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HARNESSING INDUSTRY 4.0 TECHNOLOGIES FOR SUSTAINABLE BUSINESS OPERATIONS: A CONCEPTUAL FRAMEWORK

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ABSTRACT - The advent of Industry 4.0 (IR 4.0) technologies marks a significant period of transformation for organizations on a global scale, bolstering efficiency, productivity, and competitiveness. In addition to enhancing operational efficiency, these technologies present valuable prospects for promoting sustainable business practices that contribute to local and regional development. This paper explores the integration of advanced technologies, such as Big Data Analytics, the Internet of Things (IoT), Cloud Computing, and Artificial Intelligence (AI), and their potential to enhance productivity and foster growth, innovation, and economic success. This study aims to analyze the effects of implementing IR 4.0 technologies on the sustainability of business operations through an extensive literature review. It emphasizes the potential of these technologies to optimize resource usage, enhance energy efficiency, and minimize waste, resulting in reduced environmental consequences. This paper adds to the current understanding by presenting a conceptual framework that highlights the crucial role of digital technologies in promoting sustainable business practices. Through the promotion of a continuous cycle of innovation, competition, and societal advancement, the utilization of IR 4.0 technologies has the potential to bring about lasting advantages for businesses and the communities they serve.

Keywords: IR 4.0; Technologies; Sustainability; Development

1. INTRODUCTION

The interdependence between sustainability and Industry 4.0 (IR 4.0) technologies is a cornerstone for integrating economic progress with ecological and social integrity [1]. Enhanced manufacturing systems, powered by the Internet of Things (IoT), Artificial Intelligence (AI), and advanced Data Analytics, empower organizations to improve resource efficiency, reduce waste, and increase energy conservation. These advancements lead to a diminution in both environmental impact and operational expenditures [1]. In addition, R 4.0 technologies are instrumental in fostering the development of sustainable products and services, exemplified by predictive

maintenance, which augments the durability of machinery and curtails the need for frequent replacements. The widespread adoption of IR 4.0 principles by corporations is not only achievable but also essential to foster a more resilient and sustainable global economy, which is crucial for tackling significant environmental challenges. [2]. However, the full spectrum of benefits offered by these technologies is not yet fully realized by some enterprises, primarily due to the extent of their implementation. While IR 4.0 technologies herald a new era of opportunities for sustainable business operations, the challenges associated with financial investment, workforce development, data privacy, environmental considerations, and strategic alliances necessitate a judicious and methodical approach.

2. LITERATURE REVIEW

The integration of Industry 4.0 (IR 4.0) technologies into sustainable business models heralds a pivotal shift towards more efficient, resource-conscious, and environmentally friendly industrial processes. The strategic fusion of these technologies is essential for businesses to innovatively meet environmental, social, and economic objectives. IR 4.0 technologies provide the foundational support for circular economy practices, thereby facilitating the attainment of Sustainable Development Goals (SDGs) and enhancing sustainable operations [3]. Concurrently, the factors influencing the adoption of IR 4.0 for sustainability highlight the influence of market forces and the prioritization of sustainability as a strategic avenue for growth, thus offering a comprehensive perspective on IR 4.0's impact on sustainable business practices [4]. This scholarly discourse suggests that the adoption of IR 4.0 technologies goes beyond mere business necessity; it represents a commitment to sustainability. The capacity of these technologies to transform business practices and lead the way to a sustainable future is significant, contingent upon the successful management of challenges related to financial investment, workforce development, data security, and environmental considerations. Strategic foresight and cooperative endeavors are crucial to overcome these hurdles.

Figure 1: IR 4.0 Technologies with Sustainable Business Operations

Figure 1 presents a cohesive overview of the synergy between Artificial Intelligence (AI), Big Data Analytics, Cloud Computing, and the Internet of Things (IoT). These technologies are pivotal in driving sustainable business practices within the framework of the Fourth Industrial Revolution (4IR). While the diagram is not comprehensive of all 4IR technologies, it emphasizes those that are mature, widely adopted, and fundamental to digital strategies that support sustainability efforts [1]. These specific technologies have demonstrated efficacy in enhancing resource efficiency, minimizing waste, and improving decision-making through sophisticated analytics and instantaneous data monitoring [5]. They are at the forefront of technological innovation, seamlessly integrating into extant business models to precipitate a shift towards circular economy paradigms and contribute to the achievement of Sustainable Development Goals (SDGs) [8].

Industry 4.0 technologies offer an array of tools, such as blockchain to engender transparent supply chains, and artificial intelligence (AI) to mitigate biases within decision-making algorithms thereby ensuring the judicious application of technology. The methodologies inherent to Industry 4.0 endorse sustainability by promoting energy conservation, diminishing waste via Internet of Things (IoT) devices, and

advancing smart manufacturing protocols, coupled with remote oversight, culminating in a diminution of carbon emissions [8]. The embracement of Industry 4.0 technologies goes beyond compliance; it amplifies operational efficiencies conducive to sustained profitability, attracts environmentally conscious consumers, and elevates a company's reputation [16]. Organizations that leverage the advanced capabilities of Industry 4.0 to create positive societal and environmental impacts are well-positioned for success in a global economy that values social responsibility [8]. Ultimately, embracing Industry 4.0 is a significant step towards fostering ethical behavior, ensuring environmental sustainability, and equipping organizations for the challenges of a globally connected and ethically conscious society.

Table 1: Results and Practical Implications from the Integration of IR 4.0 Technologies.

Technologies	Roles	Implications	Reference
Big Data Analytics	Perceived benefits, technological complexity, organisation's resources, organisation's management support, and government legislation influence big data adoption and promote sustainable marketing and operation.	• Assist SMEs managers in making strategic decisions. • Improve sustainable performance and contribute to economic development.	[7], [8], [13]
Cloud Computing	Cost reduction, ease of use, reliability, and sharing and collaboration have significant impacts on SMEs sustainability. Privacy and security factor has no significant impact on SMEs sustainability.	• Managers should create an inductive environment for technological support for SMEs' sustainability. • SME development authority should support technological advancements for SMEs.	[8], [10], [15]
Artificial Intelligence	Few SMEs in the Philippines use AI for sustainability.	• AI applications in SMEs contribute to sustainability.	[17], [13], [11]

	Most SMEs are in incremental and situational development levels.	• Insufficient infrastructure, data availability, and legal frameworks limit AI progress.	
Internet of Things	The paper highlights the importance of intelligent manufacturing and smart business manufacturing for sustainability.	• IoT transform manufacturing organisations from digital to intelligent. • Smart business manufacturing optimises energy and workforce needs.	[12], [6], [14]

Table 1 displays the comprehensive integration of Industry 4.0 technologies, which play a crucial role in driving Small and Medium-sized Enterprises (SMEs) towards a technologically advanced, morally principled, and sustainable future. When used effectively, these advancements may greatly enhance the economic strength and environmental stewardship of small and medium-sized enterprises (SMEs). They provide a strategy framework that improves operational efficiency and promotes a dedication to ethical and sustainable company practices. As small and medium-sized enterprises navigate the complexities of the global market, the adoption of Industry 4.0 technology becomes crucial for ensuring their long-term survival and upholding high ethical standards in business practices.

2.1. Big Data Analytics

Big data analytics emerges as a pivotal element in the facilitation of eco-friendly technology adoption and the advancement of sustainability in business operations. Through the analysis of extensive and heterogeneous datasets, enterprises can discern operational inefficiencies, identify prospects for enhancement, and implement data-driven initiatives to diminish their environmental impact [13]. For instance, organizations are empowered to optimize resource allocation, pinpoint potential for energy efficiency improvements, and scrutinize energy consumption trends by harnessing the capabilities of big data analytics. This analytical domain grants firms the ability to evaluate the environmental impact of their operational and supply chain activities, thus easing the integration of sustainable practices and green technologies. [15]. Additionally, big data analytics provides enterprises with profound insights, supporting the formulation and execution of sustainable business strategies that are congruent with environmental objectives [14]. Therefore, the application of big data

analytics is instrumental in the efficacious adoption of green technology, enhancing sustainability by enabling organizations to optimize resource utilization, mitigate environmental detriment, and foster continual advancements in their operational endeavors.

2.2. Cloud Computing

Cloud computing emerges as a quintessential catalyst for the propagation of green technology and the promotion of sustainability within the corporate sector. It offers a malleable and scalable framework that mitigates the necessity for extensive on-premises infrastructure and substantial physical hardware investments, as denoted in source [13]. The adoption of cloud services permits organizations to procure computing resources on-demand, obviating the need for hefty upfront capital outlays in hardware and infrastructural components, thereby attenuating resource consumption and ecological impact, referenced in source [15]. The inherent elasticity and scalability of cloud computing facilitate organizations in the judicious allocation of resources commensurate with fluctuating workload demands, thus optimizing resource utilization and curtailing energy wastage, as discussed in source [14]. The agility, operational efficiency, and environmental sustainability proffered by cloud computing are further augmented by its intrinsic features, such as resource pooling, rapid elasticity, and on-demand self-service provisioning. Consequently, cloud computing assumes a pivotal role in fostering environmental conservation and sustainability by empowering organizations to expedite digital transformation, enhance scalability, and nurture collaborative endeavors. It acts as a linchpin in the facilitation of green technology adoption and sustainable practices across diverse industrial domains, thereby solidifying its indispensability in the contemporary IT landscape.

2.3. Internet of Things

The Internet of Things (IoT) is increasingly recognized as a significant facilitator for the integration of green technologies and the enhancement of sustainability within business operations. It fosters improved productivity, resource optimization, and heightened environmental awareness. The strategic deployment of IoT devices and sensors across various operational sectors enables organizations to monitor and evaluate energy consumption, waste production, and overall resource utilization with real-time precision, as indicated in source [14]. The granularity of data procured through IoT devices furnishes enterprises with comprehensive insights, thereby facilitating informed decision-making processes. This, in turn, aids in pinpointing

operational inefficiencies and instituting targeted enhancements, as documented in source [10].

Equipped with IoT capabilities, smart grids are adept at refining energy distribution, which contributes to a reduction in aggregate energy consumption and associated carbon emissions. Furthermore, the application of IoT in supply chain management enhances inventory oversight and streamlines transportation logistics, culminating in diminished waste and bolstered sustainability, as per source [17]. Consequently, organizations that capitalize on IoT technologies stand to significantly augment efficiency, promote environmental stewardship, and contribute earnestly to the adoption of green technologies, thereby advancing the fulfilment of established sustainability objectives.

2.4. Artificial Intelligence

Artificial intelligence (AI) emerges as a quintessential catalyst in the advancement of green technological practices, serving as a cornerstone for enhancing resource efficiency, diminishing ecological footprints, and elevating operational efficacy within corporate frameworks. AI equips organizations with the capability to scrutinize voluminous datasets, harnessing sophisticated analytics and machine learning paradigms to unearth avenues for waste reduction and resource conservation [13]. Smart energy management systems, underpinned by AI, are adept at fine-tuning energy consumption patterns, engendering considerable economic benefits alongside mitigating environmental detriments. The application of AI in streamlining supply chain processes eradicates operational redundancies and amplifies logistical proficiency, fostering a more eco-friendly and sustainable modus operandi [17]. Furthermore, AI is instrumental in the genesis of avant-garde products and services that resonate with the tenets of sustainable commerce, thereby endorsing a business ethos that is acutely conscious of environmental considerations [17]. Hence, the integration of AI into business stratagems not only propels productivity but also fortifies the pursuit of enduring sustainability goals, advocating judicious resource deployment and the conservation of the environment.

3. CONCEPTUAL FRAMEWORK

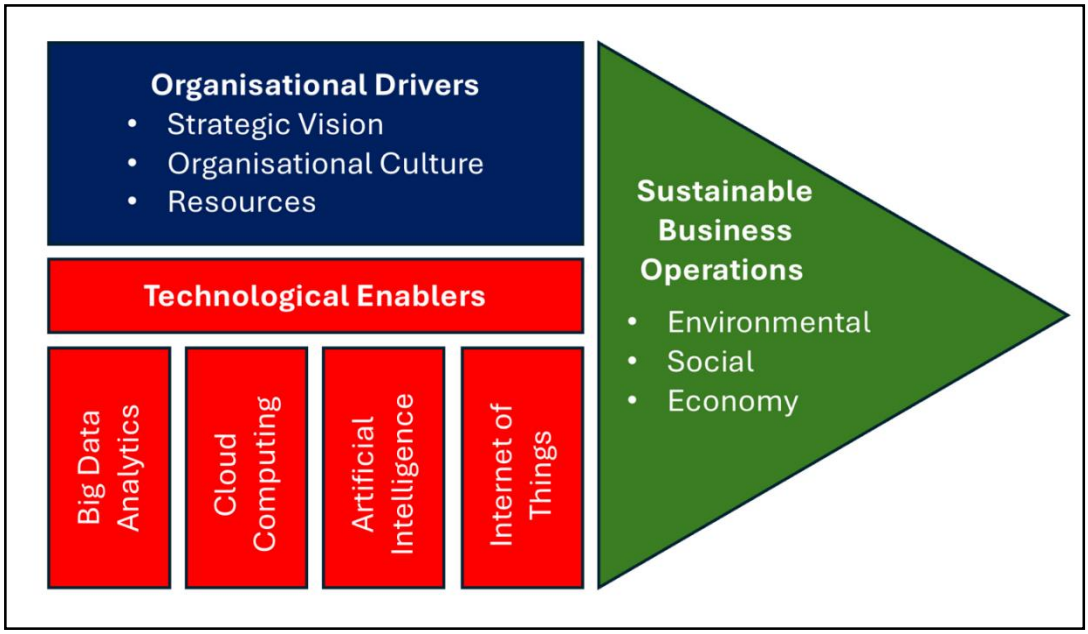

Figure 2: The connection between Organisational Drivers, Technological Enablers, and Sustainable Business Operations.

The selection of the four 4IR technologies which are Big Data Analytics, Cloud Computing, Artificial Intelligence (AI), and the Internet of Things (IoT) is based on their demonstrated impact on promoting sustainable infrastructure as depicted in Table 1. Big Data Analytics was chosen for its ability to process vast amounts of data and derive actionable insights that enhance decision-making processes, optimize resource allocation, and support the development of sustainable business practices. Cloud Computing provides scalable and flexible IT infrastructure, reducing the need for physical hardware and minimizing the environmental footprint, which supports collaboration and improves operational efficiency. Artificial Intelligence (AI) is instrumental in automating processes, optimizing operations, and enhancing predictive capabilities, thereby improving energy management, reducing waste, and enabling the development of smart, sustainable products and services. The Internet of Things (IoT) technology enables real-time monitoring and management of resources, supporting intelligent manufacturing, smart grids, and efficient supply chain management, which contribute to minimizing waste and enhancing energy efficiency. These technologies were selected based on their maturity, widespread adoption, and foundational role in digital transformation strategies that underpin sustainability initiatives [3], [4], [13], [11].

The organizational drivers which include the *Strategic Vision*, *Resources*, and *Technological Culture* are informed by seminal works that emphasize the importance of visionary leadership, resource deployment, and a culture conducive to technological innovation as essential elements for successful digital transformation. Strategic Vision ensures that organizations align their technological initiatives with long-term sustainability goals. Organizational Culture fosters continuous improvement and supports the integration of new technologies. Adequate allocation of Resources, including financial, human, and technological assets, is fundamental to implementing 4IR technologies effectively [18], [8], [1].

Sustainable business practices that address environmental, social, and economic aspects are rooted in the triple bottom line concept, which promotes a balanced approach to organizational development that is ecologically sound, socially fair, and economically feasible. The adoption of 4IR technologies supports this equilibrium by allowing SMEs to function at the intersection of efficiency and accountability. Ultimately, the embrace of 4IR technologies is a strategic choice that goes beyond technical capability—it is a pledge to cultivate ethical conduct, ensure sustainability, and prepare organizations for a future in a connected and ethically aware global community.

While this framework underscores the significant prospects that IR 4.0 technologies present for bolstering sustainability, their effective implementation is accompanied by risks and challenges. These include the need for strategic congruence between the adoption of technology and sustainability objectives, the criticality of enhancing workforce skills in novel technologies, and the pivotal role of strong data security measures. The incorporation of IR 4.0 technologies markedly improves operational efficiency and environmental preservation, thereby affirming the synergy between economic and ecological goals. Organizations must view these challenges as pivotal to nurturing a cycle of innovation, competitive edge, and societal progress, which are indispensable for enduring sustainability.

Addressing these challenges requires a multi-faceted approach. Organizations need to invest in continuous education and training programs to upskill their workforce in emerging technologies. This not only ensures that employees are competent in utilizing new tools but also fosters a culture of innovation and adaptability. For instance, strategic training initiatives can bridge the skills gap, enabling employees to leverage advanced data analytics, AI, and IoT technologies to drive sustainable practices. Data security must be prioritized to safeguard sensitive information against cyber threats. The deployment of robust cybersecurity frameworks is essential to protect data integrity and build trust among stakeholders. Implementing advanced

encryption methods, regular security audits, and comprehensive data governance policies can mitigate risks and enhance the resilience of technological infrastructures. Furthermore, the alignment of sustainability goals with technological initiatives should be embedded into the core strategic objectives of the organization. This involves setting clear sustainability targets, such as reducing carbon footprints, optimizing resource use, and enhancing energy efficiency, and integrating these targets into the planning and execution of IR 4.0 projects. By doing so, organizations can ensure that their technological advancements contribute to broader environmental and social goals. Effective collaboration between various stakeholders, including government bodies, industry partners, and academic institutions, is also crucial. Collaborative efforts can lead to the development of standardized practices, shared resources, and innovative solutions that address common challenges. Public-private partnerships, for instance, can facilitate access to funding, expertise, and technology, thereby accelerating the adoption of IR 4.0 technologies [1], [18].

4. CONCLUSION

This article offers a synthesis of the extensive literature on Industry 4.0 (IR 4.0) technologies, examining their impact on sustainable business practices. It serves as a critical instrument for charting the current knowledge landscape, identifying scholarly consensus, and highlighting areas of debate. The review reveals that while IR 4.0 technologies have significant potential to enhance sustainability, their successful implementation is fraught with challenges. The discussion emphasizes the need for strategic alignment between technological adoption and sustainability goals, the importance of workforce upskilling in new technologies, and the necessity for robust data security protocols. The integration of IR 4.0 technologies is shown to significantly benefit operational efficiency and environmental conservation, linking economic progress with ecological responsibility.

For practical and managerial implications, adopting IR 4.0 technologies requires a holistic approach that encompasses strategic planning, investment in human capital, and the establishment of secure data environments. Managers must prioritize sustainability, aligning it with technological initiatives for long-term benefits. Implementing predictive maintenance, smart resource management, and energy-efficient practices can yield substantial economic and environmental returns. Additionally, fostering a culture of continuous innovation and collaborative effort is essential to overcome adoption barriers and fully leverage these technologies.

Future research should focus on empirical studies that validate the theoretical frameworks and propositions presented here. Potential areas for investigation include the effects of IR 4.0 technologies on small and medium-sized enterprises (SMEs), the role of government policies in facilitating technology adoption, and the long-term environmental benefits of sustainable practices enabled by these innovations. Studies should also examine the socio-economic impacts of widespread technology integration, such as changes in the labor market and the digital divide. It is important to note that this study's conclusions are based on theoretical and literature-based analysis, underscoring the need for empirical evidence to strengthen these findings.

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EFFECT OF EXCESS MAGNESIUM ON FATIGUE CRACK INITIATION BEHAVIOR IN PRECIPITATION-HARDENED ALUMINUM ALLOY

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ABSTRACT - The fatigue crack initiation was examined using 6061-T6-based aluminum alloys with excess Magnesium. The rotating bending fatigue tests were performed using smooth specimens to investigate the influence of Mg content in inducing fatigue crack initiation behavior in the precipitation-hardened aluminum alloy. The stress amplitude is set at three different amplitudes of 140 MPa, 170 MPa, and 200 MPa to investigate the tendency occurrence of crack initiation. This study aimed to evaluate the fatigue crack initiation characteristics in terms of its effect on the material properties. In addition, the relationship between fatigue crack initiation and defects was also discussed. For this purpose, a replication technique with an optical microscope was used to monitor the crack initiation in the materials. The study results showed that aluminum alloy with excess Mg is more capable of inducing crack initiation. The findings were then supported by microstructure observations on the specimen surface using a microscope.

Keywords: Aluminum alloys; Rotating bending fatigue test; Fatigue crack initiation; Defects; Dynamic Strain aging.

1. INTRODUCTION

The design of a new Al alloy with outstanding strength and ductility for the purpose of substituting steel in the automotive sector has been shown to be one of the best ways to meet the increasing desire to reduce CO_2 emissions and fuel consumption [1,2]. The development of Al alloys with high strength such as Al6061-T6 alloy, has proven to be beneficial in the manufacture of automotive components due to their high corrosion resistance, good weldability, high strength, lightweight, and reasonable fatigue resistance.

Al-Mg alloys have gained popularity in recent years. Significant efforts have been made to improve these alloys' strength and ductility. The Al6061-T6 alloys have no fatigue limit [3], and their fatigue lives are scattered [4] in comparison with steels [5]. Numerous studies [6-9] show that non-metallic inclusions in the material can cause cracks, especially for high-strength steel. For the Al alloy, however, the excess Mg results in dynamic strain aging (DSA), induces a stable fatigue crack growth and able to create fatigue limits [10–12].

Although previous studies have indicated a positive effect of excess Mg, the fatigue crack initiation behavior has not been sufficiently investigated, which plays a vital role as rate-controlling in the fatigue failure of engineering materials. In addition, some other researchers have investigated fatigue crack initiation behavior of many types of Al alloys [13,14,], but the effect of excess Mg on the fatigue crack initiation has never been discussed. Therefore, the present study aimed to clarify the effect of excess Mg on the behavior of crack initiation in Al6061-T6 alloys, which is crucial because the fatigue crack initiation period affects the fatigue life [15-17]. The effect of DSA on crack initiation in Al6061-T6 alloys was investigated, and the effect of localized plastic deformation on defect formation was then explained based on observation.

2. EXPERIMENTAL PROCEDURE

2.1 Material

This study considered two newly developed precipitation-hardened Al6061-T6-based alloys with and without excess Mg. Figure. 1 shows the microstructures of the Al6061 alloy and Al6061-Mg alloys. In the fabrication stage, alloy billets with a diameter of 155mm were cast using a semi-continuous method. After homogenization at 823K for 14400s, the billet was then heated to 273K and extruded into round bars of 23mm diameter. In an air-fired furnace, the extruded bar was treated for 3600 seconds with a solid solution. The T6 aging was then performed for 14400s at 463K [18,19]. Energy dispersive spectrometry (EDS X-ray, JEOL, JF7800F) is used to identify the chemical composition for the investigated materials. More than five spots on the specimen surface were considered for assessment, and the average chemical content (wt.%) is summarized in Table 1.

Table 1. Chemical composition of the precipitation-hardened Al alloys (wt%).

Element	Mg	Al	Si	Ti	Cr	Mn	Fe	Cu	Zr
Al6061 alloy (Wt%)	0.98	97.07	0.72	0.11	0.17	0.11	0.16	0.36	0.15
Al6061-Mg alloy (Wt%)	1.39	97.03	0.72	0.12	0.17	0.10	0.12	0.33	0.13

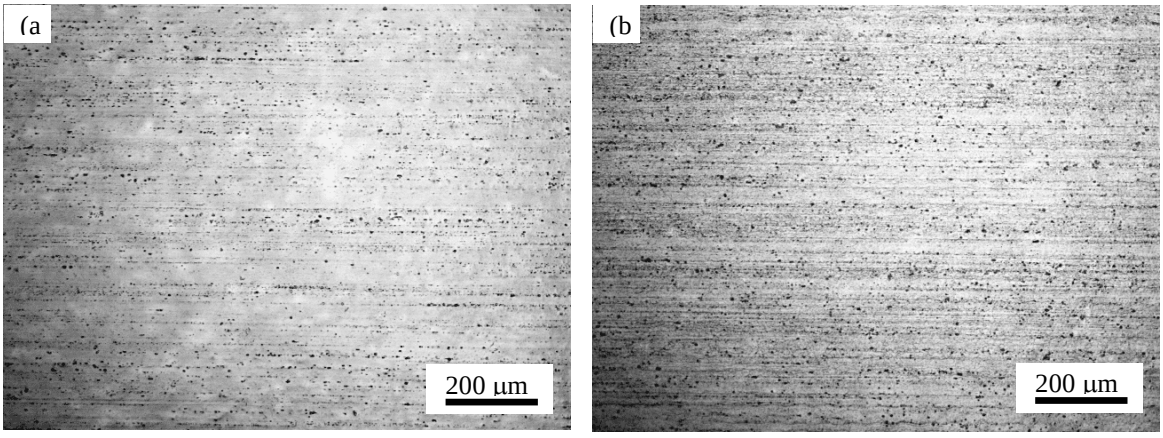


Figure. 1. Microstructure of the precipitation-hardened is observed by microscope: (a) Al6061 alloy, and (b) Al6061-Mg alloy.

2.2 Fatigue tests

The specimens for the rotating bending fatigue test were prepared with the geometry shown in Figure. 2. To eliminate the work-hardened layer, all the specimens were polished using the emery paper with grit numbers up to 3000 at the central specimen. To further refine the surface, the specimens were mechanically polished using a diamond spray of 0.3µ to minimize any influence of stress concentration on the unsmooth surface, which strongly influences fatigue crack initiation. The fatigue tests were conducted at room temperature using the LS-22 046 rotating bending fatigue test machine at a stress ratio, R, equal to -1 at room temperature. Specimen were cycled at a test frequency of 50 Hz (sinusoidal waveform). To detect crack initiation, replica film has been placed at the middle of specimen because of higher stress concentration at this region as shown in Figure. 2. The term stress refers to the nominal bending stress measured at the segment with the smallest cross-sectional

area. The fatigue test was terminated at predetermined cycles to observe the progression of fatigue crack growth.

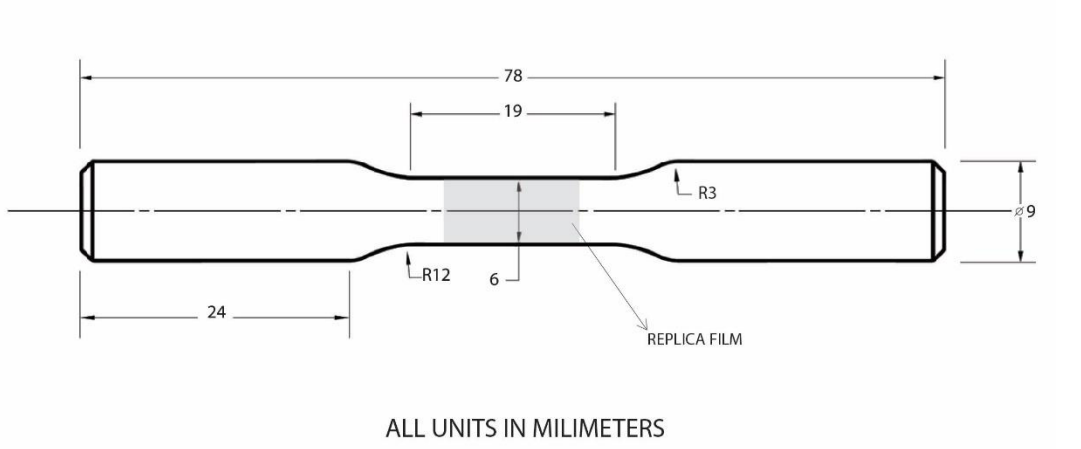


Figure. 2. Sample geometries (all units in mm) for rotating bending fatigue tests and replica film on specimen surface.

2.3 Fatigue Crack Initiation

To investigate the behavior of the crack initiation, observation at the early stage of crack growth is crucial. The replica technique [20] was used to observe the fatigue crack growth behavior on the specimen surface using a microscope. Meanwhile, the fatigue test was conducted according to ASTM standard [21]. The stress amplitude is set at three different amplitudes of 140 MPa, 170 MPa, and 200 MPa to investigate the tendency occurrence of crack initiation in the materials. The possibility of cracks initiated by the defects was also examined in both materials by using the microscopes.

3. RESULTS AND DISCUSSION

Based on the experimental results, the fatigue cracks were initiated at defects on the specimen surface due to the high-stress concentrations induced by the defects. For investigation, the stress amplitude is set at a higher value of 200 MPa to maximize the tendency occurrence of crack initiation. Figure. 3(a) and 3(b) compare the fatigue crack initiation at the stress amplitude of 200MPa for Al6061 alloy and Al6061-Mg

alloy, respectively. Figure. 4 shows a magnification image of the defect for Al6061-Mg on the specimen surface. The defect size in range between 3μm to 6μm. It was observed that the fatigue cracks in Al6061-Mg alloy were generally initiated earlier than those in Al6061 alloy. The different tendencies of the crack initiation behaviour in both Al alloys are due to the increasing number of defects with the rising number of cycles in Al6061-Mg alloy compared to Al6061 alloy. The crack initiation is strongly influenced by the defects, by examining the fatigue cracks on the specimen surface revealing that the crack is easier to initiate in Al6061-Mg alloy than that in Al6061 alloy, as shown in Figure. 5 (a), 5(b) and 5(c).

The occurrence of this phenomenon is due to the fact that stress caused by surface defects is more intense than those caused by factors internal to materials such as inclusions and microstructure. The fatigue cracks are initiated by the localized plastic deformation, and due to the higher dislocation density in Al6061-Mg alloy compared to Al6061 alloy, the slip bands interact with the phase boundaries more than the other surfaces, and the appearance of crack path will show perfectly straight [22] and which leads to the formation of defects. Slip traces also occur along the fatigue load direction, which indicates that cracking and slip activation are more likely to occur in this area [23]. Dislocations are continuously and gradually moved during cyclic loads, resulting in the formation of persistent slip bands (PSB). Interaction between PSBs and phase boundaries helps to promote the formation of defects in Al6061-Mg alloy than those in Al6061 alloy.

Dislocations cause stress to concentrate in the material. This makes it susceptible to cracks and localized deformation. Dislocations disrupt the atomic structures and cause defects to the crystal lattice as they move through a material. The defects in the crystal lattice can function as nucleation areas for new defects [24]. During cyclic loading, the interaction between dislocations, atoms, and the resulting defects is crucial. These defects can weaken the material, making it susceptible to crack formation under conditions of cyclic load. Understanding how dislocations or atoms create new defects will help develop strategies to reduce fatigue crack formation and increase fatigue resistance [25].

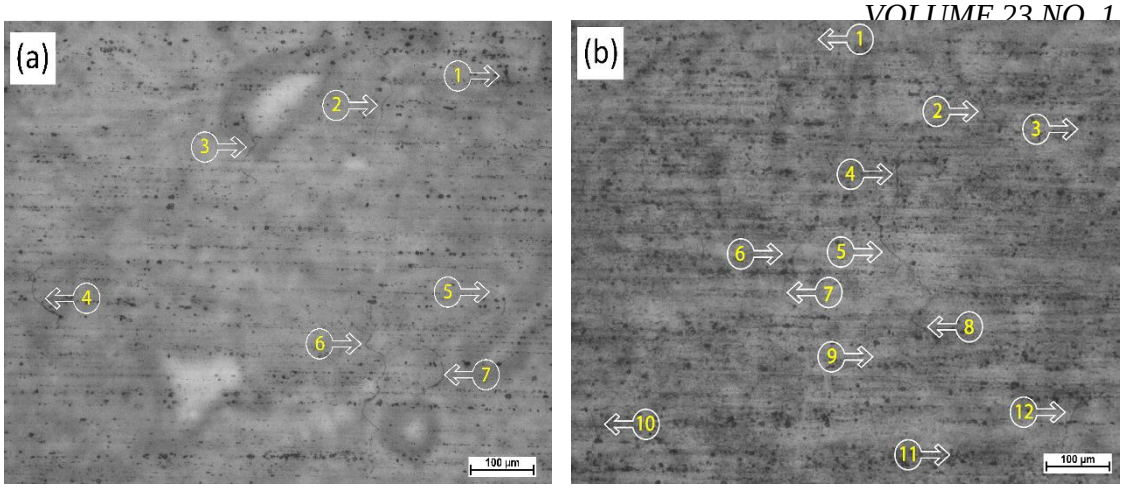


Figure. 3. Fatigue crack initiation on the specimen surface: (a) Al6061 alloy, and (b) Al6061-Mg alloy.

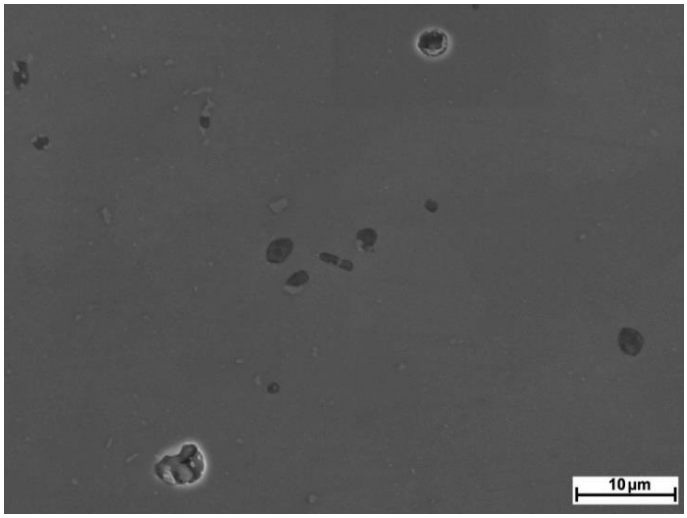
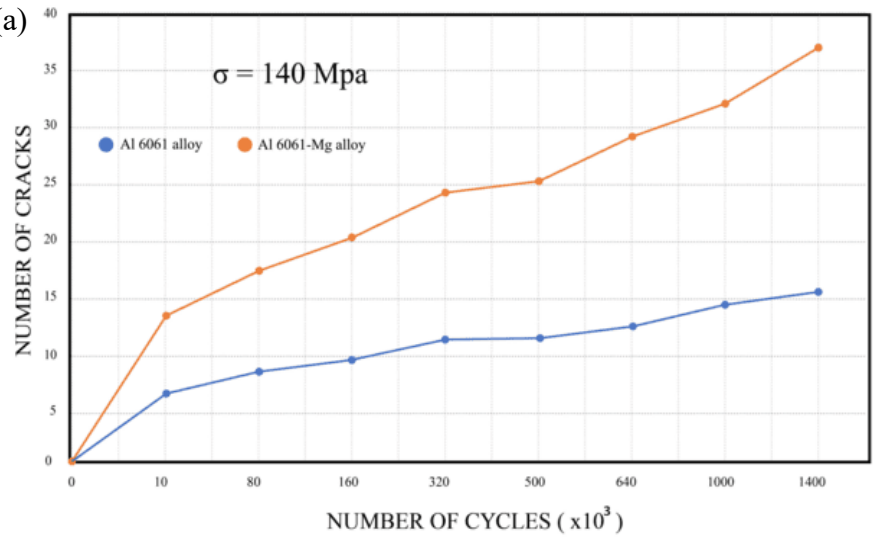
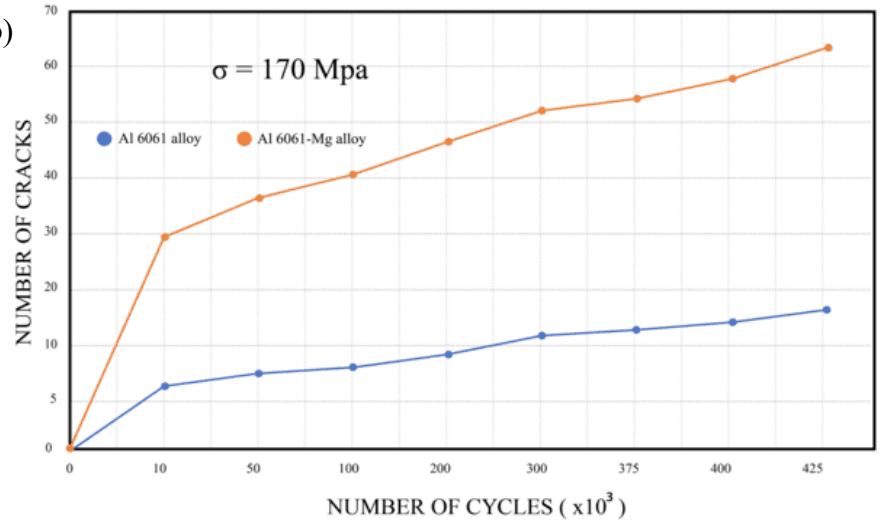


Figure. 4. Magnification image of the defect for Al6061-Mg on specimen surface.

(a)


σ = 140 Mpa
Al 6061 alloy
Al 6061-Mg alloy
NUMBER OF CRACKS
0
5
10
15
20
25
30
35
40
0
10
80
160
320
500
640
1000
1400
NUMBER OF CYCLES (x10³)

(b)


σ = 170 Mpa
Al 6061 alloy
Al 6061-Mg alloy
NUMBER OF CRACKS
0
5
10
20
30
40
50
60
70
0
10
50
100
200
300
375
400
425
NUMBER OF CYCLES (x10³)

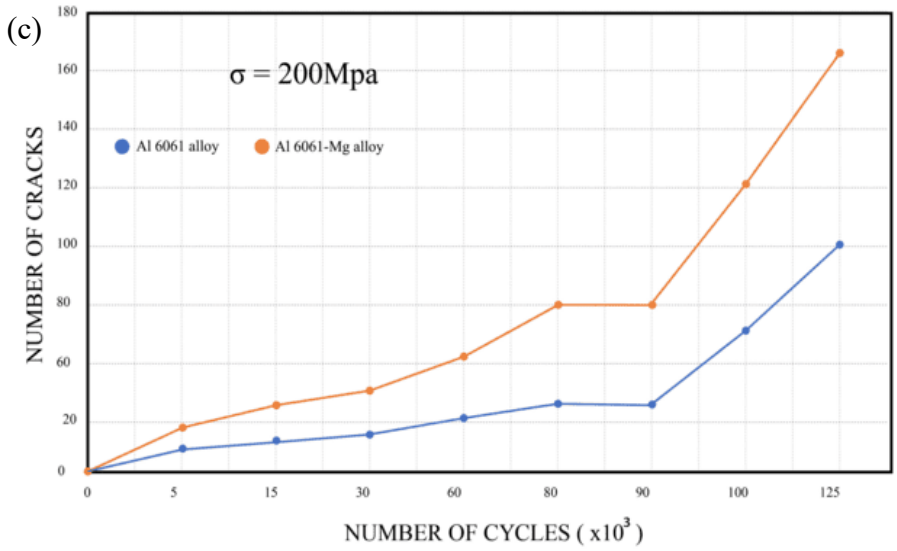


Figure. 5. Number of cracks as a function of number of cycles at different stress amplitude.: (a) 140 MPa, (b) 170 MPa, and (c) 200 MPa.

4. CONCLUSION

In this study, the fatigue crack initiation mechanisms of the alloys were observed to be affected by their excess Mg contents compared to other Al6061-T6-based alloys. Based on the experimental results, the following main conclusions are drawn:

(1) Microstructural defects influence the fatigue crack initiation in Al6061 alloy and Al6061-Mg alloy.
(2) The fatigue cracks in Al6061-Mg alloy were generally initiated earlier than those in Al6061 alloy due to its susceptibility to localized deformation.
(3) Al6061 alloy with excess Mg is easier to develop a new defect than Al6061-based alloys. The higher tendency for defects to exist in this alloy may be attributed to the occurrence of DSA.

It is speculated that the easiness of the crack to initiate in Al6061-Mg induces a smaller scatter of the fatigue life. Further study would be undertaken to examine the effects of DSA on the scatter behaviours of the two considered Al6061-T6 alloys by

using smooth specimen. For this purpose, the statistically analysis will be considered in future research.

ACKNOWLEDGEMENT

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AN EFFICIENT QR CODE-BASED ATTENDANCE MONITORING SYSTEM FOR FOUNDATION STUDENTS IN SPACE UTM: A SURVEY

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ABSTRACT - In line with the rapid growth of digital technology, the implementation of QR code technology for real time attendance monitoring is becoming increasingly widespread in educational institutions. The current manual attendance raises several issues, such as truancy issues, time consumption, and the chance of mistakes. To improve the process of monitoring student attendance, SPACE UTM is transforming towards automated systems to improve the process of tracking student attendance. With this approach, the current manual attendance has the potential to be converted into digital attendance monitoring. Hence, the proposed attendance monitoring system will implement QR code technology to make sure only students who attend the class will be recorded in the system. A recent survey was distributed to gather valuable insights, and it has been reported that a significant portion of individuals were unaware of the proposed QR code attendance monitoring system at SPACE UTM. According to the frequency of lectures at SPACE UTM, the data reflects a varied schedule, with responses indicating lectures held daily, twice a week, and weekly. This diversity underscores the flexibility and adaptability of QR code technologies to accommodate different attendance tracking needs. The findings of this paper were the evaluation results of the proposed QR code attendance monitoring system through a questionnaire that is distributed among SPACE UTM lecturers. Therefore, the proposed QR code attendance monitoring system emphasize the convenient ways for lecturers to track student attendance without any truancy issues among students.

Keywords: QR code; student attendance monitoring system; educational institution; attendance tracking attendance tracking; QR Code-Based Attendance Monitoring System.

1. INTRODUCTION

Conventional methods of taking attendance such as roll calls, manual sign-in sheets and manual registers have been used to monitor attendance in educational institutions. Nevertheless, these methods are frequently time-consuming, labor-

intensive and prone to errors. Moreover, QR code attendance tracking technologies offer a modern and efficient alternative that is gaining popularity in educational settings. Students can easily scan a QR code with their smartphones to record their attendance. This technology simplifies the process, improves the accuracy of attendance records burden and reduces administrative burden. The accessibility and convenience of QR code systems make them an attractive option for education institutions such as schools and universities looking to improve their attendance monitoring practices. As technology continues to advance, the QR code attendance tracking system offers a promising opportunity for institutions to modernize their approach to managing student attendance records.

A Quick Response Code or known as QR Code is a type of matrix barcode or two-dimensional barcode, formerly created for the automotive industry in Japan [6]. Barcodes are optical machine-readable labels that encompass information about the item to which they are attached. The application of barcodes is commonly found in a Universal Product Code (UPC) barcode. This is a standardized barcode that uniquely identifies products in retail environments. It consists of a sequence of black bars and white spaces of varying widths that encode different numbers or information. UPC barcodes are scanned at points of sale to retrieve product details such as the price, name and other data stored in a database. Due to its rapid readability and higher storage capacity compared to standard UPC barcodes, the QR Code system has gained popularity nowadays beyond the automotive industry. A QR code contains black modules or square dots that are arranged in a square grid on a white background.

QR Code attendance tracking systems utilize unique digital codes that students can easily scan their attendance using smartphones or other camera-equipped devices. These codes are generated by the attendance tracking application system and displayed at various entry points such as classrooms or event venues. At the same time, the system records the time and date of each scan automatically updating attendance records in real-time. This updates the attendance tracking process and provides immediate access to accurate attendance data for both students and lecturers.

QR Code attendance offers many advantages. One of the significant advantages is its customization flexibility. Institutions can modify QR codes to include additional information such as event schedules, and class details and enhance the scanning experience for users. Additionally, this technology can be easily integrated with existing student management systems to facilitate efficient data sharing and analysis.

Besides simplifying the attendance tracking process, QR Code systems can also increase security by providing a digital record of student presence. This is valuable in emergencies specially to track student whereabouts on campus. By implementing QR code technology, educational institutions can improve operational efficiency while boosting student engagement and accountability in attendance tracking.

Based on the previous study conducted by [1], QR code attendance tracking reduced the time required to record attendance by 40% compared to traditional manual methods. Moreover, students' attendance accuracy improved by 25% when using QR code technology instead of paper-based methods. Instructors reported a 30% increase in efficiency in monitoring attendance using QR codes compared to manual methods.

The suggested fix entails giving each student a QR code that may be scanned with a certain smartphone application by the lecturer or the student. The code will validate the student's attendance along with the identity that was obtained by the application. By using this strategy, lecturers will be able to deliver their lectures with less time and effort than they would otherwise need to. This streamlined procedure will speed up the taking of attendance, freeing up more time for instructive lectures. PHP, JavaScript, and CSS are programming languages that used in the development of the attendance monitoring system.

2. LITERATURE REVIEW

Several suggestions for automated QR Code attendance monitoring systems can be found both in academic literature and on the market. Most of these proposals focus on applications intended for use on the lecturer's device, such as a smartphone or a laptop. The previous study [2] proposed a QR code-based attendance tracking system specifically designed for college students. By using QR code scanning, the system seeks to increase efficiency and accuracy in student attendance records. It talks about the advantages, drawbacks, and implementation methods of employing QR codes to track attendance in educational settings.

In the meantime, a study by [3] investigated how to improve school attendance tracking through the use of QR code technology. According to the study, using QR codes can streamline the process of tracking attendance, cut down on paperwork, and improve data accuracy. It offers perceptions of the usefulness of incorporating QR codes into student attendance records.

A different study [4] focused on creating an attendance tracking system for university students using QR codes. The capabilities, usefulness, and advantages of employing QR codes to track student attendance such as automated record keeping and real-time data updates are highlighted in this study. It assesses how well the method works to improve university-level attendance management.

In educational contexts, an attendance monitoring system is essential because it allows lecturers to monitor student attendance and take immediate action when there is absenteeism. Students can now manipulate the traditional technique of taking attendance with the help of others, making it less reliable. Electronic methods are the way of the future for attendance tracking since they are more accurate and efficient. However, the need for expensive, particularly made equipment to implement many of the current electronic systems may discourage many educational institutions from implementing them. Reaching a more dependable attendance tracking system requires striking a compromise between efficacy and cost efficiency.

3. MATERIALS AND METHODS

3.1 Research Design

An innovative and effective method for monitoring student attendance in educational environments can be offered by the proposed QR code attendance monitoring system. Attendance tracking becomes easy and faster by giving every student a unique QR code that can be scanned with a smartphone. This creative method ensures reliability and consistency in monitoring attendance records while additionally creating the process easier for lecturers and students.

Furthermore, the effectiveness of the educational system is further enhanced by the use of technology into the attendance management method using QR codes. There is little opportunity for manual mistakes or inconsistencies because the student's identification is immediately verified upon scanning the code. In addition to save time, this digital approach helps lecturers concentrate more on giving excellent lectures and engaging students. This system may be created and scaled to match the specific needs of educational institutions by utilizing programming languages as PHP, JavaScript, and CSS. This will ultimately improve the overall learning experience for both students and lecturers.

Because PHP has several of benefits over different programming languages, it is a popular option for web development. First of all, PHP is renowned for its adaptability and compatibility with a wide range of web servers, including Apache and Nginx, as well as diverse operating systems, including Windows, Linux, and macOS. Because PHP is universally compatible it works in a variety of situations, which makes it an ideal choice for web development projects. The process implementation flowchart for QR Code Attendance Monitoring is shown in Figure 1.0.

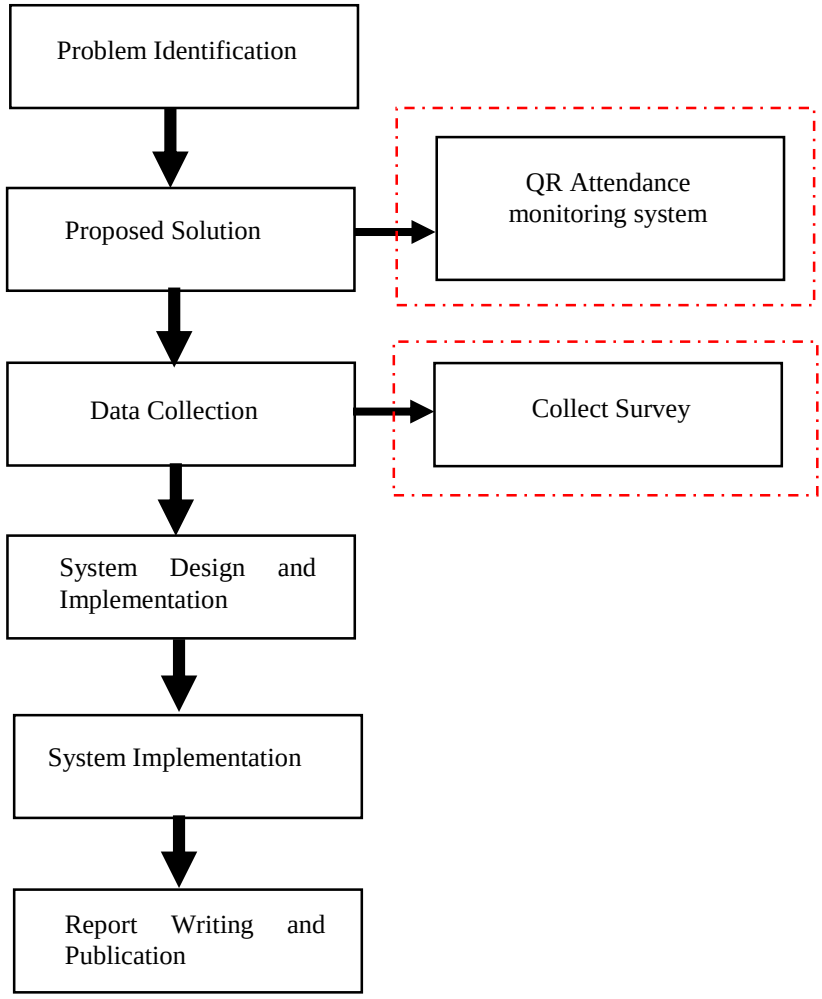

Figure 1.0 The flowchart of process implementation QR Code Attendance Monitoring.

Phase 1: Problem Identification

- Determine the present problems with conventional attendance monitoring techniques.
- Evaluate the inconsistencies and gaps in the manual attendance process.
- Recognize the need for a more modernized and reliable attendance tracking solution.
- Determine the challenges faced by students and lecturers with the existing system.
- Establish the goals and objectives for implementing QR code attendance tracking.

Phase 2: Proposed Solution Implementing QR Code System

- Outline the concept of using QR codes to track attendance.
- Describe the advantages of using QR codes to increase accuracy and efficiency.
- Describe the main attributes of the QR code attendance monitoring system, like its user-friendliness and ability to track data in real-time.
- Respond to stakeholder queries or concerns about the QR code system's implementation.
- Gather user input during the pilot study so that any necessary modifications may be made before the final implementation.

Phase 3: Data Collection and Questionnaire

- Create questionnaires to get feedback on the usefulness and satisfaction of the QR code attendance monitoring system.
- Include questions on the QR code system's general user experience, accuracy, time-saving features, and convenience of use.
- Take into consideration integrating Likert-scale questions and open-ended questions to enable respondents to add notes or recommendations for improvements.
- Distribute the survey to SPACE UTM lecturers via google form platforms.
- Gather and examine the input to determine the QR code attendance monitoring system's positive aspects and opportunities for development.
- Make any required modifications to improve the functioning and user experience of the QR code system based on the data gathered to guide in decision-making.

Phase 4: System Design and Implementation

- Begin work on development for the QR code attendance monitoring system based on input and findings from the data gathered in earlier phases. Any highlighted parts for improvement, like data management capabilities, user interface design, and integration with current systems, should be taken into consideration when adding functionality.
- Make sure the system is dependable, easy to use, and fits the needs of both lecturers and students.
- Test the upgraded system to find and fix any flaws or problems. To make sure the system is functioning and performing effectively, test it in different scenario.
- Create a detailed plan for implementing the revised QR code attendance monitoring system.
- Keep an eye on the implementation procedure and ask users for input on how well the revised system is functioning.
- Consistently assess and analyze the system to make sure it stays in line with organizational objectives and user needs.

Phase 5: System Implementation

- Training on the software is essential during the system implementation phase to guarantee an easy transition and efficient use by end users.
- The content of training sessions ought to cover a variety of system topics, including data entry, report creation, navigation, and troubleshooting. Additional tools that might improve training and assist users in connecting with the features of the software include user manuals, online resources, and practical practice sessions.
- Regular feedback and support should be provided to address any questions that may arise during the training period.

Phase 6: Report and Publication

- System documentation is prepared in detail during the report and documentation phase, which is the last stage of system implementation. User manuals, system architectural diagrams, technical specifications and result included in this documentation. The report provides a comprehensive overview of the system design, functionality, and implementation details.
- It serves as a reference for users, developers, and maintenance personnel to understand and maintain the system effectively.

3.2 Participants

A total of 24 respondents from SPACE UTM foundation programme lecturers were assigned to participate in this study. The number of samples was obtained purposively as the nine lecturers who participated in the study are qualified and has the characteristic of sample required. The samples for sampling "can provide useful information for answering questions and hypotheses "regarding QR code attendance monitoring system.

3.3 Instrumentation

A structured questionnaire consisting of twenty-four questions was designed and distributed to the lecturers in SPACE UTM focused on the utilization of QR code technology. The objective of this survey is to gather valuable insights and opinions on the effectiveness, efficiency, and user satisfaction of attendance tracking technologies, specifically QR code applications, in the context of student attendance records. As mentioned in the introduction, many educational institutions have adopted QR code technology to enhance their attendance tracking procedures, offering potential improvements to various aspects of the educational experience. Your feedback and insights are crucial in contributing to our understanding of how these systems impact educational settings and how they can be further enhanced.

The input will not only support ongoing research efforts but may also influence the future development and implementation of attendance tracking technologies in educational institutions.

4. RESULTS AND DISCUSSION

4.1 Respondent

A structured questionnaire consisting of twenty-four questions was designed and distributed to the lecturers in SPACE UTM.

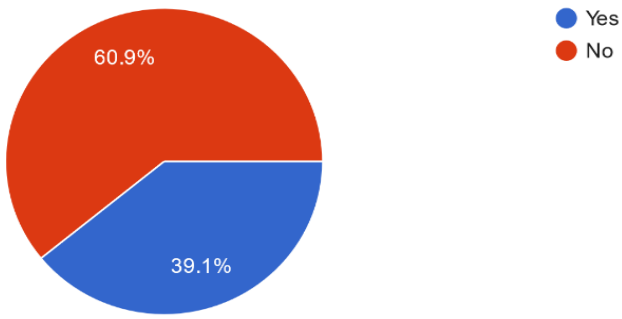

Figure 4.1 Question 1: Have you heard about the proposed QR code attendance record system for SPACE UTM before reading this survey.

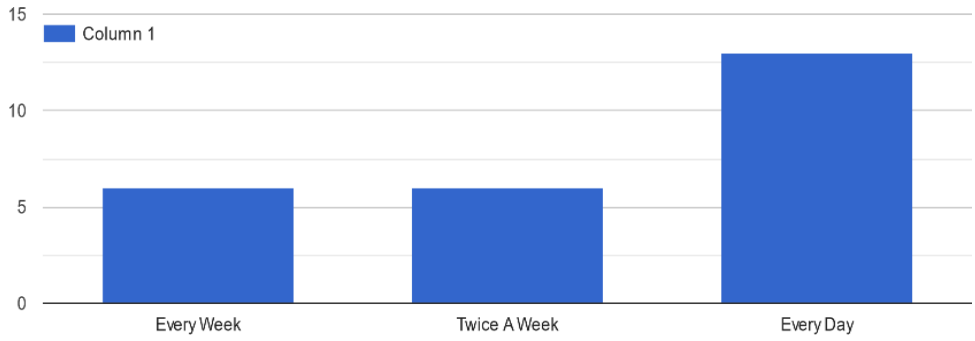

Figure 4.2 Question 2: How often do you have lectured every week at SPACE UTM?

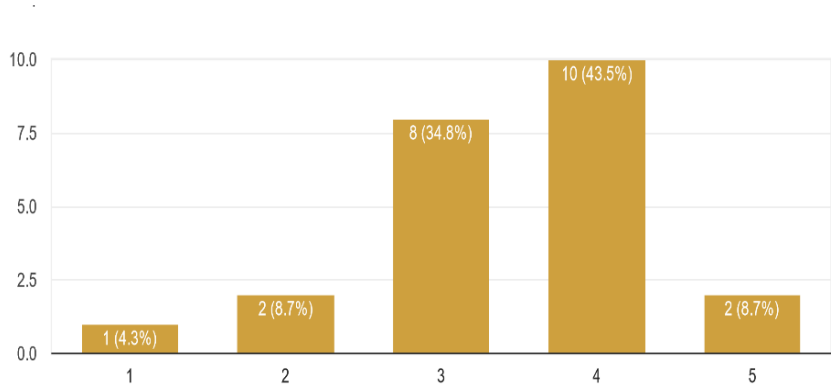

Figure 4.3 Question 3: Do you find the traditional methods of taking attendance (calling out names and paper recording) effective?

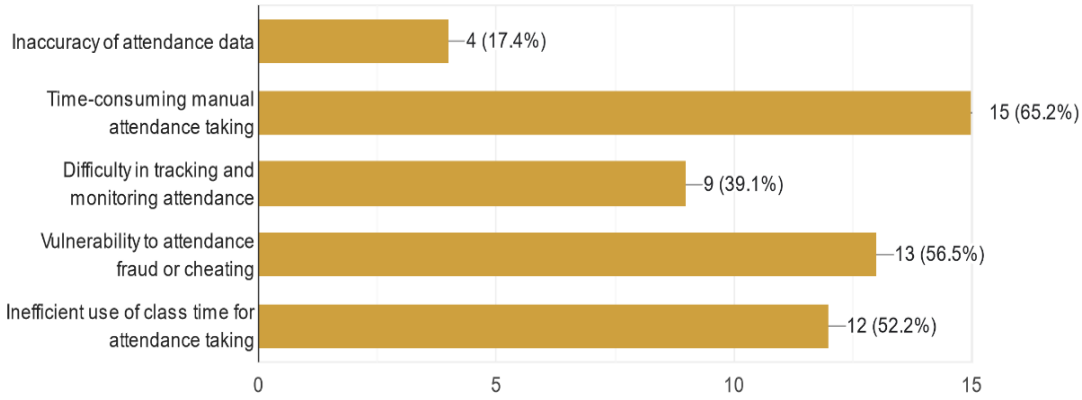

Figure 4.4 Question 4: What are the main problems you have encountered with the traditional attendance record systems at SPACE UTM?

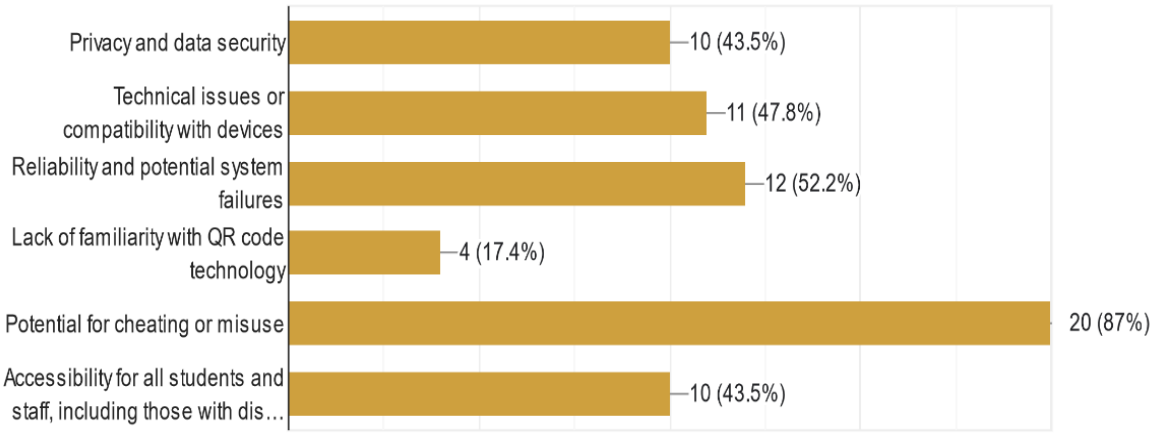

Figure 4.5 Question 5: What concerns or reservations do you have about using a QR code-based attendance monitoring system?

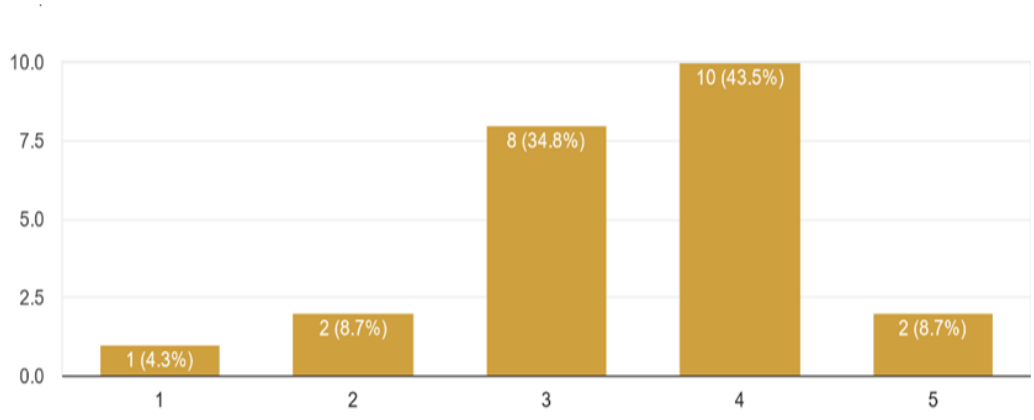

Figure 4.6 Question 6: Do you believe the QR code attendance monitoring system will reduce the chances of students cheating by having their attendance recorded when they are not present?

The respondent gave positive feedback code attendance monitoring systems benefit both lecturers and students by providing convenience. Lecturers no longer need to input attendance data manually, and students can easily meet attendance requirements without manual sign-ins or paper methods. It is to ensure the integrity of the system, display QR codes only during class to prevent other students from taking pictures of them. The digitalized systems are especially helpful for lecturers when preparing attendance reports. Overall, the implementation of QR code attendance monitoring systems has proven to be effective in streamlining attendance processes for both parties.

Figure 4.7 Question 7: How do you think the QR code attendance monitoring system will impact the efficiency of attendance recording for lecturers and students?

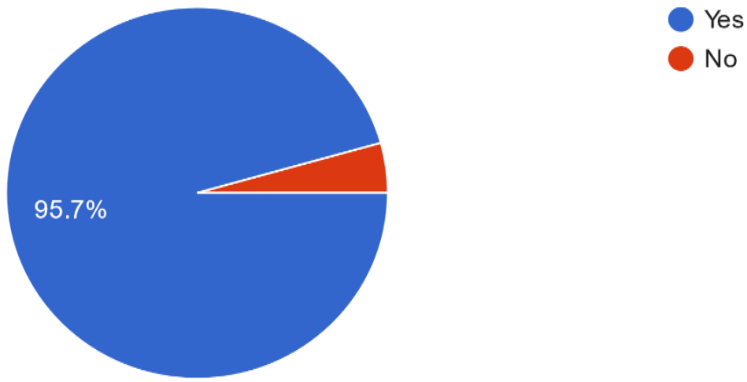

Figure 4.8 Question 8: Do you believe the implementation of a QR code attendance monitoring system would contribute positively to the academic environment at SPACE UTM?

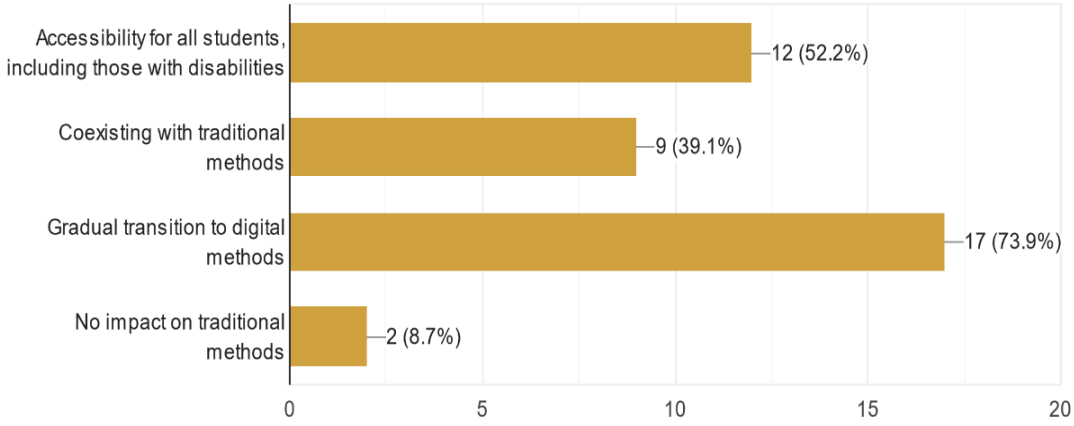

Figure 4.9 Question 9: How do you envision the transition to a digital attendance tracking system impacting the traditional methods of recording attendance at SPACE UTM?

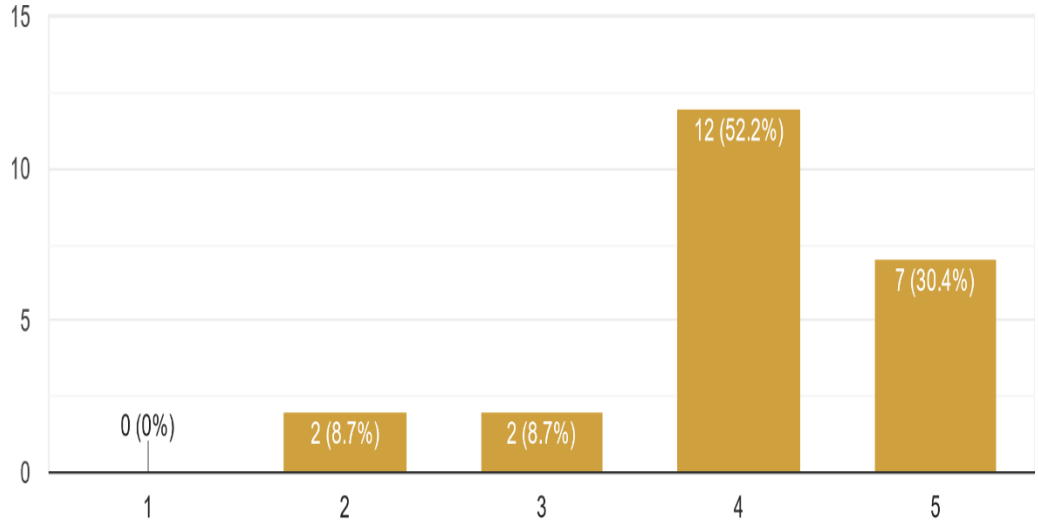

Figure 4.10 Question 10: Do you believe the implementation of a system that achieves these objectives would improve the overall quality of education at SPACE UTM?

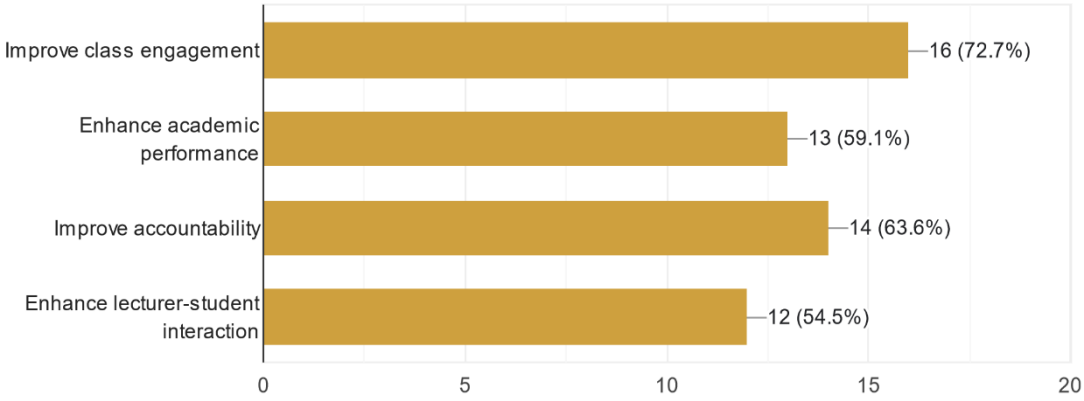

Figure 4.11 Question 11: How do you think real-time monitoring of student attendance could benefit both students and lecturers?

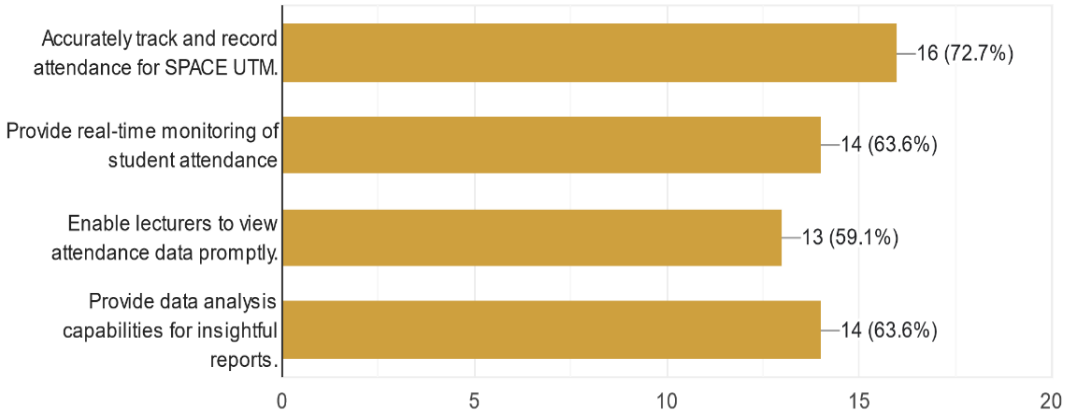

Figure 4.12 Question 12: Which of the following objectives do you believe is most important for improving the management of student attendance at SPACE UTM?

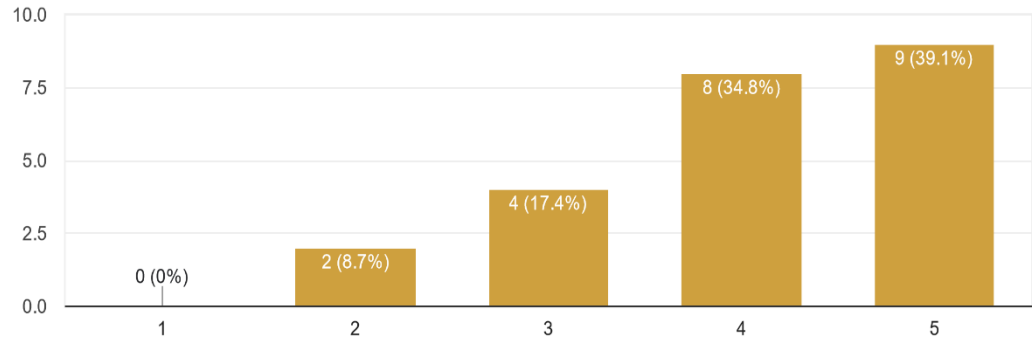

Figure 4.13 Question 13: Would you prefer the QR code attendance monitoring system over the traditional methods of taking attendance?

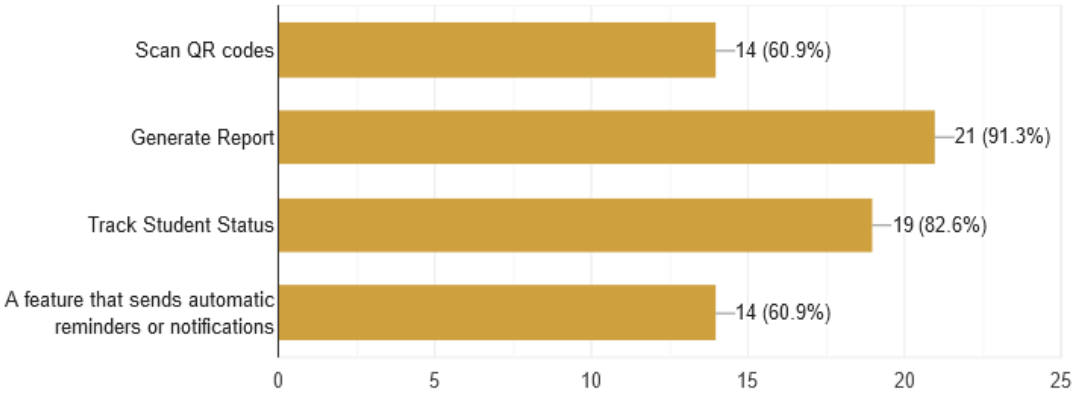

Figure 4.14 Question 14: What features or functionalities would you like to see in a QR code attendance app for students?

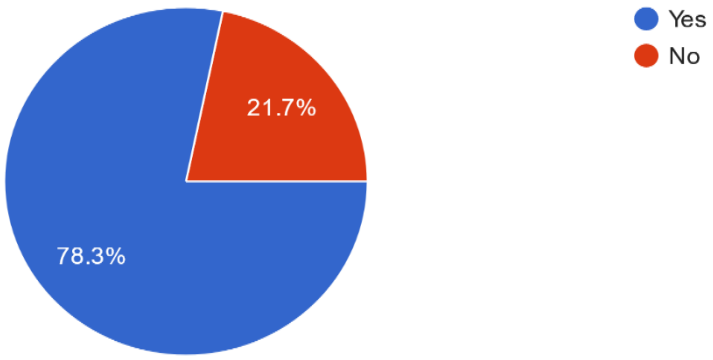

Figure 4.15 Question 15: Are you concerned about privacy and security when using a QR code attendance monitoring system?

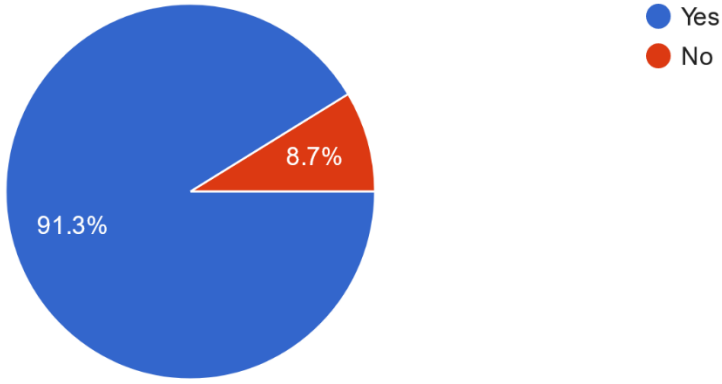

Figure 4.16 Question 16: Do you believe the QR code system will save time for both students and lecturers?

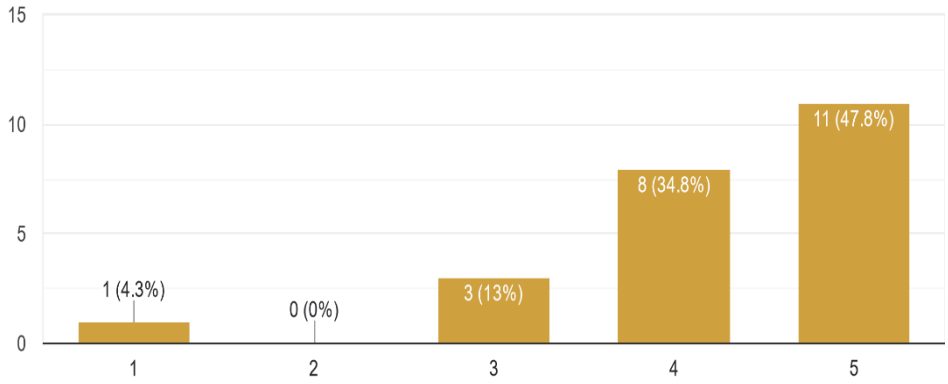

Figure 4.17 Question 17: On a scale of 1 to 5, how likely are you to use the QR code attendance monitoring system if it's implemented at SPACE UTM, with 1 being very unlikely and 5 being very likely?

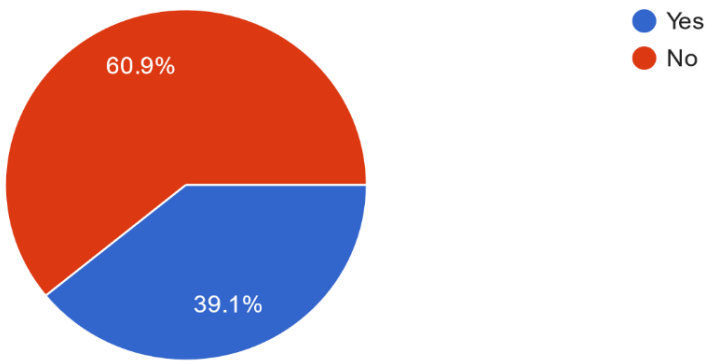

Figure 4.18 Question 18: Have you encountered or used automated attendance record systems in an educational setting before?

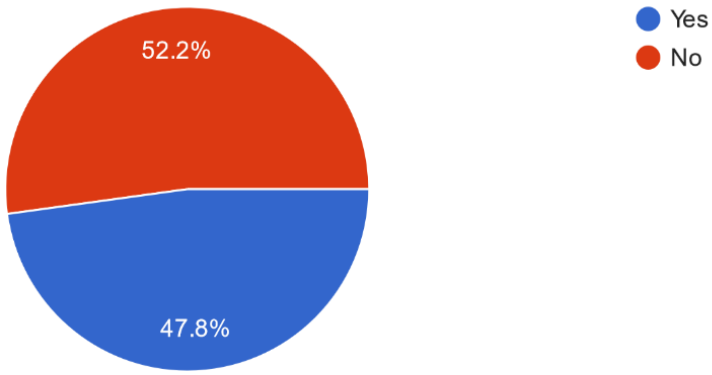

Figure 4.19 Question 19: Are you aware of any studies or research that investigate the effectiveness and efficiency of automated attendance record systems in educational settings?

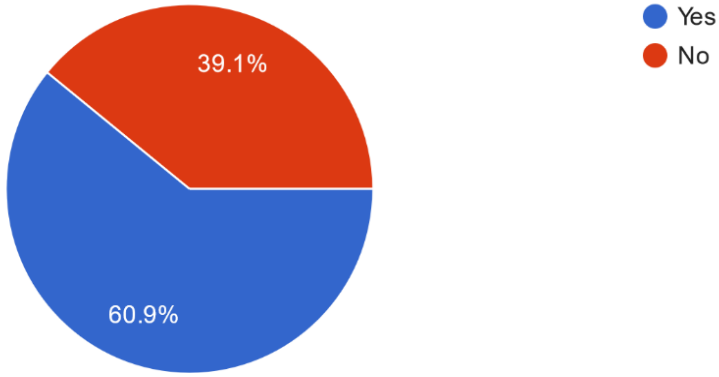

Figure 4.20 Question 20 Have you personally used QR code technology for attendance tracking or related activities?

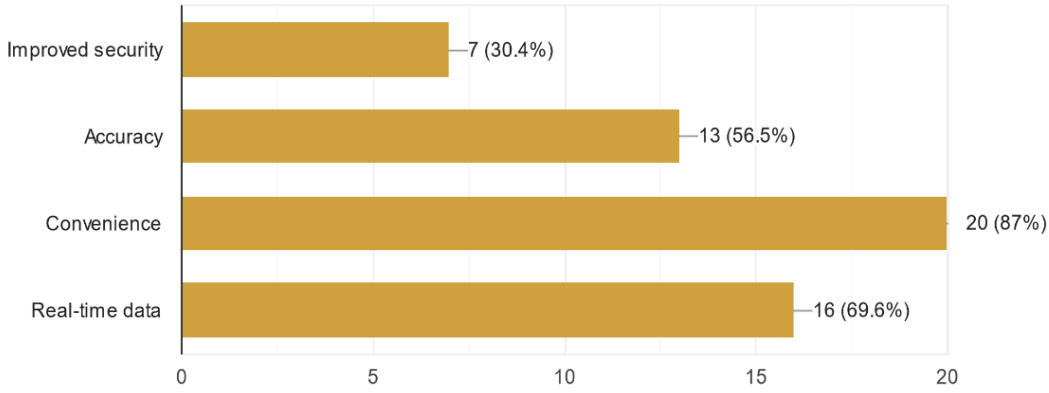

Figure 4.21 Question 21: What do you believe are the key advantages of using QR code technology for attendance tracking in educational settings?

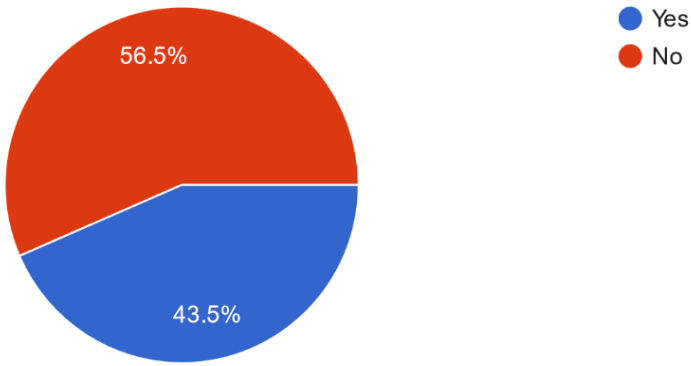

Figure 4.22 Question 22: Have you encountered any challenges or drawbacks when using QR code technology for attendance tracking in educational settings?

The respondent feedback the Challenges and drawbacks with QR code technology for attendance tracking include difficulties in detecting the QR code, it being time-consuming to remind students to scan, the potential for students to share the code with others, the need to generate new codes daily, and the lack of internet connectivity. There are concerns about security, as sharing QR codes with individuals do not present in the room may occur, highlighting the importance of securing the system and ensuring that codes are only accessible during class sessions to prevent misuse.

Figure 4.23 Question 23: If yes, please describe the challenges or drawbacks you've encountered with QR code technology for attendance tracking. If No, please leave as Null.

The respondent feedback on the last question is on implementing a variety of attendance tracking methods to prevent overuse of QR codes, allowing customization of attendance settings for lecturers, changing QR codes daily to prevent misuse, ensuring efficient use of time through technology alignment, and restricting scanning boundaries to specific locations for attendance tracking purposes.

Figure 4.24 Question 24: How do you think the QR code attendance monitoring system could be improved to better serve the needs of students and lecturers at SPACE UTM?

5. CONCLUSION

In conclusion, a survey was distributed to the respondents to get opinions from SPACE UTM lecturers. The response received through a survey emphasize the significance of implementing a different method to track student attendance using QR codes. In this paper, the proposed system allows the lecturers to customize attendance settings for monitoring student presence in class in order to accommodate varying teaching styles and preferences. Furthermore, the recommendation to change QR codes daily helps to prevents any unauthorized usage and protect the accuracy of attendance records. Through the alignment of technology to optimize time management, educational institutions can ensure efficient tracking processes that enhance overall productivity.

Moreover, the proposed system only allows students to scan the QR codes at the specific location for attendance record. This measure can enhance accuracy for student attendance and prevent any absence issues. By implementing these suggestions into the attendance tracking system, educational institutions can enhance the effectiveness of their monitoring method, strengthen student engagement, and administrative processes become smooth. Overall, the response gathered emphasizes the significance of adapting innovative strategies to optimize attendance tracking methods and ensure academic integrity within educational settings.

The respondent also highlights several issues and challenges associated with using QR code technology for attendance tracking. The several challenges raised such as problem detecting the QR code, the time-consuming nature of reminding students to scan the QR code in the class, the risk of sharing the code with absent students, the necessity of generating new codes daily, and lack of internet connectivity.

Additionally, security issues were raised including the possibility of students sharing QR codes with individuals who are not in the class. Hence, this emphasize the importance of implementing strong security measures to ensure that QR codes are only can be scanned during class hours to prevent any misuse. Addressing these challenges and security concerns is crucial for enhancing the effectiveness and reliability of QR code technology for attendance tracking in educational settings. Educational institutions can minimize these issues and optimize the benefits of QR codes for effective student attendance tracking by implementing the right solutions and procedures.

According to the survey result, implementing QR code for monitoring student attendance offers various benefits. The system provides a convenient approach to monitor student attendance, accurate data about student attendance, prevent truancy issues, and effective

attendance process. Moreover, it offers a contactless solution in line with health and safety protocols, saves time for both students and lecturers, and increases responsibility students to scan QR code during class hours. Overall, the positive feedback from respondents indicates that QR code attendance monitoring system is a valuable tool for educational institutions.

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GREEN MARKETING STRATEGIES AND CONSUMER PURCHASE BEHAVIOUR: A PILOT STUDY FOR CONSUMERS IN MALAYSIA

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ABSTRACT - This research examines the correlation between green marketing methods and consumer purchasing behaviour among Malaysian consumers. Due to increasing global environmental concerns, governments throughout the globe are adopting green legislation, leading customers to choose eco-friendly items. As a tactical reaction, green marketing has emerged, highlighting programmes like recycling and pollution control. Nevertheless, understanding consumer behaviour within this framework is vital for market competitiveness. This pilot study provides insights into the relationship between green marketing strategies and consumer behaviour by validating modified measurements that are specific to the Malaysian market. Meanwhile, this study also aims to investigate the impact of green marketing strategies on consumer purchasing behavior in Malaysia. This study uses quantitative research method to collect data from 50 respondents by fulfilling questionnaires. The results of this study provide valuable insights into sustainable consumption patterns and offer guidance for organisations aiming to adapt to this changing environment.

Keywords: Green marketing; Strategies; Consumer purchase behaviour; Malaysia

1. INTRODUCTION

Due to global warming in recent years, the depletion of natural resources, environmental pollution, endangered animal species and other problems are becoming increasingly severe, and governments all over the world are vigorously promoting and implementing green policies to protect the environment [1].

Meanwhile, with climate change and environmental degradation becoming increasingly significant threats, consumers are becoming more aware of their purchasing decisions and their impact on the planet. Due to the changes in consumer awareness, companies are faced with a fundamental challenge: how to alter their business plans to meet the growing demand for products and services from customers that are favorable to the environment. At the same time, as consumers around the world recognize the value of natural biodiversity and cultural pluralism, they are incorporating eco-conscious and green consumption concepts into their evaluation and purchasing decisions for goods and

services. Thus, changing consumer attitudes have given rise to the phenomenon of green marketing, which is a strategic approach for companies to promote environmentally friendly products and services. "Green marketing" emerged in the 1960s and goes by various synonyms, including environmental marketing and eco-marketing. Green marketing is a sales strategy that emphasizes a product or service's environmental friendliness [2].

Green marketing has become increasingly important around the world in the contemporary environment. In addition, enterprises began emphasizing product recycling, low pollution, resource conservation, advocating environmentally friendly consumption behavior, exploring green market opportunities, and creating a green corporate culture [3]. Green marketing processes that ensure the sustainability of marketing operations are rapidly becoming mainstream. Therefore, it is necessary to understand the factors that affect consumers' purchase behaviour and decision-making, which aims to improve the fit between green products and consumer needs and enhance market competitiveness [4]. Moreover, Malaysian customers that purchase green products are the target audience for the current pilot project. This sector is entirely distinct from the other studies using the modified measures. Therefore, this research has carried out a pilot study in order to further validate the modified measurements for green marketing strategies and the consumer purchasing behavior sector in Malaysia with the construct produced in this study.

2. LITERATURE REVIEW

2.1. Concept of green marketing

In recent years, as enterprises have gradually begun to implement environmental protection concepts in the process of research and development, production, and marketing, the environmental awareness of consumers and other enterprises has rapidly increased. Consumers are also increasingly concerned about whether products are green and whether companies are implementing green marketing campaigns [5]. Green marketing, also known as ecological marketing or environmental marketing, is a business approach that focuses on creating and promoting environmentally friendly products and practices. The concept of green marketing emerged as a response to growing environmental concerns and an awareness of the impact of human activities on the planet. Green marketing aims to minimize the negative effects of business operations on the environment while meeting consumer needs, including product development and promotion, packaging, and transportation [6].

2.2. Concept of Consumer Purchase Behavior (CPB)

Boyd and Mason (1999) defined purchase intention as consumers' inclination to buy a specific product. Consequently, individuals with a higher willingness to purchase are more likely to choose a particular item. Purchase behaviour encompasses people's decisions and actions when acquiring and using a product. Simultaneously, consumer purchase behaviour refers to individuals' process when seeking, selecting, purchasing, using, and evaluating products or services. Comprehending consumer purchase behaviour is paramount for businesses, aiding in developing effective marketing strategies, product design aligned with consumer needs, and overall customer satisfaction. Analysing consumer behaviour allows companies to understand their target audience better, facilitating the creation of tailored marketing campaigns that resonate with them. Additionally, understanding consumers' willingness to pay and price sensitivity enables companies to set competitive prices for profit maximization.

2.3. Theory of Planned Behavior (Ajzen,1991)

Fishbein and Ajzen (1975) pointed out the positive relationship between behavioral intention and actual behavior. They tested the relationship between behavioral intention and actual behavior by applying the Theory of Planned Behavior (TPB). The Theory of Planned Behavior (TPB) is a psychological theory developed by Ajzen in 1991. It is a widely used model for understanding and predicting human behavior, especially in the context of marketing, consumer behavior, and social psychology. The theory suggests that human behavior is guided by three main factors, namely: attitudes toward the behavior, subjective norms, and perceived behavioral control, and these intentions, together with perceptions of behavioral control, account for considerable variance in actual behavior [7].

2.4. Green Price and CPB

Green price is an essential element in green marketing. Green price may refer to the cost or pricing strategy of goods or services produced in an environmentally sustainable or socially responsible manner. Companies may adopt this pricing strategy to reflect the additional cost or effort involved in producing products with less environmental impact [8]. Hence, using the right pricing strategy while considering the environment may help a company succeed. Several components determine the green price of items. Consumer involvement rates are significantly influenced by green pricing and associated initiatives

[9]. Similarly, there is a favorable correlation exists between green pricing and consumer purchase behavior towards buying green items.
Hypothesis 1: *The green price has a positive influence on consumer purchase behavior.*

2.5. Green Transparency and CPB

Green transparency generally refers to a business or product's openness and clarity about its environmental practices and sustainability efforts, often symbolized by green, which is commonly associated with eco-friendliness. Meanwhile, the availability, efficacy, and correctness of green brand information—which includes all relevant details regarding green brand costs, features, and products as well as details about environmental protection for brands and how to attain it—are indicators of green transparency [10]. Green transparency helps consumers get clues about green brands. Green transparency helps green brands communicate their green values by increasing the transparency of information related to sustainability, thus winning the favor of target consumers for alternative brands. If green brands can convey transparent green information and improve their transparency, consumers can enhance their awareness of the true motives and brand authenticity of green brands [10]. Moreover, green transparency can foster a sense of loyalty among consumers who prioritize sustainability. When consumers feel that a company shares their values, they are more likely to remain loyal as well as build trust in that brand. In addition, green transparency contributes to a positive brand image. A positive reputation for environmental responsibility can attract environmentally conscious consumers and enhance a company's overall image [11].
Hypothesis 2: *The green transparency has a positive influence on consumer purchase behaviour.*

2.6. Green skepticism and CPB

Green skepticism is related to skepticism about the efficacy or sincerity of “green" or environmentally friendly initiatives. This skepticism could focus on whether certain practices or products labelled as "green" genuinely benefit the environment, presenting a misleading impression of environmental responsibility [12]. Moreover, people's growing skepticism and mistrust regarding the environmental performance and advantages of green products can be attributed mainly to the irresponsible environmental behaviour of businesses. These actions make customers doubt the veracity of companies and the legitimacy of green brands by making them mistrust green claims and query the green intentions and environmental advantages of businesses [13]. Therefore, green skepticism may affect consumers' perceived behavioural control by influencing their beliefs about the

difficulty of distinguishing genuine environmentally friendly products or practices from mere greenwashing.

Hypothesis 3: *The green skepticism has a negative influence on consumer purchase behaviour.*

2.7. Conceptual Framework

Based on the conceptual framework regarding to Figure 1, the independent variable is green marketing, which relates to green price (H1), green transparency (H2), and green skepticism (H3). Simultaneously, the dependent variable is consumer purchase behavior.

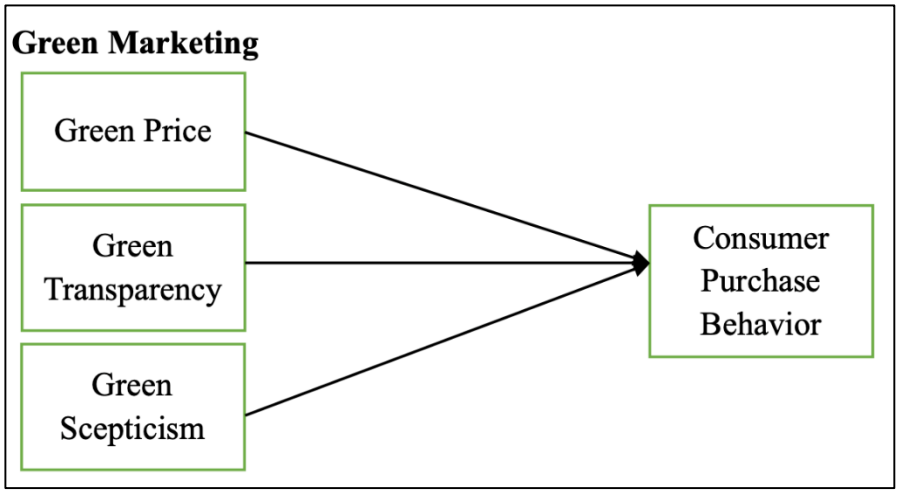

Figure 1: Conceptual framework

The conceptual framework demonstrates the relationship between green marketing and consumer purchase behavior, whereby H1, H2, and H3 significantly influence on consumer purchase behavior.

3. METHODS

3.1. Population and Sampling

The fundamental information for this quantitative study was gathered from respondents using a questionnaire as part of a survey procedure. A five-point Likert scale, with the

anchors "strongly disagree" (1) and "strongly agree" (5), was used to design the questionnaire. Meanwhile, the pilot study is a small-sized study or pre-test of a questionnaire to discover any mistakes during the test. Moreover, there is a certain number of small groups of the target population. The size of the sample pilot test, which should be in the range between 10 to 50, whereby provides greater practical advantages. Therefore, the researcher used 50 respondents for pilot testing for this study. Subsequently, the collected data underwent analysis and testing using Cronbach's alpha coefficient to offer insights into the reliability and internal consistency of the study. In addition, the research uses SPSS software to analyze the data, and get the value of Cronbach's alpha (α) for four variables.

3.2. Research Instrument

The survey utilizes quantitative method to employ a questionnaire as its primary data collection tool, encompassing various aspects. It covered demographic information, green marketing related to green pricing, transparency, scepticisms, and consumer purchase behaviour. Specifically designed for consumers in Johor with purchasing power or prior experience of buying green products, the survey utilized a single set of structured questionnaires featuring a 5-point Likert scale to gather data. Each section of the questionnaire provided clear instructions to enhance respondent comprehension and facilitate accurate completion. Table 1 below illustrates the measurement items and measuring statements.

Table 1: Measurement Items of the Construct

Construct	Item code	Statements	Method of reliability assessment in past research
Green Price	GP1	I will buy green product because the price is acceptable.	Cronbach's alpha
	GP2	I will buy green product even though the price is more expensive than other brands.	
	GP3	The price of green product is worth to the quality.	
	GP4	I may not buy the green product with higher price.	
Green Transpa-rency	GT1	Green brands clearly explain how they control production-related pollution that could harm the environment.	Cronbach's alpha
	GT2	The green environment gave us the information we needed to figure out how its production processes affect the environment.	
	GT3	The green brand tells you what you need to know about the environmental issues that come up during its production.	
	GT4	Customers are given clear and complete information about how green brand cares about the environment.	
Green Scepticism	GS1	Most environmental claims made on green branded product or in advertising are true.	Cronbach's alpha
	GS2	Environmental claims are inaccurate; consumers would be better off if such claims for green branded product in advertising were eliminated.	
	GS3	Most environmental claims for green branded product or in advertising are intended to mislead consumers.	
	GS4	I do not believe most of the environmental claims made for green branded product or in advertising.	
Consumer purchase behaviour	CPB1	I intend to purchase green products in the future because of its environmental concern.	Cronbach's alpha
	CPB2	I expect to purchase green products in the future because of its environmental performance.	
	CPB3	I am glad to purchase green products in the future because it is environmentally friendly.	

3.3. Pilot Data Collection and Analysis

This study adopts a quantitative method and selects raw data to collect relevant data from consumers who have purchasing power or experience in purchasing green products. Furthermore, the questionnaire is crafted through Google Forms and will be distributed via a display QR code to consumers who have experience purchasing green products or entered stores that implementing green marketing and initiatives in Johor, Malaysia. Subsequently, the collected data will be analyzed and tested by using Cronbach's alpha coefficient. Cronbach's alpha tests are instrumental in assessing the reliability of Likert scale surveys with multiple questions, offering insights into the internal consistency of the study [14]. As advocated by Sekaran (2003), a test value exceeding 0.7 is considered indicative of reliability and internal consistency. Conversely, values below 0.6 are deemed poor, while those ranging from 0.8 to 0.9 are regarded as good. In essence, higher Cronbach's alpha values correlate with increased scale reliability.

4. RESULTS AND DISCUSSION

This study examines the reliability of various constructs related to green marketing, specifically green price, green transparency, green scepticism, and consumer purchase behavior. Reliability analysis was conducted using Cronbach's Alpha, a measure of internal consistency. Table 2 below illustrates the results of reliability and validity for four variables.

Table 2: Construct Reliability and Validity Results

Construct	Items	Cronbach's alpha (α)
Green Price	GP1 GP2 GP3 GP4	0.870
Green Transparency	GT1 GT2 GT3 GT4	0.863
Green Scepticism	GS1 GS2 GS3 GS4	0.858
Consumer Purchase Behavior	CPB1 CPB2 CPB3	0.863

Table 2 shows the level of reliability for green price, green transparency, green scepticism after the pilot test of 12 statements in total. Meanwhile, the value of Cronbach's Alpha towards green price of four statements is 0.870. According to Sekaran (2003), it is evident that the values between 0.8 and 0.9 are regarded as good, which means the statements of the questionnaire for green price are reliable. Meanwhile, green price refers to the monetary cost associated with environmentally friendly products or services. A high alpha indicates that the items used to measure this construct reliably capture variations in respondents' perceptions of the price of green products. Furthermore, the value of Cronbach's Alpha of green transparency in the total of four statements is 0.863, whereby the value is in the range between 0.8 and 0.9. Similarly, the high Cronbach's alpha for green transparency indicates that the items measuring transparency related to environmental practices are reliable. Moreover, the Cronbach's alpha value of green scepticism with 0.858 indicates a high level of internal consistency in the items used to measure green scepticism. Green scepticism refers to the degree to which consumers doubt the environmental claims or motives of companies. Therefore, the high alpha value illustrates that the items reliably measure the level of scepticism among respondents towards green marketing and eco-friendly claims. Eventually, the Cronbach's Alpha value for consumer purchase behavior is 0.863, which indicates that the items measuring consumers' actual buying behavior regarding green products or services are reliable. Consequently, four scales from the research instruments had good reliability and consistency.

At the same time, high Cronbach's alpha values for all four constructs suggest that the scales used in the study are internally consistent and reliable measures of the respective concepts. This reliability is essential to ensure the validity of any conclusions drawn from the data. In terms of green policies and practices, these results suggest that consumers may consider both price and transparency of environmentally friendly products when making purchasing decisions. However, the existence of green scepticism suggests that consumers may treat green marketing claims with some degree of caution or scepticism. From a policy perspective, these findings underscore the importance of transparency in green marketing and the need for companies to effectively communicate their environmental efforts to build consumer trust. Furthermore, removing consumer suspicion through credible and transparent green practices may lead to more people adopting environmentally friendly products and behaviours.

5. CONCLUSION

Overall, the high reliability of the scales used to measure green price, green transparency, green scepticism, and consumer purchase behaviour underscores the importance of these constructs in understanding consumer behaviour towards environmentally friendly products. Future studies could further explore the relationship between these variables and investigate additional factors influencing green consumerism, such as demographic characteristics, environmental attitudes, and marketing strategies. Additionally, longitudinal studies could track changes in consumer behaviour over time in response to evolving green policies and market dynamics.

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INOVASI DIGITAL DALAM PENGURUSAN PENGANUGERAHAN GRADUAN PROGRAM PROFESIONAL UTMSPACE

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ABSTRAK– Sistem penganugerahan dan pengesahan kehadiran konvokesyen adalah penting bagi sesebuah institusi pendidikan. Ini adalah bagi memastikan pengumpulan data graduan untuk tujuan penganugerahan dapat dilakukan dengan tepat dan bersistematik oleh semua pihak yang terlibat. Kaedah untuk merekodkan data graduan sebelum ini adalah secara manual dengan menggunakan *Microsoft Excel dan Google Form*. Sejajar dengan misi tersebut, Pusat Pendidikan Profesional Berterusan (PPPB), UTMSPACE telah mengambil langkah proaktif dengan membangunkan satu sistem yang dipercayai mampu merealisisasikan hasrat yang telah digariskan dalam proses pelaksanaan penganugerahan graduan. Adalah diharapkan sistem ini mampu menjadikan proses permohonan penganugerahan dan pengesahan kehadiran graduan UTMSPACE ke Majlis Konvokesyen UTMSPACE ke arah yang lebih efisien dengan risiko yang minimal. Di samping itu, peningkatan graduan setiap tahun juga dilihat sebagai salah satu faktor penyumbang utama ke arah pembangunan sistem ini bagi menambah baik sistem sedia ada.

Kata Kunci: Konvokesyen; Inovasi Digital; Graduan UTMSPACE

1. PENGENALAN

Majlis Konvokesyen UTMSPACE dahulu dikenali sebagai Majlis Penyampaian Program Eksekutif dan Profesional UTMSPACE. Mulai tahun 2022, pihak pengurusan UTMSPACE telah bersetuju untuk menggunakan nama baharu iaitu Majlis Konvokesyen UTMSPACE. Graduan UTMSPACE yang berkelayakan, akan dianugerahkan sijil pada Majlis Konvokeyen UTMSPACE. Secara purata, jumlah graduan UTMSPACE bagi setiap tahun melebihi 1300 orang. Bagi menghadiri Majlis Konvokesyen UTMSPACE ini, terdapat beberapa proses penting yang perlu dipatuhi oleh setiap graduan. Data dan senarai graduan akan dikeluarkan melalui sistem akademik iaitu e-Teams. Namun begitu, sistem ini tidak boleh diakses oleh pelajar atau graduan UTMSPACE kerana terhad kepada pentadbir UTMSPACE dan Rakan Kerjasama sahaja. Oleh yang demikian, data yang diperolehi melalui sistem e-Teams ini berkemungkinan besar akan berlaku ralat terutama pada nama, nombor kad pengenalan dan program.

Lazimnya, pentadbir UTMSPACE perlu memaklumkan kepada Rakan Kerjasama untuk menyemak maklumat graduan yang akan diberikan. Selepas semakan dibuat, graduan perlu membuat pengesahan kehadiran mereka ke Majlis Konvokesyen melalui *Google Form*. Pengumpulan data melalui *Google Form* akan disemak oleh pentadbir UTMSPACE secara manual dengan menggunakan Microsoft Excel bagi membuat tapisan. Kaedah ini mempunyai banyak kelemahan seperti berlaku pertindihan data dan proses ini memerlukan masa yang lama.

Untuk mengatasi dan memudahkan proses ini, pihak UTMDigital selaku penyedia platform sistem graduan di peringkat UTM, telah mencadangkan untuk menggunakan sistem i-Convo namun terdapat kekangan dan kelemahan iaitu kesukaran mendapatkan akses dan komunikasi antara pihak UTMSPACE dan UTMDigital. Sistem i-Convo ini juga digunakan oleh program perdana di UTM. Sistem akademik yang digunakan oleh UTM berbeza dengan program profesional UTMSPACE dan akan menyebabkan kekeliruan di antara program perdana dan program profesional. Paparan maklumat di dalam sistem i-Convo tidak dapat diakses sepenuhnya oleh Graduan UTMSPACE.

Oleh itu, bagi mengatasi kekangan sistem ini iaitu dari segi pengurusan data dan masa, sistem bersekutu akan dibangunkan bagi membantu pentadbir UTMSPACE, Rakan Kerjasama dan graduan dalam proses menghadiri Majlis Konvokesyen UTMSPACE. Sistem ini akan digunakan oleh graduan program profesional UTMSPACE.

2. KAJIAN LITERATUR

2.1 Inovasi Digital

Kita kini berada dalam zaman era teknologi atau digitalisasi. Dari semasa ke semasa, penggunaan teknologi maklumat semakin berkembang selari dengan kemajuan sesebuah negara. (Simon, Helen & Morshidi, Azizan, 2017). Perkembangan ini telah dipengaruhi masyarakat dunia. Ia menjadikan teknologi maklumat itu semakin penting yang melibatkan aktiviti merekod, mengurus dan menganalisis. (Munohsamy, 2014).

2.2 Sistem Bersepadu

Dalam membantu meningkatkan prestasi sesebuah organisasi, penggunaan sistem maklumat adalah satu keperluan bagi aktiviti pengurusan dan pentadbiran. (Baharudin, R., 2016). Sistem Pengesahan Kehadiran Konvokesyen adalah satu sistem yang telah dibangunkan bagi menguruskan pengesahan kehadiran Majlis Konvokesyen di kalangan graduan UTMSPACE. Tujuan sistem ini diwujudkan adalah bagi memastikan pentadbir,

Rakan Kerjasama dan graduan memiliki akses kepada pangkalan data bagi memastikan semakan maklumat dan butiran berkaitan penganugerahan dapat dilakukan dengan lebih efisien dan seterusnya proses pengesahan kehadiran graduan ke Majlis Konvokesyen dapat dilakukan serta merta.

3. METODOLOGI

Metodologi bagi kajian ini adalah dengan memberi penerangan tentang sesuatu sistem itu dapat dibangunkan iaitu dengan menggunakan Model *Software Development Life Cycle (SDLC)* sepertimana yang ditunjukkan pada Rajah 1, di mana pembangunan sistem ini yang dilakukan secara teratur dan sistematik. Bagi meminimumkan kadar kesilapan sepanjang proses pembangunan sistem ini, perbincangan dan perancangan yang teliti amat ditekankan. Rangka kerja pembangunan sistem juga dibincangkan secara teliti bagi mengenalpasti peranan terperinci pengguna sistem tersebut.

3.1. *Software Development Life Cycle (SDLC)*

Rajah 1: *Software Development Life Cycle (SDLC)*

i. Perancangan dan kajian awal

Dalam fasa ini, perancangan dan kajian awal dilakukan untuk membangunkan sistem pengesahan kehadiran konvokesyen bagi memudahkan pentadbir, Rakan Kerjasama dan graduan untuk mengakses sistem ini. Fasa ini melibatkan proses mengenal pasti pernyataan masalah, iaitu mendapatkan maklumat perjalanan sistem pengurusan pengesahan kehadiran yang dijalankan secara manual.

ii. Analisis

Fasa analisis akan dijalankan bagi menganalisis keperluan sistem. Ini akan melibatkan kajian dan perancangan pembangunan sistem. Fasa ini juga akan menerangkan tentang sistem sedia ada iaitu sistem e-Konvo dan i-Convo yang dibangunkan oleh pihak UTMDigital agar penambahbaikan sistem dapat dilaksanakan. Perkara yang perlu dilakukan di dalam fasa ini ialah menganalisis keperluan pengguna serta sistem yang akan dibangunkan. Ini dibuat bagi melihat keberkesanan sistem tersebut kepada semua pihak yang terlibat.

iii. Rekabentuk

Antara perkara yang perlu dilaksanakan dalam fasa ini adalah menghasilkan reka bentuk pangkalan data, reka bentuk antara muka pengguna serta spesifikasi output. Pembangun sistem mereka bentuk prosedur kemasukan data yang tepat supaya data yang digunakan di dalam sistem maklumat adalah betul. Paparan yang direka bentuk bertindak sebagai perantara di antara pengguna dengan sistem dan bertujuan memudahkan pengguna menggunakan sistem tersebut.

iv. Pengujian dan Pelaksanaan

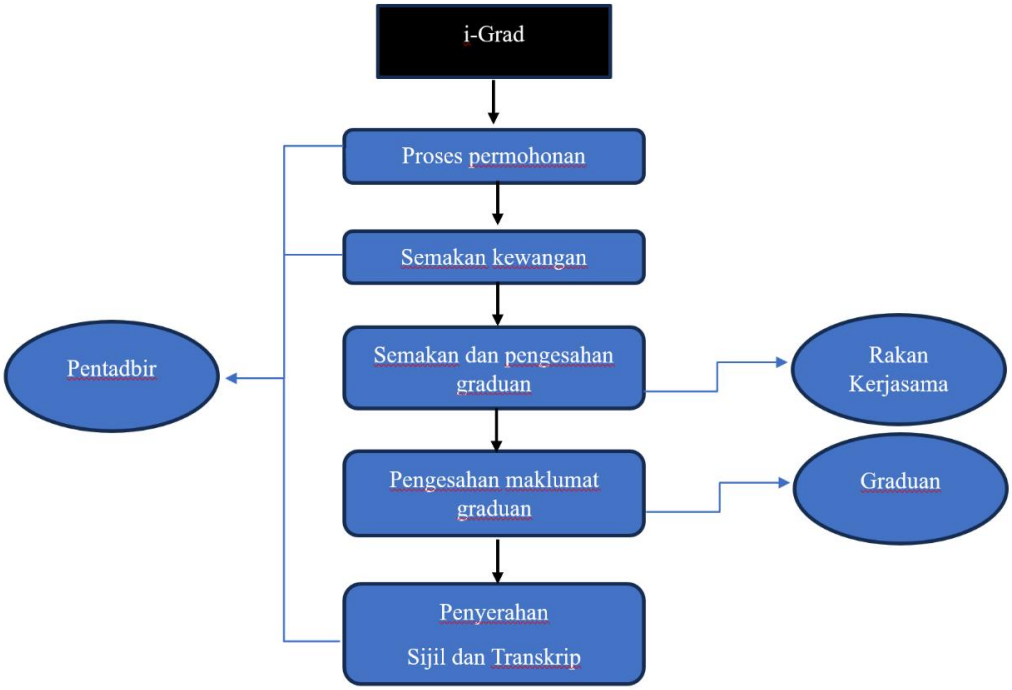
Fasa pelaksanaan melibatkan pembangunan sistem sebenar di mana pembangunan aturcara sistem akan dilaksanakan menggunakan perisian yang bersesuaian iaitu perisian PHP dan MySQL sebagai pangkalan data. Pembangunan pangkalan data bagi sistem perlu dilaksanakan dengan teliti kerana pangkalan data merupakan tunjang kepada sesebuah sistem untuk berfungsi dengan baik. Selain itu fasa ini turut melibatkan proses pengujian aturcara dan pengujian sistem. Proses pengujian juga dibuat supaya ralat dan kelemahan pada sistem dapat dikenal pasti agar sistem dapat diperbaiki.

v. Penyelenggaraan

Fasa penyelenggaraan SDLC berlaku selepas sistem beroperasi sepenuhnya. Penyelenggaraan sistem adalah termasuk peningkatan perisian dan pembaikan perisian jika ia rosak. Aplikasi perisian perlu dinaik taraf dari semasa ke semasa berdasarkan keperluan.

3.2. Proses Kerja Sistem

Proses kerja sistem yang teliti perlu diwujudkan bagi memastikan pengguna mempunyai kefahaman yang tinggi dari sudut penggunaan dan pengaplikasian. Ini bagi memastikan sistem yang dibangunkan adalah mesra pengguna dan efektif pada masa yang sama. Bagi tujuan kajian ini, rangka kerja pembangunan sistem melibatkan proses permohonan, semakan kewangan, semakan dan pengesahan graduan, pengesahan maklumat graduan dan penyerahan sijil dan transkrip graduan. Setiap pengguna sistem mempunyai peranan masing-masing seperti yang ditunjukkan dalam Rajah 2.



Rajah 2: Proses dan peranan pihak yang terlibat

Rajah 2 menunjukkan proses dan peranan pihak yang terlibat:

3.2.1 Pentadbir

3.2.1.1 Proses permohonan

- Menerima permohonan penganugerahan yang dilengkapkan oleh graduan daripada Rakan Kerjasama.
- Membuat semakan kelayakan graduan untuk pengesahan data dalam i-Grad.

3.2.1.2 Semakan kewangan

Membuat semakan kewangan ke atas setiap graduan untuk pengesahan Rakan Kerjasama.

3.2.1.3 Penyerahan sijil dan transkrip

Sijil dan transkrip akan diserahkan selepas Majlis Konvokesyen sekiranya graduan tiada tunggakan.

3.2.2 Rakan Kerjasama

3.2.2.1 Semakan dan Pengesahan Graduan

Membuat semakan dan status kewangan setiap graduan untuk pengesahan graduan.

3.2.3 Graduan

3.2.3.1 Pengesahan Maklumat Graduan

Membuat semakan dan pengesahan maklumat graduan.

4. KEPUTUSAN DAN PERBINCANGAN

Tujuan utama sistem ini dibangunkan adalah bagi menambahbaik sistem sedia ada pengurusan konvokesyen graduan UTMSPACE yang dilakukan secara manual kepada sistem digital yang dipercayai lebih bersistematik dan efisien. Sistem ini adalah untuk memudahkan proses pengurusan Majlis Konvokesyen di kalangan graduan UTMSPACE. Bagi mengukur keberhasilan sistem ini, uji lari dan tinjauan responden di kalangan Rakan Kerjasama dan graduan terhadap penggunaan sistem ini telah dilaksanakan. Seramai 30 Rakan Kerjasama dan 485 graduan telah berjaya memberi maklum balas terhadap sistem ini.

4.1. Semakan Data Graduan

4.1.1 Semakan data graduan secara manual (MS Excel) lebih mudah

Jadual 1. Semakan data graduan secara manual

Ya	25
Tidak	5

4.1.2 Paparan sistem i-Grad lebih menarik dan mudah digunakan

Jadual 2. Paparan sistem i-Grad

Ya	30
Tidak	0

4.2. Status Kewangan Graduan

4.2.1 Status kewangan graduan lebih mudah disemak

Jadual 3. Status kewangan graduan

Ya	30
Tidak	0

Jadual 1, Jadual 2 dan Jadual 3 adalah respon daripada Rakan Kerjasama selepas pihak UTMSPACE mengeluarkan data graduan di dalam sistem. Hasil tinjauan terhadap Rakan Kerjasama ditunjukkan dalam Jadual 1 di mana 5 Rakan Kerjasama lebih suka menyemak senarai graduan secara manual iaitu menggunakan *MS Excel* manakala 25 Rakan Kerjasama lebih suka menggunakan sistem i-Grad ini. Berdasarkan Jadual 2, semua Rakan Kerjasama iaitu 30 Rakan Kerjasama yang membuat tinjauan telah memberikan maklum balas yang positif di mana paparan sistem i-Grad mudah dan jelas. Jadual 3 menunjukkan 30 Rakan Kerjasama lebih cenderung dan lebih mudah membuat semakan kewangan graduan di dalam sistem i-Grad.

4.3. Semakan Maklumat Graduan

4.3.1 Semakan maklumat graduan lebih mudah

Jadual 4. Semakan maklumat graduan

Ya	432
Tidak	53

Sementara itu Jadual 4 menunjukkan sebanyak 89% graduan bersetuju bahawa semakan maklumat graduan lebih mudah. Hal ini menunjukkan graduan lebih cenderung dengan penggunaan sistem i-Grad.

5. KESIMPULAN

Penggunaan sistem digital yang terhasil ini menunjukkan pengurusan permohonan penganugerahan serta proses pengesahan kehadiran graduan ke Majlis Konvokesyen UTMSPACE didapati lebih sistematik dan efisien. Peranan pihak yang terlibat dalam proses pengurusan penganugerahan ini iaitu pentadbir UTMSPACE, Rakan Kerjasama dan graduan dilihat lebih jelas dan teratur. Selain daripada itu, maklum balas yang positif juga diperolehi daripada pentadbir UTMSPACE, Rakan Kerjasama serta graduan terlibat.

PENGHARGAAN

Kajian ini berjaya dijalankan melalui suntikan Dana Pembangunan Berpotensi 2022 UTMSPACE di bawah kawal selia Bahagian Pengurusan Penyelidikan dan Sumber Pembelajaran, SPACE Kod Projek SP-PDF2208.

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GOOD GOVERNANCE AND INTEGRITY: A HOLISTIC APPROACH

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ABSTRACT - This paper explores the principles of good governance and the role of integrity in organizational success. Through an extensive literature review, we examine the impact of governance structures and ethical standards on organizational performance and stakeholder trust. The study provides insights into best practices for fostering governance and integrity and highlights the importance of these factors in achieving long-term sustainability and success. Recently, good governance has been frequently discussed in the field of administration, where it functions as a new management approach that can positively impact the effectiveness of the public sector. For Malaysians, it is crucial to understand the complex and subjective concept of good governance. The United Nations Development Program (UNDP) defines governance as "the implementation of economic, political, and administrative authority to manage a country's affairs at every level." Integrity, on the other hand, can be defined as honesty, sincerity, and wholeness (Graham, 2021). These two elements are vital to ensure that an organization can stand firmly on the world stage. This article aims to identify the principles of good governance and integrity in an organization, highlight their importance for the development of the country and society, and explore the challenges in strengthening and integrating these concepts into organizations. The findings of this study can contribute to various stakeholders in building a new model of good governance and integrity in an organization.

Keywords: Good Governance, Integrity.

ABSTRAK *- Artikel ini bertujuan untuk meneroka prinsip tadbir urus yang baik dan peranan integriti dalam kejayaan organisasi. Melalui kajian literatur yang meluas, kami mengkaji kesan struktur tadbir urus dan piawaian etika terhadap prestasi organisasi dan kepercayaan pihak berkepentingan. Kajian ini memberikan pandangan tentang amalan terbaik untuk memupuk tadbir urus dan integriti dan menyerlahkan kepentingan faktor-faktor ini dalam mencapai kemampanan dan kejayaan jangka panjang. Sejak kebelakangan ini, tadbir urus yang baik sering diperkatakan dalam bidang pentadbiran, di mana ia berfungsi sebagai pendekatan pengurusan baharu yang boleh memberi impak positif kepada keberkesanan sektor awam. Bagi rakyat Malaysia, adalah penting untuk memahami konsep tadbir urus yang baik yang kompleks dan subjektif. Program Pembangunan Pertubuhan Bangsa-Bangsa Bersatu (UNDP) mentakrifkan tadbir urus sebagai "pelaksanaan kuasa ekonomi, politik, dan pentadbiran untuk menguruskan hal ehwal negara di setiap peringkat." Integriti pula boleh ditakrifkan sebagai kejujuran, keikhlasan, dan keutuhan (Graham, 2021). Kedua-dua elemen ini penting untuk memastikan sesebuah organisasi dapat berdiri teguh di persada dunia. Artikel ini bertujuan untuk mengenal pasti prinsip tadbir urus yang baik dan integriti dalam sesebuah organisasi, menonjolkan kepentingannya untuk pembangunan negara dan masyarakat, dan meneroka*

cabaran dalam mengukuhkan dan menyepadukan konsep ini ke dalam organisasi. Dapatan kajian ini boleh menyumbang kepada pelbagai pihak berkepentingan dalam membina model baharu tadbir urus yang baik dan berintegriti dalam sesebuah organisasi.

Kata Kunci: *Tadbir Urus Baik, Integriti.*

1. INTRODUCTION

Good governance and integrity are critical components of organizational success. Governance refers to the framework of rules, practices, and processes by which an organization is directed and controlled (Tricker, 2015). Good Governance has received widespread attention and is a key topic in policy discussions and scholarly research across many countries (Sari, 2023). Good governance encompasses various concepts. According to Malik and Mat (2016), governance refers to a mechanism administrative system that develops the country and provides ample space for the people to experience it. It includes all mechanisms in public administration, economics, and law. The government seeks to enhance the effectiveness and efficiency of public administration through a dedicated effort to strengthen principles of good governance, accountability and meticulousness (Jones et al., 2018; Smith, 2015). This purpose aimed to corporatize public agencies, introducing a structured governance framework to streamline operations and minimize bureaucratic hurdles. As a result, leaders are expected to exemplify good governance practices, setting benchmarks for both public and private sectors (Brown & Jones, 2016).

Integrity involves adherence to ethical principles and standards, ensuring honesty, transparency and accountability (Paine, 2018). According to Herasymiuk et al., (2020), the core values of integrity include independence, impartiality, reliability, caution, and personal. Despite the recognized importance of good governance and integrity, many organizations struggle to implement these principles effectively. This can lead to issues such as corruption, fraud, and loss of stakeholder trust, ultimately harming organizational performance and sustainability (de Graaf & Huberts, 2020).

The United Nations Economic and Social Commission for Asia and the Pacific presents a model of good governance consisting of eight component such as (1) participation: informed and organized participation, directly or indirectly through legitimate intermediaries or democratic representatives;(2) compliance with the law: ensuring fairness, full protection of human rights, and law enforcement with an independent judiciary;(3) transparency: enforcement must follow rules and laws; (4) responsibility: institutions must serve all stakeholders responsibly; (5) consensus-oriented: good governance requires understanding the historical, cultural, and social context for sustainable development; (6) equity and inclusion: ensuring all members of society have rights and opportunities; (7) effectiveness and efficiency: processes and institutions must

meet society's needs using available resources efficiently; (8) accountability: leadership accountability depends on whether decisions or actions are internal or external to the organization (UNESCAP, 2021). This model aims to minimize corruption, consider minority views and include the community's strong voice in decision-making.

Integrity plays a pivotal role in fostering an efficient and disciplined public administration and service, imbuing ethical values to address challenges and deficiencies across governmental spheres such as financial management, disciplinary proceedings, corruption and abuse of power. Trust, transparency, accountability and dedication to public welfare are integral components of integrity (Megat & Abd, 2020). Scholars emphasize integrity's significance in ethical decision-making (Widang & Fridlund, 2019), its role in promoting ethical standards (Mahathir, 2018) and its contribution to ensuring proper conduct (Mustafa, 2018).

However, the integrity aspect is seen as increasingly diminished today, with many unethical behaviors by public service personnel, including involvement in corruption, embezzlement, breach of trust and degradation of service quality (Daud & Nazri, 2019). This contradicts the original objective of establishing government organizations, which is to meet the needs of the people and the country. To achieve this objective, a high-integrity public service delivery system is needed. Therefore, the good governance system needs careful scrutiny to ensure it functions perfectly.

2. LITERATURE REVIEW

2.1. Concept of Good Governance

Good governance is a fundamental requirement for both national and civil society organizations aiming to achieve their objectives effectively. The term 'good governance' was first introduced in 1989 by Barber Conable, the former president of the World Bank, who defined it as involving efficient public services, a dependable justice system, and accountable administration (World Bank, 1989). This concept emerged from the World Bank's report 'Governance and Development' (The World Bank, 1994), which describes governance as 'the exercise of political authority and the use of institutional resources to manage a country's affairs.' Good governance entails implementing policies and practices that ensure the responsible management of resources according to established regulations. It embodies principles such as accountability, transparency, responsiveness, consensus-building, equity, justice, anti-corruption measures, and effectiveness in guiding organizational operations (Shipley & Kovacs, 2021; United Nations Economic & Social Commission for Asia and the Pacific, 2023). Essentially, good governance refers to how

public institutions manage public affairs, handle resources, and uphold human rights while striving to minimize abuse and corruption, and uphold the rule of law. Assessing governance practices allows stakeholders to evaluate and improve the performance of public administration agencies more effectively. Table 2.1 below is explained the concept of good governance used by various parties in the world.

Table 2.1: Definition of Good Governance

Diversity of World Parties Definition of Good Governance World Banks	**Definition of Good Governance**
World Banks	Good governance means being identified with good development management." The Bank "identifies four areas of consistent governance that are in line with the World Bank's wishes: public sector management, accountability, legal framework for development, information and transparency, voice and accountability; stability and lack of violence; regulatory framework; government effectiveness; corruption control; rules of law. World Bank. Reforming Public Institutions and Strengthening Governance: A World Bank Strategy. Washington, DC: World Bank.2000
Asian Development Bank (ADB)	The concept of good governance "focuses on the ingredients for effective management." "It's about the norms of behavior that help ensure that governments actually deliver to their citizens what they say they will deliver." The Bank has identified four principles of good governance: accountability, participation, predictability, and transparency. Asian Development Bank. Governance: Sound Economic Management, August 1995
African Development Bank	Good governance should include "accountability, transparency, anti-corruption, stakeholder participation, and enabling legal and judicial frameworks." African Development Bank. Governance Strategic Directions and Action Plan Gap 2008-2012, 2008, 15

International Monetary Fund(IMF)	"Transparency of government accounts, effectiveness of public resource management, stability and transparency of the economic environment and regulations for private sector activities." IMF. Good Governance: The IMF's Role, August 1997, iv, 3.
United Nations	
United Nations	Institutional openness and accountability, including Parliament; Election; Freedom of information; Legal regulations; Fighting Corruption; Formation of the Constitution. UN website. 'Governance'. https://www.un.org/ruleoflaw/thematicareas/governance/good-governance/
United Nations Development Programme(UNDP)	Good governance or democracy as we call it at UNDP, requires meaningful and inclusive political participation - in essence, people having more voice in all the decisions that shape their lives
Bilateral agencies	
United States (USAID)	Democratic Government; Participation; Fair Competition; Civil Society and Independent Media; Justice. USAID. 'Democracy and Governance', http://www.usaid/gov/our_work/democracy_and_governance/

Source: Xiuling Zhang, 2019

2.2 Concept of Integrity

Integrity is the key to achieving quality work involving individuals' or organizations' obligations based on integrated and comprehensive work characteristics (Megat & Abd, 2016). A person with integrity demonstrates noble character and practices pure values cohesively in individuals and organizations (Thulasimani, 2015). Integrity, as one of the principles of good governance, aims to ensure the country's governance system achieves desired targets.

Integrity can be defined as honesty, sincerity and wholeness (Graham, 2021). Simons (2020) describes integrity behaviour as "the perceived pattern of coordination between the words and actions of the perpetrator." In workplace relationships, alignment between a

leader's words and actions influences followers' integrity. Integrity involves consistency between words and actions, adherence to moral, ethical and legal principles, prioritizing public interest and delivering quality work.

According to the Megat & Abd, (2020), there are several components in integrity such as (1) Trust: trust is the foundation of any successful organization. It involves confidence in the reliability, honesty, and competence of individuals and institutions; (2) Transparency: transparency refers to openness and clarity in organizational processes, decision-making and communication. Transparent practices include disclosing information, sharing data and making operations visible to stakeholders; (3) Accountability: accountability ensures that individuals and organizations are responsible for their actions and decisions. It involves answering for one's conduct, complying with rules and being answerable to stakeholders. It also will enhance trust and promotes ethical behaviour; (4) Dedication to Public Welfare: dedication to public welfare means prioritizing the well-being of citizens and communities. Organizations committed to public welfare focus on delivering services, promoting fairness and addressing societal needs. This dedication aligns with integrity by emphasizing ethical service delivery.

In summary, integrity encompasses trust, transparency, accountability, and a genuine commitment to public welfare. Organizations that uphold these components contribute to a healthier, more effective society.

3. RESULTS AND DISCUSSION

Numerous studies have examined the relationship between governance, integrity and organizational performance. Research has shown that organizations with strong governance structures and high levels of integrity tend to perform better financially and have higher levels of stakeholder trust (García-Sánchez & García-Meca, 2018). For example, studies have found that transparency in financial reporting and adherence to ethical standards are associated with improved financial performance and reduced risk of fraud (Khan & Gray, 2018).While there is extensive research on the importance of good governance and integrity, there are still gaps in understanding how these principles can be effectively implemented in different organizational contexts. Additionally, more research is needed to explore the impact of governance and integrity on specific outcomes, such as employee satisfaction and innovation (Eisenbeiss, 2019).

In this discussion, we delve into the core aims of this article, which are to identify the principles of good governance and integrity in organizations, highlight their importance

to national development and societal progress and explore the challenges and obstacles in strengthening and integrating these principles into organizational practices.

Identifying Principles of Good Governance and Integrity

Good governance encompasses several key principles that are essential for organizational effectiveness and ethical conduct. These principles include accountability, transparency, fairness, rule of law, participation, and consensus orientation (United Nations, 2004). Integrity, on the other hand, involves honesty, consistency in actions and values, and adherence to ethical standards (Graham, 2021). By identifying and implementing these principles, organizations can establish a framework that promotes trust among stakeholders, enhances decision-making processes, and fosters sustainable development.

Importance of Good Governance to Development

The significance of good governance extends beyond organizational boundaries to influence the broader development of countries and societies. Research has shown that countries with strong governance frameworks experience higher levels of economic growth, social stability and public trust (Kaufmann et al., 2010). Effective governance practices attract foreign investments, promote innovation and ensure equitable distribution of resources, thereby contributing to overall societal well-being and progress.

Challenges and Obstacles in Strengthening Good Governance and Integrity

Despite its benefits, integrating and strengthening good governance and integrity practices in organizations face numerous challenges. These challenges include resistance to change within organizational cultures, inadequate enforcement mechanisms, political interference and complexities in balancing stakeholder interests (Cherrington, 2019; Shipley & Kovacs, 2021). Moreover, global trends such as digital transformation and globalization present new challenges in maintaining data security, ethical standards in AI and managing international regulations.

4. CONCLUSION

In conclusion, this discussion highlights the pivotal role of good governance and integrity in organizational success, national development and societal advancement. By focusing on these principles, organizations can foster a culture of transparency, accountability and ethical conduct, thereby contributing to sustainable growth and social cohesion. Addressing the challenges and obstacles requires a concerted effort from leaders, policymakers and stakeholders to implement robust governance frameworks and uphold

integrity in all organizational practices. This discussion not only addresses the aims set out in the abstract but also integrates current research findings to provide a comprehensive overview of the principles, importance and challenges associated with good governance and integrity in organizations. Besides that, the study also will provide recommendations for organizations to improve their governance and ethical practices such as prioritize transparency and accountability the governance structures and promote ethical leadership to foster a culture of integrity.

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