaw et al., 2014). As a result, the meat industry struggles to meet international standards and compete in global markets (Schiek et al. 2018).

Poor inland logistics. The road and transport network in eastern Africa is underdeveloped and old; this limits the producers' access to larger markets where they could potentially command higher prices for their goods. Additionally, the limited logistics and cargo options for export further restrict the potential for economic growth in these regions (World Bank, 2020).

Traceability and certification. The essential information such as production region, date of handling, quality assurance certificate, batch number, and laboratory testing data cannot be traced due to the absence of a traceability and certification system developed along the value chain for export markets. The lack of traceability and certification systems creates severe obstacles for exporters in meeting the requirements and standards of international markets (Canavari et al. 2010).

Weak market infrastructure. Along the value chains in Eastern Africa, supplies and produce change hands several times between the initial point of purchase and the final point of sale. Even at the higher level of a value chain, that is, regional markets with relatively better information, markets do not have adequate market infrastructure, services, and management (World Bank, 2020).

3 Methodology

The study is to analyze milk and meat production, processed and milk and meat Import and export. Five-year data have been captured from the FAO database and country database. Data were captured from three countries, namely Ethiopia, Kenya, and Sudan. The time coverage is from 2015–2019. Data is captured in the three basic functions in the milk and meat value chain. The supply chain framework is used to analyze data which is collected from FAO statistics.

The integrated approach is used to analyze the effectiveness of supply chains as it consists of suppliers, production and customers (Frohlich & Westbrook, 2001; Flynn et al., 2010). Schoenherr & Swink, 2012; Riaz et al., 2020). The agri-food supply chain considered in this study is separated into production (number of livestock used as an input), processed (quantity of meat and milk which is used as a productivity measure and considered the second actor), and supply amount of milk and meat for market particularly for export as it is related to value added of agricultural resources and its contribution to national income.

The framework is composed of the following actors and activities. Four basic actors constitute the analytical framework as shown in Table 1:

Table 1. Integrated Supply Chain Framework

Activities	*Input supply*	*Processing*	*Distribution*	*Consumption*
Actors	Cattle owners/ dairy farmers/ cooperatives	Large-scale, medium scale, small scale cooperatives	Cold chain transporters, supermarkets, 7/24 shops, cooperatives	Domestics consumers
Added value	Production	Change the form of raw material to different forms of dairy products	Storing, packaging, handling, transportation	International consumers, international distributors such as supermarket stores
Value	Farm gate price	Farm gate price + cost of processing and profit margin	Wholesale price/retail price + profit margin	Retail price, FOB price for importers

The diagrammatic representation of the analytical supply chain framework is presented in Fig. 2:

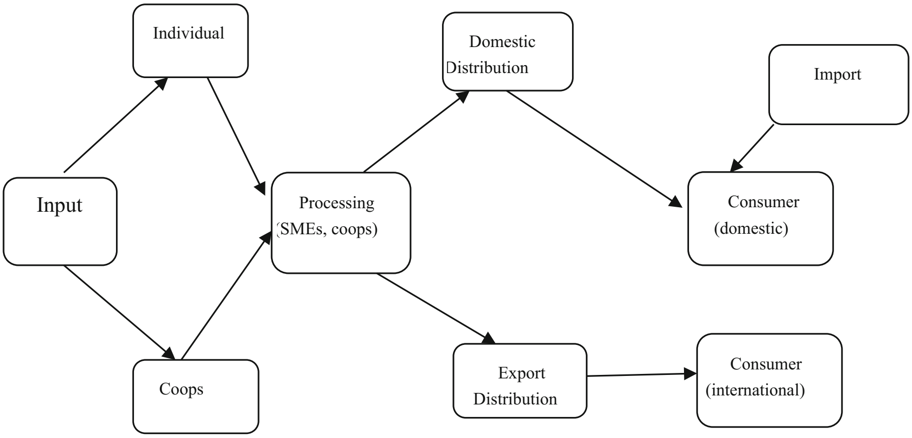
Individual
Domestic Distribution
Import
Input
Processing (SMEs, coops)
Consumer (domestic)
Coops
Export Distribution
Consumer (international)

Fig. 2. Analytical framework. Sources: Authors' compilation

4 Data Analysis and Results

Data on the number of cattle population indicates that Ethiopia's stock is the largest in contrast to Kenya and Sudan. Sudan and Kenya take the second and third, respectively. There is a slight increase in the cattle population from year to year.

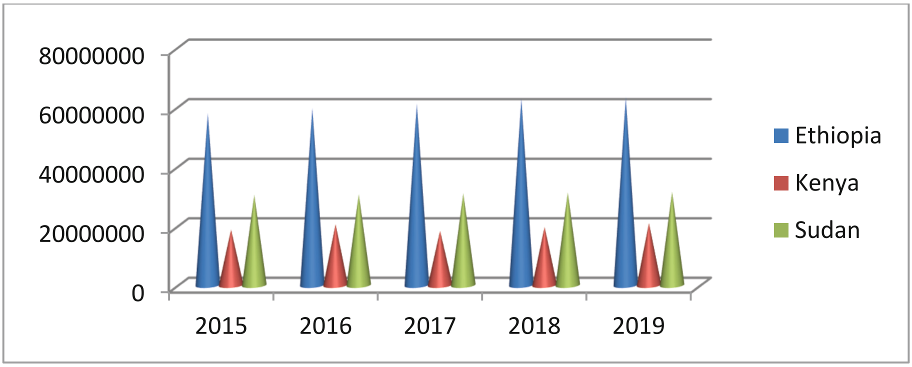

Fig. 3. Meat cattle population in the three countries. Source: Faostat 2021.

Table 2. Volume of meat and meat production

Year	No. of cattle population for meat			Production of meat in tones			Meat prod./meat cattle		
	Ethiopia	Kenya	Sudan	Ethiopia	Kenya	Sudan	Ethiopia	Kenya	Sudan
2015	3575562	2274498	3358000	387805	487176	366230	0.11	0.21	0.11
2016	3548437	2460200	3402000	384931	528990	370831	0.11	0.22	0.11
2017	3588153	2590000	3471000	389236	588963	378343	0.11	0.23	0.11
2018	3632050	2781739	3553000	393994	417261	387300	0.11	0.15	0.11
2019	3610785	3080832	3562000	391684	462125	388300	0.11	0.15	0.11
2020	433000	244000	389000	919000	593000	1004000			

Source: faostat, 2021

Table 2 shows the stock of meat cattle population and meat production in tons. Figure 3 shows that Ethiopia possesses the largest meat cattle population, with a slight annual increase from the year 2015 to 2019. Sudan takes second in the number of meat cattle population. There is also a slight annual increase in the number of meat cattle population in Sudan. The number of meat cattle population in Kenya is third in contrast to Ethiopia and Sudan. However, meat production in Kenya is the highest in contrast to Ethiopia and Sudan, implying well-established meat supply chain systems from meat cattle producers and meat processors, implying better productivity of meat in Kenya. The report from Aklilu (2008) indicates that Kenya has done a lot in establishing satellite abattoirs so as to create access to smallholders and increase meat processing efficiency. The level of productivity measured in terms of meat production as output and the number of meat cattle as an input, Ethiopia and Sudan are equally low productive. Kenya is relatively better than the two countries; relatively less in the number of meat cattle population and more in meat production. This implies better input supplier and meat processor (abattoirs) integration. In Kenya, livestock-producing farming households have closer access and integration with satellite abattoirs, resulting in better meat productivity.

Table 3 shows the number of milk animals in the three countries. Ethiopia, Kenya and Sudan possess large milk animal populations. The milk cattle population in Sudan is the largest, Kenya's is the second, and Ethiopia's milk animals are the third.

Table 3. Number of milk cattle population and production

Year	Ethiopia			Kenya			Sudan		
	Milk animals	Milk production in ton	Productivity	Milk animals	Milk production in ton	Productivity	Milk animals	Milk production in ton	Productivity
2015	14875587	3354421	0.23	11310656	3766014	0.33	48893000	4391000	0.09
2016	15519878	3292050	0.21	12454456	4430300	0.36	48507000	4446000	0.09
2017	15681593	3260649	0.21	11219776	3877302	0.35	48804000	4492000	0.09
2018	12392540	3363774	0.27	11784758	4124595	0.35	49075000	4530000	0.09
2019	12510986	3465772	0.28	13188644	4363722	0.33	49333000	4561000	0.09
2020		5 58000.8			5515000.7			4655000	

Source: faostat, 2021

Table 3 indicates the level of productivity in terms of milk animals they possess. Though Kenya possesses the second largest population in terms of milk cattle, it is found to be more productive, and there is a slight increase in productivity up until 2018, which then shows a slight decrease in 2019. Ethiopia is the third in terms of milk animal population but was found to be better in productivity. Sudan possesses the largest in terms of milk population but is found to be the least in productivity. This implies that the two countries, Ethiopia and Sudan, may share experiences and benchmark Kenya's animal productivity mechanism.

The number of meat and milk animals possessed in these three countries is the largest in East Africa. However, as the level of productivity is very low (as shown in the contrasting table), the three countries are importing meat and milk from other countries. The abundant cattle resources are not found to cover the domestic demand, pushing these nations to fill the gap by importing meat and milk. However, a positive trade balance is reported from that data analysis except for the situation in Ethiopia for the year 2015. In the three countries, modern meat processing industries are expanding, implying better value-added activity. Table 4 presents the meat and the milk imported in a years period.

4.1 Milk Animal Population, Processing, Export and Import

The milk cattle population is the largest for Sudan, larger for Ethiopia and larger for Kenya. However, in terms of milk production, Kenya is taking the lead among the three countries. Productivity is highest for Kenya, implying that their production system has to be used as a benchmark for Sudan and Ethiopia. Kenya made significant investments in the milk supply chain, establishing integrated supply chains connecting smallholder producers with processors. However, the large milk cattle population in Sudan and Ethiopia is characterized by an inefficient supply chain system, implying milk waste at the suppliers' level and not much milk is supplied to the processing market. This implies

Table 4. Meat products exported and imported

Year	Ethiopia			Kenya			Sudan		
	Export	Import	Sur/def	Export	Import	Sur/def	Export	Import	Sur/def
2015	51	105	−54	707	189	518	19223	23	19200
2016	923	6	917	772	313	459	1033	785	248
2017	1700	6	1694	1807	21	1786	360	218	142
2018	3075	3	3072	1544	25	1519	6845	435	6410
2019	3325	472	2853	1195	34	1161	6666	285	6381

Source: faostat, 2021

Table 5. Milk animal population, production and productivity

Year	Ethiopia			Kenya			Sudan		
	Cattle population no.	Milk production in tons	Productivity	Cattle population no.	Milk production tons	Productivity	Cattle population no.	Milk production tons	Productivity
2015	14875587	3354421	0.23	11310656	3766014	0.33	48893000	4391000	0.09
2016	15519878	3292050	0.21	12454456	4430300	0.36	48507000	4446000	0.09
2017	15681593	3260649	0.21	11219776	3877302	0.35	48804000	4492000	0.09
2018	12392540	3363774	0.27	11784758	4124595	0.35	49075000	4530000	0.09
2019	12510986	3465772	0.28	13188644	4363722	0.33	49333000	4561000	0.09

Source: faostat, 2021

that Ethiopia and Sudan need to benchmark the milk supply chain integration system operating in Kenya in order to scale up milk productivity.

In Table 5, the productivity of Sudan is very low in contrast to Kenya and Ethiopia, and no improvement is shown from 2015 to 2019, implying a lack of focus in the sector. However, Sudan possesses the largest milk animal population, and if it is well integrated with the processing industries, it could have contributed to the livelihood of the smallholder cattle owners. The low processing productivity is also claimed to be the lack of demand for pasteurized milk in East Africa in general (Bingi & Fabien, 2015). Besides, the channel is largely characterized by the informal sector, where a significant volume of milk is not rich in the processing sectors. This implies the weak supply chain integration in the dairy sector affects sectoral development and its contribution to employment, poverty reduction and national growth (Abebe, 2017; Abebe & Adesina, 2015; FAO, 2011).

4.2 Milk Products Imported and Exported

The three countries are found to import more milk than they export. Though the number of milk animals is the largest, milk production and processed milk are not able to supply domestic demand.

Table 6. Volume of Milk products exported and imported in tones

Year	Ethiopia			Kenya			Sudan		
	export	import	sur/def	export	import	sur/def	export	import	sur/def
2015	4473	3215	1258	4395	29014	−24619	15	31654	−31639
2016	1	2166	−2165	110	20350	−20240	0	36167	−36167
2017	0	2839	−2839	1975	84747	−82772	1	30493	−30492
2018	309	2614	−2305	800	115651	−114851	0	25460	−25460
2019	0	2742	−2742	449	160653	−160204	7	28654	−28647

Source: faostat, 2021

In relation to net milk supply in the three countries, Kenya showed an increased level of export (Table 6). Ethiopia is the next. However, the trade balance in the three countries is deficit except in Ethiopia's case in 2015. The three countries have the highest milk cattle population and production. However, they fail to fully supply milk to their own population. As it is indicated by (FAO, 2011), much of the milk production at the household level and the chain is composed of informal actors wasting milk among the channel members. All the countries fill the gap by importing milk products. Imported quantity is higher for Kenya, and the deficit is increasing from year to year for Kenya.

5 Conclusion and Implications

The descriptive analysis of the results indicates that the cattle population for meat production is the largest in Africa, with Ethiopia having the highest number of cattle, followed by Sudan and Kenya. However, when it comes to meat production, processing, and export, Kenya is leading the way. This finding is supported by Aklilu (2009), who reported that Kenya had established satellite abattoirs and improved integration with smallholder cattle suppliers, resulting in a more efficient supply chain, higher meat productivity, and greater meat exports compared to Ethiopia and Sudan.

In terms of milk cattle population, production, and export, Sudan has the highest milk animal population, but it has the lowest milk production and productivity among the three countries, indicating a significant amount of milk waste without formal processing. The loose integration of milk suppliers and processors in Sudan has led to stagnant milk productivity over the five years covered in the study. On the other hand, Kenya, despite having the smallest milk animal population of the three countries, boasts the highest milk productivity. This can be attributed to Kenya's effective integration of milk suppliers with processors, resulting in incremental improvements in milk productivity annually. Interestingly, all three countries, despite their large milk cattle populations, are unable to meet the domestic demand for milk. Therefore, it is crucial to prioritize the integration of suppliers with processors and upgrade the value chains for both meat and milk products. This will not only add value to these products but also help meet domestic demand, potentially creating employment opportunities within the value chain.

Limitations and Future Directions

This paper highlighted the issue of agri-food supply chains in an area where there are several ongoing conflicts, drought, instability and climate change; from the reports that we analyzed, our study has several limitations. More studies on agri-food supply chains and the actors in the chains are needed to determine the level of vulnerabilities on the different levels and parts of the agri-food chain. The area of agri-food supply chain market information is still facing challenges besides market regulations and policy.

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Towards Studying the Impact of Podcast on the Effectiveness of Advertising

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Abstract. Over the last decade, the podcast sector has grown significantly, and it has become one of the most important modern media, allowing consumers to transmit audiovisual materials in a comfortable and easy manner. The major objective of this study is to analyze the development and impact of podcasts on effective advertising. The majority of the research concentrated on how podcasting evolved across various media, cultural, and advertising environments. This study examined the growing prominence of podcasts in media, their effect on conventional media, and their implications for ethical issues. It explores the expanding podcast business, from its beginnings in the early 2000s to its current position as a worldwide media in effect. The study deployed several previous research to conduct the qualitative analysis. The findings of the study indicated that the worldwide accessibility of podcasts can transcend linguistic and geographical breaks down. This study also sheds light on podcasts' complex impact on advertising, media, and society. It emphasizes the importance of continual study to understand the ever-changing podcasting ecosystem and its consequences for the advertising industry.

Keywords: Podcasts · podcast industry · media · audience · broadcast

1 Introduction

The podcast industry has witnessed a great development over the last decade, and it has become one of the most important modern media that allows users to exchange audiovisual content comfortably and easily. The phrase "audio blogging" began to circulate in the early eighties of the last century, but this content did not last long due to the lack of means of distributing recordings, which led to its cessation for about 20 years. In October 2001, Apple launched its first portable music player, the iPod. This device, despite its simplicity, revolutionized the music industry and led to the emergence of the concept of transferring "podcasts" to an audio player as an MP3 file, and the possibility of its circulation and spread easily. In 2004, former MTV host Adam Curry, along with software developer Dave Weiner, developed a program known as iPodder, which allowed people to save podcasts to their iPod. In late 2004, the first podcast provider, Libsyn.com (Liberated Syndication), appeared. Before the end of the year, the number of Google visits to the term "podcast" exceeded 100,000. With the advent of 2005, Apple officially added podcasts to its iTunes Music library. During an interview, Steve Jobs explained how to create and share a podcast using a user's Mac (Al-Husain, 2022).

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Since then, the podcast industry has grown exponentially, and has become one of the most important tools that many individuals, companies, and organizations use to publish audio and video content. The podcast industry is based on the Internet, and allows users to listen to audio content via smartphones, computers, and other portable devices, and allows producers to create diverse audio content on various topics, including news, entertainment, education, culture, business, and marketing.

In view of the historical development of the podcast industry, it has witnessed great changes in the recent period, as it has become more widespread and widespread, and the technologies and tools used in its production and distribution have evolved. Statistics indicate that the podcast industry is witnessing continuous growth, as some reports expect that the number of listeners will reach more than 160 million people in the United States of America in 2023, and the industry will continue to grow in many other global markets.

Thus, studying the podcast industry and its historical development is important for understanding this modern medium of information, entertainment, and education, and for analyzing its impact on culture, society, and business. From the analysis of the previous literature, it was found that there exists a research gap which is not examined. Therefore, the current study concentrated on the historical development and the impacts of podcasts on the advertising industry. To analyze them, the study adopts a qualitative approach. As a result, the study found that the podcasts, a digital media, have grown from a technological innovation to an international phenomenon that provides specialized knowledge and entertainment to audiences worldwide. Podcasts have a huge influence on ad effectiveness since they allow advertisers to target certain groups and provide non-intrusive commercial experiences. Podcast marketing's interactive aspect promotes closer relationships between organizations and customers, showcasing the value of podcasts in boosting communication and understanding.

2 Related Work

A study (Bonini, 2015) the study aimed to review and analyze the history of podcasting as a cultural practice for the production and consumption of digital audio content. The study concluded that the podcast entered a new stage of its development, as it began to generate a market of its own and is no longer just a complement to radio, but rather an alternative to it. This is by shifting towards the professionalization of content production and the normalization of its consumption. Dubbed the "Second Podcast Era," this phase is also marked by the transformation of podcasting into a commercial production practice and medium for mass consumption, beginning in the United States in 2012, with the launch of the first models that were able to support the independent production and consumption of audio content distributed via podcast. The results also showed that the podcast has entered a new phase of its development, as it turns into a new channel for profitably distributing audio content, and this transformation is characterized by the increase in the quality of available podcasts, the use of smartphones, and the popularity of audio-based social networks. All of this led to the emergence of a new market for podcasts that contributed to the development of digital media, and it can even be said that it constitutes a new shift in the media industry in general.

A study (Berry, 2015) aimed to monitor the real beginnings of the spread of podcasts, and its results showed that until the year 2004, was the real beginning of the spread of this type of template, which contributed to its spread capacity by the development of media production tools and means and platforms for freely distributing media work. And without being restricted by the media entities that control the media labor market, and by using available open source techniques and programs and without resorting to studios, the study indicated that this movement actually threatens to disrupt the usual hierarchical media system.

A study (Nee & Santana, 2022) in light of the coronavirus pandemic making headlines and as news organizations began adding more podcast templates and episodes to their digital platforms. The thing is, this popular form of audio journalism seems unrestricted by traditional journalism practices, deadlines, and space constraints. To date, not many academic studies have examined the characteristics of news podcasts (i.e. programs created by professional journalistic organizations) and their place within the journalistic landscape. By analyzing the content of 40 episodes of the news podcast related to the Corona pandemic, this study explores the extent to which elements of storytelling (audio, character development, scene preparation, dialogue, dramatic tension) and other elements such as opinion are included in the sample under study. The results show that all but one of the episodes used storytelling elements, but the degree of editing and production varied widely. The results also show a general shift away from journalistic standards of objectivity and toward expository reporting in this emerging format. Reporters and hosts appear in episodes as characters and experts, and narrative elements are used to encourage narrative rather than content.

Sullivan, (2019) examined the use of digital platforms in podcasting and the influences on the podcast industry content, governance and structure. The theoretical framework developed by Nieborg and Poell to explain the effects of digitization on civilization is used there to make sense of the developments taking place in the podcasting industry. Podcasting is significantly transforming like other types of media, despite the fact that these alterations differ from different media in numerous crucial values. The study concentrates on the analysis of the developing landscape of the podcasts industry such as the use of major applications in particular Google, Spotify and Apple. A deep review of existing study was involved to analyze the information and trends within the podcasting industry. The study identified Platformization trends, network effects, influence on independent data privacy and dominance. It is based on an examination of industry developments including assessments, although may not fully convey the complexities of the growing podcasting setting. As a result, the study recommends that In order to maintain credibility and ethical practices, legislation on data privacy and user permission are required while processing audience data.

Cwynar, (2019) focuses on the first series of two actual podcasts, Gimlet Media's StartUp and Stable Genius' ZigZag, in connection to capitalism and self-entrepreneurship. This study explained how commercial podcasts recording the birth of private firms are the conclusion of ongoing past events in the general media industry and, more generally, in the United States. It contends that the use of public broadcasting skills and cash to develop the real world sound work series supporting commercial media enterprises is indicative of a larger change in American culture towards self-entrepreneurship. These programmes, as well as the organizations and individuals supporting them, are therefore representative of each a different stage in the emergence of podcasting as a form of communication with the generalization of business fundamentalist ideals in modern American culture.

Norsworthy & Herndon, (2020) examined the way student-produced podcasts are utilized as a platform or a support for education to demonstrate ethics and leadership. This study demonstrated that the podcasting has a capability to provide a novel pedagogical approach for the learners to involve with the leadership themes in an practical, relevant and accessible way. Chan-Olmsted & Wang, (2022) presented the first thorough evaluation of podcast listeners in the United States from the viewpoints regarding encouragement and behavior using a large-scale nationwide survey. It helped businesses to comprehend the recently launched on-demand audio service in terms of adoption drivers, behaviors, and competitive media alternatives. The results revealed that the majority of significant factors for listening to podcasts were enjoyment, knowledge, and audio platform quality. Furthermore, benefits were discovered to influence listening behaviors such as listener locations, listener dimension, comprehensive manner, and habit, as well as use of conflicting audio media such as normal radio, internet-based radio stations, and online music streaming. Previously podcast investigations have investigated the motives exactly satisfactions for why people listening to podcasts, yet there is currently not much study into how audiences decide to pay attention to current affairs podcasts in particular as well as the pleasures they experience from ingesting these types of podcasts (Whittle, 2023). Further this pilot analysis sought to investigate whether listeners prefer paying attention to daily news podcasts as well as the benefits they derive from this burgeoning form of communication. Furthermore, this investigation lays the groundwork for potential investigators to build on when investigating this area (Whittle, 2023).

The existing literature provides significant insights into the commercial, educational aspects, content-related and historical aspects of podcasting. From this literature analysis it is clear that only a small number of studies have examined the evolving dynamic aspects of podcasting in the context of communication, media and advertising. Most of the studies focused on the way in which podcasting evolved in several different media, culture and advertising landscapes. Assessing the developing significance of podcasts in media and their influence on traditional media, and their implications for ethical journalism is the research gap which can be considered. Although Chan-Olmsted and Wang (2022) give an explanation for how individuals pay attention to podcasts, further study on listener behavior, choices, and the psychological elements of podcast utilization, particularly psychological and cognition impacts on listeners, is needed. The implementation of student-produced podcasts in teaching is highlighted by Norsworthy and Herndon (2020). There is still scope for more study on the usefulness of podcasts as an educational medium, their effects on student achievement, and recommendations for incorporating podcasts within programmes. According to Berry (2015), podcasting challenges the established media structure, necessitating additional studies into its long-term viability, income structures, advertising, and the obstacles encountered by creative content providers. Whittle (2023) mentions recent developments in podcasts, indicating the possibility to investigate the function of podcasts in communication about politics, general conversation, and public opinion casting. As a conclusion, the existing literature gives significant insights but still lies a research gap correlated to the global context of podcasting, educational application and advertising strategies. Thus, this study focuses to identify the development of the evolving podcasting landscape.

3 Research Methodology

This study formulates the research problem as a result of the analysis of existing literature review. To understand the development of the podcast and the influences on advertising, media and communication, a qualitative analysis was conducted. This study collected the data from various research databases such as IEEE, springer, Science direct, google scholar and so on, using the filters and keywords. In the initial stage, the study analyzed the title and the abstract of the collected studies, and based on that criteria the papers were chosen. In the consecutive phase, the complete study reviewed the complete studies which were selected. The study may have limitations, such as possible discrepancies in self-reported survey data and the developing nature of podcasting, which may have altered by the moment the study was published. Furthermore, the applicability of the research's findings may be restricted to the selected community.

4 Podcast Industry and Its Historical Development

Digital technology has given rise to new channels of advertising such as podcasts. Among the fastest developing media industries, podcasts are important in advertising context. This increasing requirement can be evaluated from several aspects like advertising revenue, podcast listeners, and number of existing podcasts. Podcasts are comparable in idea to radio, however there are several fundamental variations between the two media, such as listener behavior, mobility, and themes. From a business standpoint, marketing solutions for the podcast sector are becoming more appealing (Kreutz & Thalmann, 2023). The podcast industry is divided into three distinct sectors. Starting with audio creation and distribution, moving on to customized podcasts, and finally advertising and marketing revenues (Hanfft, 2023). Commercial radio has been sluggish to embrace the booming podcasting market, especially on the local level (Crider, 2023). The audio industry's expansion was severely hampered by the introduction of cable television and, later, the development of the internet. Podcasts, on the other hand, have been one of the fastest developing forms of media in recent years. The podcasting decade has propelled the audio business to unprecedented levels (Rachna & Mishra, 2023).

4.1 Types of Podcasts

There are many types of podcasts available, below we mention the most popular types of podcasts, and the advantages of each:

- **Interviews podcast:** It involves one or two hosts listening and talking to one or more guests, about a specific topic. Its main advantage is the possibility of presenting many points and ideas that take the nature of diversity, but it needs additional time to organize meeting times with guests.

- **Conversations podcast:** Here, two hosts play the role of speakers, debating between themselves about various topics similar to conversations between two radio presenters.
- **Single Conversation Podcast:** In which only one host plays the role of presenting the topic discussed in detail, of course the topic must be deep, and the person is a specialist or expert in that topic.
- **Stories podcast:** In this type of podcast industry, one or more hosts play the role of a storyteller, telling in each episode a meaningful story that provides a lesson and benefit to the audience on a specific topic.
- **The Roundtable Podcast**: It is called so because it includes more than three hosts talking about a specific topic, as if they were at a round table to discuss a matter of interest to the followers.
- **Theatrical podcast:** It is similar to a podcast of stories, except that the host here plays the roles of the characters lively by changing the voices and tones, meaning that he is no longer a narrator of the story, but rather takes on the role of the characters himself (Houry, 2022).

4.2 Difference Between Radio and Podcast

Radio allows creating an intimate climate with the listener, more than any other means of communication. And US President Franklin D. Roosevelt had realized this since the 1930s, when he broadcast on the radio waves the program “Fireplace Chats” (from 1933 to 1944). But the podcast boom a few years ago has made it possible to renew the relationship between broadcaster and listener.

The renewal of this relationship resulted from two factors. On the one hand, the recipient is now listening to the podcast alone, often using headphones or individual headphones, which allows addressing the listeners by “whispering in their ears.” On the other hand, the listener is the one who chooses the media material himself. And unlike the broadcaster who has to go to great lengths to discourage the listener from moving on to another material, the podcaster is sure that the recipient wants to listen to him, which allows him to be calm and honest, and allows his audience to empathize with him more. Discovering a new podcast has become akin to a new friendship for some, which represents a huge number of friends given the 700,000 podcasts available in Apple’s iTunes, the largest platform in this sector.

Podcasting dates back to 2004: back then, it was just a technological innovation that allowed radio stations to broadcast their programs indirectly. She could publish the podcast online, and listeners could download it at their convenience. The term “podcast” is a collocation of the words “iPod” (the portable player invented by the American company Apple that allows users to download audio files) and podcast (which means “broadcast” in English). The phrase “podcast,” coined by journalist Ben Hammersley of the Guardian, reflects these characteristics.

Although some believe that they are the same term, there are several differences between radio and podcasts, the first of which is the post-publication validity date, as the content published on the radio is difficult to obtain again, in contrast, the podcast relies on recorded and archived content via the Internet. Secondly, the radio focuses on the feature of live broadcasting and topics related to the present time, which differs from the podcast service, which is pre-recorded and does not depend on live interventions from the audience. And speaking of the audience, we move on to the third point, as the radio targets a broader and more comprehensive audience with multiple content, while the podcast targets a specific audience interested in a specific issue, which gives it the characteristic of specialization (Shaheen, 2022).

In general, podcasts are spread today in the world without borders, as anyone can produce their own podcasts, relying on the small part of the technology available to them, such as a computer and audio montage programs available on the web. The cognitive element in the podcast experience forms the basis for the content, as it is connected to the audience's convictions that what they will find important and useful to them necessarily. On the other hand, the traditional media, such as television and radio, were embodied in order to obtain the interests of the audience in a specific way, so the message appears to float in the world of broadcasting. Accusations are directed at the media for creating continuous editorial restrictions on media content, while the podcast presents itself as a product intended for those who demand it from the masses, and on this basis. The podcast, with its in-depth approach to standardizing content, and its compatibility with the requirements of electronic journalism in terms of interactivity and resonance, reflects a serious area towards getting rid of the traditional restrictions of media institutions (Al-Yaqoubi, 2020).

4.3 Historical Development of Podcast

The podcasting industry originated in 2001 as a technological breakthrough that enabled audio files to be easily uploaded to the internet. The word "podcast" was invented in 2004 by Guardian journalist Ben Hammersley as a combination of "Ipod," an inflatable Apple gadget that enabled people to enjoy listening to audio, and "broadcast." Podcasting's ability to attain closeness and compassion makes it a valuable weapon for people with disabilities trying to make their opinions heard—not only metaphorically, but actually (Fox et al., 2023). For almost a century, public service radio has been connecting with Nordic listeners. On the other hand, by the early 2010s, radio and audio programmes' conventional roles had transformed (Lindeberg & Ala-Fossi, 2023), Fig. 1 illustrates the historical development of the podcast industry. Liu, (2023) addressed the utility of podcasts as English for academic materials is generally untapped. Liu's investigation examined the lexical character of general, educational, and specific to a discipline language in a 9.6-million-word corpora containing educational podcasts. The open nature of the podcast enabled the creators to conduct analysis of the contents. Initial episodes addressed everything from technologies and contemporary culture to unique interests and passions (Shamburg et al., 2023). TWiT (This Week in Tech) as well as 5by5 began to develop as podcasting networks. These media outlets merged several programmes and hosts underneath one brand, which made it simpler for audiences to access comparable material (Cucco & Scaglioni, 2023). The initial release of "Serial" was the genuine breakthrough occasion for podcasting (Human, 2023). Sarah Koenig's investigative journalism podcast drew significant notice and rekindled passion for podcasting. It established that podcasts might serve as both an outlet of entertainment and an effective tool for narration (Sheppard et al., 2023).

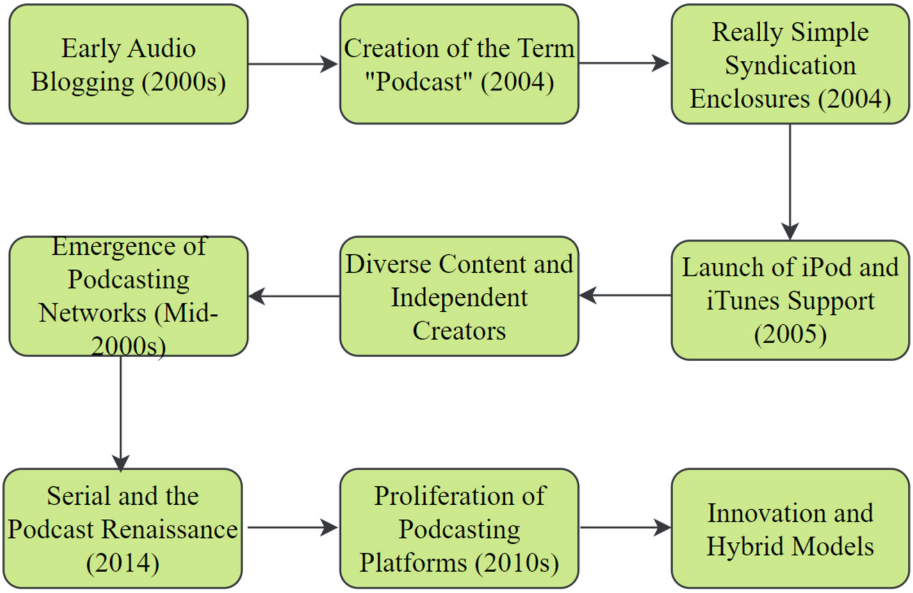
Early Audio Blogging (2000s)
Creation of the Term "Podcast" (2004)
Really Simple Syndication Enclosures (2004)
Launch of iPod and iTunes Support (2005)
Diverse Content and Independent Creators
Emergence of Podcasting Networks (Mid-2000s)
Serial and the Podcast Renaissance (2014)
Proliferation of Podcasting Platforms (2010s)
Innovation and Hybrid Models

Fig. 1. The historical development of podcast industry

Podcast listening grew more affordable than ever before with the emergence of smartphones as well as specialized podcast programmes including Apple's Podcasts, the streaming service Spotify, along with Google Podcast. This ease of accessibility led to the medium's expansion (Aenlle et al., 2023). As the popularity of podcasting expanded, so did the prospects for revenue. Podcasters began to include advertisements and endorsements in their broadcasts, while certain channels and producers struck special arrangements with streaming services (Nasta et al., 2023). Podcasting currently encompasses an extensive variety of categories, including news and stories, as well as humor, crime shows, the educational process, and specialized passions. Because of this variety, there is everything for everybody in the podcasting environment (Heiselberg & Have, 2023). Podcasting is not anymore just available in nations with an English language. It has evolved into an international phenomenon, with artists and audiences from all over the world creating and listening to material in a variety of dialects (Rosas, 2023). Podcasting is evolving as new forms emerge, including participatory podcasts as well as combination formats which incorporate broadcasting with real-time streaming along with video material (Lopez et al., 1826). In the present world, podcasts have become an influential and dynamic medium with millions of programs on creativity, audience engagement and technology which have developed this version of digital media.

5 Impact of Podcast on Effective Advertising

Podcasts have established an enormous effect on advertising, providing a distinctive and successful channel to communicate with people (Lopez et al., 1826). It provides extremely precise marketing depending on the program's speciality or the listener's preferences. Advertisers may select programmes which correspond to their desired population demographics, to guarantee their commercial achieves the intended audience (Heiselberg & Have, 2023). Host-read commercials are one of among the most profitable marketing types in podcasting. The podcast presenter directly recommends or promotes the goods or service in these advertisements. Audiences frequently form a close relationship with the presenter, making these recommendations extremely compelling (Nasta et al., 2023). Podcasts contain lengthy materials that can range from thirty minutes to a few hours in length. This expanded format allows marketers a greater opportunity to express their point of view and truly connect audiences. Despite brief advertisements, podcast advertisements can convey comprehensive details (Bonk & Kubinski, 2023). Subscribers to podcasts tend to be invested and devoted to the programmes they subscribe to. This degree of involvement indicates that audiences are inclined to pay consideration to advertisements and evaluate the items or services being promoted.

Podcast advertisements are typically more genuine and less invasive than standard advertisements. They seem like suggestions from an authoritative source rather than disturbances although they are embedded into the material and reviewed by the host (Wang & Chan-Olmsted, 2023). Advertisers may monitor the effectiveness of podcast advertising by utilizing various measures such as distinct web addresses, promotional codes, or surveillance plugins. This enables informed choices and an improved comprehension of the impact of the campaign. Pre-roll, mid-roll, and post-roll adverts, alongside commercial parts and commercial assignments, are all examples of podcast advertising. Marketers can select the layout that best matches their objectives (Bonk & Kubinski, 2023). Brands may create profound connections with their intended audiences by using podcast advertising. Audiences are more inclined to create a positive connection with an organization when it identifies themselves with a podcast that matches its beliefs or passions (Dessouki et al., 2023).

6 Conclusion

In general, it notes the scarcity of previous studies, especially Arabic ones, that deal with the problem and concept of podcasting as one of the journalistic and media arts created by digital platforms, and the research phenomena that result from the emergence of this term that deserve study. The objective of the study was to explore the developing landscape of the podcast industry particularly in advertising. Through this qualitative analysis the study found intricate dynamics of advertising strategies, podcast listening and content creation. The results of the study indicated that podcasts have emerged as a versatile platform that empowers creators and captivates listeners. In addition, the study emphasized podcasts' worldwide reach, which transcends linguistic and geographical limitations. The podcasting industry is no longer limited to English-speaking nations, as artists and viewers everywhere contribute to the medium's internationalization. The history of podcasts was traced from its beginnings as a technological invention to its current status as a thriving digital medium. Podcasts have become an international phenomenon, providing a broad and diverse selection of information that appeals to audiences desiring specialized information as well as pleasure. Among the most important findings from this study is the enormous effect of podcasts on advertising effectiveness. Advertisers have discovered a powerful channel in podcasts, allowing for precise audience targeting and the production of real, non-intrusive commercial experiences. Because of the participatory aspect of podcast marketing, companies and consumers have developed stronger bonds.

6.1 Limitations and Future Scope

Although the study has significant contributions, it still has few limitations regarding the data collection and generalizability. In the data collection process the study completely relies on the theoretical literature and this cannot be a support for generalizability. Therefore the future researchers can consider more real time data for the analysis and can include a diverse population, this might help the study contributions to demonstrate generalizability. Researchers have the opportunity to explore the numerous facets of podcasting's effect on media, interpersonal interaction, and society at large by addressing the constraints and expanding on the insights garnered in this study.

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Factors Influencing the Use of Mobile Delivery Applications in Saudi Arabia

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Abstract. Mobile delivery applications have become an important technology and have been used during Covid-19, particularly in Saudi Arabia. However, research on the use of this type of application and the factors that influence it is needed. Therefore, this study investigates how perceived ease of use, perceived usefulness, perceived security and satisfaction influence the use of mobile delivery applications in Saudi Arabia. To do so, an online survey was developed to gather data for the study. There were 712 participants who have completed this survey. SmartPLS-4 software was used to perform structural equation modelling (SEM) to analyze the data and test the research hypotheses. The findings indicate that perceived ease of use, perceived usefulness, perceived security and satisfaction significantly influence the use of mobile delivery applications.

Keywords: Perceived Ease of Use · Perceived Usefulness · Perceived Security · Satisfaction · Mobile Delivery Applications

1 Introduction

In early 2020, the COVID-19 pandemic spread all over the world. The World Health Organization declared that the SARS-CoV-2 virus was rapidly spreading among people [13]. Therefore, it was deemed imperative to enforce lockdowns to stop the spread of the virus [13, 30]. These lockdowns affected people's lives, and they could not access the goods needed, which led to the development of mobile applications to supply people with these needed goods. Because of the urgent demand, many different mobile applications were developed to deal with the lockdown situation during the pandemic [30, 31]. Mobile delivery applications are the most vital applications that were used. These applications are defined as "an online-to-offline mobile service that provides convenient and efficient online ordering and offline delivery of goods and services" [32].

A number of technology and systems companies around the world found themselves in a race with time to develop these applications. For example, in Saudi Arabia, several mobile applications were developed during the COVID-19 pandemic. These applications can be classified into government (e.g. Tawakkalna, Tatmman, Mawid, Sehha and Sehhaty) [4, 8] and commercial (e.g. Domino's Pizza, MacDonald's, Hungerstation, Marsole, Jahez and Nana) [11]. Most studies so far have focused on government applications

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covering areas such as health, education and government services. Meanwhile, studies concentrating on commercial applications, particularly mobile delivery applications, are lacking. Therefore, the present study aims to examine the influence of perceived ease of use, perceived usefulness, perceived security and satisfaction on the use of mobile delivery applications in Saudi Arabia.

2 Literature Review

Applications (apps) are software programs running on mobile devices such as smartphones, iPads and tablets [4, 6, 7]. These apps are stored on cloud platforms, from which they can be downloaded by users. The stored applications provide various functionalities, covering areas such as health, communication, entertainment, education and more [4, 6, 7]. Many applications were developed to deal with the situation during COVID-19 pandemic, as previously mentioned. However, during the pandemic, the most commonly used applications were health and delivery applications. This is likely because these applications were needed during lockdown situations, which can motivate governments to develop and use them. Consequently, researchers have endeavored to study these applications.

Health applications have received considerable attention from researchers compared with delivery applications. This is evidenced by the number of studies that have investigated the use of health applications [4, 7–11]. For example, [10] explored how mobile applications in Saudi Arabia are used to help mental health patients, and Almufarij and Alharbi [8] examined users' awareness, use and perceptions of mobile health applications during the COVID-19 pandemic. In addition, Aldayri and colleagues [11] studied the factors influencing the use of mobile medical supplies and equipment ordering applications. They found that enduring involvement, resistance to change and product awareness were significantly linked to the intention to use an application. In Saudi Arabia, the Ministry of Health (MOH) launched several health applications [4, 8, 9]. Some of these (e.g. Mawid, Sehha and Sehhaty) were developed to allow patients to book or reschedule appointments at healthcare centres, others for dealing with COVID-19 and its symptoms (e.g. Tawakkalna and Tatmman) or for emergency services (i.e. Aseafni) [4, 8].

Mobile delivery applications were the second most used applications during the pandemic. Because of lockdowns, people may not have been able to access the products they needed; thus, they considered these applications a lifeline in this situation. Notably, some of these applications had been launched before the pandemic but were used effectively during this period. Yet, few studies have investigated these applications and their use [5, 11, 13, 35, 36]. Aldayri and his colleagues [11] looked into how mobile applications facilitate food and grocery delivery during COVID-19 in Saudi Arabia. They found that the use of these applications had a positive influence on the economy. They also observed that it helped businesses increase their sales and create more jobs. Their study considered several mobile delivery applications used in Saudi Arabia, such as Domino's Pizza, MacDonald's, Hungerstation, Marsole, Jahez and Nana. Russel [5] examined how trust and image affect customer loyalty to mobile food-delivery applications. They reported that trust and image had a significant and direct effect on customer loyalty. Musakwa and Petersen [13] sought to identify the factors that affect the users' acceptance to use mobile delivery applications in South Africa. They showed that performance expectancy and facilitation influenced the acceptance and use of these applications, whereas social influence, habit and price value did not have any effect. According to [13], additional research should be conducted in specific areas. Therefore, the present study aims to fill this gap by examining the factors influencing the use of these applications in Saudi Arabia.

3 Research Model

The current study seeks to identify the factors that influence the use of mobile delivery applications in Saudi Arabia. To address this objective, we integrated four factors extracted from the literature review: perceived ease of use, perceived usefulness, perceived security and satisfaction. These factors are shown in Fig. 1 and discussed in the following sub-sections.

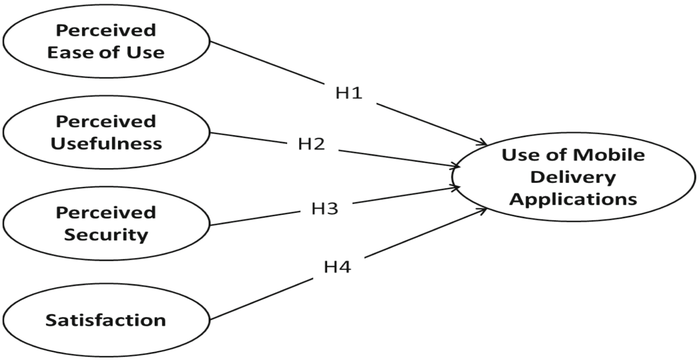

Fig. 1. Research Model

3.1 Perceived Ease of Use

Perceived ease of use (PEOU) is one of the significant factors of the technology acceptance model (TAM). It is defined as the extent to which users believe that they can use a new technology easily and with little effort [33]. Studies have found that perceived ease of use has a significant influence on the use of new technologies [3, 15–20]. For example, [3] observed that perceived ease of use significantly influenced the use of password managers. Therefore, it can be hypothesized that:

H1: Perceived ease of use significantly influences the use of mobile delivery applications in Saudi Arabia.

3.2 Perceived Usefulness

Perceived usefulness (PU) is the second major factor in the TAM. It is defined as the extent to which users believe that they can benefit from the use of a new technology [33]. Studies have reported that perceived usefulness also has a significant influence on the use of new technologies [3, 15–20]. For example, [3] noted that perceived usefulness also had a significant impact on the use of password managers. Thus, the following hypothesis is put forward:

> *H2: Perceived usefulness significantly influences the use of mobile delivery applications in Saudi Arabia.*

3.3 Perceived Security

An essential issue related to acceptance of the use of a new technology is perceived security (SE) [14]. It refers to the extent to which users' personal and important information is safe and not accessible by others when they use a new technology. Several studies have explored the importance of security during the use of applications and found that this factor has a significant influence on the use of applications [12, 14, 34]. For example, [34] looked into the factors that affect the users' intentions to use mobile government applications in Saudi Arabia and discovered that perceived security significantly affect the use of these applications. Therefore, we formulate the following hypothesis:

> *H3: Perceived security has a significant influence on the use of mobile delivery applications in Saudi Arabia.*

3.4 Satisfaction

Satisfaction (SA) is defined as the extent to which users are happy and comfortable with the use of a new technology [Author]. Users' satisfaction can be improved by using the technology over time. Multiple studies have argued that the use of technology can potentially influence the user's satisfaction [1, 2, 21, 22]. However, several studies have pointed out that the users' satisfaction can significantly influence them to continue using the technology [1, 2, 18, 21, 23, 24]. Therefore, the following hypothesis can be proposed:

> *H4: Satisfaction significantly influences the use of mobile delivery applications in Saudi Arabia.*

4 Methodology

For the current study, an online survey was designed to gather data from a large number of participants. This method is one of the effective tools to collect data from many participants and form different areas [25, 26]. The present study has adopted the items in the survey from several studies (see Table 1) to measure the impact of these four factors on the use of these applications. Five-point Likert scale technique was used to measure these items, where 1 = 'strongly disagree' and 5 corresponds to 'strongly agree'. The survey contained two sections. One section focused on demographic information (gender, age, and education level), and the second section focused on the main points of this study (Appendix A).

Before the survey was sent, it was evaluated by some experts in the field, and ethical approval was received from the Research Ethics Committee at the College of Computing and Information Technology (No: 2003092023). The survey was piloted with a small sample which represents the main sample of the study. Then, we examined the survey's level of reliability, finding a Cronbach's alpha of 0.91, which indicated excellent reliability. Thus, the link of the survey was sent to a convenience sample via email and on the Twitter platform to reach participants who are available and willing to participate. A total of 712 people participated and completed the survey, 59% of which were men and 41% were women. The ages of the participants varied: the largest group (43%) was aged 18–30 years, followed by 30–40 years (23%), under 18 years (22%), 40–50 years (7%), 7–8 years (6%) and finally 50–60 years (5%). With regards to the education level, 40% of the participants had received a bachelor's degree, 32% had a secondary-school level of education, 16% held a diploma, 8% had obtained a master's degree, and 4% held a PhD.

Table 1. Sources of measurement items

Variables	Sources
Perceived Ease of Use (PEOU)	[3, 15–20, 33]
Perceived Usefulness (PU)	[3, 15–20, 33]
Perceived Security (SE)	[12, 14, 34]
Satisfaction (SA)	[1, 2, 18, 21, 23, 24]
Use of Mobile Delivery Applications (UMDA)	[2]

Structural equation modelling (SEM) was applied to test the hypotheses of the study. To facilitate this test, we utilized SPSS (version 27) and SmartPLS-4 software. The results are shown in the next section.

5 Results

In this section, the results are presented. They include the results of descriptive statistics, validation tests and structural equation modelling.

5.1 Validity and Reliability

There are several strategies that were used to assess the validity and reliability of the used instrument in this study. The first strategy is performing construct validity, which was established by adapting the items from previous studies (Table 1) to develop the instrument for the present study. According to [27], items of the survey have to be significantly loaded to their constructs which they were used to measure. Thus, to ensure that these items have been correctly allocated to their constructs, this paper performed loading and cross-loading of items (see Table 2). The second strategy is convergent validity. For this strategy, three procedures were followed: internal consistency (Cronbach's alpha), composite reliability and average variance extracted (AVE) [28]. Cronbach's alpha values were between 0.72 and 0.83, indicating that the items were internally consistent. For composite reliability, the values were between 0.84 and 0.9 which specify that they are higher than 0.7, as recommended by [29]. With regard to AVE, the values were between 0.54 and 0.74, which were higher than 0.5. Moreover, the results of confirmatory factors analysis (CFA) ranged from 0.7 to 0.8 (see Table 2). The third strategy adopted was discriminant validity. As explained by Teo et al. [18], "discriminant validity was assessed by comparing the square root of the average variance extracted for a given construct with the correlations between that construct and all other constructs" (p. 1004). Table 3 shows that all the constructs were discriminately valid.

Table 2. Constructs, Items, and Confirmatory Factor Analysis Results

Variables and Items		Factors Loading	Cronbach's alpha	Composite reliability	Average variance extracted (AVE)
Perceived Ease of Use	PEOU-1	0.783	0.756	0.838	0.633
	PEOU-2	0.755			
	PEOU-3	0.847			
Perceived Usefulness	PU-1	0.757	0.717	0.825	0.542
	PU-2	0.792			
	PU-3	0.710			
	PU-4	0.720			
Perceived Security	SE-1	0.831	0.764	0.850	0.603
	SE-2	0.700			
	SE-3	0.899			
	SE-4	0.870			
Satisfaction	SA-1	0.706	0.722	0.843	0.643
	SA-2	0.860			
	SA-3	0.832			
Use of Mobile Delivery Applications	UMDA-1	0.879	0.827	0.895	0.739
	UMDA-2	0.847			
	UMDA-3	0.853			

Table 3. Discriminant Validity

Constructs	PEOU	PU	SE	SA	UMDA
Perceived Ease of Use (PEOU)	0.796				
Perceived Usefulness (PU)	0.590	0.736			
Perceived Security (SE)	0.504	0.692	0.776		
Satisfaction (SA)	0.829	0.521	0.480	0.802	
Use of Mobile Delivery Application (UMDA)	0.808	0.713	0.612	0.571	0.860

5.2 Structural Model

This subsection presents the hypothesis testing. The PLS algorithm and bootstrapping from SmartPLS-4 were used to test the research hypotheses. Figure 2 shows the measurement model loading, while Fig. 3 displays the structural model.

Table 4 reveals that perceived ease of use significantly influenced the use of mobile delivery applications ($\beta = 0.872$, $t = 14.420$, $p < 0.001$), supporting the first hypothesis. The results also indicate that the use of mobile delivery applications was significantly affected by perceived usefulness ($\beta = 0.289$, $t = 6.861$, $p < 0.001$), confirming the second hypothesis. The third hypothesis is also supported as perceived security significantly influenced the use of mobile delivery applications ($\beta = 0.153$, $t = 5.387$, $p < 0.001$). Similarly, satisfaction had a significant impact on the use of mobile delivery applications, confirming the fourth hypothesis ($\beta = -0.377$, $t = 7.560$, $p < 0.001$).

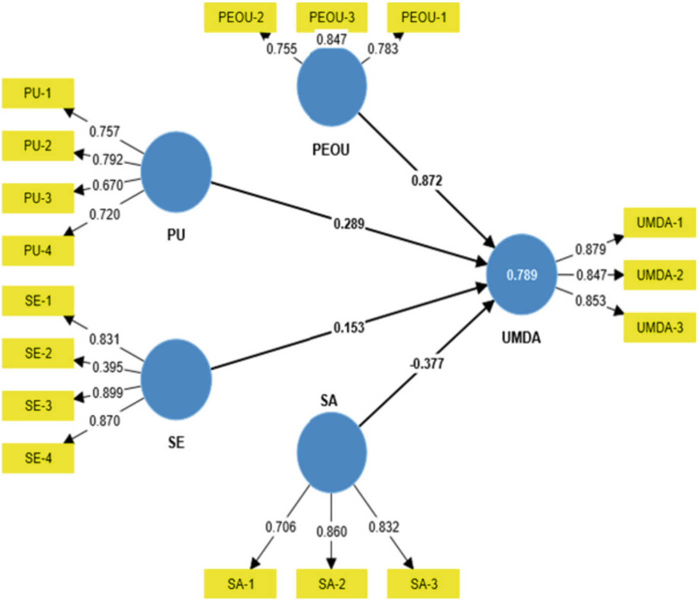
PEOU-2
PEOU-3
PEOU-1
0.755
0.847
0.783
PEOU
PU-1
PU-2
PU-3
PU-4
0.757
0.792
0.670
0.720
PU
0.872
0.289
UMDA-1
UMDA-2
UMDA-3
0.879
0.847
0.853
0.789
UMDA
SE-1
SE-2
SE-3
SE-4
0.831
0.395
0.899
0.870
SE
0.153
-0.377
SA
0.706
0.860
0.832
SA-1
SA-2
SA-3

Fig. 2. Path coefficients results

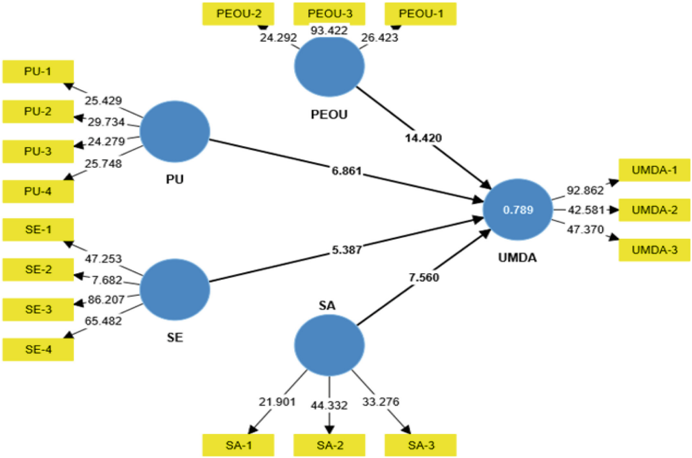
PEOU-2
PEOU-3
PEOU-1
24.292
93.422
26.423
PEOU
PU-1
PU-2
PU-3
PU-4
25.429
29.734
24.279
25.748
PU
14.420
6.861
UMDA-1
UMDA-2
UMDA-3
92.862
42.581
47.370
0.789
UMDA
SE-1
SE-2
SE-3
SE-4
47.253
7.682
86.207
65.482
SE
5.387
7.560
SA
21.901
44.332
33.276
SA-1
SA-2
SA-3

Fig. 3. Path coefficients T values

Table 4. Hypotheses Testing

Relationships	S. E	T-Values	P Values	Results
H1: PEOU -----> UMDA	0.060	14.420	0.000	Supported
H2: PU----------> UMDA	0.042	6.861	0.000	Supported
H3: SE---------> UMDA	0.028	5.387	0.000	Supported
H4: SA---------> UMDA	0.050	7.560	0.000	Supported
Note: S.E standard error				

6 Discussion

6.1 Discussion of the Results

This study investigated how perceived ease of use, perceived usefulness, perceived security and satisfaction influence the use of mobile delivery applications. To pursue this objective, we collected data using an online survey and employed structural equation modelling (SEM) for data analysis. The study shows that perceived ease of use, perceived usefulness, perceived security and satisfaction have a significant influence on the use of these applications.

According to [33], perceived ease of use and usefulness are two important factors that can influence the use of a new technology. Thus, the high level of belief in the ease and usefulness of the use of mobile delivery applications dramatically promotes their use. This finding aligns with [3, 15–20], who found that perceived ease of use and usefulness are important factors influencing the use of new technologies.

However, the perception of the ease of use and usefulness of using these applications will not improve unless they are used effectively and efficiently. In other words, the effective use of these applications will prove whether their use is easy and useful or not.

The results also indicate that security is important to the use of all mobile applications and particularly delivery applications. Security is a vital issue nowadays, especially in the context of cybercrime and hacking. Users might be willing to use or concerned about using applications because of their level of security. The present study confirmed the significance of this factor. This finding is in line with those of [14], who reported that individuals can be influenced by the level of security in the use of new systems. Moreover, [12] argued that lack of security can be the main reason behind distrust in a new technology.

The results of the present study also show that users' satisfaction significantly influences the use of mobile delivery applications. This finding coincides with those of [1, 2] who found that satisfaction can influence the use of new technology and motivate users to use it effectively. Thus, users' satisfaction can be improved if they use these applications effectively and efficiently and figure out how to obtain benefits from their use.

6.2 Implications

This study has several implications. From a theoretical perspective, the model in this study was developed by integrating four factors that were extracted from the literature. These factors are perceived ease of use, usefulness, perceived security and satisfaction. Previous works have focused on the use of government applications, and studies concentrating on commercial applications, particularly mobile delivery applications, are scarce. Additionally, very few studies have investigated the factors that influence the use of these applications. To the best of our knowledge, no study has so far explored the factors that influence the use of mobile delivery applications in Saudi Arabia. Therefore, a model was developed for the present study to examine how these four factors influence the use of these applications.

From a practical perspective, the study shows that users need to know and understand how to use these applications effectively to utilise them easily and enjoy the benefits of their use. The ease and usefulness of using these applications lead to user satisfaction. Regarding security, users must have confidence in the mobile delivery applications that they use and their level of security. They need trustworthy applications. Before using any application, users should seek information about its services and level of security.

7 Conclusion

This study investigated how perceived ease of use, perceived usefulness, perceived security and satisfaction influence the use of mobile delivery applications in Saudi Arabia. To address this objective, we used an online survey to collect data and structural equation modelling (SEM) to analyse them. The findings of this study indicate that perceived ease of use, perceived usefulness, perceived security and satisfaction have a significant impact on the use of these applications.

This study contributes to the existing literature by proposing a model and investigating how these four factors influence the use of these delivery applications. It helps to fill the research gap identified in the literature. However, more studies of this phenomenon are needed, particularly in cybersecurity awareness in the use of these applications. Therefore, future research may pay more attention to these points.

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