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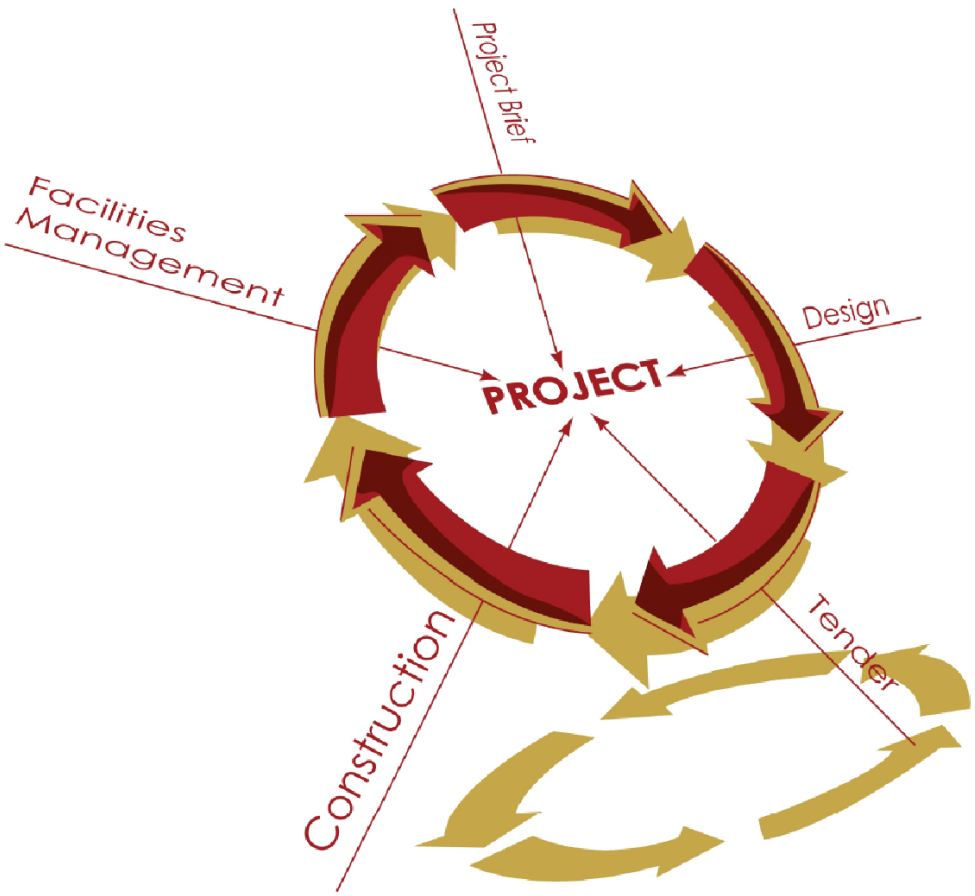

CREAM CONSTRUCTION RESEARCH INSTITUTE OF MALAYSIA
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Contents

Introduction

It is with great pleasure and anticipation that this special issue of the First ASEAN Quantity Surveying (AQSA) Academic Conference 2022 (AQSA 2022), in collaboration with Malaysian Construction Research Journal (MCRJ), is dedicated to the exploration and advancement of "Promoting Learning Through Common Shared Value, Knowledge-Sharing, and Best Practices". The co-organisers included the AQSA, the Royal Institution of Surveyors Malaysia (RISM), the Singapore Institute of Surveyors and Valuers (SISV), the Philippine Institute of Certified Quantity Surveyors (PICQS), Persatuan Ukur, Jurutera dan Akitek, Negara Brunei Darussalam (PUJA), and Ikatan Quantity Surveyor Indonesia (IQSI). As the world undergoes rapid transformations driven by technological innovation, societal changes, and global challenges, the need for rigorous scholarly inquiry becomes ever more imperative. The AQSA Academic Conference 2022 allowed for interaction and idea exchange among universities, research institutions, governments, industry, and experts from ASEAN countries.

This special issue brings together a diverse array of research papers and contributions that delve into the heart of contemporary issues within the realm of quantity surveying and academic community collaboration in education, research, and professional practice. The twenty (20) papers featured in this issue are the result of a rigorous peer review process, reflecting the highest standards of scholarship and innovation. Accepted papers covered seven (7) categories under built environment and engineering, including construction contract and procurement, economic and financial management, sustainability, project management, quality management, technology and innovation, and learning.

This special issue will serve as a valuable resource for academics, practitioners, and policymakers alike, fostering a deeper understanding of the complex challenges and opportunities associated with promoting learning through common shared values, knowledge sharing, and best practices. The research presented here will stimulate new ideas, encourage critical thinking, and contribute to the ongoing discourse that shapes the future of quantity surveying.

Editorial Advisory Board

Secretariat Special Issue

Editorial

Welcome from the Editors

Welcome to this special issue in the Malaysian Construction Research Journal (MCRJ) for the First ASEAN Quantity Surveying Association (AQSA) Academic Conference 2022 (AQSA 2022). We would like to express our sincere gratitude to our contributing authors, reviewers, organisers, and readers.

This special issue in MCRJ for AQSA 2022 contains twenty (20) exciting papers covering the theme of "Promoting Learning Through Common Shared Value, Knowledge-Sharing, and Best Practices". It is hoped that the readers will greatly benefit from the scientific content and quality of the papers published in this issue. A brief introduction to each article is given as follow:

Jaafar et al., have presented a study on the facilities for persons with disabilities at public hospitals. This study aims to explore the facilities needed by persons with disabilities (PWDs) in hospital buildings and investigate the availability of PWDs facilities provided in hospitals. The study employs a qualitative approach that was used for data collection, using observation with an audit checklist. Two (2) public hospital buildings in Kedah were selected as case studies and anonymously labelled due to privacy and confidentiality. The study concludes that only Hospital B had PWDs facilities that complied with all the required design criteria. This study highlights the significance of ensuring that PWDs facilities comply with the MS1184 criteria before construction.

Othman et al., have discussed the risk management plan process among service providers for clinical waste at hospital facilities. This study aims to identify the process of developing risk management plans among service providers for clinical waste in hospital buildings. The study uses a thorough qualitative method that uses semi-structured interviews and case studies. Four (4) hospital buildings were randomly selected as case studies, and service providers involved in managing and handling risk management plans will be interviewed. The study acknowledges eight (8) processes of the risk management plan; the findings show the process of the risk management plan used by service providers was the same and achieved the objectives; however, there are some differences in the system and software used.

Nizam Akbar et al., have discussed about developing a single common SMM for ASEAN countries might be a practical proposal that could be discussed and materialized. Referring to the philosophical aspects of the SMM, published and unpublished research indicate the presence of key players not underpinned by or committed to one standardized SMM. It was supported by informal exploratory study with few practitioners from ASEAN Countries. They claimed that in some countries, local SMMs are used or other countries' SMMs are adopted, while some countries do not have any SMM to be utilised. Literatures have indicated that there are many SMM versions produced using updated or amended UK SMMs. With the formation of ASEAN Quantity Surveyors Association (AQSA), the reason why a single SMM is needed can be easily justified, especially with the possibilities of cross-ASEAN Quantity Surveyors (QS) practice is highly anticipated and fully expanded. This paper emphasizes the need of having a single common SMM for AQSA to be accepted and

adopted by ASEAN practitioners. It is proposed that a focus group discussion to be held with various ASEAN participants. The results are expected to reveal SMM usage issues which will form the basis for the development of an SMM Framework. The proposed SMM framework is expected to be the first step in establishing collaboration between QS practices and academia in AQSA member countries before developing a single ASEAN-common SMM.

Zulkeflee et al., have examined the key factors of construction foreign workers' safety non-compliances in hesitance to change behaviour. The study aims to explore the fundamental key factors of construction foreign workers' safety non-compliance in the workplace. This study employs a qualitative approach through semi-structured interviews with nine (9) selected informants who are working closely with foreign workers at the operational level. The study highlights ignorance, negligence, overlooking, overconfidence, and misconception as the five (5) key factors of construction foreign workers' safety non-compliance at Malaysian construction sites. The factors are similar and capable of extending the Resisting to Change theory's original components. The study concludes that if these elements are thoroughly evaluated, it is possible to attain a high degree of safety compliance among foreign workers.

Mohd Roshdi et al., have highlighted the application of resource-based view theory on human behavioural strategies to organisational success in cost and project performance in the oil and gas industry. This study presents strategies for controlling the cost of resource allocation management at every human behavioural level involved in onshore fabrication projects. The data for the study were gathered from previous researchers' studies and literature reviews. The study reveals the primary relative importance of the theories underpinning, project management, resource allocation, activity identification, cost element attributes, and human behavioural strategies towards business profit. The study concludes that project management should establish effective project planning, management, and monitoring to improve project performance and control costs in resource allocation for onshore oil and gas fabrication projects.

Marhani et al., have emphasised the critical success factors of lean construction (LC) implementation in residential projects. This paper aims to identify critical success factors in LC implementation and make recommendations for improving successful LC implementation in residential projects. Quantifiable data was obtained from a survey of 104 registered Grade 7 contractors with the Construction Industry Development Board of Malaysia (CIDB). The study reveals four (4) critical success factors: management commitment, growth and market share, regular meetings, and a supportive environment for workforce efficiency. The study recommends employee skill development and productivity through on-the-job training and continuous learning, customised applicable lean practices, and increased transparency through effective communication and information sharing. The study concludes that LC can be successfully implemented for residential projects in Malaysia's construction industry.

Mohd Nor et al., have emphasised on the efficient closure as one of the mechanisms adopted to assess whether or not a specific construction project is successful in terms of its finance and management. This paper is written based on a thematic literature review made on the patterns and trends in final account publications align with the construction industry in Malaysia. ATLAS Ti 23 was adopted to synthesis publications from the year 2010 to 2021 which were gathered from recognised databases such as SCOPUS, Mendeley and Google

Scholar by using identified keywords. The findings of the code-to-document analysis revealed patterns and trends on publications discussing on final account. Accordingly, the results help to charter the route for future research on final account as it highlights the gap existed in areas which call for further investigation.

Md Anuar et al., have examined the maintenance management elements during the procurement stage of the private finance initiative (PFI) construction project. This study aims to identify the maintenance management elements during the procurement process of the PFI project. For this pilot study, a questionnaire survey was distributed to a maintenance practitioner, and the data gathered was analysed using Statistical Package for the Social Science (SPSS) software. The study highlights six (6) elements of maintenance management that need to be addressed during the procurement stage, which are facility management, performance management, output specification, tender, structure and framework, and finance. The study concludes that all six (6) elements are beneficial and can be used for future studies in both the public and private sectors.

Ishak et al., have discussed the best practices of construction waste minimisation and the challenges of implementing sustainable practices of construction waste management. This study aims to determine the best practices for construction waste minimisation and the challenges of implementing sustainable practices for construction waste management. The study conducted semi-structured interviews with six (6) construction practitioners. The study discovers six (6) factors contribute to waste minimisation, namely: 1) knowledge; 2) on-site practices; 3) material and equipment; 4) regulation; 5) human resource management; and 6) technology. The study addresses the challenges associated with implementing best practices in construction waste management to achieve sustainable development.

Mohamed Yusof et al., have studied waste management practices in higher educational institutions. This study aims to review higher educational institution practices and initiatives towards the management of solid waste in educational institution operations. The study reviews relevant literature by selecting established publishers using "waste management on university campuses" and "waste management in higher educational institutions" as keywords. The study provides a basis for understanding the concepts of the practice by identifying the practices of managing solid waste that are beneficial to the management of higher educational institutions to decide the suitable practices for their institutions.

Idris et al., have discussed about Innovative technologies or Construction 4.0 technologies that have already been in the construction industry for quite a while and innovative technologies are on different levels of maturity. Technologies such as BIM, Cloud Computing, and Modularisation have developed significantly while other technologies such as Augmented, Virtual and Mixed Reality are still being enhanced. Thus, the researchers piloted a study to examine the current implementation of innovative technologies with a small sample of decision makers of construction organisations within the Malaysian context before proceeding with the main data collection with a larger sampling size. Findings indicate that the current implementation of innovative technologies in the Malaysia Construction Industry is still low. Pilot study findings also suggest that Clients/Government need to change the norm of continuous search for the lowest price to award projects that limits creativity and critical thinking, to promote the use of innovative technologies. It can be concluded that the

Malaysian Construction Industry has yet to stretch out and comprehend the opportunity of the innovative technologies implementation.

Abdul Tharim et al., have investigated the influence of the pandemic outbreak on the employability of fresh graduates in the Malaysian construction industry. This study aims to identify factors influencing the demand for fresh graduates and to suggest strategies for enhancing employability among fresh graduates in the Malaysian construction industry during the pandemic outbreak. The study applies a quantitative method using a questionnaire survey. The study indicates that the factors influencing the demand for fresh graduates are graduate attributes, expectations of employers, employability skills, and external factors. The study reveals that employability strategies showed soft skill sets, graduate attributes, and curriculum design as strategies to charm employers. The study concludes that universities may better prepare graduates for the construction industry by incorporating practical learning, working with industry partners, improving employability skills, and adjusting to shifting hiring preferences from the epidemic age.

Saharuddin et al., have explored the critical challenges to implementing sustainable construction. This study aims to identify the critical challenges in implementing sustainable construction among contractors in Malaysia. The study conducts an extensive analysis of the literature on sustainable construction and the challenges to implementing sustainable construction. The study reveals that there are nine (9) challenges that are identified as the main contributing factors that hinder the implementation of sustainable construction. The study concludes that it can improve the current local sustainable construction practices, especially by ensuring that the contractors are exposed to the advantages and incentives given to sustainable construction practices in the country.

Mohamad Yassin et al., have determined the critical success factors of value management for sustainable public housing in Malaysia. This study aims to contribute to a better and more comprehensive understanding of value management's (VM) critical success factors (CSFs) for public housing projects. The study conducts a systematic literature review to better understand the key topics and employs a qualitative method involving semi-structured interviews with three (3) personnel from a VM consultant in Malaysia. The study concludes that stakeholders and knowledge, effective workshops, and culture and environment play a significant role in the implementation of VM. The study suggests the outcomes could be vital for the future framework of VM that can guide decision-makers looking to maximise value for money and improve sustainability in Malaysian public housing projects.

Saidan Khaderi et al., have studied cloud computing for better construction project management performance. This study aims to identify the awareness of construction practitioners about the implementation of cloud computing, examine the causes of the failure of cloud computing implementation in the construction industry, and investigate the effectiveness of cloud computing implementation towards better construction project management performances. The study conducted a quantitative method and descriptive analysis, which included frequency and mean scores, to interpret the data. The study shows that cloud computing effectiveness can be achieved through operational, financial, and environmental performance. The study concludes that cloud computing can contribute to high

productivity, a good financial return, and the efficiency and environmental efficiency of construction projects.

Ahmad Sekak et al., have examined the employers' expectations towards the soft skills competencies of quantity surveying graduates in Malaysia. This study aims to determine the soft skills development in Malaysia, the employer expectations of soft skills amongst QS graduates, and the challenges of soft skills amongst QS graduates. A set of questionnaires has been distributed to 132 registered quantity surveyor consultant firms in Selangor. The study reveals that the most preferred soft skills are willingness to learn and integrity skills, followed by ethical behaviour and teamwork skills. The study concludes that the soft skills competency of QS graduates in Malaysia should be reviewed and improved to cater to the construction industry's needs.

Mohd Noor et al., have discussed revolutionising quantity surveyors: unleashing competency in Construction 4.0. This study aims to develop a competency model for quantity surveyors equipped with the enabling technologies that have emerged in Construction 4.0. This pilot study conducted a quantitative survey approach by distributing questionnaires to 50 quantity surveyors using purposive sampling, and three key constructs were measured: i) non-technical competency, ii) technical competency, and iii) enabling technologies in Construction 4.0. The study indicates that a significant number of respondents acquired both technical and non-technical competencies. However, the integration of enabling technologies in Construction 4.0 was observed to be limited to specific technologies that are highly demanded and extensively utilised in quantity surveying practices. The study concludes that the outcomes are feasible and can proceed with the main data collection phase, which will involve a larger sample of targeted respondents.

Zairul Azidin et al., have identified the application of biophilic design concepts in the Malaysian construction industry from the architects' perspectives. This study intends to identify the application of biophilic design in a building and determine the importance of having biophilic design components in a building. Questionnaire surveys were distributed via an online platform to know in depth the application of the biophilic design concept and the importance of having it in a building in the Malaysian context. The study reveals that most of the respondents agreed that the biophilic design concept offers many benefits to buildings and their environment, especially in terms of health, both physically and mentally. The study highlights that the concept of biophilic design plays a vital role as a crucial element in the design of new project developments and is important in having a nature-concept relationship with humans.

Zainal Abidin et al., have investigated reconceptualising the construction project management body of knowledge for the Malaysian construction industry. This study re-examines the project life cycle, its various phases, and the associated activities within these phases. The study suggests that the project management Body of Knowledge (BoK) is optimally perceived through the lenses of both construction project management (CPM) and construction management (CM). Within CPM, there exist 24 distinct work processes spanning the five phases of inception, design development, tendering, construction, and closeout. On the other hand, CM comprises 13 work processes encompassing the stages of tendering, site mobilisation, construction, and handover. The study highlights a more comprehensive and

contextually grounded understanding of conceiving CPM, which is very significant for grasping the nuances of project management and its underlying processes.

Mohd Zaki et al., have studied the effectiveness of centralised labour quarters (CLQ) in Malaysian construction project. This study aims to investigate the standard guidelines for workers' accommodation and the features of the existing CLQ and to survey the construction workers' satisfaction with the quality of accommodations and facilities in the CLQ. This study adopts a mix of qualitative and quantitative measures through an interview session with the CLQ manager and a set of questionnaires distributed among the construction workers who live at the CLQ. The study reveals that the labourers that have been placed at the CLQ majority rated well on the amenities and facilities provided and eased their daily activities. Moreover, the best practices that have been adopted in CLQ are to maintain the facilities with a maintenance framework and follow standard operating procedures. The study concludes that shifting to CLQ may reduce risk, especially in terms of health, contagious disease, safety, security, and social aspects, and furthermore enhance labourers' productivity.

PERSONS WITH DISABILITIES FACILITIES AT PUBLIC HOSPITAL

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Abstract
A disability is any condition that causes difficulties for the person with any impaired condition to do certain activities compared to a person with a normal condition. The term refers to a range of human disabilities, including vision impairment, communication impairment, physical impairment, hearing impairment, mental disorder, multiple impairments, and learning disability. People with disabilities frequently encounter numerous problems, including the lack of access to facilities for people with disabilities in hospital buildings. There is a general dearth of Persons with Disabilities (PWDs) facilities. Even when available, the facilities often only cover some categories of PWDs. This paper aims to explore the facilities needed by PWDs in hospital buildings and investigate the availability PWDs facilities provided in hospitals. A qualitative approach was used for data collection, using an observation with an audit checklist. Two public hospital buildings in Kedah were selected as case studies and anonymously labelled due to privacy and confidentiality. The data collected were analysed using thematic analysis. This paper found that among the two hospital buildings (i.e., Hospital A and Hospital B), only Hospital B had PWDs facilities that complied with all the required design criteria. This study highlights the significance of ensuring that PWDs facilities comply with the MS1184 criteria before construction.

Keywords: *Disability; Facilities; Public Hospital*

INTRODUCTION

According to the Department of Social Welfare (2021), a disability is defined as a condition or function that is significantly impaired compared to the accepted standard of an average person. The term refers to a range of human disabilities, including physical impairment, sensory impairment, cognitive impairment, mental illness associated with intellectual disability, and various forms of chronic disease. Persons with Disabilities Act 2008 defines persons with disabilities (PWDs) as individuals with physical, mental, or intellectual disabilities that prevent them from fully participating in a normal way of life (Kamarudin et al., 2014; Mohd Isa et al., 2016).

PWDs encounter numerous problems in their lives. One of the ongoing challenges for PWDs is non-compliance with laws and regulations related to facility provision for PWDs. Kamarudin et al. (2014) suggest that relevant governing bodies take appropriate actions to ensure facilities comply with PWD-related legislation and guidelines. However, existing facilities only sometimes prioritise the needs of PWDs. According to Mohd Isa et al. (2016), there is a dearth of appropriate PWDs designs and facilities. One possible explanation for this is a lack of physical access to PWDs. This paper aims to explore the facilities needed by PWDs in hospital buildings. The next step is to investigate the availability of the PWDs facilities provided in hospital buildings. Overall, this paper provides an overview of the design criteria for hospital buildings' PWDs facilities.

PERSON WITH DISABILITY FACILITIES IN HOSPITAL BUILDINGS

The Definition of Person with Disabilities

Persons with disabilities (PWDs) are people with impairments in their physical or mental capabilities (Department of Social Welfare, 2021). The World Health Organization (2017) suggests that PWDs are the most criticised globally due to their poorer health conditions, lower educational achievements, lower economic participation, and higher poverty rates. The Department of Social Welfare (2021) categorises PWDs into seven groups based on their impairments.

Previous Research on Persons with Disabilities

Previous studies were reviewed to comprehend all sources of PWDs facilities provided in the buildings. Hasim et al. (2011) investigates the level of satisfaction with current facilities provided for PWDs in shopping malls in Klang Valley, Malaysia. The study employed a combination of case study audits, interviews and questionnaires, and observation at shopping malls. The findings revealed that shopping malls are considered to be barrier-free environments. However, the study indicated that specific areas need improvement to ensure the accessibility of PWDs. The improvement shall include the need for consistent and glare-free lighting, proper signage, and ramps alongside the steps. Nevertheless, the study focuses only on shopping malls. Thus, it is necessary to focus on other types of buildings, such as hospitals.

Soltani et al. (2012) examined the impact of current legislation and standards designed for the PWDs facilities at public transportation terminals. The study employed a questionnaire survey as a diagnostic tool. The findings indicated that many improvements could be made to accommodate the PWDs in the current facilities. There is a need for efforts from government bodies, especially in re-designing the current facilities for PWDs. Nevertheless, the study focuses only on the PWDs facilities at public transportation terminals. Therefore, there is a need to focus on other types of buildings.

Abdul Talib et al. (2016) surveyed the provision of disabled facilities in a public hospital in Perak, Malaysia. The study employed field observations and questionnaire surveys to identify the awareness among the public on disabled facilities. The findings indicated that most of the PWDs facilities' requirements are fulfilled. However, several rooms for improvement are needed for all disabled facilities for better effects. Nevertheless, this study only focuses on the PWDs facilities at public hospitals in Perak. Thus, it is necessary to investigate the PWDs facilities for hospitals in another state.

Awang et al. (2017) investigated the condition and maintenance priority of PWDs facilities at government hospitals in Selangor. The study employed field measurement and adopted the Building Assessment Rating System (BARS) by the Public Works Department. The method of analysis used in this research is matrix analysis. The findings indicated that PWDs facilities at both hospitals are in the critical category. There is a need to discuss further with the management of PWDs facilities, which will contribute to better quality facilities for PWDs.

Awang et al. (2021) surveyed the perception of PWDs towards facilities management (FM) service quality at hospital buildings in Malaysia. The study employed a questionnaire survey as a diagnostic tool to understand PWDs' perceptions. Purpose sampling was employed for respondent selection. The respondents' selection criteria are: (i) possess a PWDs' card granted by Social Welfare Malaysia, (ii) have a stable condition in terms of emotional and mental, (iii) Capable of understanding languages, (vi) Comprehension, and (vii) able to respond. The findings indicated the vital role of facilities management in healthcare. Yet, the study merely focused on the PWDs' perception. Hence, there is a need to further study the availability of PWDs facilities.

In summary, it can be concluded that hospital buildings are considered among the crucial areas, ensuring that PWDs facilities are available and accessible for PWDs. Thus, this study investigates the availability of PWDs facilities in hospital buildings.

Design Criteria and Facilities for Persons with Disabilities

The understanding and inclusion of universal design for PWDs, as required by MS1184, are still at a nascent stage. Bringolf (2008) defines the terms "universal design", "design for all", and "inclusive design" as a design approach for the entire population bell curve aimed to achieve the most value for the maximum number of people regardless of age, culture, and levels of education. PWDs facilities in hospital buildings can assist PWDs in their affairs without having to rely on the help of others. Abdul Talib et al. (2016) suggest that governments must take the necessary steps to ensure that all relevant facilities follow the universal design approach. In providing facilities for PWDs, facility providers must fulfil several requirements. Six main facilities are outlined by Awang et al. (2017) in Figure 1.

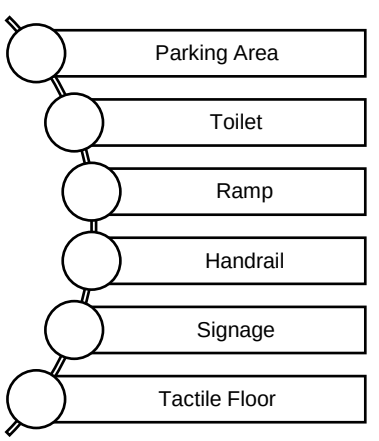

Figure 1. Summary of PWDs Facilities

The first requirement is the parking area. PWDs parking areas differ from the rest parking spaces (Sudarjat, 2022). There are several criteria for parking provisions for PWDs (Lu et al., 2019; Sudarjat, 2022). At least one reserved PWDs parking bay should be provided for PWDs. The second requirement is the toilet. Access to toilet facilities can protect PWDs' dignity by ensuring their safety and privacy in buildings where primary healthcare services are provided to the general public (Cruz et al., 2016). When the required design criteria for PWDs toilets are not enforced, going to the toilet can become a complicated activity for PWDs.

The third requirement is the ramp. Nonko (2017) suggest that ramps function as a means of accessibility and architectural creativity for PWDs as required by the Americans with Disability Act (ADA). The fourth requirement is the handrail. A handrail can give people stability, especially when floor surfaces are slippery. Handrails are intended to provide support, prevent people from falling down the stairs, and assist people in the event of a sudden fall (Skirton, 2018). The fifth requirement is the signage. The typical signages for PWDs are the wheelchair access signage and the PWDs symbol. The wheelchair access signage can be seen in any area with improved wheelchair accessibility. The last requirement is the tactile floor. The tactile floor is the textured section of the floor, often found on sidewalks. The tactile floor is used to assist PWDs with vision impairments when walking. Mackrell, (2019) explains that the dotted blocks of the tactile floor indicate a hazard, while the bar blocks usually indicate a direction. Tactile pavements should be included in building corridors.

METHODOLOGY

A qualitative approach was used for data collection, using observation. The flowchart for the methodology adopted for this research is presented in Figure 2. The observation took place at two public hospitals in Kedah with the aid of an audit checklist. Merriam (2001) claims that an observation using an audit checklist offers a first-hand account of a situation in a case study. The PWDs facilities requirement is extracted from the MS1184 – Universal Design and Accessibility. All PWD's facilities required by the regulations are included in examining the PWDs facilities provided in the hospital buildings. The facilities are (i) parking, (ii) toilet, (iii) wheelchair, (iv) ramp, (v) handrail, (vi) signage, and (vii) tactile floor.

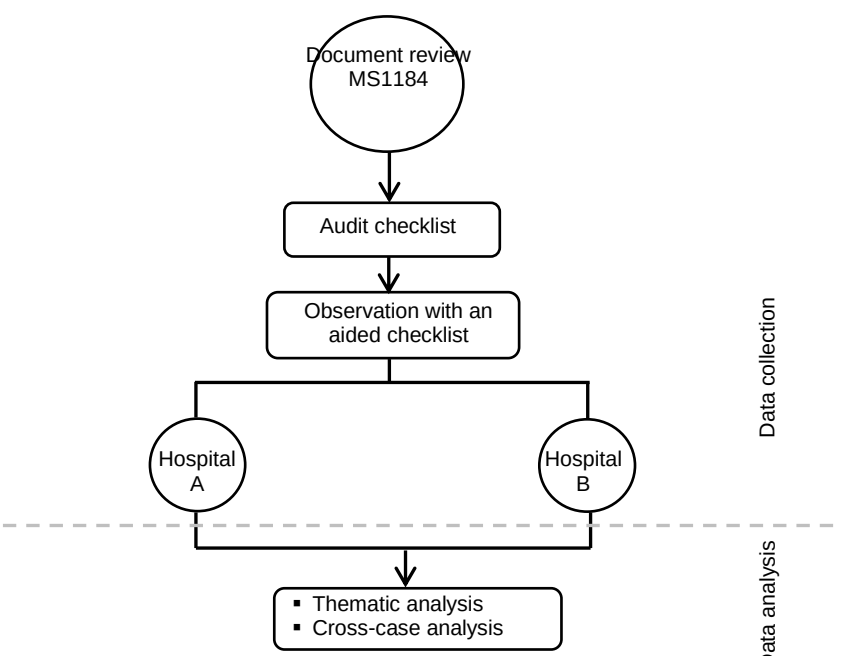

Figure 2. Research Flowchart

Table 1. Audit Checklist for Walkthrough Audit

	Disabled Facilities in Hospital (MS1184)	
A	**Parking**	
	1.	Parking for PWDs provided on every block of the building.
	2.	The parking is marked by a universal design (PWDs signage).
	3.	The parking is nearby to accessible bays.
	4.	The parking space is free from any obstacles.
B	**Toilet**	
	1.	Toilets for disabled people are available in every department of the hospitals.
	2.	The floor finishes used an anti-slip floor.
	3.	The bathroom area is wide enough to fit the wheelchair.
	4.	The entrance of the toilet is easy to access.
C	**Ramp**	
	1.	Ramps are anti-slip.
	2.	Ramps are free of obstruction.
D	**Handrail**	
	1.	Handrails on the wall are available along the hallway.
	2.	Handrails for stairs are provided continuously.
	3.	Handrails for the ramp are provided on both sides.
	4.	Handrails in the toilet for vision impairment are provided.
	5.	Handrails in the elevator are provided.
E	**Signage**	
	1.	People can readily recognise the signage.
	2.	No obstruction near the signage.
	3.	The signage is marked with the PWDs symbol.
F	**Tactile Floor**	
	1.	Tactile floors for blind people are provided at the entrance.

The checklist presented in Table 1 was used to examine the PWDs facilities provided at the hospital buildings. These buildings were audited visually. The data collected from the walkthrough audit was analysed using thematic analysis. Yin (2014) explains that a multiple-case study aims to build a general explanation that fits each case, even when the case studies vary. The research findings are presented as a cross-case analysis to explore the best practice for PWDs facility design criteria in hospital buildings.

RESULTS AND DISCUSSION

Persons with Disabilities Facilities in Hospital Buildings

Table 1 presents the results from the walkthrough audit in Hospital A and Hospital B in Kedah. "/" indicates that the facilities in the hospital buildings abide by the requirements listed. "X" indicates that the facilities in the hospital buildings did not comply with the requirements listed. "NA" indicates that the facilities required were not available.

The first requirement is parking. A parking area is an important part of any public building, especially a hospital, where many PWDs seek help. Based on the observation and data presented in Table 2, Hospital A and Hospital B provided PWDs parking facilities, fulfilling the requirement. In addition, the PWDs parking lots were located near the hospitals' entrances. This is supported by Abdul Talib et al. (2016) that parking near the entrance will ease the movement of disabled people. However, there is a need to ensure that the parking should provide a space for wheelchair movement.

Table 2. Observation Results Regarding PWDs Facilities in Selected Hospitals

	PWDs Facilities in Public Hospitals		Hospital A	Hospital B
A	**Parking**			
	1.	Parking for PWDs provided on every block of the building.	/	/
	2.	The parking is marked by a universal design (PWDs signage).	/	/
	3.	The parking is nearby to accessible bays.	/	/
	4.	The parking space is free from any obstacles.	/	/
B	**Toilet**			
	1.	Toilets for disabled people are available in every department of the hospitals.	/	/
	2.	The floor finishes used an anti-slip floor.	/	/
	3.	The bathroom area is wide enough to fit the wheelchair.	/	/
	4.	The entrance of the toilet is easy to access.	/	/
C	**Ramp**			
	1.	Ramps are anti-slip.	/	/
	2.	Ramps are free of obstruction.	/	/
D	**Handrail**			
	1.	Handrails on the wall are available along the hallway.	X	/
	2.	Handrails for stairs are provided continuously.	/	/
	3.	Handrails for the ramp are provided on both sides.	X	/
	4.	Handrails in the toilet for vision impairment are provided.	/	/
	5.	Handrails in the elevator are provided.	/	/
E	**Signage**			
	1.	People can readily recognise the signage.	/	/
	2.	No obstruction near the signage.	/	/
	3.	The signage is marked with the PWDs symbol.	/	/
F	**Tactile Floor**			
	1.	Tactile floors for blind people are provided at the entrance.	NA	NA

Figure 3. Parking at Hospital A

Figure 4. Parking at Hospital B

The second requirement is the toilet. PWDs toilets need to be provided in every hospital's department to ensure that PWDs can access toilet facilities without sharing them with other people. Furthermore, PWDs toilets should be separate from those used by persons without disabilities. Hospital A and Hospital B fulfilled all the requirements for PWDs toilet facilities. The PWDs toilets were accessible to PWDs.

Figure 5. Disabled Toilet at Hospital A

Figure 6. Disabled Toilet at Hospital B

The third requirement is the ramp. A ramp is an inclined plane that replaces steps to improve mobility for PWDs. It allows wheelchair users to move to different floor levels. Based on the observation, Hospital A and Hospital B provided ramps as alternatives to stairs. In addition, the ramps in both hospitals had anti-slip floor finishes.

Figure 7. Ramp at Hospital A

Figure 8. Ramp at Hospital B

The fourth requirement is the handrail. Handrails are intended to provide support and assist people, primarily in the event of a sudden fall when walking down the stairs (Skirton, 2018). Handrails are critical in assisting PWDs and elders to walk in hospital buildings. Based on the observation, Hospitals A and B provided handrails along the walkways. However, no handrails were installed at the entrance area and the ramps of Hospital A. In addition, handrails were also provided on both sides of the staircase areas in Hospital A and Hospital B. These handrails will help PWDs climb the stairs.

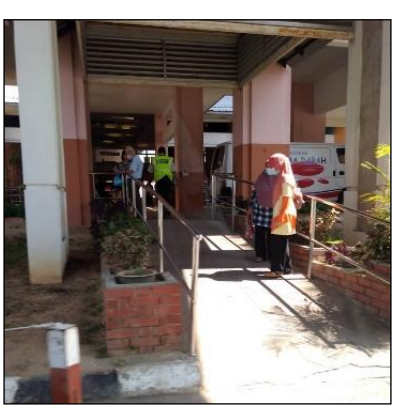

Figure 9. Handrail at Hospital A

Figure 10. Handrail at The Entrance of Hospital B

The fifth requirement is the signage. Signages for PWDs are located in various locations, including parking areas, toilets, elevators, and other areas. These signages aim to provide information regarding the facilities provided for PWDs. These signages must be installed in specified areas to ensure users can see them easily.

Figure 11. Signage at Hospital A

Figure 12. Signage at Hospital B

Based on the observation, both Hospital A and Hospital B provided signages with a PWDs symbol. In addition, the signage was not obstructed and could be viewed clearly. The last requirement is the tactile floor. Based on the observation, Hospital A and Hospital B did not provide any tactile floor for PWDs, especially those with vision impairment. Without tactile pavements, PWDs with vision disabilities would have trouble moving on their own without any assistance. Mackrell (2019) argues that the tactile floor is critical in instructing PWDs with vision impairment as they provide different indicators with specific meanings depending on their textures.

CONCLUSION

Based on the observation and data collected, Hospital B complied with all the design criteria required by MS1184 except for the tactile floor. Hospital management and designers should take adequate measures to ensure PWDs facilities are available in hospital buildings. Besides, all these requirements should be considered during the design stage before construction. The hospital management must act and ensure that the PWDs facilities are in excellent condition and accessible. It is advised that the hospital management provide PWDs with information regarding the PWDs facilities available in the hospital. As this study only examined the PWDs facilities in two hospital buildings in Kedah, further study is needed to explore the best practice for PWDs facilities in Malaysia.

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RISK MANAGEMENT PLAN PROCESS AMONG SERVICE PROVIDERS FOR CLINICAL WASTE AT HOSPITAL FACILITIES

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Abstract
The risk management plan contains an analysis of likely risks with both high and low-impact mitigation strategies to help avoid being derailed should common problems arise. Every year, there are at least three million cases of preventable death globally caused by various types of risks. Risk management plans in clinical waste management can be a strong driver for achieving a wide range of hospital-specific targets and goals. It is crucial to manage clinical waste properly to avoid health risks and environmental damage. Thus, improper waste management can cause environmental pollution risks. Recently, it was reported that the process of the team's risk management plan is not up to the standards, which leads to major threats of environmental pollution. Furthermore, the lack of risk plans for site waste and lack of risk decisions also needs to be improved in the risk management plan. Thus, this research aims to investigate the most appropriate significant plan in the risk management plan process among service providers for clinical waste in healthcare. The research was carried out to identify the process of risk management plans among service providers for clinical waste in hospital buildings. The methodologies are based on a thorough qualitative method that uses semi-structured interviews and case studies. Four (4) hospital buildings were randomly selected as case studies, and service providers involved in managing and handling risk management plans will be interviewed. The analysis is based on cross-case analysis and pattern matching. The study identified eight (8) processes of the risk management plan; the findings show the process of risk management plan used by service providers was the same and achieved the objectives; however, there are some differences in the system and software used. Future research should also be expanded, and it is essential to generate more on different natures of project data in establishing the appropriate risk management plan.

Keywords: *Risk Management Plan; Service Providers; Hospital Facilities*

INTRODUCTION

Every year, at least three million cases of preventable death globally are caused by various types of risks. Improper waste management can cause environmental pollution risks and can lead to major threats to environmental risks. A risk management plan in clinical waste management is one of the systems that can contribute to achieving Sustainable Development Goals (SDG 3); it can act as a strong driver for achieving a wide range of specific targets or goals, whether directly or indirectly. This research aims to investigate the most appropriate significant risk management plan among service providers for clinical waste in healthcare.

These risks threaten to impact not only healthcare providers' bottom line but also patients' medical costs (Akpieyi et al., 2015). More hospitals are working to improve their risk management plan to mitigate this issue. There is now greater recognition that these plans must be more integrated and sophisticated. Hospital risk management comprises the clinical and administrative systems, processes, and reports employed to detect, monitor, assess, mitigate, and prevent risks (Atkins, 2005). By utilizing risk management, the service providers proactively and systematically safeguard patient safety and the organization's assets, market share, accreditation, reimbursement levels, brand value, and community standing (Lim, 2001).

A Risk management plan is a document that needs to be prepared to foresee risks, estimate impacts, and define responses to risks. It also contains a risk assessment matrix. Andrew (Akpieyi et al., 2015) states a risk is "an uncertain event or condition that, if it occurs, has a positive or negative effect on a project's objectives." Risk is inherent in any project, and project managers should assess risks continually and develop plans to address them. The risk management plan contains an analysis of likely risks with both high and low impact, as well as mitigation strategies to help avoid being derailed should common problems arise. The project team should periodically review risk management plans to avoid the analysis becoming stale and not reflecting actual potential project risks (Akpieyi et al., 2015). Furthermore, as reported by Ahmad et al. (2020), the purpose of project risk management is to define, evaluate, manage, and track project-related risks systematically by minimizing the possibility and consequence of negative (threats) events and enhancing the possibility and consequence of positive (opportunities) event throughout the project.

During the past few years, public concern has increased about the management of clinical waste on a global basis (Ali et al., 2017). Clinical waste is a special category because it poses potential health and environmental risks; typically, it includes sharps, body parts, and other infectious materials (Blenkharn, 2017). Approximately 15-25% (by weight) of clinical waste is considered infectious (Harris, 2010). Although current clinical waste management practices vary from hospital to hospital, the problematic areas are similar for all service providers and at all stages of management, including segregation, collection, packaging, storage, transport, treatment and disposal (Blenkharn, 2017). Improper waste management can cause environmental pollution, unpleasant odours, and the growth of insects, rodents, and worms. It may lead to transmitting diseases like typhoid, cholera, and hepatitis through injuries from sharps contaminated with human blood (Lim, 2001). It is vital to manage clinical waste properly to avoid health risks and damage to flora, fauna, and the environment.

Utusan Malaysia, dated 8th September 2008, report in a government hospital, found that the yellow trolleys used to collect clinical waste must be satisfactorily maintained and rarely washed. The situation worsens when the wastewater is allowed to flow into the common public drains and not according to the requirement that clinical wastewater must be treated first (Loke, 2019). The service providers in Malaysia are responding to the trend of having a risk management team. The service providers are moving beyond just the clinical champions leading the risk management plan (Abdulla et al., 2008). Hospitals realize they need managers trained in risk management plans and familiar with healthcare practices to take care of such risks, as healthcare is a complex, regulated business requiring specific skills, such as service providers (Loke, 2019). The risk managers must be knowledgeable or experts in dealing with stakeholders and the complexity of the process. Moreover, there is always some uncertainty regarding the clinical aspects, such as disease outcomes or hitting the revenue target. Thus, proper clinical waste management must be practiced in all sources of clinical waste generation, from significant to small sources, to reduce the risk (Omar et al., 2012). Maintaining high clinical quality will increasingly impact financial performance and reduce the risk of brand impairment as reimbursement moves away from a fee-for-service model and towards a greater emphasis on value and outcomes.

According to Farah and Muneera (2018), risk management is vital to apply in every stage of the project because a lack of dealing with the risk and uncertainty event from the initial to handover stage of the project life cycle may fail, especially in time, cost and quality of the

project also affecting the safety and environment of the project. The essential things that should be included in the risk management plan for clinical waste are a commitment from all levels of the organization, policies, and procedures established and clearly defined for all staff; all staff should have clearly defined roles, responsibilities, and accountability, adequate resources, tools allocated for the plan, ongoing training, testing and monitoring of the risk management plan (Atkins, 2005). Thus, the proper process of a risk management plan can also make clinical waste management run smoothly and more efficiently. In Malaysia, most research on risk management plans focuses on the construction industry. However, a few publications are on healthcare systems related to this research, such as Analytical methods to support risk identification and analysis in healthcare systems (Nadime, 2021).

LITERATURE REVIEW

Service Providers for Hospitals in Malaysia

A service provider provides organizations with consulting, legal, real estate, communications, storage, and processing. According to Bernie (2020), although a service provider can be an organizational sub-unit, it is usually a third-party or outsourced supplier, including telecommunications service providers (TSPs), application service providers (ASPs), storage service providers (SSPs), and internet service providers (ISPs). Service providers are enormous in scope. However, unlike new construction, the service provider is to be taken within the context of property maintenance and management, and retrofitting, refurbishment, and renovation works involve more risks because of their higher level of uncertainty (Finch, 2011). The best management concept is already in place in construction management, but as the world becomes more competitive, it needs to be revised. The concept of service provider contributes towards creating new knowledge in the organization. This will lead to betterment in industries. In Hospital service, service providers can also provide businesses with group healthcare solutions that provide employees with dental, vision, pharmacy, behavioural health plans, and supplemental insurance (Alam, 2016).

Service providers are leading in managing hospital waste with extensive experience and expertise in servicing the public and private healthcare sectors. Service providers are committed to providing a comprehensive approach to hospital waste management solutions covering collection on site, supply of containers, receptacles, transportation, and incineration in compliance with stringent Department of Environment regulations (Finch, 2011). The service providers have characterized most countries undergoing a structural change from low to high value-added hospital activities. The process of privatization and contracting out services to private businesses has led to an increasing shift in healthcare from being delivered as an essential public utility to a profit-seeking target by service providers (Akpieyi et al., 2015). Service providers for hospitals in Malaysia are divided based on region, such as:

- Northern Region: Perlis, Kedah, Penang, Perak.
- East Coast Region: Kelantan, Terengganu, Pahang.
- Central Region: Selangor, federal territories of Kuala Lumpur and Putrajaya.
- Southern Region: Negeri Sembilan, Malacca, Johor.

Waste management is one of the services offered by hospitals to service providers. Wastes from healthcare establishments can be categorized as clinical waste, radioactive waste, chemical waste, pressurized containers, and general waste. Usually, clinical waste is one of the services that healthcare offers to others. Facilities Management Organization (Service Providers) to handle and manage.

Overview of Clinical Waste Management in Hospital

Responsible management of waste is an essential aspect of sustainable building. With the emergence of HIV, the Ministry of Health, in collaboration with the Department of Environment, took the initiative to revise policies and guidelines for preventing and controlling infectious disease and clinical waste handling. It is estimated that the total bed's strength is about 47,000, and 35,000 come from government hospitals with an occupancy rate of 65% (Kang'ethe, 2018). The total hospital waste generated is about 8000 tonnes per year, and DOE (2005) estimated that the generation rate for clinical waste varies from 0.3 to 0.8 kg per occupied bed per day.

To manage materials waste from hospitals effectively, consideration needs to be given to such as generation and minimization, source separation and segregation, identification and labelling, handling and storage, safe transportation, treatment, disposal of residues (including emissions), occupational safety and health, public and environmental health, and research and development into improved technologies and environmentally friendly practices. Figure 1 shows the materials waste from the hospital generated for each month.

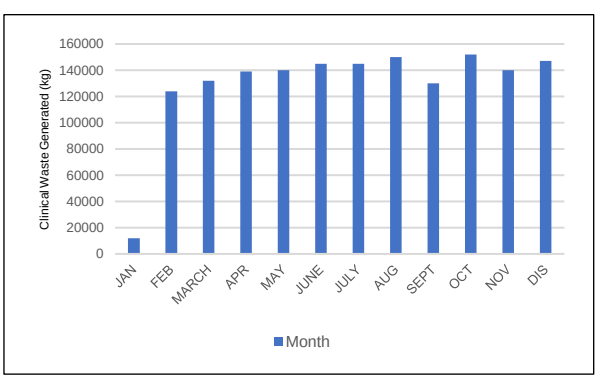

Figure 1. Generated Materials Waste from Hospital Presented in Months

Clinical Waste Management Under COVID-19 Scenario in Malaysia

The increase in the number of infections of COVID-19 can be correlated to the increase in clinical waste in almost every part of the world. The Malaysian government announced an MCO on 18 March 2020. New cases are increasing, with more than 8904 cases and 124 deaths reported as of 27 July 2020. With the increase in new cases almost every day and the number of tests being done, the amount of clinical waste from hospitals is increasing. In Malaysia alone, a 27% increase in clinical waste from the hospital is reported by the MoH following the COVID-19 outbreak. The growth is mainly attributed to the medical staff's increased usage of disposable gloves, face masks, and personal protective equipment (PPE) (Astro Awani, 2020). Besides that, the public's use of face masks and disposable gloves to restrict infection from others is also well noticed.

Incidentally, improper waste disposal would result in environmental and occupational health risks. According to the World Health Organization (2018), hospital clinical waste contains potentially harmful microorganisms that can easily infect other patients, hospital workers, or the public if it is not handled and disposed of properly. This, of course, includes COVID-19-related waste. The viable COVID-19 virus could be detected in different conditions for up to 3 hours post aerosolization, up to 4 hours on copper, 24 hours on cardboard, and 2–3 days on plastic and stainless steel. This relatively long viability on studied materials suggests the virus's potential in waste. Therefore, proper storage and disposal is necessary to avoid spreading the virus to healthcare workers and the public. As per World Health Organization (2020b) advice, if decontamination cannot be performed in the laboratory area or on-site on the hospital waste, the contaminated waste must be packaged in an approved manner for transfer to another facility with decontamination capacity.

Properly managing hazardous waste from those activities becomes an area of increasing concern. Besides that, it could also spread from the healthcare facilities to the environment if there is a need for proper waste management handling. Some of the adverse effects to human health associated with this waste and products include sharps-inflicted injuries, toxic exposure from pharmaceutical products in particular antibiotic and cytotoxic drugs released to the environment, substances such as mercury and dioxin, air pollution arising from results of the particulate matter during incineration of hospital waste and thermal injuries occurring in conjunction with open burning and operation of clinical waste and radiation burn. Disposal procedures in healthcare facilities have been proposed by the World Health Organization (2020b), such as controlled thermal treatment conditions or the use of traditional biocidal agents, which effectively eliminate the coronavirus (Kuhn & Youngberg, 2012). All hospital waste generated from COVID-19-related patients should be collected safely in designated containers and bags, treated, and then safely disposed of or treated, preferably on-site. If waste is moved off-site, it is critical to understand where and how it will be treated and destroyed. All who handle healthcare waste should wear appropriate PPE (boots, apron, long-sleeved gown, thick gloves, mask, goggles, or a face shield) and perform hand hygiene after removing the PPE (World Health Organization, 2020b).

The Importance of Risk Management Plan by Service Providers

Risk management aims to identify potential problems before they occur or, in the case of opportunities, to try to leverage them to cause them to occur. Risk-handling activities may be invoked throughout the life of the project. It is less costly to mitigate risks to prevent them from triggering (to be proactive) than it is to deal with issues that arise if the risk does begin (to be reactive) (Cherkaoui & Berrado, 2010). Management risks can easily prevent a project from achieving objectives or even cause it to fail to succeed. Risk management is essential during project initiation, planning, and execution; well-managed risks significantly increase the likelihood of project success (Daniel, 2018). The service providers can recognize and establish successfully. Hence, it could be regarded as a familiar idea in management. It is a process of externalizing tasks and services previously performed in-house to outside vendors. Hence, it can be seen as an action taken to minimize the workload of any practice firm by subletting its services or tasks to another firm (GolyasaminKhanehzaei et al., 2018). There are differences in the aim and arrangement subject to the nature of the firm.

On the other hand, the public sector seeks to achieve best practices, improve managers' cost discipline skills, improve service quality, and help senior managers focus more clearly on the organizations' core competencies. Another study on the benefits of service providers increased flexibility on staffing where fewer expenses related to employee salaries, health and benefits, training, administrative costs, and retirement programs are considered (Kuhn & Youngberg, 2012). The idea of using the service providers public healthcare of the Malaysian Ministry of Health (MoH) was raised in 1996 by the Government while announcing the Seventh Malaysia Plan to increase the efficiency of services and to retain its own qualified and experienced manpower (Kuhn & Youngberg, 2012). To gradually reduce its role in providing health services, the Government will increase its functions as an enforcement and regulator (Economic Planning Unit, 1996). Its mechanisms implementation is very diverse and include the sale of equity or assets, lease of assets, management contracts, build-operate transfer or build-own-operate, and management buy-out (Coronado & Wong, 2014).

According to Wong, Faizul and Loo (2019), training and awareness programmed are also essential to instil risk awareness and knowledge across the organization. Regarding the risks, as service providers for hospitals have increasingly considered more areas of their operations, it is essential to understand the liabilities so the service providers can determine whether the benefits outweigh the disadvantages. The essential things that should be included in risk management plans are a commitment from all levels of the organization, policies and procedures established and clearly defined for all staff; all staff should have clearly defined roles, responsibilities, and accountability; adequate resources, tools allocated for the plan, ongoing training, testing, and monitoring of the risk management plan (Anderson, 2019). The benefits of having a risk management plan include saving valuable resources like time, income, assets, people, and property if fewer claims occur. Second, it creates a safe and secure environment for staff, visitors, and customers, reduces legal liability, increases stability in operations, protects people and assets from harm, protects the environment, and reduces the threat of possible litigation (Lippi & Guidi, 2017).

Combining a risk management plan with patient safety has also been revealed. The risk management and patient safety departments are separated (An & Tang, 2020). It incorporates different leadership, goals, and scope. However, some hospitals recognize that providing safe, high-quality patient care is necessary to protect financial assets and, as a result, should be incorporated with risk management. With a risk management plan, the service providers can prepare for the unexpected, minimizing risks and extra costs before they happen (Skalka et al., 2007). The service providers can save money and protect the client organization's future by considering potential risks or events before they happen and having a risk management plan.

METHODOLOGY

Data Collection

The methodologies are based on a thorough qualitative method that uses semi-structured interviews and case studies. The qualitative approach is intended to provide detailed information about risk management plans in hospital waste and was conducted with service providers. Four (4) hospital buildings were randomly selected as case studies. The interview was held during the case studies. The question had three main sections. Section A determines

the respondents' demography; Section B focuses on the general information for case studies, and Section C respondents' opinions about the process of the risk management plan for waste at the hospital. The targeted respondents were service providers who had risk management knowledge. All the interviewees were chosen and have experience in the risk management plan for hospital waste in Malaysia and have experience more than seven years. All interviewees were well informed about the survey's objective and aims, which helped to create confidence and trust during the data collection procedure. All the interview sessions have been recorded. The analysis is based on cross-case analysis and pattern matching, and it involves determining consistent patterns and summarizing the appropriate details revealed in the investigation.

ANALYSIS AND FINDINGS

This research adds to the existing body of knowledge on the subject. Skilled service providers collaborated on developing questions that would be used to collect the essential data for the study. In essence, the report summarizes the participants' perspectives. Respondents' Demographic.

The sample characteristics of the interviewees can be shown in Table 1 below. The level of working experience for all respondents exceeds seven (7) years, and they are experts in risk management plans in healthcare fields. All the respondents were involved in managing government and private hospitals. All of them had been involved in supervising risk management plans, especially for clinical waste.

Table 1. Respondents Profile Overview

	Gender	Position	Working Experience	List of Hospitals that Handled
Respondent 1	Male	General Manager	10 years	Seremban Hospital, Melaka Hospital, Johor Hospital and Port Dickson Hospital
Respondent 2	Male	Operation Executive	9 years	Kuala Terengganu Specialist Hospital, Raub Hospital, Pahang Hospital
Respondent 3	Male	General Manager	11 years	Klang Hospital and Kuala Lumpur Hospital
Respondent 4	Male	Operation Executive	7 years	Selangor Hospital and Ampang Hospital

The Process of Risk Management Plans for Clinical Waste in Hospital Buildings

The interview input and the literature study on the process of a risk management plan for clinical waste were modified to ensure all the context-related aspects of the hospital sector were covered and the questions were understandable. The total clinical waste generated is about 8000 tons per year, and DOE (2005) estimated that the generation rate for clinical waste varies from 0.3 to 0.8 kg per occupied bed per day. Environment Minister Datuk Tuan Ibrahim Tuan Man states that clinical waste at various medical facilities has increased by 17% since early February after the COVID-19 outbreak.

Hospital buildings and facilities are a high-risk sector because of the high incidence of work-related injuries and diseases due to inadequate compliance with standard waste management protocols and safety measures against occupational hazards. The idea of using the service providers public healthcare of the Malaysian Ministry of Health (MoH) was raised

in 1996 by the Government while announcing the Seventh Malaysia Plan to increase the efficiency of services and to retain its own qualified and experienced manpower (Kuhn & Youngberg, 2012). To gradually reduce its role in the provision of health services, the Government will increase its functions as enforcement and regulator (Economic Planning Unit, 1996).

Hospital organizations must have an established and ongoing risk management plan. The risk management plan becomes the guiding document for how an organization strategically identifies the potential risk, estimates the impact and the probability of happening, and defines responses to risk. The interviewees, therefore, add four suggestions for good possible responses to risks in the process of the risk management plan, such as avoiding eliminating the threat, transferring off-loaded the risk to a third party, mitigating to reduce the probability or impact of the risk event and accept the risks means sometimes there is no other alternative than to proceed with that and accept the risk. Risk management plan advisors are responsible for creating a plan that includes all processes and procedures and meets the demands of all interested parties. The service providers need to review the needs of each of the organization's stakeholders.

Investigate Background Information

The first phase process of the risk management plan, stated by the respondent, needs to be noticed based on the risks that occurred to ensure that objectives are agreed upon and understood by all stakeholders and determine the scope and level of detail required for the risk process in managing the clinical waste and driven by the riskiness and strategic importance of the situation risk. The plan created the organization chart for managing risk. Therefore, the team can see and know the flow of risk and understand their responsibilities. The supervisor will ensure the team understands the organization's objective and goal.

Identify The Potential of Risk

The second step is to identify all the potential risks that occurred. Here is where the respondent needs to consider all levels of the knowability of known, unknown, and unknowable risks. There are two ways that they can identify risks, such as discussing with crucial healthcare and other teammates who could shed light on some of the more unknown risks. Then, brainstorming sessions will be to find the best sources of information on potential risks. In many cases, they have worked in similar hospitals and will know where the part of the process of clinical waste can cause risk. A group meeting and a brainstorming session must be carefully planned and run to keep it on track.

Estimate the Impact and the Probability of Happening

For this step, the respondent mentioned that he needs to evaluate and assess each risk's consequence, impact, and probability. He used the risk assessment matrix to plot the risk visually, as shown in Figure 2. In the segregation of clinical waste, there are many mixed wastes in the plastic. General waste and clinical waste mix in one plastic.

Mistaken views from staff can make the risk occur in process segregation. In this step, he needs to review the qualitative and quantitative impact of the risk and then assign a likelihood score (from low to high probability) and a risk impact score (either low, medium, or high). This shows how dangerous certain risks are and how urgent a response needs to be. The more complex their scores, the more complicated their matrix will become.

			Impact			
			0 Acceptable	1 Tolerable	2 Unacceptable	3 Intolerable
			Little or No Effect	Effects are Felt but Not Critical	Serious Impact to Course of Action and Outcome	Could Result in Disasters
Likelihood	Improbable	Risk Unlikely to Occur				
	Possible	Risk Will Likely Occur				
	Probable	Risk Will Occur				

Figure 2. Risk Assessment Matrix

Define Responses

The experienced general manager with ten years of experience in risk mentioned that in the last step, he needs to find a way to respond based on the risk that occurred. The respondent works together and continues to monitor and report on each risk. While every healthcare comes with some level of risk, there are ones where the potential adverse outcomes are too much to gamble on. This is what is known as the risk threshold. The amount of risk their company is willing to take on. When creating a risk management plan, staying in contact with key stakeholders and sounding out their feelings is essential. When working together by mentioning the respondent, the risk can be reduced in clinical waste management because all the parties cooperate in each stage.

Respondents always reminded and shared information with staff healthcare to be alert and noticed in separating waste. It is better to make changes early rather than hit serious issues once it has committed time and energy. Risk management is a circle, not a linear path. Because the respondent dealing with the client and risk management plan needs to be a living document. Whoever owns the risk needs to be responsible for tracking it, updating it in the management tool, and making sure other people know what is happening. In progress, new risks will likely arise, or current ones will evolve and change, mainly when infectious waste occurs.

DISCUSSION

The case studies have been compared to recognize the similarities and differences between the case studies. All this data gathered will be further used, and future studies can elaborate more details on the process of risk management plan and ability to follow by the parties in Malaysia. It is essential to generate more on the different nature of project data in establishing the appropriate risk management plan.

Table 2. Comparison of Case Studies

Process Risk Management Plan	Case Study 1	Case Study 2	Case Study 3	Case Study 4
Background Information	✓	✓	–	–
Identify Potential of Risk	✓	✓	✓	✓
Estimate The Impact and The Probability of Happening	✓	✓	✓	✓
Define Responses	✓	✓	✓	✓
Perform Compliance Reporting	✓	✓	✓	✓
Intervations	✓	✓	✓	✓
Capture and Learn from Near Misses & Good Catches	✓	✓	✓	✓
Multiple Platforms for Reporting & Managing Risks	✓	✓	✓	✓

According to Scavetta (2019), the first phase of a risk management plan needs to be noticed by service providers in Malaysia is to ensure that objectives are agreed upon and understood by all stakeholders and determine the scope and level of detail required for the risk process in the risk management plan and driven by the riskiness and strategic importance of the situation at risk. Based on the interview conducted, Respondent 1 and Respondent 2 investigated the background information to review objectives and how the risk management plan process aligns with current and future goals.

After investigating the background information, all respondents agreed that service providers must identify potential risks. Here is where the respondent needs to consider all levels of knowability of known, unknown, and unknowable risks. According to Alam (2016), suitable software can help service providers identify the risks. Based on the semi-structured interview, the respondents used software like project manager software and worked to help respondents identify potential risks. Once a risk has been identified, the risks need to be analysed. All the respondents mentioned that the risks need to be evaluated and assessed, and each risk's consequence, impact, and probability. In this step, respondents will review the risk's qualitative and quantitative impact and assign a likelihood score (from low to high probability) and a risk impact score (either low, medium, or high).

Blenkharn (2017) mentioned that this shows how dangerous certain risks are and how urgent a response needs to be. The more complex their scores, the more complicated their matrix will become. The respondents agreed that after estimating the impact and the probability of happening, the respondents need to define responses. The respondents said they must plan their responses to possible risks, such as mitigation and contingency. Mitigation documents how the respondent will take action to lower the probability of a particular risk. According to Harris (2010), there are four possible responses to risks: avoiding or eliminating the threat, transferring off-loaded the risk to a third party, mitigating or reducing the probability or impact of the risk event, and accepting the risks means sometimes there is no other alternative than to proceed with that and accept the risk. All respondents agreed that this process is included in the risk management plan. For interventions, details can be described in analysing the risks. Detailed explanations for performing compliance reporting, capturing, and learning from near misses and good catches, and multiple platforms for reporting and managing risks are included in responses to risks. According to the literature review, for the process risk management plan by a developing country, Malaysia, China, and Thailand used all these processes in their risk management plan.

CONCLUSION

The term risk management plan can be defined as the continuous and developing process that should address all past, present, and future risks. Service providers need to coordinate properly with the stakeholders in the company to establish an effective risk management strategy and plan by which managers can identify the strengths, weaknesses, opportunities, and threats for managing the business operations in the clinical waste. The objective has been reached successfully, where the process risk management plan among service providers for clinical waste has been identified. The process of risk management plan used by service providers was the same.

However, based on the data analysed, there are some differences between the systems or software used by service providers in preparing the risk management plan. The Risk assessment matrix, PRA technique, and project manager software were used to plot the risk visually. So, it can see the impact and know how to respond to risks by mitigating, accepting, tolerating, or avoiding them. The limitation of this study is that it only focuses on risk management plans by selected companies of service providers in Malaysia for clinical waste at healthcare facilities. It is recommended that future studies cover and expand to investigate and emphasize details on the process in risk management plan like investigating background information, identifying the potential of risk, analysing the risk, and defining risk responses from the hospital side. Future studies can elaborate more details on the process of the risk management plan and the ability to be followed by the parties in Malaysia. It is essential to generate more on the different natures of project data in establishing the appropriate risk management.

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A COMMON SINGLE STANDARD METHOD OF MEASUREMENT (SMM) FOR ASEAN COUNTRIES: AN ACADEMIC PERSPECTIVE

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Abstract
Standard Method of Measurement (SMM) allows consistency in describing and measuring items, which indirectly serves as the basis for producing good construction procurement documentation. Developing a single common SMM for ASEAN countries might be a practical proposal that could be discussed and materialized. Referring to the philosophical aspects of the SMM, published and unpublished research indicate the presence of key players not underpinned by or committed to one standardized SMM. It was supported by informal exploratory study with few practitioners from ASEAN Countries. They claimed that in some countries, local SMMs are used or other countries' SMMs are adopted, while some countries do not have any SMM to be utilised. Literature have indicated that many SMM versions are produced using updated or amended UK SMMs. With the formation of ASEAN Quantity Surveyors Association (AQSA), the reason why a single SMM is needed can be easily justified, especially with the possibilities of cross-ASEAN Quantity Surveyors (QS) practice is highly anticipated and fully expanded. This paper emphasizes the need of having a single common SMM for AQSA to be accepted and adopted by ASEAN practitioners. It is proposed that a focus group discussion to be held with various ASEAN participants. The results are expected to reveal SMM usage issues which will form the basis for the development of an SMM Framework. The proposed SMM framework is expected to be the first step in establishing collaboration between QS practices and academia in AQSA member countries before developing a single ASEAN-common SMM.

Keywords: *ASEAN Quantity Surveyors Association (AQSA); Standard Method of Measurement (SMM)*

INTRODUCTION

Standard Method of Measurement (SMM) as defined by the Royal Institution of Chartered Surveyors (RICS) New Rules of Measurement is a standardised set of measurement guidelines for the acquisition of building works that may be easily understood by all parties engaged in the project. It is also created to provide a set of rules to describe how work is measured and what is to be included or excluded in the description (Mohammad, 2012). A comprehensive examination of the function of the SMMs indicated the rules of measurement that have been drafted in SMMs are used for the purpose of producing a good standard construction procurement document (Adnan, Mohd Nawawi, Mohd Akhir, Supardi and Chong, 2011; Nani, Mills and Adjei-Kumi, 2007; Nizam Akbar, Mohammad, Ahmad and Mysham, 2018). Hansen and Salim (2015) defined SMM as a document which is recognized by the government as guidance in measuring construction work and which sets up uniform principles in measurement by giving both employer and contractor the same perspective in measuring the work.

A Standard Method of Measurements (SMMs) protocol was developed and implemented in order to produce an appropriate procurement document that is accurately measured, determined, and quantified (Mohammad, 2012). In the meantime, Oforeh (2008) asserts that

measurement is the most important factor when it comes to defining the cost of a construction project. The quantity and quality of the design information, the state of the economy, and the clarity of the information that is available will affect the measurement's quality. Therefore, measurement is strategically important in order to have efficient cost management for construction projects (Ganiyu, Mohamed, Yusof and Misnan, 2012).

The research aimed to highlight the importance of standardising a Standard Method of Measurement (SMM) for ASEAN countries. Firstly, the research would address a SMMs usage globally and within ASEAN countries. The issues might arise due to discrepancies in SMM practices and measurement standards also being disclosed. Next, proceed with an academic perspective element in proposing to have one common single SMM for ASEAN countries. Academic perspective may refer to the way researchers approach a topic or subject in a careful and systematic manner. By combining work of previous researchers (Ganiyu, 2015; Nizam Akbar, 2018) and experts, citing their contributions, and, most importantly, contributing new insights or ideas to advance the field of study. An academic perspective proposal will become the main conclusion upon this article.

The Important of Standardization in Construction

Abd Rashid (2002) claimed that separation and fragmentation of the construction environment are inevitable due to the nature of the construction industry, which is a fragmented and dynamic sector with a project-based focus and the participation of a large number of key players. In order to lessen the effects of separation and fragmentation among the various key players and distinct project lifecycles, information was viewed as a crucial input for coordination (Abd Rashid, 2011; Adnan et al., 2011; Davis & Baccarini, 2004; Davis, Love & Baccarini, 2009; Jaggar, Ross, Love & Smith, 2001). More people need to be aware of how crucial it is to standardise construction information after reviewing the significance and importance of information in the construction industry and the need to make construction more efficient.

Standardisation will aid in achieving management and operational consistency, thereby indirectly reducing conflict among key players. The primary objective of adopting standardisation is to establish a particular level of conformity (Perumal & Abu Bakar, 2011). Standardized project documentation and records will indirectly support the establishment of a reference line and serve as communication tools for the project's key participants. To accomplish this, it is essential to standardise the documents in the most proficient manner (Perumal & Abu Bakar, 2011). By the increasing complexity of buildings, legal, statutory, and contractual requirements in ASEAN's current construction industry, these requirements define the need to support and enhance the management function on a daily basis through the delivery of accurate information. Besides that, having a good document standardisation will have an indirect effect on the effectiveness of internal communication between the various levels and functions of the organisation. According to Perumal and Abu Bakar (2011), standardisation boosts productivity. Construction documents and information which are standardised throughout the process will make them easier to understand later.

In the meantime, from an Islamic perspective, Abdul Rashid and Hassan (2014a) discussed the existence of "gharar" (uncertainty) in contract documents, which is contrary to the 'maqasid al-Shari'ah'. Based on their research, it appears that the application of "gharar"

elements is insufficient to protect the contractual parties' interests. It has been established that Istisna can be used as a Shariah-compliant instrument in a contract where the subject matter is not yet present (Abdul Rashid & Hassan, 2014a). According to research conducted in August 2014 by Abdul Rashid and Hassan (2014b), prior to entering into a contract, the nature, quality, quantity, and description of the manufactured asset must be known. It appears that the stated condition can be satisfied using BQs (Abdul Rashid & Hassan, 2014b). A standard document is required in order to produce BQs that adhere to Istisna's requirements.

A BQ can be defined as a type of technical information that is generated in addition to many other types of information that are produced over the course of a construction project's lifetime. A BQ is a document used in the pre and post-contract phases of a building or other civil engineering project that contains a comprehensive list of the work and quantities required (Adnan et al., 2011). Through BQ, the needs and specifications of the clients will be translated from architectural and engineering drawings, schedules, and specifications into a tender document (Abd Rashid, 2011; Abd Rashid, Mustapa & Abdul Wahid, 2006; Davis & Baccarini, 2004; Myles, 2006; Razali, Tajudin, Fadli, Tajuddin, 2014). In other words, clients use BQ as a channel of communication between the major players. BQ is a crucial type of information that is utilised for a variety of purposes throughout the project's life cycle. The most important thing it does is give the construction key players the information they need (Abd Rashid et al., 2006; Adnan et al., 2011).

Effect of SMM Usage in Preparing BQ

Based on a thorough review of the literature, the following are some of the effects of using the SMM to prepare a BQ for construction works:

Effect Before the Compilation of The Bills

According to Nani et al. (2007), adopting SMM while preparing a BQ will indirectly remind the client and the design team to complete the design prior to preparing the bill. Nonetheless, some studies have indicated that incomplete design and specification is one of the barriers to adopting SMM in preparing BQs in Malaysia (Nizam Akbar, Mohammad, Ahmad & Mysham, 2013). Drawings and specifications must be completed in accordance with the SMM's established rules. Milliken (1996) stresses out on the benefit of a detail BQ is that the QS needs to interrogate both the drawing and specification. Thus, it is possible for clients, design teams, and QSs to discover design, drawing, specification, and contract or procurement documentation ambiguities using this technique. Indirectly, it will reduce post-contract issues, such as the need for a variation order.

Conferring to Adnan et al. (2011) and Nani et al. (2007), the risk distribution between clients, consultants, and contractors can be better understood when bills are prepared in accordance with the SMM rules. Through SMM, the scope and limitations of the work, as well as how the work is categorized are made clear. This makes it possible for clients, consultants, and contractors to share the risk from the beginning (Adnan et al., 2011).

Effect During the Tendering Stage

BQs based on SMM could be comparable because all major participants could interpret the described items in the same way (Adnan et al., 2011). It will directly provide commonality in tender documents, allowing for realistic tender evaluation. As per the rules drafted in Clause A.1 and A.2 (Malaysian SMM for Building Works; SMM2), Davis et al. (2009) and Oforeh (2008) indirectly agreed that the purpose of following the provision is to ensure that any number of different BQs on a given project, even though they were prepared by different QSs, still contain or convey the same information.

Effect During the Construction Stage

When BQs are prepared using the SMM, the efficiency of project control and contract administration is improved (Ganiyu & Mohamed, 2012), and potential arguments arising from the interpretation of measured items are reduced (Abd Rashid, 2011; Bandi & Abdullah, 2012a-c; Molloy, 2000, 2001, 2007). Furthermore, when BQs are prepared using the SMM, the unit rate in the BQ can be used as a comparative measure between different projects and could be used in feasibility studies (Ganiyu & Mohamad, 2012). Because the rules in section A4.2 were used to figure out the unit rates, it indirectly sets up the data and information that are useful and ready to be used by the estimators.

The preceding discussion illustrates the significance of BQs as part of procurement or contract documents to be underpinned by one standard document. Although SMM is gaining importance in the preparation of BQs and other procurement documents, there are still barriers to its use and adoption. This paper will therefore attempt to highlight the importance of having a single common SMM for the ASEAN Quantity Surveying Association (AQSA) to be accepted and adopted by ASEAN practitioners.

ASEAN Countries and ASEAN Quantity Surveyors Association (AQSA)

The ASEAN countries, comprising ten (10) member states in Southeast Asia, form a diverse and dynamic region characterized by a rich tapestry of cultures, histories, and economic strengths (Severino, 2008). These nations, namely Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam, have come together under the umbrella of the Association of Southeast Asian Nations (ASEAN) to promote regional cooperation and stability (Severino, 2018). Collectively, they represent a significant geopolitical and economic bloc, fostering diplomatic dialogue and mutual respect among themselves and with the wider international community. With a combined population of over 650 million people and a rapidly growing middle class, ASEAN is a pivotal player in the global economy, attracting investments and driving economic growth (Severino, 2001). Moreover, ASEAN's commitment to the principles of non-interference and consensus-based decision-making underscores its unique approach to regional governance, aimed at maintaining peace and prosperity while respecting the sovereignty of its member states (Jones, 2010).

Meanwhile, the ASEAN Quantity Surveyors Association (AQSA) is a professional organization that plays a pivotal role in the field of quantity surveying within the ASEAN region. Comprising members from the ten member states of the ASEAN, AQSA serves as a

platform for collaboration, knowledge exchange, and the promotion of best practices in quantity surveying. With a mission to uphold the highest standards of professionalism and ethical conduct, AQSA facilitates the development and advancement of quantity surveying as a discipline critical to construction and infrastructure projects. Through its initiatives, including training, conferences, and research activities, AQSA contributes to the enhancement of the construction industry's efficiency, cost-effectiveness, and overall quality in ASEAN nations.

Evaluation of SMM Development

Historical reviews of the evolution of SMM practices and standards offer a fascinating journey through the records of the construction industry, peeling light on the transformative shifts that have occurred over time. In the early 19th century, the construction sector saw the emergence of the first standardized measurement systems, with the British practice of SMM dating back to the 1830s. This marked a fundamental moment, as construction professionals began to adopt standardized measurement protocols to enhance project accuracy and efficiency. These early SMM practices laid the foundation for modern construction quantification methods.

The mid-20th century witnessed a significant evolution in SMM practices, encouraged by advancements in technology and globalization. The construction industry expanded rapidly, necessitating more comprehensive measurement systems to accommodate complex projects. During this period, international organizations such as the Royal Institution of Chartered Surveyors (RICS) played a crucial role in developing standardized measurement frameworks that transcended national boundaries. These efforts aimed to provide consistency in measurement practices across different regions, facilitating the internationalization of the construction industry.

In the 21st century, SMM practices have experienced a digital revolution. The advent of Building Information Modelling (BIM) and sophisticated software tools has revolutionized how construction measurements are conducted. SMM has seamlessly integrated with digital technologies, enabling automated quantification, real-time project data management, and enhanced accuracy in cost estimation. This modernization not only streamlines construction processes but also positions SMM as a dynamic and adaptable tool in the face of rapidly changing industry demands. Historical reviews of SMM practices reveal a rich needlepoint of innovation and adaptation, showcasing the industry's resilience and commitment to precision and standardization over the decades. Although the evaluation of SMM development, reveals a multifaceted landscape characterized by both advancements and challenges, through this study, the researcher expected to disclose the most current SMMs' usage among ASEAN countries.

Why SMM's Internationalization is Needed Within ASEAN Countries

The need for SMM internationalization within the Association of Southeast Asian Nations (ASEAN) countries is evident in the region's robust construction industry and its increasing interconnectivity. Statistical evidence highlights the imperative of harmonizing SMM practices across ASEAN nations. For instance, a report by the ASEAN Secretariat in 2020 revealed that the total value of construction projects in the region exceeded $1.5 trillion,

with a consistent annual growth rate of approximately 6%. This significant construction activity underscores the economic importance of the sector within ASEAN (ASEAN Secretariat, 2020). However, despite the booming construction industry, if there are discrepancies in SMM practices and measurement standards persist among ASEAN member states. This divergence can lead to inefficiencies, project delays, and disputes, which in turn hinder the seamless execution of cross-border construction projects.

Statistical data further reveals that such inconsistencies result in cost overruns of up to 15% on average for international construction ventures within ASEAN. These financial implications underscore the urgency of SMM internationalization to enhance cooperation, reduce uncertainties, and ultimately drive economic growth within the region (Amiri & Dennis, 2018; Horta et al., 2016). Considering these statistics, the harmonization of SMM practices emerges as a strategic imperative for ASEAN countries. By aligning measurement standards, member states can harness the full potential of their construction industries, fostering economic integration and promoting regional development.

METHODOLOGY

In order to achieve the aim and approach (academic perspective) of this paper, the primary data were gathered through literature review then followed with exploratory study. The literature review will be used to present previous works by other authors and discuss their findings and approaches. For the purpose of this research, literature will be conducted in searching the SMMs usage globally and on the issues arising from the different types of SMMs used in ASEAN countries. Conducting an exploratory study will result in the cultivation of ideas rather than focusing solely on facts and statistics. Exploratory studies, in accordance with Saunders, Lewis and Thornhill (2019) and Sekaran & Bougie (2019), will enable a direct investigation into the respondents, subsequently serving as the preliminary data assisting the remainder of the research process and procedures. Consequently, practitioners in numerous ASEAN nations had engaged in an informal discussion regarding the use of SMMs and related issues. The exploratory study has been conducted within five (5) months only (January – May 2022) due to limited time and resources. In this research, the exploratory study has been undertaken using qualitative method via semi-structured interviews, which is geared towards serving as preliminary data, supporting the whole research process and procedure, used to interpret the literature findings, and generating general feedback on the research area opted.

FINDINGS

SMMs Usage Globally

This subchapter will thoroughly discuss the usage of SMMs globally, collected through literature and exploratory studies. The main purpose of the review is to study the pattern of SMMs that exist globally and locally (in ASEAN countries). According to the literature, some countries have relied on their own national SMMs, while others have relied on adopting SMMs from other countries, and still others have no SMM to begin with (Molloy, 2007; Nani et al., 2007; Utama, Peli & Jumas, 2008). A decade ago, a global survey by the Building Cost Information Service (BCIS) on behalf of the Royal Institution of Chartered Surveyors (RICS) has identified 44 SMMs documents spread over 32 countries (RICS, 2003). Literatures have

also indicated that there are many SMM versions that have been using the updated editions or amended versions of the UK's SMM5 and SMM7 editions. According to Nani et al., (2007), British SMMs are the most widely used SMMs. It was supported by a survey conducted by RICS Construction Faculty in 2003, which revealed that approximately 20% of the total number of countries surveyed adopted British SMMs in their local SMMs. Table 1 shows a list of the standard methods or codes of measurement that are used globally. The list was put together from different pieces of literature and backed up by exploratory research.

Table 1. List of Standard Methods or Codes of Measurement Used Globally

Country	SMM Name	Published By
South Afrika	Standard System of Measuring Building Works 6th Edition	Africa Association of South Africa Quantity Surveyor
Australia	Australian Standard Method of Measurement of Building Works 5th Edition	AIQS and Master Builders Australian Incorporated
Belgium	NBN B 06-001 Measurement for Building – Measurement Methods for Quantities 1982	Belgian Standards Institute
Taiwan	Chinese National Standard	Ministry of Economy
Qatar	SMM 3	Ministry of Municipal and Agriculture
	SMM7 or POMI or NRM2	Royal Institution of Chartered Surveyors (RICS)
Zimbabwe	System Measurement of Building Works in Zimbabwe 3rd Edition	Zimbabwe Institution of Quantity Surveying (ZIQS)
China	Code of valuation with bill quantity of construction work	Ministry of Construction
Hong Kong	HKGSMM	Hong Kong Institute of Surveyor
England	SMM7, Principles of Measurement International (POMI), NRM2	Royal Institution of Chartered Surveyors (RICS)
Malaysia	MySMM	Royal institution of Surveyors Malaysia (RISM)
	MyCESMM2	Construction Industry Development Board (CIDB)
Myanmar	No SMM. Just refer to the Analysis of Rates for Building Works	Ministry of Construction, Myanmar
Filipina	SMM of Building Works for Philippines 2nd Edition (PSMM)	Special Consultant
	SMM7	Royal Institution of Chartered Surveyors (RICS)
Singapore	CP97 Code of Practice for Construction Measurement Standards.	Enterprise Singapore
Indonesia	In House version of SMM	In house department
Brunei	SMM of Building Work (2nd Edition) (1986) – Singapore SMM	Singapore Institution of Surveyors and Valuers
Thailand	No records	No records
Cambodia	No records	No records
Loas	No records	No records
Vietnam	No records	No records

(Sources: Utama et al., 2008; RICS, 2003; Wood & Kenley, 2004; Goh & Chu, 2002; Molloy, 2007; Hansen & Salim, 2015 & Exploratory Study Results)

Table 1 indicate there is limited literature reported on the SMM usage within ASEAN countries. There are only six (6) out of ten (10) ASEAN countries founded. Others four (4) ASEAN countries does not expose their SMM usage openly. By looking at ASEAN countries listed in Table 1 above, three (3) (Myanmar, Brunei and Indonesia) out of six (6) ASEAN countries are yet to establish their own SMM and there is the presence of key players not underpinned by or committed to using one standardized SMM. Although Malaysians have their own SMMs for building and civil engineering works, research done by Nizam Akbar, Muzafar, Mohammad and Jamaludin (2021) found that Malaysian industry key players are

still referring to various types of SMMs for civil engineering works and building works. Surprisingly, the study also reports that some of the respondents even create their own SMM when preparing BQ. In Singapore, an ancient study conducted by Goh and Chu (2002) revealed the industry's need to refer to one standard practice because it could affect costs. The research also looks into the various types of construction information that needs to be exchanged when faced with changes in design, construction, and contract-related issues. However, as per exploratory study, Brunei being claimed used an old version of Singapore (SMM of Building Work (2nd Edition)) which being publish since 1986. In Indonesia, the researchers started with Utama et al. (2008), then Hansen & Salim (2015), and Jumas et al. (2017), whereby all of them have done research on the importance of standard method of measurement (SMM) in Indonesia, which focuses on the benefits of having a single SMM for the country. Although there is a pressing need to produce one standard SMM for Indonesia, the results of an exploratory study conducted in 2022 revealed lack of action has been taken in that direction.

Through exploratory study conducted, participants also claimed that one noteworthy achievement is the ongoing efforts towards one common single SMM practices across member states. This endeavour, facilitated by organizations like the ASEAN Secretariat, aims to foster greater regional collaboration within the construction sector, ensuring that measurement standards adhere to common principles and guidelines (ASEAN Secretariat, 2021). This harmonization not only promotes transparency but also streamlines cross-border construction projects, ultimately contributing to economic integration across the region. Nevertheless, it is vital to acknowledge the diversity in progress among ASEAN nations, with some exhibiting more robust implementation of standardized SMM practices than others (Tan & Nguyen, 2022). This diversity underscores the need for ongoing initiatives to ensure a consistent and equitable adoption of SMM standards across the ASEAN landscape. The results demonstrate the urgency and significance of having a single SMM to be accepted and adopted by practitioners in ASEAN countries.

Issues on the Different Types of SMMs Used in ASEAN Countries

According to Table 1 supported by exploratory studies, ASEAN countries are reported to have their own SMM without mandatory rules to back them up, or to have relied on adopting SMMs from other countries, or to have no SMM at all. As a result, one could argue that the various types of SMMs utilized in ASEAN countries may be appropriate or may be inappropriate to use in other countries due to differences in the following factors:

i. contractual practices or conditions in a particular country
ii. construction practises in a particular country
iii. procurement practises in a particular country
iv. supply chain practises in a particular country

Whenever there are differences in the factors listed above, a meeting point needs to be established to accommodate the impact of the differences. Through literature and supported by exploratory study, existing ASEAN countries' SMMs may be appropriate or may be inappropriate to be used as one common SMM due to the fact that they may be prepared with different approaches and by different professional backgrounds. For example, Myanmar does not refer to a standard measurement method in producing its procurement documentation. As

per the exploratory studies' results, they used a standard document which consists of an analysis of rates in preparing their procurement documents without having a guideline on how to describe and measure the items.

Besides that, in accordance with information retrieved from Adnan et al. (2011), Davis & Baccarini (2004), Hassan (2011), Mohammad (2012), Molloy (2001), Nizam Akbar et al. (2014a-c) and Jumas et al. (2017), the SMM rules may be impacted by local, national, and international professional practices and cultures, including customs, local jargon, and other factors that are incorporated into current practice. No exception to the introduction of the SI metric system, which happened in the 1960s (Jumas et al., 2017). Therefore, it is necessary to consider and standardize the differences in order to lessen their impact. Also, it is important to adapt the current SMMs to the growth of new technologies and practices in the construction industry, as these changes may affect how construction work is measured (Abd Rashid et al., 2006; Adnan et al., 2011; Davis & Baccarini, 2004; Mohammad, 2012).

Beyond that, a good SMM should consist of the need to satisfy certain construction industry stakeholders (Nani, et al., 2008; Nizam Akbar, Mohammad, Mysham & Hong, 2015). SMMs rules need to check on the clients', contractors', and consultants' requirements for quantity estimates, financial budgeting, construction planning, etc. SMMs rules also need to be confirmed with the new national classification system, such as the "common arrangement of work sections' which may affect the format of tender documents; BQs' format (Adnan et al., 2011; and Molly, 2001). Again, a study needs to be conducted to get a point of similarity to cater to the issues listed.

Current ASEAN countries' SMMs may be appropriate or may be inappropriate for use in other countries because they may be just a duplication of SMMs from other countries. Through the results of exploratory studies, there is an existence where there are countries that copy and reuse or duplicate SMM from other countries without looking into it deeply and relating it to the country's needs and practices. The findings again clarified an issue once expressed by Hassan (2011), Nani et al. (2007) and Utama et al. (2008).

Aside from that, Mohammad (2012), Nizam Akbar (2018) and Muzaffar (2021), agreed that the strength and influence of professional institutions may also become the driving factors in enforcing practitioners to be underpinned with one single common SMM. Whereby for Malaysian, RISM, BQSM, and CIDB are the professional institutions that may be in power. In the case of ASEAN countries, AQSA may be appointed to lead and guide ASEAN countries' professional institutions since in some ASEAN countries, the QS profession is not being governed by QS' professional institutions.

Based on the above discussion, it can be concluded that SMM must take into account all the factors that have been discussed and should not look lightly on the following: a) current needs of the industry, b) current legal requirements in project procurement; c) all current practices and cultures of local and international professionals; d) current transformation of technology; and e) the importance of strength and influence from professional institutions. All these issues should be considered in developing an accepted and adopted common SMM for ASEAN countries.

CONCLUSION AND RECOMMENDATIONS

The paper has revealed the importance of having a single common SMM for ASEAN countries to be accepted and adopted by the practitioners in ASEAN countries. The paper proposed a formal discussion through a focus group with the participation of various ASEAN countries. The expected outcome of the proposed focus group discussion is to reveal the existence of various SMM usage issues that will form the basis for the development of an SMM Framework for ASEAN countries. The proposed SMM framework is expected to be the first step towards establishing collaboration between QS practises and academia in AQSA member countries before a single common SMM for ASEAN countries can later be developed and materialized.

The proposed single common SMM for ASEAN countries will be based on academic fundamentals and will be rationalized, justified, and endorsed by industry players in ASEAN member countries in view of a best practice approach to be implemented. The SMM is also not meant to replace or compete with any existing SMM in member countries, but to have a common agreement and acceptance of a single SMM to be used across ASEAN countries. Besides that, this SMM can also be used by member countries that have yet to establish their own SMM, like the Philippines, Cambodia, Thailand, Vietnam, etc. or to be used as a basis for developing their own SMM in the future.

A single common SMM for ASEAN countries is also expected to ease and facilitate inter-ASEAN country construction project procurement through mixed cross-country appointments and collaborations. Whereas it is expected that all ASEAN countries will agree on, understand, and use a single SMM that is accepted by all practitioners.

An SMM for ASEAN countries is also expected to be used in developing other useful and necessary QS practice systems such as Tender Cost Analysis and Tender Evaluation for Bid Selection. Through this system, tender price records and material price analysis could be developed and used by all ASEAN countries. A good and useful database could be created through this single common SMM. Subsequently, with the existence of a consistent and standard format and phraseology of the single SMM for all ASEAN countries, more reliable studies can be pursued on cost comparison of construction projects between countries in ASEAN. This database is expected to be used for budgeting and estimating purposes for future projects within the ASEAN countries.

In conclusion, a single common SMM for ASEAN countries is important because it not only sets up a reliable and standard format for all member countries, but it can also create and develop many other useful and necessary QS services tools and purposes that can be used not only in their own country but across ASEAN.

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HESITANCE TO CHANGE BEHAVIOUR: KEY FACTORS OF CONSTRUCTION FOREIGN WORKERS' SAFETY NON-COMPLIANCES

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Abstract
Foreign workers served to alleviate the labour shortage in the Malaysian construction industry. High dependence on their workforce has elevated negative impacts on the social and behavioural perspective. Nevertheless, cultural and behavioural differences have appeared as the primary sources of their unwillingness to practise proper safety procedures. This study aims to explore the key factors of construction foreign workers' safety non-compliance in the workplace. This research was conducted via a qualitative approach through semi-structured interviews with nine (9) selected informants who are working closely with foreign workers at the operational level. Thematic analysis was adopted in this research to analyse the responses by familiarising the data coded and identifying the main factors and the sub-factors. The result shows that ignorance, negligence, overlooked, over-confidence and misconception are the five (5) key factors of construction foreign workers' safety non-compliance in Malaysian construction sites. The factors are similar and capable of extending the Resisting to Change theory's original components Therefore, if these elements are thoroughly evaluated, it is possible to attain a high degree of safety compliance among foreign workers.

Keywords: *Foreign Workers; Reluctances; Resistance; Safety Behaviour; Safety Non-Compliances*

INTRODUCTION

Foreign worker workforce is regarded as a critical necessity for a country's quick growth and rapid development (Najib et al., 2019). Therefore, the increase of foreign workers in the construction sector has raised the issue of safety non-compliance as a result of their poor safety behaviours (Zulkeflee et al., 2020). The unwillingness of foreign workers to practise safety procedures is no longer a novel subject, as various studies have shown that safety non-compliance behaviour is one of the most imperative causes (Hasmori, Akhir and Said, 2020; Zulkeflee et al., 2021). According to Williams et al. (2018), the unethical attitudes and behaviour of foreign workers, such as breaching the safety protocols, defying safety instructions, and neglecting safety procedures, are the major causes of accidents on construction sites. Foreign workers act in such manner as a result of their own personal choices, behaviours, and actions (Hasmori et al., 2020). Aliabadi et al. (2018) stated that foreign workers are more inclined to take shortcuts when completing a task due to their ignorance behaviour to practice safety. Ultimately, if this issue is not addressed and controlled from the start, the number of accidents and mishaps will escalate significantly (Agyekum, Simons and Botchway, 2018). In truth, there is a scarcity of research on the exact causes of operational health and safety non-compliance among construction foreign workers (Hamid et al., 2019). Many researchers have indicated the management's responsibility to invest in safety, but they rarely emphasise each individual's safety behaviours when they are exposed to risks and dangers (Williams O. S. et al., 2018; Wan Faida & Misnan, 2015; Kemei et al., 2015; Aniekwu, 2007). Moreover, most safety and health literature focus on improving safety

compliance from the management standpoint (Zulkeflee et al., 2021). Based on Rodriquez-Lopez et al. (2016), most of the safety literature has perceived construction safety compliance from a macro perspective including institutional, technical, and macroeconomic perspectives. However, few studies have looked at workplace accidents from a cultural perspective, and even fewer have focused on events involving foreign workers. Hence, the factors of construction foreign workers' safety non-compliance in Malaysian construction sites have not yet been examined in order to reduce the rising prevalence of accidents and mishaps. Zulkeflee et al. (2021) recommended that the problem in regard to safety non-compliance should be controlled at their primary source by assessing the genuine behaviours of the foreign workers rather than waiting for further complications to develop from other sources. This paper focuses on analysing the main factors contributing to safety non-compliance among foreign construction workers. It examines the reasons behind their reluctance to embrace safety changes, drawing insights from Stonehouse's model (2010). The study specifically looks into Malaysian construction sites including buildings, commercial, infrastructure and manufacturing segments where foreign worker is extensively involved, aiming to understand the operational intricacies at play.

The Issues of Foreign Workers in the Malaysian Industry

The Malaysian government has been working hard to fill the employment shortages by implementing more development projects. However, a large number of these positions have been occupied by foreigners (Ministry of Finance, 2018). In 2017, about 135,997 foreign workers were registered to be working in the construction sector and the number increased by 10.6% in 2018 which indicates that most of the foreign workers are inclined to work in the construction industry (CIDB Malaysia, 2018). The Malaysian construction industry's reliance on foreign workers is undeniably owing to the lack of local workers (Ashaari and Razak, 2018). Most of the foreign workers in Malaysia are from Southeast Asian developing nations such as Bangladesh, Nepal, Indonesia, Sri Lanka, Vietnam, Myanmar, Philippines and Thailand (Ministry of Human Resources of Malaysia, 2019). Based on the report by the Ministry of Human Resources of Malaysia (2019), most foreign workers who began working in Malaysia had no prior job experience. They all come from various cultures, origins, and diverse perspectives on the value of safety in construction sites (Lyu et al., 2018). Remarkably, the amount of safety awareness and safety compliance in construction sites remains ambiguous (Hasmori, Akhir and Said, 2020).

According to the Social Security Organization's (2018) released data, there were about 72,682 accident cases in 2018, representing a 3.88% increase over the previous year's total of 69,968 accident cases. Figuratively, in the year 2018, industrial accident cases increased by 2.12% from 36,662 cases to 37,439 cases respectively (Social Security Organisation, 2018). According to the statistical data published by the Department of Occupational Safety and Health (2020), the mortality rate among 100,000 workers fell from 4.90% in 2017 to 4.14% in 2018. On top of that, on-site foreign worker demand was estimated to reach 1.95 million in 2018, 2.1 million in 2019, and 2.4 million in 2020. Indeed, the number of unreported construction accidents might be greater, given that 36% of construction workers are illegal migrant workers without work permits, 19% are legitimate workers, and the other 45% are locals (Nungsari et al., 2020). According to Lingard and Rowlinson (1994), foreign workers are more vulnerable to face construction accidents owing to their reluctance to obey safety procedures. Plus, the diversified ethnicities of foreign workers have aggravated

communication issues, which have hampered productivity and efforts to ensure site safety (Debrah and Ofori, 2001). In order to improve the workers' safety behaviours, effective safety intervention procedures are necessary when dealing with foreign workers with diverse cultural backgrounds (Mazlina Zaira and Bonaventura, 2017). Hence, the strategies entail changes in attitudes, human knowledge, competence or safety-related behaviour should be highlighted (Robson et al., 2001).

Unsafe Behaviour of Construction Foreign Workers

The level of foreign workers' safety compliance in the workplace remains questionable, as seen by the annual accident rates and reports (CIDB Malaysia, 2018; Zulkeflee et al., 2020). Most of the safety literature highlighted that human mistakes and hazardous workers' behaviour are the primary causes of the thriving construction accident rates (Williams et al., 2018; Hasmori et al., 2020; Aliabadi et al., 2018). Nevertheless, in order to uncover the deficient actions frequently undertaken by foreign workers, the concept of poor safety practices in the workplace must be described in depth (Collins, 2016). Therefore, poor safety procedures may be defined as an unsafety activity that highlights the risk and hazard exposed to people, equipment, the surroundings, and work processes (Rajathi and Ramya, 2021). For example, poor safety practices include activities and actions like disregarding safety regulations, being cynical while working, or simply not wearing the required personal protective equipment (PPE) (Williams et al., 2018). Majority of the foreign workers are unwilling to comply with safety procedures, even though it is a legal responsibility to protect them from risks and hazards in the workplace (Fang, Ding and Love, 2018). Furthermore, negligence, overconfidence, sloppiness, and ignorance of safety issues are perceived as the crucial causes of construction workers' safety non-compliance in construction sites (Krishnamurthy, 2006). Fang, Ding and Love (2018) stated that most of the typical excuses for these poor actions have been discovered to be caused by discomfort while applying the safety equipment and the limitation it imposes on movement. This irresponsible behaviour of construction workers would increase behavioural safety non-compliance problems in construction sites (Zulkeflee et al., 2020). Thus, the main causes of their risky actions are due to behavioural factors such as overestimation of one's ability, carelessness, ignorance and overlooking of safety matters (Ahmed, Sobuz and Haque, 2018; Johanson, 2021; Zerguine, Jalaludin and Tamrin, 2016). On top of that, the most prevalent excuses provided by foreign workers for not applying safety equipment in the workplace are discomfort, distress, inconvenience, and trouble applying while doing activities (Hasmori et al., 2020). Despite several attempts by top management to reduce accidents and fatalities, foreign workers continue to do risky work as a result of their poor demeanour, poor safety habits, and refusal to practise safety (Adinyira et al., 2020).

According to Stonehouse (2013), workers will be hesitant to change their behaviour if the organisation's norms are not open to change and growth. Hence, Stonehouse (2010) has identified the key reasons for reluctance to change based on the initial phase of denial. For instance, if the significance of the change fails to sink in, an individual would continue to act normally as if nothing has changed. This model emphasises that the individual's level of understanding and emotional engagement are two important components that may influence their reluctance to change (Stonehouse, 2012). These two components would influence a person's perception of how they see the issues as the change will have an instantaneous impact on themselves and their surroundings. Therefore, it is critical to include them in the process,

even modest adjustments can have a significant influence on them. The key reason of reluctance to change by Stonehouse (2010) is illustrated in Figure 1.

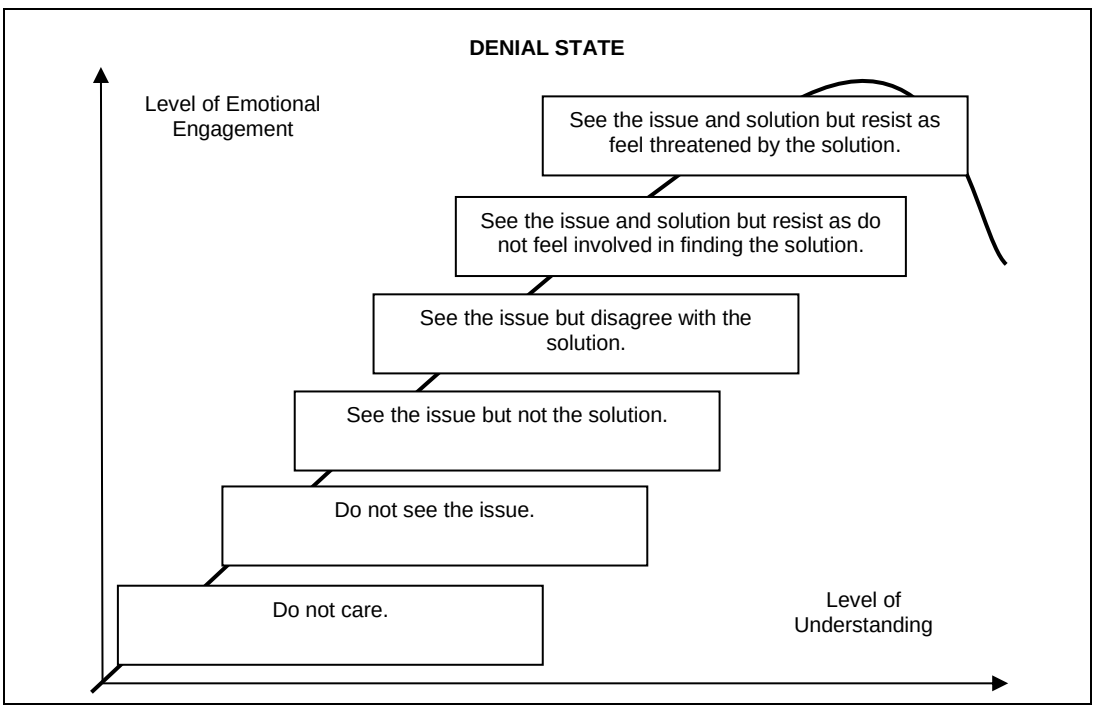

Figure 1. Key Reason of Reluctance to Change by Stonehouse (2010)

METHODOLOGY

The qualitative technique was adopted in this research which enables further investigation of the informants' responses, as greater understanding and more insight could be gathered from them (Konstantina Vasileiou et al., 2018). In order to achieve the research aim, an extensive response from primary sources should be analysed through a qualitative approach via semi-structured interviews with nine (9) qualified construction representatives who have experience working with foreign workers at the operational level.

Inclusion and Exclusion Criterion

Preliminary screening questions were administered using an initial screening process, as outlined by Slaton, Hanley, and Rarftery (2017). This step was taken to ensure that only suitable participants were included. Clear inclusion and exclusion criteria were established to further refine the informant pool. The study focused exclusively on main contractors classified as Grades 7 and 6, given their organisational capacity and expertise in employing a substantial foreign workforce. Participation was restricted to individuals directly engaged with foreign workers, deliberately excluding those operating at the managerial level to maintain a non-managerial perspective. Individuals without direct experience working with foreign workers were not eligible to take part in the study.

Data Collection Protocol

The interview questions were prepared and conducted in English. However, if the informants requested that the interview be conducted in Malay language, the questions were translated to meet their needs. With the purpose of extracting as much information as possible, the interview questions were open-ended with adequate follow-up questions. It is aware that, owing to their responsibility to maintain their own reputation and position, accidents and safety measures may be sensitive topics for a certain organisation. Therefore, some informants may be unwilling to share any technical details regarding their safety procedures. Hence, the interview questions were designed without using any technical words in order to avoid misunderstanding and allow informants to share information more openly. Questions regarding foreign workers' site practise, safety perceptions, reasons for misbehaving, disobedience, and reasons for unwillingness to practise safety procedures are included in the interviews.

Informants Selection

In addition to the interviews, a theme saturation strategy was applied whereby; when theoretical saturation is reached, data gathering will be halted. For example, the process will be stopped if no additional evidence or patterns are being acquired, or if the questioning technique yields no new information (Konstantina Vasileiou et al., 2018). Initially, the intention was to conduct a substantial number of interview sessions to ensure comprehensive and detailed research outcomes. However, the employment of the saturation strategy, resulted in the involvement of only 9 informants as this number proved sufficient to substantiate the findings of the study as shown in Table 1.

Table 1. Profile of the Selected Informants

Informants	Position	Grade	Experiences
A	Site Supervisor	G7	15 Years
B	Deputy Site Manager	G7	17 Years
C	Site Supervisor	G7	13 Years
D	Site Supervisor	G7	16 Years
E	Safety Site Supervisor	G6	13 Years
F	Safety Site Supervisor	G7	10 Years
G	Site Supervisor	G7	9 Years
H	Safety Site Supervisor	G7	9 Years
I	Site Supervisor	G6	9 Years

Thematic Analysis Procedure

Informants were welcome to disclose their comments and points of view on any safety-related matters especially when involving foreign workers. The interviews lasted approximately 40 minutes on average, and their comments were captured and transcribed into in-depth conversations. To minimise any data misrepresentation, the transcripts were presented to the informants for subsequent comments and confirmation. After the informants' validation was checked, all transcripts were read through for the coding process. Then, additional comments and thoughts were made in order to identify probable trends as well as establish appropriate categorisation and classifications. Thorough reading is essential to detect recurrent patterns, identify major and obvious factors, and gain a wide perspective of

the data. Then the process involves disintegrating all raw data into sections and classifying them into categories. This practice entailed grouping each piece of information that would later be separated and coded. After that, the data is evaluated with the purpose of making sense of what has been captured. The process of data interpretation entails creating links and identifying similarities and variations between each category. Thus, the sub-factors are determined based on the categories. Lastly, the representation process begins with a thorough drafting of the analytical data, followed by a description of the outcomes gained from the interview's findings. Therefore, the discovered sub-factors are connected to identify the key factors of foreign workers' safety non-compliance in the construction sites.

FINDINGS

During the analysis stage, exemption criteria were set where any responses pertaining to managerial or environmental key factors were omitted from the analysis in order to meet the aim of the study. All informants believed that safety is an essential matter, and every construction individual is responsible for ensuring their own safety as well as others. Nevertheless, accidents and mishaps often occur in the workplace due to the poor behaviour of construction foreign workers while performing the tasks. Based on the feedback of the informants, factors of unwillingness to practise safety among foreign workers were found.

Behaviour Key Factors

The behaviour-based concept relies on the attitudes of foreign workers by assessing conflicts at their origin source rather than waiting for problems to occur. These factors were analysed from an operational standpoint in order to determine the true cause of safety non-compliance in the construction sites. The findings of this study were tabulated in Table 2.

Table 2. Factors Influencing Foreign Worker's Unwillingness to Practise Safety

Informants	Code	Sub-Factor	Key Factors
B, G, I	Believe that the rules are inappropriate	Witlessness	Ignorance
ALL	Perceive safety very lightly		
A, C, D	Not comfortable to wear PPE		
A, C, D	Believe that the rules are troublesome and outdated		
A, C, D, E, F, G, H, I	Disobey safety on purpose	Laziness and Stubborn	
A, C, D, E, F, I	Applying safety is time-consuming		
A, B, C, D	Workers expect others to do it for them	Relying on others	
A, C, D	Refuse to comply if others do not.		
E & F	Drunk or Hallucination	Drunkenness	
ALL	Misplace of PPE, Stolen, or left at home	Fails and forgot	Negligence
ALL	Negligence		
D, E, F	Perform pranks and rough play	Horseplay	
B, E, F	Overlook the safety rules	Oversight Instruction	Overlooked
A, B, C, E, F, G, H	Does not notice the safety rules displayed		
A, C, D, E, F, G, H, I	So far, I have never had an accident	Arrogant	Overconfidence
B, E, F	Believe accidents will not occur to them		
B.E.F.H	Perceived safety as non-returning profit or benefit	Measure Life by the value of money	Misconception
ALL	Workers don't have money to spend on safety		
ALL	Workers tend to chase progress	Safety Prioritisation	

Ignorance

Some of the foreign workers assumed that safety regulations are inappropriate and unsuitable to be practised; thus, they tend to take them for granted (*Informants B, G, and I*). Foreign workers are already accustomed to not complying with safety regulations as they have a distorted perception towards safety. Foreign workers perceived safety to be unpleasant, illogical, inconsequential, and obsolete since they had not practised proper safety for such a long time (*Informants A, C and D*). Foreign workers often complained that the usage of safety equipment may cause discomfort and distress. Furthermore, most foreign workers are stubborn and irresponsible when it comes to practising basic safety procedures as they often claim that using safety equipment is time-consuming especially when applying safety harnesses to climb at height. Hence, all informants believed that most of the foreign workers are obstinate and irresponsible disobeying safety regulations on purpose (*All informants*).

Workers frequently blame others when they are discovered violating occupational safety regulations as no one has trained them how to use correct PPE or they assume others to do it for them. For example, since they rely on others to install the safety barriers workers opt not to do so. Foreign workers frequently disregard safety guidelines and procedures deliberately as they believe that if others do not, they will not (*Informants A, C and D*). Moreover, there are several incidents of drunken workers have been reported as a result of excessive alcohol use (*Informants E and F*). Their psychological state is unstable during working hours due to drunkenness or delusions caused by heavy drug usage.

Negligence

Foreign workers' inability to practise safety in the workplace is owing to their sloppiness and negligent behaviour. Foreign workers frequently make excuses for not implementing safety precautions on the site as they are often unable to retain and protect their personal safety equipment (*All Informants*). They often argue that their safety equipment was taken, damaged, lost, or misplaced, or they just forgot and left it at home. Due to their own carelessness, foreign workers purposely do not take care of their protective safety belongings. There are situations when workers are reckless while working and do not complete their duties in a decent manner, resulting in accidents and mishaps. Workers who work in groups frequently enjoy making jokes with their co-workers, and their jokes may be excessive, absurd, and risky (*Informants D, E and F*). Horseplay is seen as normal in society, although it is possible that it will cause major injury to others.

Overlooked

Safety procedures and regulations mostly are common logic (*Informants A, B, C, E, F, G and H*). However, due to their weak senses and poor behaviours, foreign workers frequently forget, oversight and disregard safety precautions. Management has taken steps and measures to increase foreign workers' safety awareness by offering additional safety training courses and posting safety signage and guidelines on-site. Unfortunately, due to their incapacity to read and comprehend the instructions provided, foreign workers frequently disregard safety guidelines displayed in the workplace (*Informants B, E and F*). In truth, several of them were either unaware or did not notice the safety procedures and restrictions displayed on sites.

Overconfidence

Some foreign workers appear to be arrogant. There were foreign workers who claimed that they had not had a single accident during their time in the workplace, although they had been working without safety precautions for so long (*Informants A, C, D, E, F, H and I*). Furthermore, most skilled foreign workers who do not comply with safety indicated that mishaps would not occur to them since they are cautious enough when working on construction sites. Foreign workers are overly optimistic and do not implement safety precautions, especially while working at heights, because they believe that they are safe enough to work although their workplace only provides them with ledges or extra working spaces (*Informants B, E and F*). They are confident that they will not be harmed once they are at ease and familiar with their task.

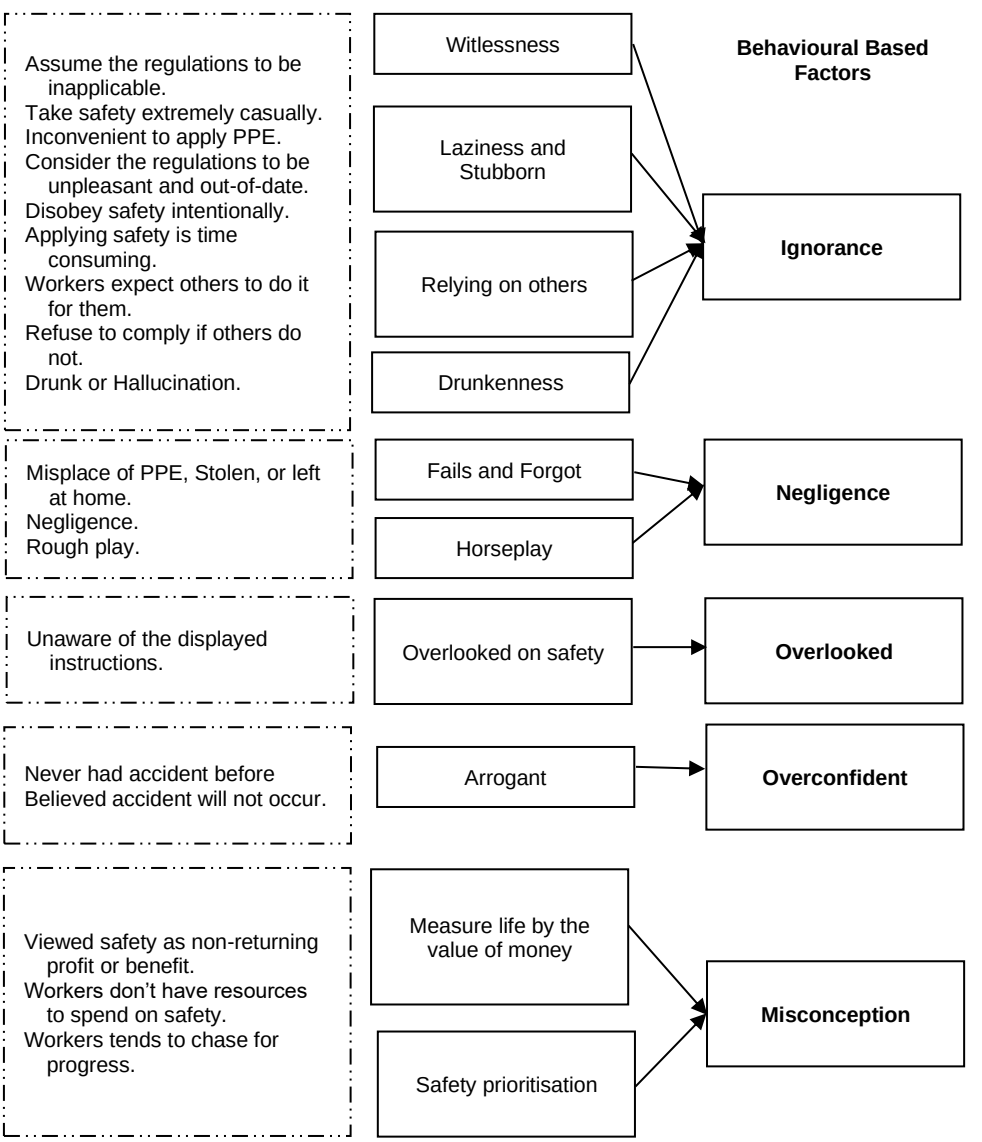

Figure 2. Factors Influencing Foreign Worker's Unwillingness to Practise Safety

Misconception

Accidents will not just occur; they are the result of human error (*All informants*). However, foreign workers do not comprehend this notion and misunderstand its meaning. Workers frequently interpreted safety as a non-returning benefit that would provide no value to them (*Informants B, E, F and H*). They choose to measure their lives by the value of money as they are hesitant to invest their resources in safety. Furthermore, they would rather not spend their money on adequate safety equipment. Plus, most foreign workers viewed work progress are more vital than safety, owing to their proclivity to pursue project progress and complete the work ahead of schedule, particularly for those working on a 'finish and go' basis (*All informants*). Moreover, foreign workers said that using PPE would be exhausting, impractical, and time-consuming because they would have to devote all their time and resources to the project. Although the project activities had to be finished within the time range, most of the informants agreed that foreign workers who rush around in the workplace will increase the chance of mishaps, accidents, or near misses. Hence, one of the causes of unwillingness to practise safety in the workplace is their misinterpretation of the importance of safety (see Figure 2).

DISCUSSION

The ideas and opinions of the competent informants who have worked closely with foreign workers were examined in order to determine the causes behind the foreign workers' unwillingness to practise proper safety. The ignorant attitude of foreign workers stems from their lack of experience working in a safe environment or with people who practise health and safety. It is agreed that inexperienced workers who are unwilling to comply with safety will lead to higher accident rates in the construction industry (Dennerlein et al., 2020). The attitudes or actions of surrounding people, whether they are acting well or poorly, might impact the behaviour of other workers while executing a job (Oah, Na and Moon, 2018). Most foreign workers are also accustomed to non-safety culture behaviours in their home countries as they believe safety standards are inconvenient, irrational, unrealistic, and obsolete. The informants emphasised that foreign workers frequently ignored safety practises on purpose because of their defiant attitudes, claiming that they rather not comply with safety if the others do not. Foreign workers behave in this manner as a result of their lack of exposure to basic safety standards and their terrible behaviour (Hasmori et al., 2020). The individual-based factors such as misunderstanding of safety procedures, inability to adhere to safety, and inability to use correct PPE contribute to major causes of safety noncompliance and risky behaviour (Zerguine, Jalaludin, and Tamrin, 2016). Furthermore, according to Laryea and Mensah (2010), foreign workers are hesitant to obey safety practices and reluctant to wear PPE due to their terrible habits and alcohol intake during working hours. Andersen et al. (2015) also stated that the construction site supervisor is compelled to dismiss the inebriated workers in order to avoid any unintended consequences for others. As a result, these impacts will hinder the workers from acquiring any safety coping skills and may result in increased threats and violence at work (Heiskanen, 2007).

Results reveal that most foreign workers are incapable of applying safety precautions in the workplace owing to their carelessness and negligence act. The typical excuses reported by the foreign workers for not applying safety equipment at the workplace is due to them being lost, forgotten or stolen. Furthermore, there were cases where foreign workers were

careless while working, failing to complete tasks in a proper way. The major causes of construction mishaps are poor safety decisions or carelessness in implementing precautionary measures by workers (Ahmed, Sobuz and Haque, 2018). Ahmed et al. (2018) also stated that foreign workers frequently create an unhealthy working environment by performing their duties hurriedly carelessly and recklessly while disregarding safety requirements. Workers' behaviours such as not wearing PPE, horseplay, carelessness, and failing to identify the cause of an accident are key contributors to safety noncompliance on construction sites (Williams, Hamid and Misnan, 2019). Horseplay behaviour refers to dangerous play or pranks that include body contact, fooling about, silly activities, and social pressure to engage in hazardous acts that generally begin with innocent intentions (Iacuone, 2005).

Foreign workers frequently disregard and overlook safety procedures due to their incapability to understand and interpret the instructions displayed. Several of them would not even see or were unaware of the workplace safety signs. Being alert and vigilant to health and safety regulations would affect the fate of the workers in the workplace as actions overlooked and disregard of safety precautions should not be used as an excuse. In agreement with Ajslev et al. (2020), interaction and engagement activities should be normal practice in the workplace so that workers do not intentionally miss or overlook health and safety issues while transmitting effective safety information.

Some of the experienced foreign workers feel that they will not be involved in any accidents or injuries. They are frequently overconfident while executing jobs, particularly while working at a height. Johanson (2021) emphasised that workers are usually unconscious of their flaws, overconfident in their higher-level capabilities, and overestimate their ability while doing their duties. Johanson (2021) added that this is similar to the Dunning-Kruger Effect which is a psychological phenomenon whereby; workers will feel that they are much more capable than they actually are. Foreign workers who are overconfident in their expertise are often eager to take risks since they are unaware of the potential drawbacks (Carpio-de Los Pinos et al., 2021). There are numerous unknowns and hazards on worksites, but accidents and mishaps could be averted if workers are focused and committed to their work (Kim et al., 2019).

This research shows that foreign workers typically misunderstand the value of health and safety issues, perceiving safety as a non-returning profit or advantage towards them. Foreign workers are willing to put their lives in jeopardy in order to complete their tasks regardless of the consequences that may occur to them. Foreign workers may not consider safety to be a priority since they are generally focused on project completion rather than the value of their own lives (Keng and Razak, 2014). Plus, they are unable to appraise the value of safety since they are hesitant to spend money on safety equipment. Foreign workers who are incapable of performing basic safety are nonetheless given the opportunity to work due to misinterpretation and misperception of the importance of safety (Zulkeflee et al., 2020). Even if foreign workers are under tremendous time constraints to complete the project on time, safety ought to be a top priority. Besides, whenever foreign workers are paid on a 'finish and go' basis, they tend to neglect safety issues (Ahmed et al., 2018). Foreign workers have claimed that there is time pressure while implementing basic safety procedures, which might inflict inconvenience and discomfort when completing the tasks. For example, foreign workers are hesitant to use safety harnesses or any protective gear when working at high places owing to the discomfort, impracticality, and inconvenience they have experienced (Hasmori et al., 2020).

In fact, the factors discovered as a result of the research appear to be comparable to the theory articulated by Stonehouse (2010). There are patterns with similar meanings to the theory components that have been coupled to extend the theory according to the applicability of this study. Stonehouse (2012) stated that people who are resistant to change are often unaware of the need to change since they regard changes as an embarrassment to themselves. Thus, they tend to both ignore and accept the need for change. Even though they are aware that they must adhere to safety standards, they may be prompted by negligence and carelessness to do so. Subsequently, even if they are worried about safety, they may overlook and violate workplace safety procedures. Although foreign workers are aware of the hazards and risks, they face, they feel that an accident will not happen to them. Furthermore, foreign workers frequently misinterpret the concept of safety since they are usually focused on project development and view safety as a non-returning profit (see Figure 3).

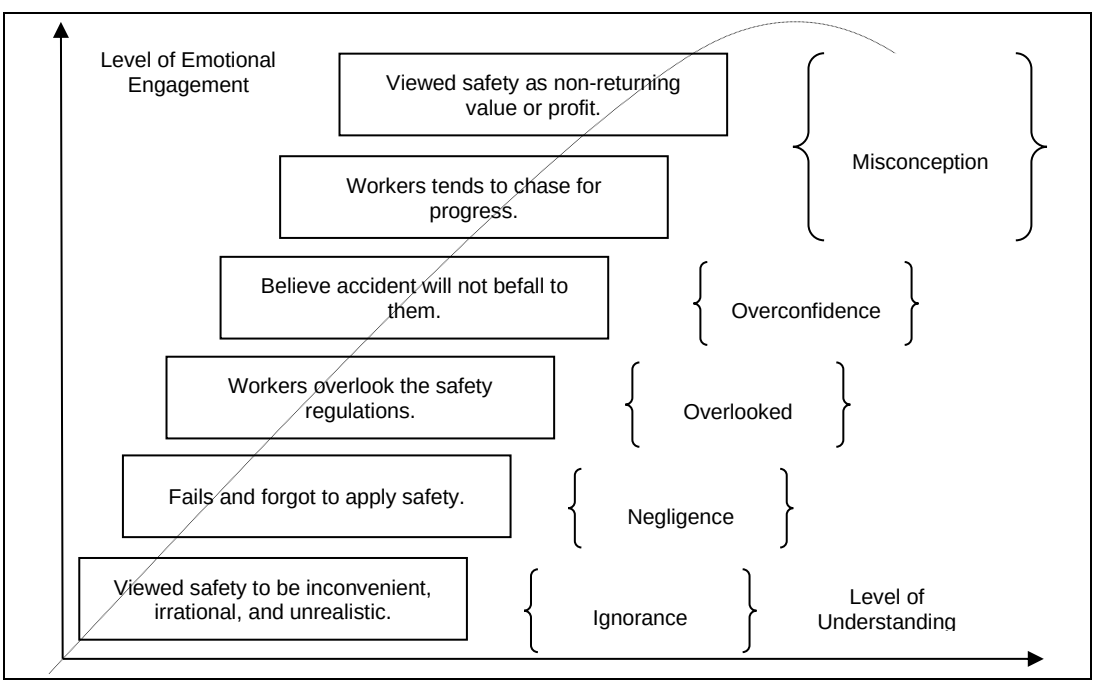

Figure 3. Key Factors Influencing Foreign Worker's Unwillingness to Change Extended Model

CONCLUSION

Accidents, mishaps, and near misses are common at construction sites owing to the unwillingness of foreign workers to implement safety precautions. Hence, this study reveals the fundamental key factors of construction foreign workers' safety non-compliance in Malaysian construction sites. According to the Reluctance to Change Theory, the factors are similar to the theory's original components. Foreign workers who believe safety to be inconvenient, illogical, unrealistic, or antiquated are labelled as obstinate, which might lead to ignorant behaviour. Foreign workers are typically unconscious of their shortcomings, and their overconfidence in their higher-level abilities causes them to exaggerate their capabilities while on the job. They neglected to take safety precautions and were unable to adhere to safety regulations, resulting in negligence and carelessness. Moreover, foreign workers frequently disregard safety measures since they are unfamiliar with the surrounding environment and

safety guidelines on construction sites. Furthermore, foreign workers stated that they are always under time constraints since they do not have time to comply with safety precautions in order to pursue project completion. Certainly, their misperception of safety would taunt them if they viewed safety as a non-returning profit and rather measured their lives by the value of money.

LIMITATIONS AND RECOMMENDATIONS

This study was carried out throughout the movement control order (MCO) imposed by authorities to halt the spread of the COVID-19 pandemic. It has been revealed that there has been a significant increase in COVID-19 infections among Malaysian construction foreign workers over time. Nevertheless, to avoid spreading any infection, the data were gathered through online platforms with construction officers who engaged closely with the foreign workers on the construction site. This research recommends that the data be more accurate if interviews are performed from the standpoint of construction foreign workers in order to uncover the true causes of their safety non-compliance in the construction sites. Moreover, the Theory of Planned Behaviour seems appropriate to be used in order to explain and predict all behaviour over which workers have the ability to exert self-control. It is also recommended that to enhance the robustness of the study's findings, an augmentation of the methodological approach is advisable. While thematic analysis serves as a valuable preliminary tool in uncovering various factors contributing to non-compliance, it is essential to supplement this approach with statistical data to pinpoint the key determinants. To bolster the identification of these crucial factors, it is suggested to validate the interview data using qualitative data software like Nvivo or Atlas Ti. as this methodological triangulation can provide a more comprehensive and well-rounded understanding of the underlying dynamics, thus fortifying the study's outcomes.

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HUMAN BEHAVIOURAL STRATEGIES TO ORGANIZATIONAL SUCCESS IN COST AND PROJECT PERFORMANCE FOR OIL AND GAS INDUSTRY: AN APPLICATION OF RESOURCE BASED VIEW THEORY

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Abstract
In science and engineering, the life cycle of project management involving people, processes, and technological assets serves as the foundation for achieving organizational objectives. Initiating, planning, executing, monitoring, controlling, and closing are the steps in the life cycle. In project management, the life cycle also includes construction, resources, facility, and other management tasks necessary for overall project success. The construction industry might be unique and sophisticated because it involves numerous complex aspects such as structural designs, site circumstances, resources regarding building materials and labour requirements, landscape requirements, construction procedures, functional individualities, and managerial competence. Furthermore, projects need the participation of several parties, including customers, consultants, suppliers, manpower, authorities, and other stakeholders. Every project owner envisions to have a successful project. The paper presents the strategies for controlling the cost in resource allocation management at every human behavioural was involved in onshore fabrication projects. Nowadays, cost overrun is prevalent in building construction, infrastructure, and oil and gas construction projects. The data of the study were gathered from previous researchers' studies and literature reviews. The study revealed the primary relative importance in; theory underpinned, project management, resource allocation, activities identification, cost element attributes, and human behavioural strategies toward business profit. Hence, the project management should establish effective project planning, management, and monitoring to improve project performance to control costs in resource allocation for onshore oil and gas fabrication projects.

Keywords: *Human Behavioral; Project Management; Cost Control Element; Resource Based View (RBV) Theory; Onshore Fabrication Oil and Gas Projects*

INTRODUCTION

Costs are defined in the enormous sense to encompass all resources such as labour, materials, land, and opportunities forfeited (Ashworth Perera, 2017). Each business and organizations have their own products and operations. The nature of the organization and its purpose determine the resources required (Stefaniak & Tracey, 2014). The resource-based nature of each organization may differ.

For example, the oil and gas Industry of the drilling division requires the oils, technical skills, labour, and particular instruments that are familiar to that industry. Low porosity and low permeability, super heavy oil or extra-super heavy oil, deep to ultra-deep oil and gas resources, tight oil and gas, shale oil and gas, and other unconventional oil and gas resources are the most common resource types in the drilling division. However, the engineering technology requirements for developing difficult-to-produce reserves in the oil and gas industry are diversified and interrelated, with poor quality, low efficiency, and challenging recovery (Liu, 2020).

In contrast, the textile Industry requires resources such as wool and latex and competent staff. There was also a spinning jenny and a power loom for weaving textiles in the latter (Majumdar et al., 2021). While the key driver of future mining production is mining exploration investment. Metal production cannot be sustained without investment in exploration. Countries with more substantial mining competitiveness are more likely to attract sizeable exploratory funding. Mineral discoveries or a considerable level of mineral output in a country can also change people's ideas of the country's geological potential. (Vásquez Cordano & Prialé Zevallos, 2021).

The oil and gas industry are the fastest growing and most important contributor to the country's economic development. As a result, the government strongly supports new investment projects in the business, including through legislation and co-investment. In addition, the government intends to expand the present gas pipeline capacity, including the building of additional pipelines and gas processing facilities and the establishment of a gas-based power generation sector (Orazgaliyev, 2019). Due to the expandable project, the new oil platform is required for the fabrication on land and sailing away to offshore for the drilling operation (Suppramaniam & Ismail, 2019).

Moreover, construction planning defines effective strategies (methods, operations scheduling, and needed resources) for attaining construction project objectives inside the construction business. To address the question of how much work should be put into construction project planning to ensure project success, construction firm leaders may use planning to calculate how much money it need to invest to achieve cost-effectiveness in their planning efforts. When the right amount of planning work is put in, the project implementation time is cut in half, and the project's stated goal is more likely to be met. Additional planning work above the ideal amount increases the likelihood that the project will fulfil its goals. This work, however, is often squandered owing to implementation delays caused by the increased time necessary to complete the planning and the rising number of planning loops that occur when planners plan and replan minute project elements (Faniran et al., 1999). The resource-based industry has a significant impact on the success of an operation which matches with the outcomes of the organizations. Behind the business's success is the correct allocation of resources (Olsen et al., 2005).

Human Behavioural Among Project Management Teams

In the oil and gas sector, project management entails organising, motivating, and controlling resources to accomplish predetermined objectives. The four most crucial leadership abilities for completing future projects successfully are motivating others, strategically planning, inspiring commitment, and managing change (Eweje et al., 2012). The project management discipline can contribute to the strategic use of improvement projects by developing expertise and methods for incorporating projects into the organization's strategy process (Kannimuthu et al., 2019).

Communication within each team is crucial to the success of a project in project management. The idea of communication is frequently misunderstood, particularly when oil and gas projects are being carried out. According to George Bernard Shaw "The greatest problem with communication is the illusion that it is accomplished" (Thinkexist.com, 2010).

This is common in most projects, with the expectation that the other person or party would be able to understand the communication (Alnoor Akberali Halari, 2010).

No further responsibility is released from the communicating party by an illusion of communication. This, regrettably, happens frequently in project communications. For a variety of reasons, none of the qualities of appropriate communication are adhered to when working on projects. "Effective project management is based on effective communication. It needs to be timely, exhaustive, correct, and verified." writes (Çelik et al., 2018).

All project team members must share a common understanding of the work to be done and the deliverables that must be produced by the respective engineering, procurement, and construction groups. This is ensured by a communicated scope. The engineering design and drawings that result from the scope, on the other hand, cannot be finished independently from the stakeholders.

The Importance of Resources in Onshore Fabrication Oil and Gas Projects

Resources are key items in every organisation since it determines project output and progress. Distribution of each resource is an early requirement after the site in every project has been assigned (Suppramaniam & Ismail, 2019). Resource allocation is a tough process in the management of finite resources. The resources are requested following the activities involved and the project timetable. Money is one of the major important resources allocated on request for equipment, raw materials, and labour within time management (Beckie, 2003). The entire project milestone timeline must be met according to the plan. The planning engineer lays up all the resources required for the building phase to go well. All parties participating in project management, construction management, resource management, facilities management, and other management essential to achieve project success must capture resources from the start of the project. Project success hinges on the capacity to manage resource allocation versus scheduled activities successfully (Aljohani, 2017). Organizations repeat comparable tasks in a variety of contexts. Consider the following project types: software installation, recruiting and hiring, hardware installation, requesting, analysing, and selecting suppliers and providers, and upgrading business processes. Projects of this type can be performed numerous times per year and will most likely follow the same stages each time are completed.

At one stage, providers are chosen, and costs for each resource are assigned using a resource-based approach. These costs contribute to the organization's long-term and sustainable benefit. The appropriate management focuses on cost distribution while synchronizing with the needed resource to move activities following demand. The demand is the result of profit for the business's long-term viability. (Zhang et al., 2021) as per Resource-based View Theory.

Resource-Based View Theory

The resource-based view theory (RBV) involves an in-depth analytical view of sources and organizational wealth creation and captures (Wernerfelt, 1984). Resource-based theory or approach shows that valuable, unique, and irreplaceable resources position the company for long-term success. These strategic resources can provide the basis for developing powerful

capabilities that can produce superior performance over time. The ability to combine, manage, and vice versa to exploit resources in a way that adds value to customers and creates advantages over competitors is crucial. According to Maina (2016), resources include all assets, capabilities, organizational processes, firm attributes, information, knowledge, and other resources that the firm handles that allow the firm to understand and implement strategies that increase its efficiency and effectiveness. Resources are significant, especially to buy, and manage, and are difficult to replace, so an organization must position itself strategically with its competitors. Otherwise, competitors can make profits. If the firm's resources and capabilities are mixed and used in the right way, it can create a competitive advantage for the organization. Ultimately, only the company can maintain a competitive advantage with innovation and a strategic position in the sustainable and competitive market. Outsourcing of resources leads to increased performance and costs, and investment in internal capabilities maintains competitive advantage, but companies must identify their capabilities. Maina (2016) has observed the process of outsourcing strategic decisions and their relevance to RBV.

In addition, with the most influential theories in management, resource-based theory (RBT) explains the sources of sustainable competitive advantage at the firm level. Resources are generally defined as all assets, capabilities, organizational processes, firm attributes, information, knowledge, etc., controlled by a firm (Barney J, n.d, 1991). Zhang et al. (2021) added that RBT focuses on an internal analysis of the variance in resource endowments to explain the heterogeneity in firm performance. According to resource-based theory, the possession of strategic resources provides an organization with a wonderful opportunity to establish competitive advantages over its competitors. However, the focus of this study is more on the theory of RBV where RBV was introduced first before RBT.

Communication in shaping human behavior applied to theory underpinned with excellence is one way of achieving a healthy team with balanced and active work progress. The dominant theme in management is the roles and responsibilities of project organization team members. Although each project has an organizational chart, specific questions need to be answered, such as whether the job descriptions for the various positions are clear and whether the corresponding roles, responsibilities, and accountability are clearly defined in terms of knowledge transfer. How are these terms communicated to the project team members? Teams need to know how to interact with each other effectively. The team deepens the line of authority for all practical purposes and follows it as the project progresses.

Moreover, communication is essential in critical path activity. A lack of clear and non - aggressive communication should be avoided. Not only that, duplication of roles and duplication of effort, which occurs in some projects, can also be avoided. More importantly, the project can be handled, controlled, and directed with the right decisions by the team members responsible for achieving the objectives set for their respective fields for the project. Some solutions are deserved for making decisions efficiently and promptly. According to (Alnoor Akberali Halari, 2010), the decision-making process should start with sound problem analysis, being aware of bias and eliminating it from the decision alternatives, viewing the problem from an outsider’s perspective, rather than as an insider and "considering the opposite" by asking the questions. Cost savings are part of the cost-controlling work in a project.

Resources Classifications

Manpower, equipment, physical facilities, and inventories are examples of resources with restricted availability and each of the resources needs to be classified according to its priority and task. The classification of the resources is by the project activities, project schedule, and duration, type of business, industry, complexity, technology used, and cost (Ismail et al., 2014). The classification will aid the project management team to allocate resources appropriately, such as methodology for the project length to ensure timely completion, cost savings, and quality assurance. Besides time, cost, and quality, other criteria determining successful projects include safety and environmental concerns (Markou et al., 2017). All classes must act following the project's goal further dividing project success criteria into four categories: cost overruns, project performance, and customer satisfaction are all examples of project overruns (Vrchota & Řehoř, 2019).

The classification might be based on the scope of work in a specific project. Each prioritized scope of work established the project's boundaries and the restrictions that applied to the job until it was finished following the specifications (Al Subaih, 2015). This classification work scope also known as a statement of work in the engineering profession involved a letter of intent, scoping material, project beginning documentation, or a request form. Starting a project at the correct stage is critical, as is remaining on track (Ismail et al., 2014).

The project manager must have forecasting abilities to strategize resource allocation concerning the project's schedule and activities. The significant resources will be fully utilized once the project begins, either inside or between projects. The protectiveness toward resource allocation timeframes can determine whether or not a milestone is met according to plan (A. Papadopoulos et al., 2016). As a result, time establishes a time limit or deadline for the project's completion (Hu & He, 2014). To some extent, time and cost are inversely connected (Ramanathan et al., 2012). Time was devoted to determining the resources required to expedite the operation to meet the deadline (Hu & He, 2014).

Another important resource classification is the allocation of cost in the project. Cost is a primary consideration throughout the project management linked with construction management, resource management, and others (Cletus O. Akenbor & Thankgod C. Agwor, 2015). The guidance engaged as a team should adhere to the forecasted cost for commencing a project to the letter. As a result, brainstorming sessions are critical for capturing deliverables. The cost granted comprises the breakdown cost of each job, which reflects activities in the project schedule to estimate resource costs. It serves as a baseline for fabricators, as well as an estimate of when tenders.

Manpower such as fabricators, engineers, and developers is one of the important resources which need to be classified according to the requirement of the project task and timeline. The fabricators can schedule the resources, lease them from a third entity, or own them. Fabricators that conduct projects regularly have some fixed resources and some long-term resource variables. Another example is in another project where in the systems development projects, people or workers are the significant resources (Momeni & Martinsuo, 2018).

Other than that, another valuable resource is the method in the application in the projects, including software in computerized processing. The scheduling can be traced and tracked using influential and significant project success (Joshi et al., 2019).

RESEARCH METHODOLOGY

Reviewing the literature reviews from earlier researchers in the chosen field of study constitutes the first stage. The purpose of a literature review is to identify the issue and research gap while gaining an understanding of human behaviour and its significance reflected in the application of the Resource Based View (RBV) Theory that aims for cost control elements. A related field of study is necessary to adequately capture and observe the problems associated with managing the oil and gas sector in light of the onshore fabrication of oil and gas megaprojects. The impact of human behaviour in project management is part of the larger perspectives in organizational performance that manages resource allocation, and at this point, contributing strategies related to cost controlling in fulfilling resource allocation are extracted. As secondary data sources for this, journals, articles, conference papers, annual reports, and books will be used. Further to this study the researcher will a depth study on the strategies in cost control elements as per the table in the result and discussion of resource allocation in onshore fabrication projects. A case study research technique is used. Interpretivism is the research philosophy, and the inductive approach and methodology are the qualitative research designs (Creswell & Creswell, 2018).

RESULT AND DISCUSSION

The theory on project success as mentioned relies on the Resource-based View (RBV) theory, which also involves the roles and responsibilities of stakeholders, decision-making, and communication by every stakeholder involved in the projects. All the strategies on cost element indicate control of the Cost of 5M from the exploratory research. At the same time, information flow and data transfer are essential to be appropriately channelled from project management team to the team responsible for the strategies identified in Table 1 for a project.

From Table 1, the strategies on human behaviour are required to control the cost of the construction project which can also affect and impact the project performance and success.

Besides, to procure the request for resources, the parties involved should execute strategies in each resource allocation to achieve project success while minimizing project costs. Whereas for material resources, the requirement to identify price fluctuation, material shortages, and temporal variations that affect material price, which necessitates material price check sporadically before purchase, inaccurate quantity take off, and design cost estimation should not be taken lightly. On the subject of manpower resources, solutions for labour supply, labour productivity, and labour absenteeism are required. Several critical techniques must be in place to successfully manage a machinery fabrication project and reduce cost overruns. These tactics provide alerts on equipment availability and failure, delivery duration, communication with subcontractors and suppliers, quality control, and financial control. The availability and failure of vital equipment necessitates the implementation of a contingency plan. The delivery duration strategy comprises determining effective delivery routes and planning deliveries ahead of time. Regular meetings and proper communication channels are part of the subcontractor and supplier communication plan. Regular inspections and testing

are part of quality control. Financial control entails creating a project budget, cost estimates, and a plan to keep expenditures under control and payments on schedule. These methods must be constantly examined and altered to ensure that the project remains on schedule.

Table 1. Strategies on Cost Elements Identification for Controlling the Cost of 5M; Resource Allocation (Money, Material, Manpower, Machinery, and Method) in Construction Activities

Money	Material	Manpower	Machinery	Method
From project value, wrong time, and cost estimates.	Fluctuation price and variation of price.	Labour supply at the right schedule without delay.	Equipment availability and failure.	Regular meetings with subcontractors and suppliers. Ensure safety and health.
Poor financial control at site.	Shortage in material.	Problem with subcontractors.	Late delivery of equipment.	Slow information flow between parties. Establish appropriate communication with all parties via Traffic Light tracking.
Financial difficulties by the owner. Ensure labour and contractor are paid on time.	Time variation could change the material price. Material price check irregular before purchase.	A project manager is someone who has worked in a comparable sector and can predict potential problems from the start to finish of a project.		Don't underestimate the project's complexity. Frequent design charges. Used effective methods to visualize the overall project view such as BIM Technology, Oil and Gas used traffic light tracking.
Delay in progress payment.	Inaccurate quantity takes off.	Labour productivity.		Control mistakes during the construction stage and errors and errors in design.
Inaccurate time and cost estimates.	Cost and design estimation should not be treated lightly.	Labour absenteeism.		Delay in drawing approval [8] Incomplete design at the time during tender (FEED).
Contractual claims.		Shortage of technical personnel.		

Traditionally, contractor estimators employ resource analysis to estimate their rates for things measured in the quantity bill. Each measured item is disassembled into its compiler, material, and plant components. Prices are determined by output, gang size, amount of material, factory hours, and so on.

Focus is placed on project characteristics such as kind, size, location, shape, and height as important elements influencing costs. In theory, the contractor will use input extensively, however, some research suggests that the entire process is mostly influenced by value appraisal based on prior experience. Instead of specific bill items, other analytical methods might calculate resource costs based on operations. Due to the time and type of data required, resource allocation is not a pre-tender price forecasting strategy. However, in this case, where accessible cost data is uncertain, it will get the application, and the design team may own it. In addition to referring to source-based estimations, there are several more options (Allan Ashworth and Srinath Perera, 2017). The impact of any decision analysis approach on the company and its decision-makers is the ultimate litmus test. The method is also accessible and reasonably simple to implement, thanks to the software system's assistance (Kleinmuntz, 2008).

Since the reasoning behind these resource distribution decisions is public, human behaviour appears to be on a level playing field. It will foster agreement on the recommendations that arise. In the best spirit of decision analysis, the process's rational and logical nature offers participants confidence that scarce resources are being used wisely. Any technique for combining decision analysis with resource allocation is believed to have the advantage of basing judgments on reflective, systematic study. When a portfolio has dozens or hundreds of eligible projects, the effort required can be considered. Many organizations lack the means or the determination to do comprehensive decision analysis on this scale. Organizations frequently require assistance in calculating the actual costs and benefits of decision-analytic techniques for resource allocation.

CONCLUSION

The research in strategies from human behaviour on awarded projects involves investigating the resources that affect the cost from activities and the construction operations which play an important role in cost allocation. Capitalization or money is a fundamental process and an integral indicator, the economic essence of which is to increase the cost of capital, both due to rising assets and the efficiency of their use. The capitalization of oil and gas resources is a cost reflection of the potential of the resources of oil and gas fields in the subsoil, considering the current price at the time of the assessment, the technical and technological level of the project of development, and the geological and economic risks specific to this field. It should be noted that the primary method of capitalization of most assets is the income approach, which is based on the process of discounting cash flows. This method is based on the concept of accounting for changes in the value of money over time, which are influenced by numerous factors. According to the study, industry practitioners in Oil and Gas industry should use the outcomes as an instrument of strategy to achieve optimal project outcomes while minimizing cost overruns.

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THE CRITICAL SUCCESS FACTORS OF LEAN CONSTRUCTION IMPLEMENTATION IN RESIDENTIAL PROJECTS

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Abstract
In recent decades, the importance of lean construction (LC) in improving construction management has grown, with the potential to improve industry practices and outcomes. LC may increase project performance by boosting efficiency, decreasing waste, and enhancing customer value. It is a production-based management strategy that assists construction firms in increasing profits while reducing waste. The research strategy entails gathering secondary and primary data on how to improve the success of LC implementation for residential projects. The objectives of this paper are to identify critical success factors in LC implementation and to make recommendations for improving successful LC implementation in residential projects. Quantifiable data was obtained from a survey of 104 registered Grade 7 contractors with the Construction Industry Development Board of Malaysia (CIDB). SPSS version 26 was used to analyse the quantitative data, and the results are presented in descriptive charts and tables. The data analysis revealed four critical success factors: management commitment, growth and market share, regular meetings, and a supportive environment for workforce efficiency. Several recommendations were made as a result of the research. Some of the proposals include employee skill development and productivity through on-the-job training and continuous learning, customized applicable lean practices, and increased transparency through effective communication and information sharing. Finally, it can be concluded that LC can be successfully implemented for residential projects in Malaysia's construction industry.

Keywords: *Lean Construction; Critical Success Factors; Implementation; Residential Projects; The Malaysian Construction Industry*

INTRODUCTION

According to Alhaji Mohammed (2012), the construction industry is a large, dynamic business that necessitates significant financial investments. The construction industry as a whole is comprised of a wide range of challenges and concerns that may impact a construction project (Ahmad Rafidi et al., 2023). The way claims are woven into the fabric of the construction process is a unique risk component in the construction industry. As time goes on, the construction industry must meet the growing and changing demand for construction. The construction industry is one of those that has to deal with a lot of uncertainty on a daily basis. The importance of construction stems from its role in the creation of both physical facilities and jobs, both of which are important and visible components of the country's development (Agyekum et al., 2013). Because the construction industry is so important to every nation's economy, and so many other sectors rely on it for acquiring inputs and providing goods to practically every other sector, reducing waste in the sector would result in huge cost savings for both the industry and society (Khaleel & Al-Zubaidy, 2018). Construction waste is also distinct since it is influenced by construction processes, styles, countries, and other variables. As a result, according to Ahmad Rafidi et al. (2023), the building industry is frequently recognized as one of the most serious environmental

pollutants. Thus, the construction sector has embraced lean techniques in order to overcome this dilemma (Marhani et al., 2022).

LC is a revolutionary approach to construction management that has revolutionized production planning, sourcing, and assembly. This technique was developed to reduce waste production using lean manufacturing techniques (Selva Prasanth et al., 2018). When applied to construction, lean concepts have the potential to improve the way things are done throughout the project's completion process. A "LC" project is one that adheres to lean principles (Mossman, 2018). Furthermore, LC is a method of manufacturing that aims to save time, money, materials, and effort. It all boils down to designing and building a solution that meets the client's needs the first time (Sumayya, 2017). Construction companies may fully embrace a lean culture that encourages development, innovation, and success by eliminating waste, resulting in significant cost savings for both the company and society. Although several ways or methods for enhancing quality, efficiency, and effectiveness have been established, lean principles allow for the reduction and elimination of non-value-adding activities, hence increasing customer value (Maradzano et al., 2019). Additionally, throughout implementation, construction activities must be guided by a deeper grasp of the objectives and tactics (Howell & Ballard, 2015).

LC, or the application of lean concepts in the construction industry, is one of the most effective ways for improving project management, reducing waste, and shortening project schedules that include a culture, goals, tools, and ideas for creating value (Oguntona et al., 2018). According to Marhani et al. (2021), there are also frameworks or guidelines that advocate certain tools, important concepts, or approaches for LC implementation. This strategy covers not only the building process, but also product development, supplier relationships, strategic management, and human resource management. Customers are increasingly demanding excellent products, improved performance, and lower costs; thus, this is used to meet their requirements (Reinbold, 2017). As a result, the goal of this paper is to identify critical success factors in LC implementation and make recommendations for bettering LC implementation in residential projects. Employee skill development and productivity through on-the-job training and continuous learning, customized applicable lean practices, and increased transparency through effective communication and information sharing are all examples of how LC can be successfully implemented for residential projects in Malaysia's construction industry.

LEAN CONSTRUCTION IMPLEMENTATION IN RESIDENTIAL PROJECTS

High-level management must encourage the effective implementation of LC or any other creative approach. Top management must devote sufficient time and resources to developing an effective strategy and managing changes that arise during the implementation phase (Ward, 2015). Organizations should embark on a lean path at their leisure, with a strong desire to gain a competitive advantage and improve their corporate image, which may result in early results. According to Ward (2015), effective leadership with a strong vision, purpose, and serious commitment is required to develop a successful lean culture in a company. Furthermore, due to a lack of understanding of lean philosophy and awareness of the benefits of employing its methods. The most important critical success factors in lean adoption at the project level were identified as scope management, connections between parties, and interactions (Nasrollahzadeh et al., 2016). Adopting customer satisfaction of LC in the construction

industry would improve quality and efficiency, eliminate waste, and increase value for the client. It is a production-based management method that assists construction companies in increasing profits by increasing efficiency and reducing waste (Merker, 2018). Without consumer pleasure, construction parties may face a number of challenges when implementing the LC concept.

By using LC tools, standardized LC processes can increase production and provide cost savings for long-term profit. Reduced waste improves project efficiency and cost management, resulting in higher profit margins (Ward, 2015). LC reduces time spent waiting for supplies, equipment, and information while eliminating inefficiencies in operations. LC is easier to implement when people are willing to invest in LC tools and techniques. Adequate funding to provide relevant equipment and materials, professional wages, incentives, and reward systems; investment in training and development program; and possibly hiring a lean expert to provide guidelines to both employers and employees during the initial implementation are all required for the successful implementation of LC (Salunkhe, 2018).

According to Bayhan et al. (2019), one of the critical success factors of LC is the compatibility of lean tools and methods with building processes. Furthermore, the selection of tools that may deliver the maximum benefits in terms of cost, time, and productivity is one of the critical success factors for LC (Bayhan et al., 2019). Moreover, the critical success factors of LC are the identification of best practices and the definition of lean concepts; a better understanding of LC practices would result in a more appropriate selection of LC tools and a better understanding of technical requirements; and a clear and concise implementation strategy for lean techniques can be developed, complete with a time frame (Nasrollahzadeh et al., 2016). Daily meetings are held when team members are ready to discuss their accomplishments and challenges by holding a 10-to-15-minute morning meeting every day (Marhani et al., 2022). The goal is for everyone on site to understand what is going on and what is expected of them. The seminars improve two-way communication within the team while increasing employee job satisfaction. Employees can engage in daily huddle meetings and identify the positive and negative elements of their jobs (Prayuda et al., 2021).

The management performs tasks that are frequently described as planning, organizing, leading, and controlling. As a result, the success of lean implementation practices will be determined by how effectively they assist and inspire employees to work toward each specified goal (Bayhan et al., 2019). Lean consulting and an approachable consulting team are critical for the success of lean adoption. Workplace disagreements occur when team members do not always agree or know how to work together despite their differences. For a team to be successful, disagreements must be resolved in a timely and professional manner that minimizes disruption to production (Bayhan et al., 2019). The ability to manage team disagreements is critical to the success of any business. High-performing teams are synergistic social units that collaborate to achieve a common short- and long-term objective or goals (Ward, 2015). They frequently show complete dedication to both the task at hand and to one another. According to Ward (2015), team members perform better when they understand their responsibilities: they know how to complete their tasks and why they are performing them. All team members must understand and support the significance and importance of the team's purpose and vision. Clarifying the goal and connecting it to each person's position and responsibilities, as well as including stretch goals that increase the challenge required to motivate team members, increases team potential.

The recommendations for improving successful LC must focus on ensuring supervised quality control techniques throughout the process, where managing the entire process reduces misunderstandings when the flow crosses multiple units in a hierarchical organization and the risks of not having a responsible person when the procedure crosses organizational boundaries (Oyedolapo, 2014). Although a process authority may be appointed, interaction with suppliers and team building are also beneficial for optimal flow. Another significant issue that arose was the requirement to express a consistent vision throughout the organization. Furthermore, success necessitates a high level of involvement and dedication (Wan Muhammad et al., 2013). Creating a vision statement at the project level lays the groundwork for the project's goals, objectives, and tactics. This provides everyone involved with a clear picture of what needs to be done, how it should be done, and what success looks like once the implementation process is complete. Among the organizations involved in a project where trust is required, trust is perhaps the most important foundation (Oyedolapo, 2014). Creating a contractual structure to encourage lean may not be enough to persuade people to act in a certain way. Instead, the organization or the person in charge should establish the tone, define expectations, and lay out the conceptual framework before bringing in individuals who are willing to work within it.

Integrate continuous improvement into the process, as it is a critical concept for employee skill development and productivity. Measuring and monitoring progress, involving employees in the improvement process, and standardizing procedures are all methods for implementing and driving continuous improvement (Ghazi, 2018). In addition to the concept and principles of lean, certain useful techniques should guide lean companies' daily operations. These techniques aid in the detection of issues while also protecting the system from variation, laying the groundwork for ongoing development and learning (Demirkesen & Bayhan, 2020). Because time for learning is limited in construction, and project teams include people with varying degrees of experience and understanding of lean, training is critical. Training is one of the most important aspects of increasing lean awareness, and it can also help workers acquire expertise through training. Technical training enhances expertise, whereas behavioral development fosters commitment (Naim et al., 2015). The training must be equal in terms of understanding both the idea and concepts of lean as well as the tools required to put the approach into action.

The correct choice of lean tools and processes is critical to lean success. On the contrary, the vast majority of construction firms employ some form of tool or technique to aid in the execution of LC. Many researchers believe that many lean tools and techniques must be used and customized in order to achieve all of the LC concepts, because one technology cannot adequately cover all of the lean concepts and functions (Demirkesen & Bayhan, 2020). The value of lean tools and methods in easing the implementation process and achieving optimal results must be thoroughly investigated to ensure effective project delivery. Improve workflow while also incorporating technology and a deeper shift in the process. Technology will provide even more benefits if the flow is managed and optimized. Another advantage of an optimized flow is that it requires less conversion investment. The best initiatives start with meticulous planning. Determine product quality and set attainable team goals. Maintain ongoing inspection checklists and analyse leading indicators from all of these checklists to improve project quality (Naim et al., 2015). As a result, quality control may help to accelerate the advancement of effective LC.

Organizations must start small and provide their perspectives within a single project. It is preferable to have a good worker to bring on board. Results will follow when momentum is built and ideas and efforts are implemented (Chugani et al., 2017). However, everyone in the industry must be willing to make decisions. When everyone is pleased with the results, it is critical to communicate them to the rest of the company. Communication is critical for improving the performance of Lean efforts. A well-established communication system facilitates the establishment of effective communication channels, allowing Lean practices to be implemented effectively in order to meet the goal (Naim et al., 2015). Communication is essential for brainstorming, sharing ideas, speaking up openly, and learning from mistakes. As a result, businesses that create effective communication channels can promote Lean and accelerate its positive impact on workplace performance. One of the most critical aspects is deciding when and how the results will be communicated. The most important aspect of achieving worker commitment is communication (Ghazi, 2018). All project stakeholders will receive assistance in establishing trust and improving communication. This argument may be strengthened by contractors' early engagement, partnership, and concurrent engineering.

METHODOLOGY

A survey consists of a structured questionnaire that is based on "questioning the respondent." The questionnaire should be well-written, error-free, and its efficacy evaluated. Instead, because respondents may have varied degrees of experience, the questionnaire should be straightforward to comprehend and free of unclear statements (Babbie, 2011). The questionnaires were created utilizing the two research objectives and information gained from the literature review. The surveys are written in a way that allows respondents to simply comprehend and complete them. A well-structured questionnaire with two components was developed to achieve the research's purpose. The first section of the questionnaire collects professional background information, while the second employs a 5-point Likert scale, with 1 indicating "strongly disagree" and 5 indicating "strongly agree".

The closed-ended question surveys were prepared using Google Forms and sent to the intended respondents by mail, online, social application, and social media platforms such as WhatsApp, Facebook, Telegram, and LinkedIn in order to meet the research objectives. For this research, construction companies were employed as the unit of analysis. Considering industrialized building system (IBS) is one of the LC tools, IBS contractors are the ideal population. Based on the IBS contractor population, Table Krejcie and Morgan (1970) was used. As a result, the research population was taken from a pool of 1,575 Malaysian IBS contractors who were registered with the CIDB under the G7 (projects valued at more than Ringgit Malaysia 10 million) classifications and defined from the CIDB database.

The questionnaire was distributed by stratified random sampling to 310 contractors in Malaysia. One hundred and four surveys were received, yielding a 33.5% response rate. As a result, this study is positive about the respondents' percentage of response rate derived from a high-quality group, which ranged from 20 to 30% (Takim et al., 2004).

The responders were all LC experts in their respective organizations. They are well-informed and committed to engaging in the LC and providing input in the Malaysian construction industry. They have substantial experience managing building waste utilizing the LC method. Data analysis is an essential component of the research process. It summarizes

and evaluates all of the data collected. After the data has been collected, it will be analysed. The study data is evaluated and quantified by occurrence frequency using a computer program, and the outcome is displayed as a percentage and graphed for better understanding.

In addition, the data for this research was analysed using the IBM Statistical Package for the Social Sciences (SPSS) statistics software version 26. It is a comprehensive software package that enables researchers to study complex statistical data in a descriptive manner by displaying data in numerical representations (Bala Jyoti, 2016). The mean (μ) and standard deviation (σX) are descriptive statistics used to describe the basic properties of data in research. They provide concise summaries of the sample and measures. They are the basis for practically all quantitative data analysis as well as simple graphical analysis.

DATA ANALYSIS AND FINDINGS

This section discusses the findings of the questionnaire surveys on critical success factors for LC implementation and how to improve successful LC implementation.

Table 1. Critical Success Factors of LC Implementation

Item	Descriptions	Mean Score (μ)	Std. Deviation (σX)	Ranking
	Management			
1.	Management commitment	4.32	0.672	1
2.	Creating awareness for lean	4.30	0.652	2
3.	Adopting customer satisfaction	4.29	0.759	3
	Financial			
1.	Long term profit of implementing lean tools	4.17	0.830	3
2.	Willingness to invest in lean practices	4.26	0.800	2
3.	Growth & increase in market share	4.27	0.827	1
	Technical			
1.	Availability of Lean tools & techniques	4.18	0.798	3
2.	Clear understanding of technical requirements in lean practices	4.31	0.722	2
3.	Daily meetings for lean	4.36	0.736	1
	Communication			
1.	Supportive environment for workforce efficiency	4.19	0.764	1
2.	Availability of consulting team members in lean	4.16	0.826	3
3.	Existence of clear roles in lean	4.17	0.864	2

According to Table 1, the most influential critical success factors of LC implementation are management commitment ($\mu = 4.32$, $\sigma X = 0.672$). This is followed by raising awareness for lean, which received a 4.30 mean score ($\sigma X = 0.652$) and adopting customer satisfaction, which received a 4.29 mean score ($\sigma X = 0.759$). Following that, the critical success factors of LC implementation in the Malaysian construction industry are discussed from a financial standpoint. With a mean score of 4.27 ($\sigma X = 0.827$), growth and increased market share take first place. The willingness to invest in lean practices came next, accounting for 4.26 of the mean score ($\sigma X = 0.800$). Furthermore, the long-term profit from implementing lean tools has the lowest mean score of 4.17 ($\sigma X = 0.830$). Furthermore, the majority of respondents strongly agreed that the most influenced critical success factors of LC implementation in the Malaysian construction industry under technical aspect by daily meetings for lean, which recorded a mean score of 4.36 ($\sigma X = 0.736$). This is followed by a clear understanding of technical

requirements in lean practices, which received a mean score of 4.31 (σX = 0.722), while the availability of lean tools and techniques received the lowest mean score of 4.18 (σX = 0.798). Finally, with a 4.19 mean score (σX = 0.764), the majority of respondents strongly agreed that the supportive environment for workforce efficiency is the critical success factor of LC implementation in the Malaysian construction industry. Apart from that, the presence of distinct roles in lean received a 4.17 mean score (σX = 0.864) and the availability of consulting team members in lean recorded the lowest mean score of 4.16 (σX = 0.826).

Table 2. Enhancement of Successful LC Implementation

Item	Descriptions	Mean score (μ)	Std. Deviation (σX)	Ranking
	Management			
1.	Assures supervised quality control procedure	4.27	0.806	3
2.	A clear methodology, with well-defined & rigorous strategies	4.38	0.740	1
3.	Improved relationships to enhance cooperation, avoid conflicts & establish trust	4.36	0.723	2
	Training & Skill			
1.	Skill development & productivity of workers on job training for workers & continuous learning	4.25	0.772	2
2.	Train employees in the lean philosophy	4.22	0.812	3
3.	Increasing lean awareness & knowledge through training	4.36	0.709	1
	Technical			
1.	Customize suitable lean techniques	4.25	0.760	1
2.	Technology adoption & infrastructure	4.23	0.753	2
3.	Monitoring for quality	4.19	0.764	3
	Communication			
1.	Empower the employees in the field to make decisions	4.30	0.774	2
2.	Brainstorm for opportunities to achieve goals	4.29	0.809	3
3.	Increased transparency through effective communication & information exchange	4.38	0.672	1

Table 2 shows that the majority of respondents strongly agreed that the most influenced the enhancement of successful LC implementation in the Malaysian construction industry under management aspect is due to a clear methodology, with well-defined and rigorous strategies, which recorded a 4.28 mean score (σX = 0.740). This was followed by improved relationships to improve cooperation, avoid conflicts, and establish trust, which recorded 4.36 (σX = 0.723), and the assures supervised quality control procedure, which recorded the lowest mean score value of 4.27 (σX = 0.806). Then, under the training and skill aspect, the enhancement of successful LC implementation in the Malaysian construction industry. To begin with, with a mean score of 4.36 (σX = 0.709), increasing lean awareness and knowledge through training indicates that the majority of respondents strongly agree with those issues. Workers' skill development and productivity on the job training and continuous learning come in second place with a mean score of 4.25 (σX = 0.772), while employees who were trained in the lean philosophy had the lowest mean score of 4.22 (σX = 0.812). Furthermore, a technical summary of the respondents' responses on how to improve successful LC implementation in the Malaysian construction industry. First and foremost, a mean score of 4.25 (σX = 0.760) indicates that the majority of respondents strongly agree with customize suitable lean technique. Aside from that, the average mean score for technology adoption and infrastructure was 4.23 (σX = 0.753), and quality monitoring recorded the lowest mean score of 4.19 (σX = 0.764). Finally, increased transparency achieved the highest mean score of 4.38

(σX = 0.672) through effective communication and information exchange. This is followed by empowering field employees to make decisions, which received a mean score of 4.30 (σX = 0.774), and brainstorming for opportunities to achieve goals, which received the lowest mean score value of 4.29 (σX = 0.809).

DISCUSSION

The effective implementation of LC or any other new creative method must be supported by top management. Organizations should embark on a lean journey on their own initiative in order to gain a competitive advantage and improve their business image, which could lead to early success. In this regard, 'communicate, inform, and discuss,' which entails talking about lean implementation, listening to workers, and explaining why it is necessary. Following the implementation of LC, the company's image will improve, increasing the likelihood of additional contract awards. To develop a successful lean culture in a company, effective leadership with a strong vision, purpose, and serious commitment is required (Ward, 2015). In addition to cost reduction, lean manufacturing can help businesses achieve revenue growth and market share goals. Manufacturers can improve their company performance, including revenue growth, by employing lean thinking strategically. It demonstrates that revenue growth and market share are critical success factors in implementing LC in Malaysia. Lean manufacturing can help businesses achieve revenue growth and market share goals while also saving money (Ghazi, 2018). The daily huddle sessions improve employee job satisfaction while also improving two-way communication within the team. During daily huddle sessions, employees may participate in conversations and express their thoughts on the positive and negative aspects of their jobs. The goal is for everyone on-site to be more aware of what is going on and what to expect. The sessions increase employees' job satisfaction while improving two-way communication within the team (Bayhan et al., 2019). Management operates on a function-by-function basis, which reinforces and develops a high level of initiative among subordinates to engage in, drive, and regulate project work and management. As a result, the extent to which lean implementation practices enable and inspire employees to work toward each intended goal will determine their success (Bayhan et al., 2019). To properly execute and reap the most benefits from the lean approach, an organization's level of dedication and understanding should be higher.

Creating a vision statement at the project level serves as the foundation for the project's goals, objectives, and tactics. Priorities must be established by construction stakeholders prior to the start of a project. It will raise awareness of the benefits of LC among building industry stakeholders, making them more receptive to it. Wan Muhammad et al. (2013) agreed to this recommendation to improve the successful LC, stating that success necessitates a high level of participation and dedication. Training is one of the most important aspects of raising lean awareness, and it can also assist workers in gaining knowledge. The training must be balanced in terms of understanding both the idea and principles of lean as well as the tools required to put the approach into action. Individuals and project teams should receive training and ongoing education from internal or external LC professionals to develop and maintain a passion for the practice. Lean implementation in a plant is unlikely to succeed without adequate training and instruction. Managers, on the other hand, require education and experience. Managerial education is thought to be more important than employee education in some settings, particularly large factories, though both are required. Naim et al. (2015) agree with this recommendation, stating that technical training increases expertise while

behavioral development encourages dedication. The proper selection of lean tools and techniques is critical for lean success. Many researchers believe that many lean tools and techniques must be used and customized in order to achieve all of the LC concepts, because one technology will not adequately cover all of the lean concepts and functions (Demirkesen & Bayhan, 2020). In essence, it will improve project and financial performance by eliminating wastes in construction operations such as transportation, overproduction, incorrect processing, lead time, inventory, rework, and unnecessary procedures. Transparency is regarded as an essential component of any successful project. More transparency in the construction industry is needed, especially to improve LC. The most important factor in achieving worker commitment is communication (Ghazi, 2018). All project stakeholders are encouraged to work together to build trust and improve communication. The construction industry is made up of various stakeholders with opposing viewpoints who must work together as a team to ensure the project's success. As a result, all parties must work to improve and expand communication.

CONCLUSIONS

The critical success factor of LC was identified and evaluated in this study, as well as recommendations for improving successful LC. The success factor is divided into four major components: management, finance, technology, and workforce. According to the data analysis, the four major success factors discovered are management commitment, growth and increase in market share, daily meetings, and a supportive environment for workforce efficiency.

Senior management must also support the effective implementation of LC or any other new creative technique. Furthermore, lean manufacturing can help businesses increase revenue and market share while decreasing costs. The daily huddle sessions also increase employee job satisfaction by improving team communication. Furthermore, the success of lean implementation practices will be determined by how well they encourage and inspire employees to work toward each intended goal. According to the study's findings, a number of researchers employed and used the LC approach to improve the quality of their work.

Following that, it is suggested that the Malaysian construction industry improve its successful LC implementation. The enhancement of successful LC previously discussed is divided into four main parties: management, skill and training, technical, and communication. A better understanding of lean ideas may aid in overall improvement in the construction industry. Based on the data, the majority of respondents agree on the enhancement methods recommended in the questionnaire to increase their level of satisfaction with the successful implementation of LC in the Malaysian construction industry.

Having a clear methodology with well-defined and rigorous strategies will help building players understand the benefits of LC. Furthermore, increasing lean awareness and knowledge through training can assist workers in learning. Following that, the proper selection of lean tools and techniques is critical for lean success. LC technologies aim to improve delivery systems and processes by reducing waste, increasing productivity, improving health and safety, and meeting client needs. Finally, increased transparency through effective communication and information exchange is important for achieving worker commitment. As

a result, this research paper may assist the contractor in saving time and selecting appropriate materials, ensuring a smooth project delivery and shortening the project duration.

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ANALYZING PATTERN AND TRENDS FOR FINAL ACCOUNT ISSUES IN THE MALAYSIAN CONSTRUCTION INDUSTRY: A THEMATIC REVIEW

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Abstract
A final account is one of the important project documents used to determine the final cost of a project completed by a contractor. The efficient closure of it is also one of the mechanisms adopted to assess whether or not a specific construction project is successful in terms of its finance and management. This paper is written based on a thematic literature review made on the patterns and trends in final account publications align with the construction industry in Malaysia. ATLAS.Ti 23 was adopted to synthesis publications from the year 2010 to 2021 which were gathered from recognised databases such as SCOPUS, Mendeley and Google Scholar by using identified keywords. The findings of the code-to-document analysis revealed patterns and trends on publications discussing on final account. Accordingly, the results help to charter the route for future research on final account as it highlights the gap existed in areas which call for further investigation.

Keywords: *Final Account; Trend; Issues; Thematic Review*

INTRODUCTION

The construction industry is an essential part of the Malaysia economy. According to Construction Industry Development Board (CIDB), the construction industry remains as a main driver of the national economy (CIDB, 2020). In construction industry, payment is one of the important elements to safeguard project will be completed within the time, cost, and quality (Judi & Mustaffa, 2021; Thanuja & James, 2015). Payment is the lifeblood to the contractor because performance in this business relies on a constant flow of funds and payment is the core of any business and without it, no company can succeed (Nayan et al., 2023). According to Muhammad (2019) and Judi & Mustaffa (2021) contractors' cash flow and performance will be affected by delaying payment by client. Payment in construction not only the interim payments but also final payment, which are made by the issuing of final certificates and final account settlement (Muhammad, 2019; Kenyatta, Alkizim and Mbiti, 2015).

Khairul and Othman (2021) in their study highlighted final account should be prepared immediately after the project have been completed and the contractor fulfils their obligations under the contract covering defect work and upon claims for additional losses or expenses that the contractor is entitled to under the contract (Termizi, 2018). A construction project's effectiveness is determined by several factors, not only by its physical completion, but also the efficient closure of the final account (Khairul and Othman, 2021; Zakaria, Ismail and Md. Yusof, 2013e).

RESEARCH BACKGROUND

The construction industry is an essential part of the Malaysia economy. According to Construction Industry Development Board (CIDB), the construction industry remains as a main driver of the national economy (CIDB, 2020). In construction industry, one of the

important elements is payment. Payment is the lifeblood because performance in this business relies on a constant flow of funds and payment is the core of any business and without it, no company can succeed (Thanuja & James, 2015). According to Muhammad (2019) contractors' cash flow and performance will be affected by late or non- payment by client.

Payment in construction not only the interim payment but also final payments, which are made by the issuing of final certificates and final account settlement (Muhammad, 2019; Kenyatta, 2015). Final account should be prepared immediately after the project have been completed (Khairul & Othman, 2021) and contractor fulfils its obligations under the contract covering defect work and upon claims for additional losses or expenses that the contractor is entitled to under the contract (Termizi, 2018). A construction project's effectiveness is determined by several factors, not only by its physical completion, but also the efficient closure of the final account (Zakaria et al., 2013). The final account was defined as the assessment and mutual agreement of the final construction cost between the employer and the contractor, as well as a fair assessment of the work done. The final account represents the agreed-upon amount that the employer will pay the contractor and is the conclusion of the contract sum including all necessary adjustment. Final account is an important document to indicate contractor's final cost of a project (Van Der Westhuizen and Fitzgerald, 2005).

The final account is an important project document for any construction project which is processed to finalize the final cost of a project that was completed by the contractor (Muhammad, 2019; Westhuizen and Fitzgerald, 2005). Final account indicates the negotiated amount that the employer will pay the contractor, and it includes all works that are charged to the contractor by the main contract (RICS, 2015).

The process of settling a final account, which brings together all financial aspects of the deal, can be long drawn of process (Muhammad, 2019; Romli, 2015). The closing of final account negotiations between the contractor and the architect, engineer, or quantity surveyor on behalf of the employer will in due course trigger the issue of the final account statement and ultimately, enable the issuance of the final certificate (Zakaria et al., 2013). It also denotes the resolution of any pending conflicts, effectively drawing a line under all parties' financial commitments, including of defects (RICS, 2015). Final payment of accounts that are not completed within the stipulated time will cause the contractor to suffer and affect the construction project (Zakaria et al., 2012). Any delay in the closing of final accounts should be avoided and as a result, the contractor may have difficulty accessing working capital and may face bankruptcy (Ismail & Zakaria, 2014).

Despite the important of the successful final account closing, there is very minimal review paper discussing the patterns and trends in final account publications. This paper explores a thematic review of the literature regarding new trends and patterns that align with final account in the construction industry from year 2010 to 2021 by using the thematic review analysis.

RESEARCH METHODOLOGY

Clarke and Braun (2013) defined thematic analysis as a process of identifying the pattern and construct themes over thorough reading on the subject. Thematic Analysis was applied in this study given its ability to emphasise specific contexts and offers an integrated view of

texts, which looks beyond word frequency and capturing objective elements from texts in assessing themes, patterns or meaning, as well as allowing one to comprehend the social reality, both scientifically and subjectively (Zhang and Wildemuth, 2009; Anderson, 2007). Thematic Analysis allows flexibility in understanding vast data sets more readily by arranging them into wide-ranging themes. Atlas.Ti (version 23) was also used to assist in analysing qualitative data (Zhang and Wildemuth, 2009).

The data pertaining to the subject matter of final account was obtained from primary sources, including SCOPUS, Mendeley, and Google Scholar searches. Datasets are linked with the article, making it accessible to look for literature in the databases. The critical part is to identify the patterns and construct categories to understand the trends of Final Account publications. In order to fulfil the research purpose of identifying area for future research recommendations in the context of fraternity final accounts, a comprehensive analysis and interpretation of all relevant publications was conducted. This analysis employed a thematic review approach that encompassed a diverse range of research approaches.

To illustrate the steps involved in a thematic review, this paper performed the analysis based on several selection criteria: 1) publications from 2010-2021, 2) possess keyword(s) of 'Final Account' in the content, 3) focusing on Final Account discussion in all publications around the world. The literature discovery was performed in the SCOPUS, Mendeley and Google Scholar search using the following search strings.

From the SCOPUS search, the TITLE-ABS-KEY (final AND account AND closing) AND (LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017) OR LIMIT-TO (PUBYEAR , 2016) OR LIMIT-TO (PUBYEAR , 2015) OR LIMIT-TO (PUBYEAR , 2014) OR LIMIT-TO (PUBYEAR , 2013) OR LIMIT-TO (PUBYEAR , 2012) OR LIMIT-TO (PUBYEAR , 2011) OR LIMIT-TO (PUBYEAR , 2010)) generated 61 articles which discuss Final Account closing from 2010 to 2021. The next strings of searches used "Final account" AND "closing" AND "construction" [year: 2010 TO 2021] which yielded 14 results.

From the Mendeley literature search, the initial search came out with the term "Final Account AND closing" yielding 214 articles. The next strings of searches used "Final account" AND "closing" AND "construction" which yielded 40 results. In the final round, the search strings used "Final account" AND "closing" AND "construction" [year: 2010 TO 2021] which yielded 33 results. Then, from Google Scholar search strings final account final OR account OR AND OR closing OR AND OR construction (2010 – 2021) yielding 96 articles. As this review is limited to peer-reviewed journals and thesis and after some duplications and not related articles found 108 publications were removed. As a next step, articles have been considered for review that was published during the last eleven years (2010 until 2021 inclusively). After removing duplicates and scanning of all abstracts to remove articles irrelevant to the topic of this research total of 35 papers resulted as a basis for review further filtration from SCOPUS, Mendeley and Google Scholar consisting of articles from journals, theses and conference publications which were reviewed thematically as presented in Figure 1 below.

Figure 1. The Procedure of Identifying the Articles for Thematic Review

Hence, the final count of valid publications came down to 35 from the 143 papers in the preliminary stage. Following the first stage of selection, the articles were uploaded into the ATLAS. Ti version 23 software (textual analysis software) as primary documents which were then grouped into 1) author; 2) issue number; 3) periodical, 4) publisher, 5) volume and 6) year of publication. In doing so, the articles were conveniently categorized to be analysed according to the year of publication and the discussion pattern each year.

After many counts of filtration, 35 articles were finalised using the ATLAS.Ti software. Based on Figure 2 below, a word cloud from the 35 documents captured the term 'final' which was used 46 times, while 'account' was mentioned 36 times and 'construction' 22 times. Based on the thematic analysis of the selected articles and sequence of frequency, the present discussion was based on the following themes: 1) Issues and Problem; 2) Management; 3) Financial; 4) Framework; and 5) Contractual. The result of the present thematic review is reported in the results section.

Figure 2. Word Cloud Generated from 35 Articles

Through searches in databases, all journals, theses, and conference proceedings included to evaluate the trends and patterns and recorded that varies publication for final account. From Table 1 below indicates types of publications relevant with final account in construction.

Table 1. Types of Publications from 2010 Until 2021

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Articles	0	1	1	4	2	1	3	1	2	1	2	1
Conference Proceeding	2	1	2	3	1	0	1	1	0	0	0	0
Theses	0	0	0	0	0	1	0	1	0	1	2	0

FINDINGS OF THE STUDY

This paper reviews the pattern and trends of final account publications and application in construction industry. After recalling the 35 articles, the trend and patterns have produced 27 initial coding. However, following several rounds of re-coding and code merging in ATLAS.Ti 9 the final trends and patterns delivered into five (5) main patterns as tabulated in Table 2 below.

Table 2. Thematic Review of Final Account Publications from 2010 Till 2021

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Issues & Problems	1	0	1	4	1	1	1	0	0	2	3	1
Management	1	0	2	2	1	0	1	0	0	0	0	0
Financial	0	1	0	0	0	0	0	1	2	1	1	0
Framework	0	1	0	1	1	1	0	0	0	0	0	0
Contractual	0	0	0	1	0	0	1	1	0	0	0	0

Issues and Problem

Within this theme, the issues and problem of final account in the construction industry were discussed (Figure 3). The most discussed topics included issues and problem that delaying settlement of final account. Romli (2015) identified variation, price, time, contractor, contract, management matter (contract administrator), human, contractual, client and external factor being a main factor delaying in final account preparation while Sing et al. (2013) in his research revealed that time and variation order were the most significant factors influencing the settlement of a final account. Delay in final account settlement have existed for decades, and the major factors affecting final account settlement of construction projects include Project-related, Contractor-related, and Engineer- related problems (Kwok, 2009).

The most common cause of final account settlement delays is valuation or variation, and the best solution to mitigating final account settlement is to proper track of documentation. (Hassan, 2019) and also supported by (Ilmi & Yip, 2014) stated the most contributory factor to the problems was variation claims. (Khairul Hisham, 2020) identifies that contractor document submission, enhancing quantity surveyors' financial control and reporting skills, and allocating enough allocation for cost contingencies are all essential to a successful final account closing. According to Zakaria, Ismail and Md. Yusof (2013g) identify the important factors that significantly affect this closing of final account are contractor related, management-related and contractual-related. All that statement is related with final account scenario in Malaysia. Ssegawa et al. (2020) in their research revealed that rectifying cost for defects during defect liability period being a main factor to delay in closing of final account.

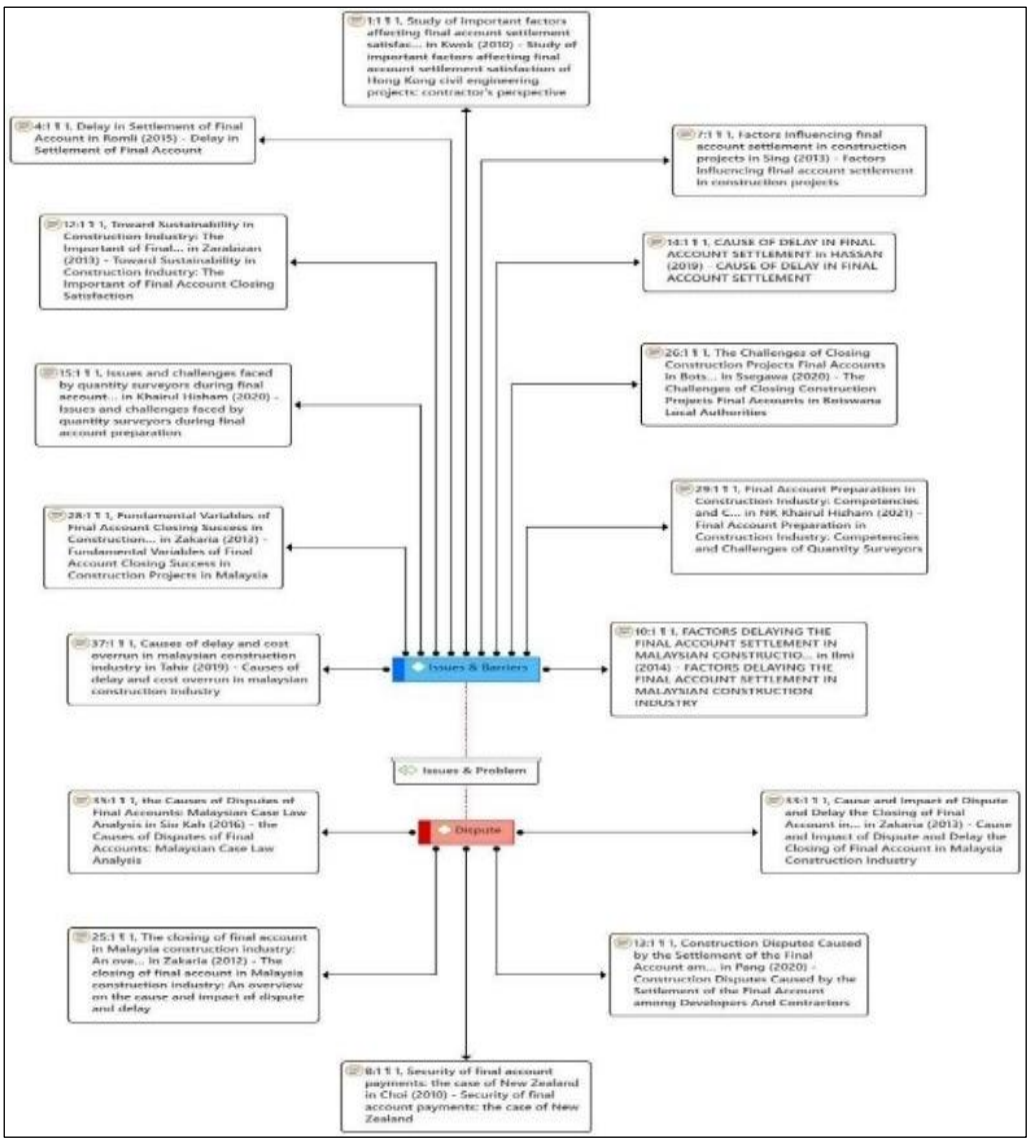

Figure 3. Network View on The Issues and Problems

The closure of final accounts also has always resulted in conflict and court proceedings and contracting parties especially contractors suffer when final account is delayed due to disputes (Kah & Shyang, 2016). Choi et al. (2010) found that the number of court cases on final accounts in New Zealand have increased significantly since the introduction of the Construction Contracts Act (CCA) in 2003. Disputes are identified as a major hindrance to the successful delivery of construction projects. They are also time consuming and costly, and significant problem for the industry. Zakaria, Ismail and Md. Yusof (2012a) spelt out in their study, dispute, and delay in the closing of the final account represent additional cost to the contractor where in most cases, the owner is anxious to know his ultimate financial commitment. The issues and problem pattern are among the most popular publications or research conducted by researchers, considering the adversarial factors involved among the contractual parties in the construction.

Management

Within this theme as presented in Figure 4 below, the titles are divided into several sub-themes such as project management, risk management and procedure. Several publications raised on effective management is critical to ensure that each task on site is completed on time. The availability of qualified and experienced parties participating in the construction industry also contributes to the success of construction projects. Buildability and maintainability of effective management that can contribute the successful completion of a final account (Zakaria, Ismail and Md. Yusof, 2013c).

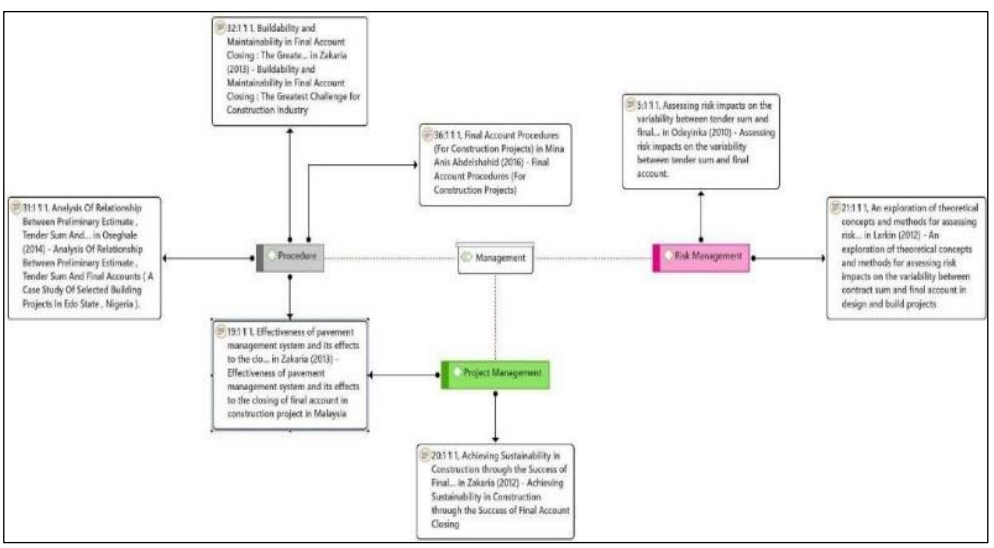

Figure 4. Network View on The Management

Management in preliminary estimate, tender sum, and final account of construction projects have a significant connection and really important to ensure final account accurately from tender sum and preliminary estimate. (Oseghale and Wahab, 2014). To ensure system accuracy improvement measures to ensure the accuracy of final account closing, pavement management system is developed to assess current system accuracy in terms of generating an annual work programme for periodic pavement maintenance, to identify factors that contribute to system inaccuracy in selecting the location and length of roads that require treatment (Zakaria, Ismail and Md. Yusof, 2013d).

Proper planning and understanding of strategies in terms value for money and other social considerations will emerge in form of the key performance indicators which measure project sustainability via the success level of final account closing (Zakaria, Ismail and Md. Yusof, 2012b). The study seeks to assess the impacts of the identified risk factors on the observed variability between tender sum and final account. It is a first step in an ongoing programme of research which seeks to model risk impacts on the variability between tender sum and final account (Odeyinka et al., 2010).

According to Larkin et al. (2012) the insights gained from the foregoing steps then helped in devising a methodological framework for assessing the variability between the contract sum and final account in client-led and contractor-led Design and Build projects.

Financial

Budgeting dan estimating was among the popular topics discussed by researchers in financial themes (Figure 5). (Hiyasat, 2018) that it is possible to improve Jordanian the estimation efficiency of central government budget depending on information based on final account statement, with a high relative degree of importance. In light of this, the researcher recommends the necessity of depending greatly the central government on final account statement information showing among the recommendations depending greatly on final account statement justifications in improving Jordanian central government budget estimation. Nevertheless, the deviation between budget and final account has become increasingly prominent, which has seriously impaired the fund utilization efficiency (Zhang et al., 2019).

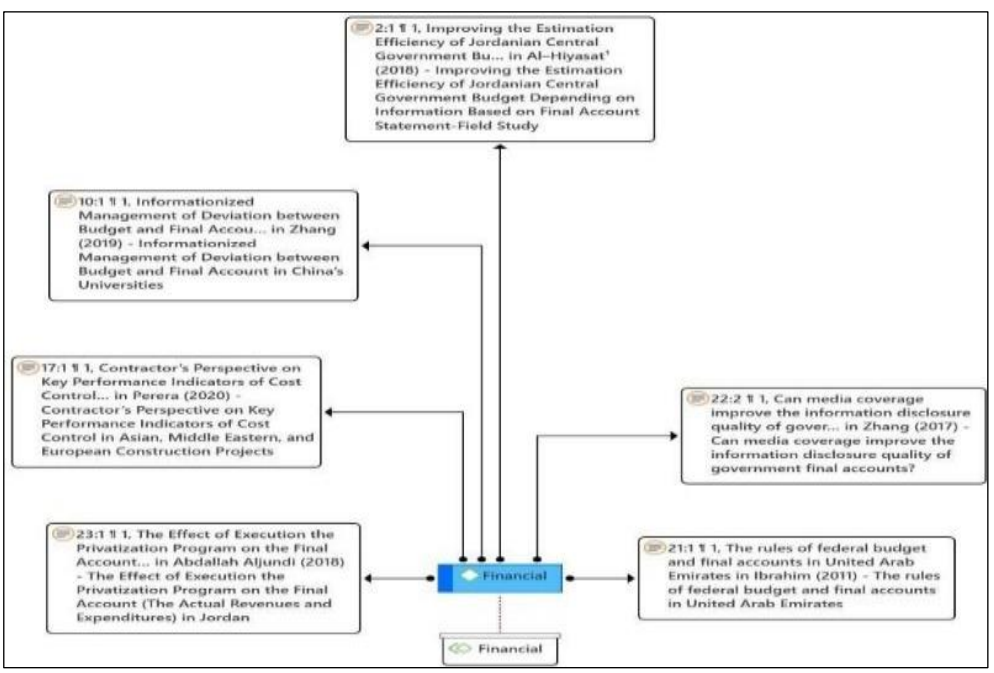

Figure 5. Network View on The Financial

The research also discovered that the implementation of the privatization programmed had no statistically significant impact on the level of local income, grants, or investment spending. However, the program's implementation has a statistically significant effect on the total of recovered loan repayments and current expenditure. According to the findings of the research, Jordan's privatization initiative did not contribute to the reduction of the general budget's financial burden (Abdallah et al., 2018).

According to Perera et al. (2020), the preliminary project estimate, with its most important Key Performance Index (KPI) of cost per functional unit is the most important technique used in the initiation stage. In execution stage, contract management identified as important technique adopted while the main technique used in the closing stage is final accounts with efficient contract sum as the key performance index (KPI).

Framework

The framework is the next theme under the pattern of final account publications as presented in Figure 6 below. Under this theme, several frameworks were proposing such as theorical framework (Zakaria, Ismail and Md. Yusof, 2013c), risk impact management (Odeyinka et al., 2011) and fuzzy risk management model (Ameyaw et al., 2015). The developed models could help the construction contractor to predict the likely impacts of risk occurring at project execution phase on out turn construction cost. (Odeyinka et al., 2011) Theoretical framework are summarized in the context of construction players and academician perspective. It is anticipated that the finding reported in this paper could assist the planning of future strategies and guidelines of final account closing for the betterment of construction projects in Malaysia (Zakaria et al., 2013c).

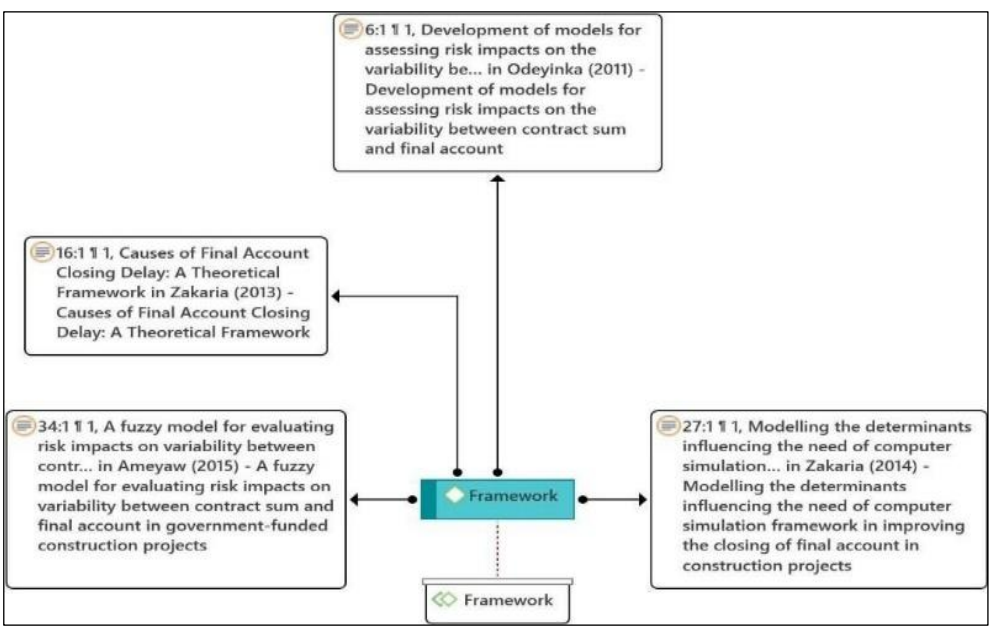

Figure 6. Network View on Framework

Ameyaw et al. (2015) stated risk factors in construction projects have a major effect on the variability between the contract sum and the final account. Project funding problems, shortage of quantities, variations by client, adjust in scope of works, improper specification, design changes by client, defects in design, and unforeseen site (ground) conditions are among the eight critical risk factors that have a high impact on variations between contract sum and final account, according to initial findings. Two factor solutions emerged from principal component factor analysis (PCFA): "professional-related factors" and "client factors. The fuzzy model also found that risk factors have a significant impact on contract amount and final account variations in public construction projects. Client- related factors have a major impact, while professional-related factors have an impact on project cost variability. The main risks associated with cost overruns in public projects are evaluated using a practical model. Variability between contract sum and final account, which is widespread in Ghana, can be controlled to produce cost savings in public infrastructure projects by paying effective and sustained attention to these factors (Ameyaw et al., 2015).

Zakaria, Ismail and Md. Yusof (2014) create a new theoretical framework to identify the elements that influence the acceptance and necessity for computer simulation framework and guidelines in improving the closing of final account in construction projects-as an Information and Communications Technology (ICT) application in the context of users. performance expectancy (PE), effort expectancy (EE), facilitating conditions (FC), social influences (SI), and behavioural intention are the eight dimensions included in the suggested model (BI). Individual variables in age, gender, education, income, and experience moderate the influence of these dimensions on behavioural intention and use of technology. The findings described in the research are expected to contribute to the formation of future strategies and guidelines for the enhancement of Malaysian building project.

Contractual

Contractual was also amongst the favourite type of articles for the final account researchers (Figure 7). Contract administration is required to ensure contract effectiveness. Contract administration entails ensuring that the form of contract is carried out in accordance with the terms of the agreement and the conditions of the contract, including within the framework of applicable laws and construction industry practices (Zakaria, Ismail & Yusof, 2013f). According to Sennatra (2017), when contracting parties encounter a problem that cannot be resolved, a contract can be terminated by mutual agreement with neither party defaulting and the impact to repayment of advance payment, final progress payment, variations, retention, and time for completion. He also indicates from their findings that the lack of contract condition has a significant cost and time impact. Furthermore, the method of settlement and prevention is identified so that the contract condition is terminated, and a deal is not repeated.

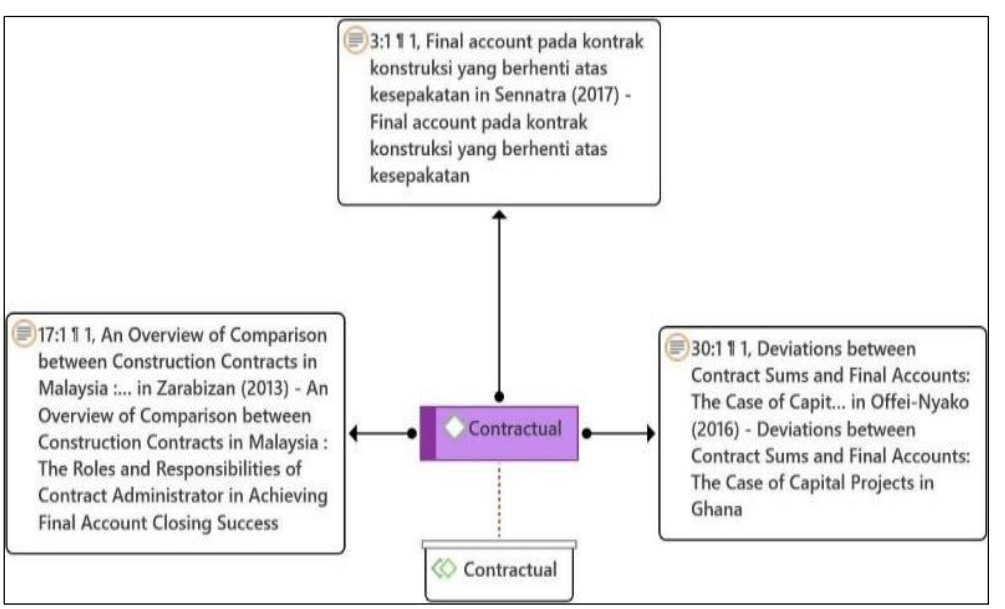

Figure 7. Network View on The Contractual

The standard form of contract to be used must be understood by all parties involved, especially the contractor in the construction project to avoid any disputes or problems in the future, especially in the final closing of the account and most of the standard form of contract

in Malaysia contain provisions that are the basis for the contract administrator to settle the payment of this final account to the contractor within a certain period (Zakaria et al., 2013g). In Malaysia, the International Federation of Consulting Engineers (FIDIC), Public Work Department 203A (PWD203A), and Malaysian Institute of Architects (PAM) standards are commonly used and the objective of each standard form of contract to ensuring effective, efficient and non-disputable contract administration (Zakaria et al., 2013f) and from their findings shows that the project owner/employer, type of project, and the nature of the project but also funding involved, all determine the use of form of contract and generally most government projects will use the PWD203A contract, while private sector projects will use the PAM contract, and international projects will apply the FIDIC contract.

Offei-Nyako et al. (2016) identify that the significant factors that result in differences between contract sums and final accounts is price fluctuations, late material supplies, variation of work, market demand fluctuations and design changes.

CONCLUSION

In conclusion, this paper highlighted the results of the code-to-document analysis by using ATLAS.Ti (version 23) revealed that the patterns and trends on final account highlighted issues and problems, including management, financial, framework, and contractual issues. This paper has contributed to the analysis of final account patterns by extensively identifying thematic codes within final account publications from 2010 to 2021, as well as assessing the trends of the publications to date. Referring to the findings of this analysis, issues and problems patterns in final account settlement are the most popular themes and topics of discussion among researchers based on most publications (15 papers) from 2010 to 2021. This paper also highlighted dispute, conflict, disagreement and court proceedings as the significant causes and major factors contribute to unsuccessful final account among the contractual parties in the construction. Indirectly, it proves that the topic of final account is still relevant to be explored.

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MAINTENANCE MANAGEMENT ELEMENTS DURING PROCUREMENT STAGE OF PRIVATE FINANCE INITIATIVE (PFI) CONSTRUCTION PROJECT: A PILOT STUDY

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Abstract
Many countries use the Private Finance Initiative (PFI) to build public projects to overcome issues such as a lack of financial resources and technologies. A PFI project can be highlighted as a long-term contract between the public and private sectors whereby the private sector is responsible for financing, designing, constructing, operating, and maintaining throughout the concession period. Like PFI projects, the operation and maintenance stage are crucial because it has the most extended period in the PFI project. Even so, there is still inadequate adoption of maintenance elements during the early stage of the PFI project. This issue may lead to a negative impact, especially during the operation and maintenance stage. Therefore, maintenance management elements must be addressed, especially during the procurement stage. The procurement stage is advantageous in preparing contract and tenders. Thus, this study aims to identify the maintenance management elements during the procurement process of the PFI project. For this pilot study, a questionnaire survey was distributed to a maintenance practitioner, and the data gathered was analysed using Statistical Package for the Social Science (SPSS) software. The Cronbach Alpha value is taken for reliability analysis. As a result, the findings highlighted six elements of maintenance management that need to be addressed during the procurement stage, which are facility management, performance management, output specification, tender, structure and framework and finance. The tender element has the highest Cronbach alpha value. All these six elements are beneficial and can be used for future studies in both the public and private sectors.

Keywords: *Maintenance Management; PFI Project; Procurement Stage*

INTRODUCTION

A Private Finance Initiative (PFI) is a long-term contract between the private and public sectors in which the private sector is responsible for the overall life cycle of public infrastructure, and the public sector responds by making regular payments as operating costs for a period specified in the contract (Ismail, 2011). There are four stages in the PFI project, which are strategy formulation, procurement phase, construction process, operation, and maintenance (Ismail, Khaderi, Syed Abdul Karim, Abdul Talib & Salleh, 2019). Strategy formulation stage is the stage where the public sector establishes business case. The procurement stage is where the negotiation occurs, and bidders are selected. Meanwhile the construction, operation and maintenance stage are the process of constructing and maintaining the building and its services until the concession ends by the public sector.

In the nature of the PFI project, the operation and maintenance stages alone cover a 25 to 30 years period, much longer than any other stage in the PFI life cycle. Due to its nature over

a long-term period, the operation and maintenance are subjected to uncertainty that leads to many risks. Operation and maintenance were found to be top the 10 critical risks in the operational phase (Gupta & Verma, 2020). In order to reduce the risk associated with maintenance management, the provision of maintenance management is needed during the pre-development stage of the PFI project. However, there is inadequate adoption of maintenance elements (Khaderi & Abd Shukor, 2016) during pre-development stage of the PFI project. The focus is more on design and construction. According to Rocha and Rodrigues (2017) the decision made during the pre-development stage must consider the maintenance aspect while also increasing safety, durability, and comfort over time. Thus, the procurement stage of the PFI project plays an important role in reducing these risks.

Many procurement approaches are being developed to perform better in the construction industry (Zoest, Volker, & Hermans, 2020). The procurement system can be very useful in preparing contracts and tenders, selecting contractors and consultants, and constant monitoring and reporting (Patil & Nadaf, 2017). Procurement can be an excellent platform to design and build facilities to meet a specific need for a client. Procurement is also not limited to any criteria, including the maintenance management element. In general, maintenance management elements are the fundamental component in developing maintenance strategies and implementing maintenance activities. In the context of the PFI project, maintenance management elements can be addressed during the procurement stage. Hence this study aims to identify the maintenance management elements during the procurement process of the PFI project.

LITERATURE REVIEW

Maintenance can be defined as an act to meet the standards that increase the value of facilities and an institution's securities by conserving, preserving, and maintaining the buildings, services, equipment, and surrounding area (Nawi, Baharum, Ibrahim, & Riazi, 2017). Besides that, maintenance is also a means of procedures, activities, and processes being carried out to a building for the purpose of repair, maintain, and keep up the building facilities and structure throughout the building life cycle (Mydin, 2014). Thus, maintenance refers to the activities related to preserving, conserving, maintaining, and repairing buildings throughout their life span. In the nature of PFI projects, maintenance briefs are already given in the early phase of building development to ensure that operation and maintenance works run smoothly after the construction phase. However, there are still some maintenance issues that should be taken seriously.

According to Laporan Ketua Audit Negara (2019), two PFI projects were evaluated; the findings highlighted some of the weaknesses in maintenance management in the PFI projects, including no financial indicator for maintenance charges and maintenance reserve fund, insufficient maintenance system, and there is weakness in the construction aspect. According to the report, there is no detailed paperwork on determining the charge of maintenance charge and maintenance reserve fund, causing the charges can be manipulated. In terms of weakness in the construction aspect, the building that has been constructed is different from the specification. Meanwhile for the insufficient maintenance system, there is unclear specification causing the data produced is not reliable.

The report also mentioned there is no maintenance clause for system services. According to the report, there is no agreement clause for scheduled maintenance for the system services after the defect liability period, causing it to fail to function correctly. Other than that, maintenance issues in PFI projects include the absence of a facilities management consultant during the design stage, the rate of maintenance charge, unclear guidelines, and standard operation procedures (Ismail et al., 2019). The facilities management consultant during the design stage is needed to ensure the provision for maintenance is made for the operation and maintenance stage (Enoma, 2005). Apart from that, to give input regarding maintainability for the building design. Thus, a facilities management consultant during the design stage is needed. Therefore, maintenance management elements need to be addressed during the procurement stage of the PFI project.

Maintenance Management Element

It is imperative to determine the maintenance elements that should be addressed during the procurement process of the PFI project. Systematic maintenance planning can be achieved through effective maintenance at an early stage (proper maintenance objective, strategy, and policy) and efficiency in maintenance through proactive maintenance implementation (Khalid, Abdullah, Hanafi, Said & Hashim, 2019). Maintenance management has evolved to include a variety of perspectives, such as resource allocation, financial management, and workforce management. Mong, Mohamed, and Misnan (2018) summarised parameters that can be incorporated into maintenance management. The parameters are maintenance policy, organisation management, planning and scheduling, operational management, resource allocation, financial control, information management, and performance assessment and control.

In terms of PFI projects, Osei-Kyei, Chan, Javed, and Ameyaw (2017) highlighted several criteria for Public Private Partnership (PPP) project success, which are effective risk management, meeting output specifications, reliable and quality service operations, adherence to time and satisfying the need for public facility/services. For this study, six maintenance management elements have been identified from the previous literature. The criteria selection is based on the topic PFI/PPP project and previous literature highlighting the maintenance aspect. Based on previous literature, six maintenance management elements are facility management, performance management, output specification, tender, structure and framework, and finance. Each of the elements and sub-elements is gone through the pre-test process and is finalised in the Table 1. Then the explanation of each element is as follows:

Table 1. Maintenance Management Elements & Sub Elements

Maintenance Management Elements	Sub Elements	Source
Facility Management	Existence of functional helpdesk during operational stage	Oyelede (2013), Baldwin (2003), Ismail, Abdul Talib, Salleh, and Japri (2018), Hashim, Sapri, and Ab Azis (2019), Hashim, Sapri, and Low (2016), Enoma (2005), El -Haram and Agapiou (2002), Sapri, Ting, Hashim, and Adjei-Twum (2016), Mohd Rahim, Abd Rahim, Zainon, Chuing, and Abd Samad (2018)
	FM input in terms of maintainability, availability, and operability	
	FM function at the early design stage of PFI project	
	FM strategies during operational stage	
	Existence dedicated team for maintenance	
Performance Management	Performance management system	(Oyelede, 2013), Lam and Javed (2015), Akbiyikli and Eaton (2006), Mohd Rahim et al. (2018), Zhou, Keivani, and Kurul (2013), Kim and Thuc (2021)
	Clear performance standards	
	Functional and physical performance	
	Effective communication structure	
	Performance evaluation at all stages of the PFI project	
Output Specification	Clear output specification	Ismail et al. (2018), Hashim et al. (2019), Osei-Kyei and Chan (2017), Robinson and Scott (2009), Hashim, Sapri, and Low (2016), Kuslijic and Marenjak (2012)
	Functionality and availability aspect that related to design, construction, maintenance, and facility management	
	Existence of service level requirements	
	Sustainable implementation	
	Date of commencement operation	
Tender	Transparency and competitive procurement	Abdul Rahman, Memon, and Zulkiffli (2014), Hardcastle, Edward, Akintoye, and Li (2005), Khaderi, Bakri, Abd Shukor, Kamil, and Mahbub (2019), Song, Hu, and Feng (2018), Mohd Noor, Hamid, Abdul Ghani, and Haron (2011), Chua, Ali, and Alias (2014)
	Technical feasibility of PFI project	
	Forecast data including future requirement of PFI project	
	Project criteria	
	Clear project scope and requirements	
	Relevant strength and credibility criteria for bidders	
	Allocation of time to develop plans	
Structure & Framework	Clear accountability arrangements of organizational and management structure	Mohd Rahim et al. (2018), Patel and Robinson (2010), Bashar, Fung, Jaillon, and Wang (2021), Belachew and Shyamsundar (2013), Lam and Javed (2015), Mohd Rahim et al. (2018), Hashim et al. (2019), Osei-Kyei and Chan (2017)
	Policy preparedness and framework	
	Change management practice	
	Communicate and share information frequently among parties in consortium	
Finance	Estimation of FM cost	El -Haram and Agapiou, (2002), Mohd Noor et al. (2011), Yuan, Chan, Xiong, Skibniewski, and Li (2015)
	Existence of budget based on implement strategy	
	Cost effective design	
	Adequate details in tender document to prevent low estimation cost	
	Risk value during PFI project	

Facility Management (FM)

In the development of the PFI project, a facility management consultant is a part of the concession that acts as a service provider responsible for the overall operation and maintenance of the PFI life cycle. Facility management is important in the PFI project, which needs to cover 25 to 30 years of overall PFI development. Despite that, the focus has been on design and construction, and there has been little research on the operation and maintenance

stage (Martinez & Walton, 2017). Apart from that, the design development stage's emphasis is not on long term and low maintenance (Eadie, Millar, & Grant, 2013). The role of FM should be considered an essential aspect during the strategy formulation stage to ensure the PFI projects can deliver good performance (Ismail et al., 2018). Hashim et al. (2016) added that the FM input, especially maintainability and operability, considered essential input at the early stage of the project. Therefore, facility management input throughout the procurement stage is to minimise the risk during the operation and maintenance stage.

Performance Management

Performance management is one of the aspects that is being discussed among stakeholders at the early stage of the PFI project. Usually, performance metrics are negotiated during the bidding process, which cause it to vary widely between contracts (National Audit Office [NAO], 2010). Performance management is one of the tools that are being used to monitor the level of service delivery. Poor performance by the service provider may lead to a payment deduction. The performance of FM in PFI projects is one of the issues that is being stressed by Kipli, Abdullah, and Mustafa (2016). Maintenance factors are one of the identified causes that affect performance (Lop, Ismail, Mohd Isa, & Khalil, 2017). For example, defect occurrence and low user satisfaction. In regard to this situation, proper action is required. In order to have a smooth implementation of the PFI project, PFI performance should be assessed at all stages by developing Key Performance Indicator (KPI) (Kim & Thuc, 2021). Performance standards should have mutual understanding to minimise the low operating productivity risk in PFI projects (Mohd Rahim et al., 2018). Thus, it is important to set up a clear performance standard that service provider can fulfil.

Output Specification

An output specification is an important document that specifies what is expected from the project rather than how it should be delivered by the private sector (Lam & Javed, 2015). In PFI projects, the public sector does not take charge for the design of the project but rather describes its service through an output specification (Alshawi, 2009). Even so, the output specification provided is unclear. Some of the issues, including difficulties in identifying output specifications for soft services (Robinson & Scott, 2009), lack of completeness and clarity (Oyelede, 2013), and lack of understanding by the concession in the PFI projects caused many maintenance problems appeared mainly during the operational and maintenance stage of the PFI project. The output specification should be comprehensive and cover all of the maintenance aspects. Khaderi, Abd Aziz, and Abd Shukor (2018) highlighted the success factors for PFI projects during pre-construction stage by comprehensive output specifications according to service and identifying maintenance elements at the early stage of the PFI project. Besides that, developing FM output specifications is one of the suggestions and considerations for the PFI project (European Bank, 2016). In connection with that, a thorough output specification is requisite.

Tender

The development of the PFI project starts with the tendering stage (Wang, 2011). The tendering process for PFI is higher due to the complexity and takes a longer time to conclude (Khaderi et al., 2019). Both parties need to appoint technical, financial, and legal consultants

to ensure profitability, quality of bidding, and project affordability, as well as value for money for the government sector (Alshawi, 2009). The tendering process for PFI projects always deals with incomplete contracts. A PFI contract is inevitably incomplete since PFI projects are often long-term, high-risk, and high transaction costs (Mansor & Abdul Rashid, 2016). Regardless, tendering contracts should not neglect future requirements without any backup plan or continuing maintenance plan (Mohd Noor et al., 2011). The public sector should improve the tender process and screen out bidders with comprehensive strengths and credibility (Song et al., 2018). Lack of experience by the service provider may cause the operation and maintenance not to be done correctly. Last, the tendering stage should be allocated enough time and resources (Khaderi et al., 2019). Concerning this, proper documentation with maintenance consideration can be prepared during the tendering process.

Structure & Framework

In the context of this study, structure, and framework for the PFI project refer to the arrangements of management structure and guidelines for the overall development of the PFI project. These two factors play an essential role in ensuring the good implementation of maintenance practices. Lack of direct experience and inadequate legislation are the main issue for the PFI projects, which caused the project to be unsuccessful (Kavishe, Jefferson, & Chileshe, 2018). Also, inefficient management is one of the influencing factors for PFI renegotiations (Sun & Yin, 2017). The consequences of these two could have a negative impact on the PFI project during the operational and maintenance stages. Selecting a service provider with lean experience for PFI projects can help both sectors decrease the risks, prevent renegotiation, and increase the quality of the facility (Malek & Gad, 2017). Besides that, clear accountability arrangements in organizational and management structures can improve service delivery in PFI projects (Patel & Robinson, 2010). Therefore, a clear framework and accountability structure need to be highlighted.

Finance

The last element of maintenance management is finance. Finance in this study refers to the maintenance and operating costs for the PFI projects. The current maintenance practice adopted by most government agencies has caused many faultiness, such as improper maintenance strategy and improper long-term cost (Hashim, Che-Ani, & Ismail, 2017). In terms of PFI projects, there is no risk transfer in terms of operating & maintenance expenditure (Thillainathan & Cheong, 2019). Besides that, Carbonara, Costantino, Gunnigan, and Pellegrino (2015) emphasized operating risk in PFI during the operation phase, which is operating cost overrun. Furthermore, five critical factors with a very high likelihood of occurrence during the operation phase, including delays or interruption in operation, inability to service debt, operating cost overrun, changes in taxes or tariffs and life facility shorter than anticipated (Babatunde, Perera, & Adeniyi, 2019). These issues will cause serious problems in the long term. A maintenance budget should be determined based on the type and implemented strategy (Mohd Noor et al., 2011). Mohd Noor et al. (2011) also stated adequate details should be included in the tender document to avoid underestimating cost. In a nutshell, this element should be discussed in detail during the procurement process of the PFI project.

Methodology

The purpose of conducting a pilot study can help researchers discover existing and possible difficulties that can be solved before starting the actual main survey (Fraser, Fahlman, Arscott, & Guillot, 2018). In connection with that, it is recommended first to undertake a pilot study. For this study, a quantitative method was used in order to gather the data. A quantitative method can describe elements, for example, sample size, types of data to be collected, procedure of data collection, data management, and analysis plan (Al Zefeiti & Mohamad, 2015). A questionnaire survey was used as a strategy survey, and it was distributed to the maintenance practitioners either from industry or involved directly with the operation and maintenance of the PFI project. Before the survey was conducted, a pre-test was conducted first in order for the purpose of content validity. The questionnaires were distributed first to the maintenance practitioner and academician as a measure to check content, grammar, wording, sequence, and understanding. After content validity was confirmed, then a pilot study was conducted. For the pilot study, the questionnaire survey was distributed through via email via Google Forms. The questionnaire survey was distributed to 45 respondents. The background of the respondents was identified first as a medium for suitability. A Likert scale from 1 to 5 was used for the questionnaire survey. A Likert scale of more than a 7-point scale, the increase in reliability would be so small (Croasmum & Ostrom, 2011). Therefore, this study used 5-point scale only. All the data gathered is analysed using the Statistical Package for the Social Sciences (SPSS).

Data Analysis

A total of 20 respondents answered the questions. The total number of respondents is same as the study conducted by Sari, Shaharoun, Ma'aram and Yazid (2015). The structure of the questionnaire consists of three sections. Section A is regarding the respondent profile. Section B is about the significance of maintenance management elements that need to be addressed during the procurement process of the PFI project. Section C is about the importance of maintenance management elements during the procurement process of the PFI project. A Likert scale from 1 to 5 was used, 1 is strongly insignificant, 2 is insignificant, 3 is neutral, 4 is significant, and 5 is strongly significant. A Likert scale was used only for sections B and C, whereas multiple answers were for section A. In section A, more than half of respondents (60%) have more than 10 years of working experience, followed by (20%) 3 to 5 years and (10%) for both 6-8 and 9-10 years.

Reliability & Validity Testing

A reliability test evaluates the consistency between several measurements of a variable (Sari et al., 2015). A reliability test was conducted using Cronbach alpha to measure the reliability of the elements measured. The Cronbach alpha value is considered fairly high when the value is between 0.76 - 0.95 (Taber, 2018). The value of Cronbach alpha for each element is shown in Table 2 below. In line with the reliability test, the validity test was conducted only for content validity. Content validity is a validity study that shows the extent to which each construct in the measuring instrument serves the purpose (Surucu & Maslakci, 2020). It was validated by several maintenance practitioners and academicians. Therefore, the questionnaire used has content validity.

Table 2. Reliability Test (Cronbach Alpha Value)

Elements	Number of Sub Elements	Cronbach Alpha Value
Facility Management	5	0.792
Performance Management	5	0.910
Output Specification	5	0.909
Tender	7	0.951
Structure & Framework	4	0.901
Finance	5	0.947

Significance of Maintenance Management Element

In section B, the respondents were asked to rate from 1 to 5 the significance of each sub-elements of maintenance management. The top 5 highest mean values are drawn and ranked accordingly. Although the FM element has the lowest Cronbach alpha value, one of the sub elements has the highest mean value. Based on the questionnaire survey, FM input in terms of maintainability, availability, and operability has the highest mean value. It shows that this sub-element has the highest significance in maintenance management during the procurement stage. This aligns with Ismail et al. (2018) that highlighted FM function at the early stage of the PFI project. On top of that, clear project scope and requirements have the second-highest mean value. Instead of FM input, project scope and requirements must be briefed and understood clearly by all stakeholders in a PFI project. Apart from that, clear output specification and service level requirements have the same mean value that is ranked at number 3. Both of these sub-elements are under the output specification. The output specification should be comprehensive and cover all of the maintenance aspects. Performance management systems were ranked at number 4. Although the performance management system ranked number 4, the performance management system in the PFI project is important because bad performance by the private sector may subjected to payment deduction by the public sector. The private sector should have knowledge, experience and must be able to fulfil the desired performance in the long-term period. All of these sub-elements have a significant impact on maintenance management. The mean value for each sub-elements is shown in Table 3.

Table 3. Highest Rated Sub-Elements According to Mean Value

Elements	Sub Elements	Mean Value	Rank
Facility Management	FM input in terms of maintainability, availability, and operability	4.70	1
Tender	Clear project scope & requirement	4.60	2
Output Specification	Clear output specification	4.55	3
	Existence of service level requirement	4.55	3
Performance Management	Performance management system	4.50	4

The Importance of Maintenance Management Elements During Procurement Process of PFI Project

Apart from that, in section C, respondents were asked to rate from 1 to 5 the importance of maintenance management elements during the procurement process of the PFI project. In the questionnaire, there are 6 areas of positive impact of maintenance management elements during the procurement process. The 6 areas are maintenance charge, contract clause, output specification, maintenance implementation, maintenance performance, and guidelines &

standard operation. From these 6 areas, it was found that the output specification, guidelines & standard operation have the highest mean value. This indicates that maintenance management elements are essential for these two areas during the procurement process of a PFI project. Apart from that, maintenance implementation has the second highest mean value, followed by maintenance charge and contract clause. Maintenance implementation needs to be appropriately planned because the operation and maintenance stage has the longest period in the PFI project. Any decision made during the early stage could significantly impact the overall performance of the PFI project. Apart from that, due to the long-term period, the operation and maintenance stage are exposed to many uncertainties and risks such as operation and maintenance risk. Operation and maintenance risk was found to be among the top ten critical risks in the operational phase (Gupta & Verma, 2020). As for maintenance charges and contract clauses, maintenance management is essential in estimating budget and identifying suitable maintenance clauses for the PFI project. In terms of maintenance performance, maintenance management elements could help to achieve better performance. The result is shown in Table 4 below.

Table 4. Importance of Maintenance Management Elements According to Mean Value

Areas	Mean Value
Output Specification	4.45
Guidelines & Standard Operation	4.45
Maintenance Implementation	4.40
Maintenance Charge	4.35
Contract Clause	4.35
Maintenance Performance	4.25

CONCLUSION

In conclusion, this study is about maintenance management elements that must be addressed during the procurement process for a PFI project. This study aims to identify the maintenance management elements during the procurement process of the PFI project. Based on the questionnaire survey section B, this study identified 6 maintenance management elements. The elements are facility management, performance management, output specification, tender, structure and framework and finance. These elements should be taken into consideration. As for the public sector, these elements will be referenced in the new PFI project, which is more suitable for maintenance needs as it can be extended to other government buildings. In terms of the private sector, the findings of this study will not only help to reduce payment deductions but also aid in the establishment of a clear vision of the maintenance programme during the early stages of PFI project development. Based on the questionnaire survey also in section C, it is highlighted that the maintenance management elements are important to maintenance areas, as mentioned previously. In a nutshell, maintenance consideration is required during the procurement process because it must be cultivated among all stakeholders to raise awareness of the importance of maintenance at an early stage of the PFI project. Good maintenance management practices are determined by the good implementation and organisations solve the problems encountered.

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BEST PRACTICES OF CONSTRUCTION WASTE MINIMISATION AND THE CHALLENGES OF IMPLEMENTING SUSTAINABLE PRACTICES OF CONSTRUCTION WASTE MANAGEMENT

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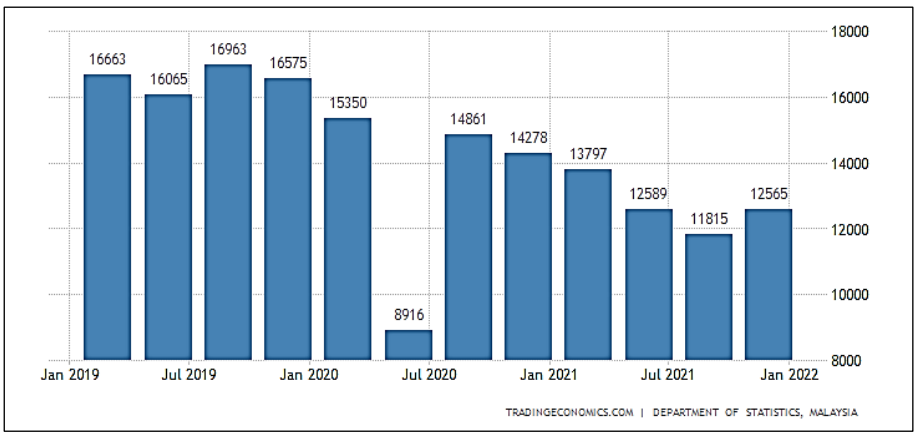
Abstract
Construction waste management is a critical component of sustainable construction. In this context, waste management entails eliminating and minimising waste whenever possible and reusing items that would become waste. Effective waste management will prevent and divert construction waste dumped into landfills. Hence, it reflects the term of "best practices", which refers to the most effective option among a range of alternative approaches developed to manage construction waste. These recommended practices can assist construction practitioners in minimising waste in their projects. Therefore, this paper aims to determine the best practices of construction waste minimisation and the challenges of implementing sustainable practices of construction waste management. To achieve this aim, semi-structured interviews were conducted with six (6) construction practitioners. The data from semi-structured interviews were then analysed by content analysis. Based on the analysis, six factors contribute to waste minimisation, namely 1) knowledge; 2) on-site practices; 3) material and equipment; 4) regulation; 5) human resource management and 6) technology. The six factors have further produced 17 new criteria for best practices in minimising construction waste in the project. The findings also addressed the challenges associated with implementing best practices in construction waste management to achieve sustainable development. This paper also provides information that construction practitioners can apply to establish waste management strategies and set the benchmark for their waste management performance.

Keywords: *Best practices; Challenges; Construction waste; Sustainable construction waste management; Waste minimisation*

INTRODUCTION

Malaysia's construction industry has been crucial in improving the country in achieving ongoing sustainable growth. In the same way, the construction industry is a vital component of any country's socio-economic development. This industry has grown significantly in recent years, especially in developing countries. The rapid growth is due to higher living standards, demands in infrastructure, urbanization, and an increase in the population (Hamid et al., 2020; Nagapan et al., 2012). Despite the COVID-19 outbreak, the Malaysian construction industry has been solid in recent years. Even though there was a slight decrease in the percentage of Gross Development Product (GDP) in the industry, the industry is expected to rebound sharply in 2021, supported by investments in transport infrastructure, renewable energy, residential, telecommunications, and water infrastructure projects. Figure 1 shows Malaysia's construction sector growth and economic trend. GDP from construction in Malaysia increased to RM12,565 million in the first quarter of 2022 from RM11,815 million in the third quarter of 2021. Even though there was only a slight increment, the construction industry is deemed to be one form of economic force in Malaysia. Despite this, the construction industry generates a significant amount of waste due to rapid construction activities. (Nagapan et al., 2012).



(Source: Department of Statistic Malaysia,2022)

Figure 1. Malaysian GDP from The Construction Industry

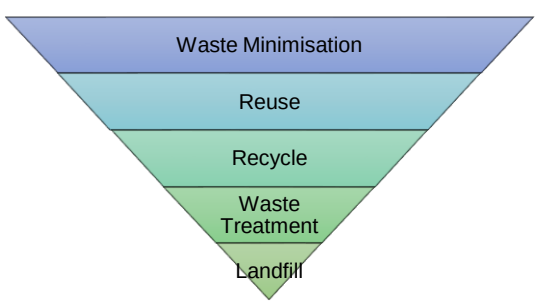
Generally, construction produces approximately 35% of global solid waste, which is often disposed of in landfill sites or sometimes in improper locations (Maués et al., 2020). Previous researchers had gathered the data on waste generated during construction projects to acquire a better understanding of the issues and devise solutions. The percentage of landfilled construction waste (by weight) varies between 13% and 60% in each country compared to the overall amount of waste (Luangcharoenrat et al., 2019). Whereas in Malaysia, according to data published by the Solid Waste and Public Cleansing Management Corporation (SWCorp), total waste generation in 2018 was estimated to be around 37,890 tons/day, which is equivalent to 13,829,850 tons/year (Theng, 2020) This equates to a per capita generation rate of approximately 1.17 kg per day. SWCorp Malaysia also confirms that approximately 8 million tonnes of construction waste per year are generated from construction projects (Saadi et al., 2016). This vast amount of construction waste contributes a significant impact on landfill sites. Despite the foregoing, Malaysia has a total of 138 disposal sites around the country, with over 80% of these sites being unsanitary or open dumps. These landfills receive nearly all of Malaysia's solid waste, as the country lacks adequate waste management facilities (Theng, 2020). Construction waste requires an effective process and management in order to minimise unnecessary dumping activities and environmental problems (Hung & Kamaludin, 2017). In conjunction with limited landfill area and increasing disposal rates, indeed, addressing the waste management issue and minimise the impact on the environment and general well-being of the population is important.

Based on the discussions, the issue can be resolved by effective construction waste management. Effective construction waste management is crucial to minimise the negative impacts of construction waste to the environment towards achieving sustainable development (Kabirifar et al., 2020). Hence, the construction industry must have an effective method or best practices for minimising construction waste on-site. Therefore, the objective of this paper is to identify the best practices factor and criteria of construction waste minimisation in construction projects and the challenges of implementing sustainable practices of construction waste management using feedback from experienced professionals through semi-structured interviews. This is followed by a section discussing the best practices and challenges and finally, the conclusion section summarizes the significant findings of this exploratory study.

CONSTRUCTION WASTE MANAGEMENT

Waste Minimisation Through Best Practices on Site

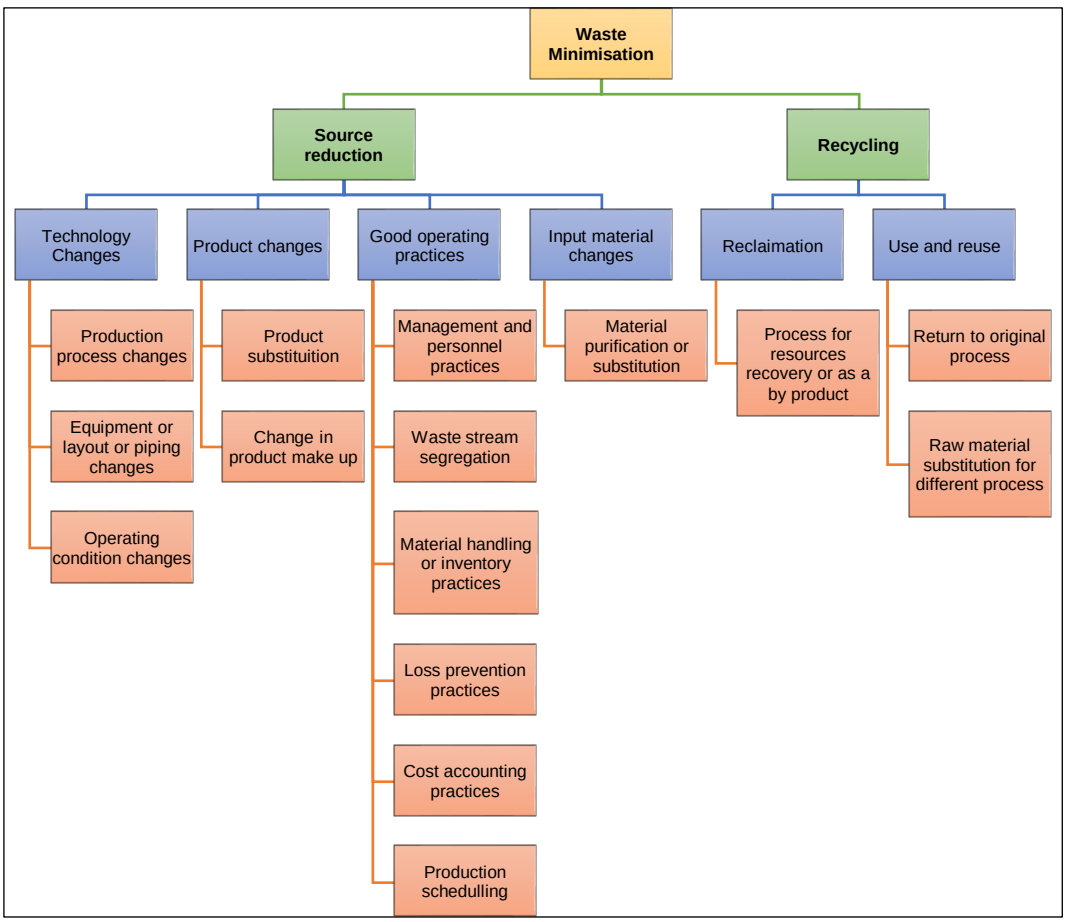
In the Malaysian construction industry, waste minimisation, recycling, and reuse measures are considered insufficient (Umar et al., 2018). For this reason, the environmental impact of construction waste is becoming more concern by both scholars and practitioners around the world. Furthermore, managing and improving the performance of construction waste is critical for future sustainable development (Fikri Hasmori et al., 2020). Thus, implementing best practices of construction waste management in construction projects is one of the most effective methods of minimising waste. The implementation of zero waste is widely recognized as the most effective way to manage construction waste (Liyanage et al., 2019). The term "best practices" refers to the most effective option among a range of alternative approaches developed to manage construction waste. These recommended practices can assist construction practitioners in minimising waste in their projects. Good waste management strategies which consist of awareness, training, award and 3Rs practices have significant impact on the economic, social, and environmental aspects of Malaysian construction project (Ishak et al., 2022) Furthermore, best practices implementation will ensure that the activities carried out within the construction project have the least possible environmental impact, reflecting a good company image among its client (Sáez et al., 2019). Figure 2 shows the waste management hierarchy, which describes the most ideal and desired situation in construction waste management.



(Source: CIDB Malaysia, 2015)

Figure 2. Waste Management Hierarchy

The figure illustrates an arrangement of the most preferable practice to the least preferable practice in the form of a reverse pyramid. The hierarchy is considered one of the efficient instruments for managing construction waste (Hwang & Yeo, 2011). Previous literature review discussed various waste minimisation strategies, measures, and practices to improve the performance of a construction project (Fikri Hasmori et al., 2020; Doust et al., 2020; Janani & Lalithambigai, 2020; Ajayi et al., 2017; Ling & Nguyen, 2013). Therefore Figure 3 illustrates the framework of waste minimisation practices. Construction waste minimisation is vital in achieving sustainable construction. Thus, there is a need to increase the construction waste management practices level among construction practitioners. Yet, Malaysia is still suffering from the awareness problem of the importance of best waste management practices (Nawi et al., 2018). Significantly, improving awareness of the best practices among the construction practitioner is seen as crucial to minimise these issues.



(Source: Umar et al., 2018)

Figure 3. The Framework of Waste Minimisation Practices

Minimising construction waste has many advantages, including saving natural resources and reducing the usage of virgin materials to produce construction material, minimising construction costs, and minimising waste disposal costs (Ling & Lim, 2002). Furthermore, minimising waste also will be able to reduce CO_2 emissions, improves worker and community health, extends landfill life, and save project costs (Lingard et al., 2000) Previously, there was no stringent enforcement and compulsory requirement for the construction company to practice sustainable resources and waste management in Malaysia. Thus, the authorities faced a problem encompassing illegal dumping and environmental issues (Begum et al., 2009). The Solid Waste and Public Cleansing Management Act 2007 (Act 672) was introduced in response to this issue. Then, four years later, on 1st September 2011, Act 672 was gazetted and came into operation in several states. Meanwhile, for the construction sector or the industrial, commercial, and institutional sector (ICI), The Construction Solid Waste Management Regulations were gazetted on 1st November 2018 and have been fully enforced on 1st January 2020, involving seven states that have adopted Act 672, namely Johor, Negeri Sembilan, Melaka, Pahang, Perlis, Kedah and the Federal Territory of Kuala Lumpur and Putrajaya to improve and strengthen the industry' commitment towards sustainable development. Despite this, the Construction Industry Development Board (CIDB) is also responsible for transforming the industry by improving its environmental performance. In

addition, the government has devised numerous construction waste management plans. But, alas, the results are still far behind regardless of the strategies and practices used to control construction waste (Kabirifar et al., 2020).

Challenges of Implementing Best Practices on Site

Construction waste is a significant source of waste generation in Malaysia. Still, despite the numerous regulations implemented by the government to address these issues, the notion of a sustainable resource and waste management strategy on-site is not even a primary concern for most contractors and developers in the country (Begum et al., 2009). Hence, it is crucial to reveal the underlying cause of the problem that needs to be resolved. To successfully implement the concept of sustainability in waste management, identifying the challenges that stand in the way of achieving long-term sustainability is essential (Sin et al., 2013). To make a change or something better, there will be challenges.

Generally, a myriad of obstacles still needs to be addressed to implement best practices on site towards achieving sustainable construction waste management, namely 1) Insufficient legislative enforcement (Mahayuddin et al., 2008; Manaf et al., 2009; Yuan & Shen, 2011; Ghafourian et al., 2019), 2) Lacking of awareness (Mahayuddin et al., 2008; Manaf et al., 2009; Yuan & Shen, 2011; Menegaki & Damigos, 2018; Ghafourian et al., 2019), 3) Insufficient proper recycling markets (Yuan & Shen, 2011; Ghafourian et al., 2019), 4) Lacking of funds (Saeed et al., 2009; Yuan & Shen, 2011; Menegaki & Damigos, 2018), 5) Insufficient technologies and facilities (Mahayuddin et al., 2008; Saeed et al., 2009; Periathamby et al., 2009; Huang et al., 2018; Menegaki & Damigos, 2018), 6) Lack of knowledge and guidance for effective construction waste management (Huang et al., 2018) and 7) Poor communication and coordination among parties involved (Menegaki & Damigos, 2018). Understanding construction waste management challenges and obstacles faced by the industry allows both private and government sectors to devote more attention to addressing the issues to achieve sustainable waste management (Abd Rahim et al., 2021).

METHODOLOGY

In this section, the methodology used is described. The methodology is the plan of action that guides the study's selection and application of qualitative or quantitative approaches. The goal is to provide a research work plan. Thus, this research will adopt a qualitative approach because it is more appropriate for obtaining information regarding the best practices of construction waste minimisation at the project from participants. Furthermore, this research will employ a qualitative approach to elicit information on participants' perceptions and understandings of the best practices to minimise waste in the project based on their work experience. The qualitative approached used is semi-structured interview. The methodology is separated into three stages: an extensive literature review of prior research, data collection through qualitative methods, and data analysis through content analysis, as shown in Figure 4.

A semi-structured interview was planned to discover the contributing factors and criteria of effective waste minimisation practices. The sampling for this semi-structured interview focused on experts in the construction industry in Malaysia. The participants are involved in various projects and represent various positions and have more than 10 years of working

experience in the construction industry. In addition, the participants need to involve directly or indirectly in construction waste management at construction projects.

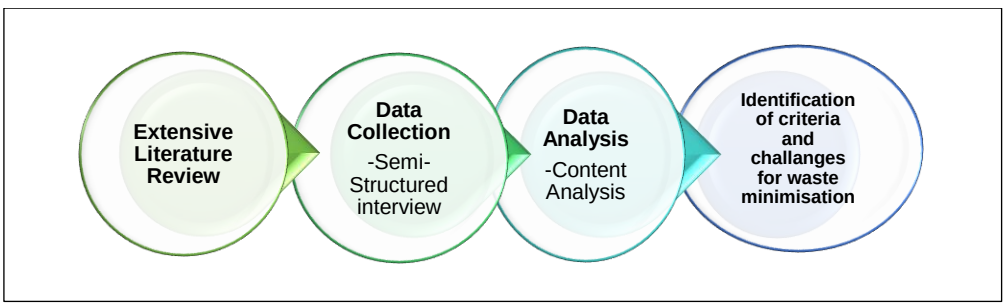


Figure 4. Flow Chart of the Research Methodology

Before the interviews were conducted, a set of interview questions had been emailed to the construction practitioners earlier to have a brief idea of what will be asked later. Besides, it will help smoothen the interview session later. The interview was conducted through an online platform using Google Meet Application as a communication channel. Google Meet is a secure video meeting that connects everybody around the world. The COVID-19 pandemic has created an extraordinary challenge for in-person interviews and qualitative study, forcing researchers to redesign their approach and switch to online interviews. An online interview platform is an Internet-based application that provides a virtual setting for remote interviews among participants spread across a large geographical area (Kathiravan et al., 2021). Next, an interview protocol has been developed to ensure the reliability and validity of the data. Samples were chosen based on related and skilled construction waste management practitioners in Malaysia. A snowballing procedure was used, in which each participant was invited to recommend more potential interviewers. The interviewees' roles are varied, but they all had extensive construction waste management experience. Next, the data obtained were analysed using the content analysis approach. Finally, the findings reflect industry participants' perspectives on how they manage waste on construction sites, the techniques that they employed, and the challenges that may prevent them from implementing best practices towards sustainable waste management.

RESULTS AND DISCUSSION

Overview of The Participants

A general summary of the participants includes their position and their professional experience. Table 1 shows an overview of the participants. A total of six participants agreed to take part in the study. There are two (2) Safety, Health, and Environment Managers, three (3) Project Managers, and one (1) Managing Director. In terms of work experience, the majority of participants had between 11 to 25 years of experience. The diversity of experience demonstrates that the experts' perspective on best practices of construction waste minimisation in a construction project is reliable, as all participants had more than ten years of construction industry experience. The interview duration takes time between approximately 60 minutes to 106 minutes, which is enough range time to obtain participants' views, ideas, experiences, and suggestions regarding the topic discussed.

Table 1. Overview of The Participants

Participants	Positions	Years of Experience	Duration of Interview (in minutes)
P1	Safety, Health, and Environment Manager	13 years	60 minutes
P2	Managing Director	17 years	80 minutes
P3	Project Manager	21 years	60 minutes
P4	Project Manager	15 years	86 minutes
P5	Safety, Health, and Environment Manager	11 years	73 minutes
P6	Project Manager	25 years	106 minutes

Best Practices of Construction Waste Minimisation

Table 2 shows the participants' overview of contributory factors and criteria for best practices of waste minimisation in the project based on the semi-structured interview. Based on the analysis, six factors contribute to waste minimisation, namely 1) knowledge; 2) on-site practices; 3) material and equipment; 4) regulation; 5) human resource management and 6) technology. The six factors have further produced 17 new criteria for best practices in minimising construction waste in the project.

Knowledge

Knowledge factor is vital in minimising construction waste on-site (Hassan et al., 2012). As a result, inadequate knowledge and expertise of construction practitioners in waste management are impeding the adoption of better practices (Tam & Lu, 2016; Song et al., 2017). Based on the analysis, most of the participants agreed on the knowledge factor. There are three criteria under the knowledge factor, namely KN1) Adequate knowledge of construction methods and sequence: KN2) Knowledge of reduce, reuse, and recycle and KN3) Adequate knowledge of construction waste. Based on the results, only participant P5 does not agree with the KN1 criteria. In addition, there are three additional criteria obtained from the results: firstly, adequate knowledge of advanced technology suggested by participant 3 (P3). As been described:

> *"Apart from this listed knowledge, we need to know about technology as well. Our technology system has to be advanced to minimise construction waste at the site".*
> (Participant 3)

Secondly, as mentioned by participant 6 (P6), the construction practitioner or person in charge (PIC) needs to have the technical knowledge and basic design background knowledge so that the waste can be reduced.

On-Site Practices

The on-site practices factor is significant in preventing more waste from being generated. All of the practices implemented on-site will have an impact on the project (Sáez et al., 2019). According to the data, there are fifteen (15) criteria for site-practices factors, as presented in Table 2. The participant agreed with most of the criteria except for OSP7, which occasionally checks the construction waste container. P3, P4, P5, and P6 disagree with the criteria. As for OSP14, P3, P5, and P6 disagreed with the criteria as they believe that time scale does not affect waste minimisation at the site. Furthermore, there are three other additional criteria:

first, replace material that can be used repeatedly, for example, supporting for prop or falsework as described by P1 and P5. Next, proper construction waste management logistic plan and lastly is construction waste bin needs to be labelled accordingly based on the type of waste so that the site can implement segregation at the source that will ease their work later on.

Material and Equipment

Material and equipment are the most crucial component in every construction project. As a result, if material and equipment management in construction projects are not appropriately managed, it will lead to a significant project cost discrepancy (Khandve et al., 2015). Based on the analysis, there are 8 (eight) criteria under material and equipment factor, which all the participants mostly agree on except for ME3) Use material with high content of recycled material, which is disagreed by participant 3 (P3). Whereby P3, P5, and P6 disagreed on ME5) Avoid unnecessary packaging while buying material. According to the participants, packing depends on the manufacturer where it is not under the contractor's control, and it is properly packed. In addition, there are two (2) more additional criteria that the participants, namely have suggested, every project needs to have an experienced operator in handling machine or crane as indicated by participant 6 (P6), and the other additional criteria is the adoption of new machine or technology as proposed by participant 2 (P2).

Regulation

Under regulation factor, there are 7 (seven) listed criteria and mainly agreed by all the participants except for RG1) Market structure for recycled material, which disagreed by P5 and P6. The majority of the participants disagree with RG2) Increase the landfill disposal fee. They believed that increasing landfill disposal fees does not help in minimising construction waste and it might lead to another problem which is illegal dumping. Moreover, there are another 5 (five) additional criteria recommended by the participants. Firstly, promoting all the regulations by the authority. As been described:

"I think the authority should be promoting in regards of the regulations. So far, we are not very aware of this regulation by authority. There is a need for some announcement, briefing, etc. So far, some of the contractors are aware, and some don't". (Participant 3)

Secondly, as suggested by P3 and P5, the regulation needs to comply with all levels of the contractor. Not only focus on big contractors but also on small contractors as well. For example, renovation work done by this small contractor majority does not have proper construction waste management, and sometimes most of the waste is piled up in front of the house. This will cause an unsafe condition in the area as well as an unpleasant view. Thirdly, P4 suggested creating another body or authority focusing on construction waste management. Besides, P6 suggested that incentives need to be provided by the government as an encouragement to contractors for minimising waste in their projects. Next, P5 recommended that all sites need to have Environment Officer in charge of waste management at the construction site. This need to be thoroughly covered at all levels of the contractor.

Table 2. Factor and Criteria of Construction Waste Minimisation

ID	FACTOR AND CRITERIA	P1	P2	P3	P4	P5	P6	ADDITIONAL CRITERIA
	Knowledge							**Knowledge**
KN1	Adequate knowledge of construction methods and sequence	√	√	√	√	X	√	1. Adequate knowledge of advanced technology. (P3) 2. Construction practitioners need to have technical knowledge. (P6) 3. Adequate knowledge of design background. (P6)
KN2	Knowledge of reduce, reuse, and recycle	√	√	√	√	√	√	
KN3	Adequate knowledge of construction waste	√	√	√	√	√	√	
	On-site Practices							**On-site Practices**
OSP1	Waste segregation at the site	√	√	√	√	√	√	1. Replace material that can be used repeatedly (e.g., supporting prop or falsework). (P1, P5) 2. Proper construction waste management logistic plan. (P3) 3. Labelled construction waste bin. (P3, P5)
OSP2	On-site reuse and recycle of construction material	√	√	√	√	√	√	
OSP3	Safe storage is provided to reduce broken material	√	√	√	√	√	√	
OSP4	Effective communication on-site	√	√	√	√	√	√	
OSP5	Appropriate space located for construction waste	√	√	√	√	√	√	
OSP6	Temporary Bins are provided at each zone of a building	√	√	√	√	√	√	
OSP7	Occasionally check the construction waste container	√	√	X	X	X	X	
OSP8	Storing waste in the easily accessible area	√	√	√	√	√	√	
OSP9	Update staff on reuse and recycle material	√	√	√	√	√	√	
OSP10	Avoid waste mixture with oil	√	√	√	√	√	√	
OSP11	Follow project drawing/ design	√	√	√	√	√	√	
OSP12	Reduce the number of design changes that take place during construction	√	√	√	√	√	√	
OSP13	Keeping site clean to prevent waste generation (housekeeping)	√	√	√	√	√	√	
OSP14	The time scale of the project can reduce the generation of waste	√	√	X	√	X	X	
OSP15	Every project must have a recycling goal	√	√	√	X	X	√	
	Material and Equipment							**Material and Equipment**
ME1	Use of mechanical fixture (proper handling)	√	√	√	√	√	√	1. Experienced operator in handling machines or cranes. (P6) 2. Adoption of a new machine or technology. (P2)
ME2	Avoid over-ordering of material	√	√	√	√	√	√	
ME3	Use material with high content of recycled material	√	√	X	√	√	√	
ME4	Avoid double-handling material	√	√	√	√	√	√	
ME5	Avoid unnecessary packaging while buying material	√	√	X	√	X	X	
ME6	Just in Time (JIT) deliveries to reduce material waste	√	√	√	√	√	√	
ME7	Proper storage for material	√	√	√	√	√	√	
ME8	Access to the site is adequate for material delivery and transportation	√	√	√	√	X	√	

Table 2. Factor and Criteria of Construction Waste Minimisation (cont'd)

ID	FACTOR AND CRITERIA	P1	P2	P3	P4	P5	P6	ADDITIONAL CRITERIA
	Regulation							**Regulation**
RG1	The market structure for recycling material	√	√	√	√	X	X	1. Promoting all the regulations by the authority. (P3, P5) 2. Enforcement needs to comply with all level contractors. (P3, P5) 3. Create another body (authority) responsible just for waste management. (P4) 4. Incentives provided by the government as an encouragement to contractors. (P6) 5. All sites need to have an Environment Officer in charge of the waste management. (P5)
RG2	Increase landfill disposal fee	√	X	X	X	X	X	
RG3	Improved waste management regulation	√	√	√	√	√	√	
RG4	Improve database management for construction waste	√	√	√	√	√	√	
RG5	Raising fees for mixed waste	√	X	√	X	√	√	
RG6	Reducing fees for separated waste	√	X	√	X	√	√	
RG7	Integrate construction waste management into the assessment of contractor	√	√	√	√	√	√	
	Human Resource Management							**Human Resource Management**
HRM1	Appoint Environment Officer on-site	√	√	√	√	√	X	1. Incentives are provided to site personnel for reduction of construction waste by the company. (P6) 2. Budget allocation by the top management for managing waste. (P3) 3. Awareness of waste management to top management. (P4)
HRM2	Appointment of labour just for waste management	√	√	√	√	√	√	
HRM3	Reduce or no overtime for workers	X	X	X	X	X	X	
HRM4	Awareness of waste management to all staff (example, talk, briefing, campaign, etc.)	√	√	√	√	√	√	
	Technology							**Technology**
TC1	Waste sorting/segregation technologies	X	X	X	X	X	X	1. Used of Industrialised Building System (IBS). (P1, P2)
TC2	Waste sorting/segregation technologies	√	√	√	√	√	X	
TC3	Automatic tracking and identification of waste items supported by RFID technology	X	X	√	√	X	X	
TC4	RFID encourages the reuse of construction components and reduces waste	X	X	√	√	X	X	
TC5	GIS and GPS provide real-time location of the material and its arrival time at the construction site	X	X	X	X	X	X	
TC6	GIS and GPS technology can identify the dumping sites where construction waste is illegally dumped with potential risk.	X	X	X	X	X	X	

Description:
√ = Participants Agreed
X= Participants Disagreed

Human Resource Management

There are 4 (four) criteria under human resource management, as shown in Table 2. Mostly, all participants agreed on all the criteria except for HRM3) Reduce or no overtime for workers. However, all the participants disagree on those criteria as they believe that reducing overtime or no overtime for the workers does not affect waste minimisation on-site. In addition, there are 3 (three) other additional criteria suggested by the participants. Firstly, P6 suggested that incentives be provided to site personnel for the reduction of construction waste by the company. This is one of the approaches to encourage site personnel regarding construction waste minimisation. Secondly, top management needs to allocate a budget for construction waste management which is suggested by P3. According to P3, budget allocation is essential to manage waste at the site. Therefore, it will be easier to manage waste if a proper allocation is provided. Lastly is awareness of waste management to top management, which is proposed by P4. Top management is the ultimate decision-maker. Therefore, it is crucial that top management aware of how important it is to have proper construction waste management on-site that will benefit the company in the long run.

Technology

To achieve sustainability in waste management, every construction practitioner needs to cope and adapt to a relevant approach and technology (Sin et al., 2013). However, previous researchers found that Malaysia still lacks of construction waste technology (Hassan et al., 2012; Begum et al., 2006). Based on the finding, under the technology factor, there are 6 (six) listed criteria and mainly disagreed by most of the participants except for TC2) Reuse technology for construction waste (i.e., bricks and tiles). P1, P2, P3, P4, and P5 agreed that reuse technology would benefit in minimising construction waste. Technology is beneficial in reducing waste, but Malaysia is still lacking in this kind of technology. As been described:

"I think we don't have advanced technology. Therefore, as compared to Japan and Korea, we are way far behind. We just do basic construction waste management only". (Participant 3)

"Controlling waste management using technology is a good thing, but I think it is quite difficult to implement, especially in Malaysia. Moreover, it will reflect on the cost impact". (Participant 1)

In addition, there is 1 (one) additional criteria suggested by the participants, which is the use of the Industrialised Building System (IBS). However, the greater initial costs incurred make it difficult for construction practitioners to embrace this technology, although IBS can be a great strategy to reduce waste on-site (Sin et al., 2013). As been described:

"In my experience, using the IBS method will minimise waste, but it involves cost for the early stage. That's why most contractors today are still using the conventional method. But it depends on the type of project as well". (Participant 3)

Finally, as a conclusion, to overcome construction waste management problem, construction practitioners need to equip themselves with good knowledge on minimising waste, exercise good practices onsite, such as implement 3R, segregate waste, practice

effective communication and etc. In addition, it is essential to know how to handle equipment and material onsite to prevent wastage. Nevertheless, human resource and technology contribution also plays an important factor in minimising construction waste in a projects.

Challenges of Implementing Sustainable Practices of Construction Waste Management

Table 3 shows the participants' overview of the challenges of implementing sustainable practices of construction waste management based on the semi-structured interview. Based on the analysis, there are seven (7) challenges that contribute to implementing sustainable practices of waste management, namely 1) lack of awareness; 2) lack of knowledge; 3) attitude and behaviour of construction practitioner; 4) lack of enforcement; 5) insufficient fund; 6) commitment and cooperation from all parties, and 7) the thinking of the importance of waste management.

Table 3. Challenges of Implementing Sustainable Practices of Construction Waste Management

Participants	Challenges
P1, P2, P4	Lack of Awareness
P1	Lack of knowledge
P2, P3, P4, P5	Attitude and behaviour of construction practitioner
P2	Lack of enforcement
P3, P4	Insufficient fund
P3	Commitment and cooperation from all parties
P6	The thinking of the importance of waste management

Based on the semi-structured interviews, P1, P2 and P4 described that one of the challenges is a lack of awareness of construction waste management. Most construction practitioners were unaware of the basics of implementing construction waste management. As been described:

"Person in charge (PIC) and workers need to have awareness and knowledge. They have to understand that all the material bought is related to cost. If they throw away the material, they will also throw away the cost". (Participant 1)

"I think the barrier all starts with awareness. Whether it is the top management, workers, or the staff. It is a big obstacle if they believe that waste management is not an important matter". (Participant 4)

Next, most of the participants believe that the attitude and behaviour of construction practitioners is one of the barriers or challenges. P2, P3, P4, and P5 significantly emphasise that. The significant causes of construction waste are directly or indirectly caused by worker attitudes and behaviour. Most of the waste generated on-site can be avoided by changing the construction practitioner's attitude and behaviour. As been interpreted:

"Either the workers or the staff themselves, the attitude needs to change". (Participant 3)

"Ok first I will say decision-makers behaviour. Those people who want to spend money. Therefore, it depends on whether they want to do it or not". (Participant 4)

The biggest obstacle is the behaviour and attitude of construction practitioners towards construction waste management". (Participant 5)

Lack of enforcement has been described by P2. Regulations concerning construction waste management are required to be followed and implemented by construction practitioners. However, it is a challenge in terms of enforcement. The next challenge pointed out by P3 and P4 is insufficient funds. Although waste minimisation entails a significant financial investment, many construction practitioners are hesitant to implement this waste management approach. As been described:

" I believe that the first hurdle is the budget". (Participant 3)

"I would say untrained workers is one of the problems. Thus, when it comes to untrained workers, we always have to train them. Consequently, training involves cost". (Participant 4)

"If the government policy works out on the campaign for encouragement, provide the budget for the award and so on to achieve the KPI, then when it reaches the KPI, and there is a rating that can be used for the next project, so that helps". (Participant 3)

Furthermore, P3 mentioned the commitment from all the parties. Cooperation and support from all parties are required to ensure successful construction waste management can be achieved.

"I believe that we need to have the cooperation from all parties, for example, the client, the authority, JKR, SWCorp as well as developer and also the contractor". (Participant 3)

Finally, P6 stated that the main barrier in implementing construction waste management is the thinking of the importance of construction waste management itself. The challenges described reflects the psychological basis of that particular construction practitioner. The mindset itself. The way one thinks will shape the habits and affects how they think, feel, and do.

CONCLUSION

This paper presented a finding from a semi-structured interview conducted with 6 (six) construction practitioners looking at the best practices of construction waste minimisation in construction projects and investigating the challenges that hinder the construction practitioner from implementing sustainable practices of construction waste management. This paper reveals that there are 17 new criteria produced from the six factors listed. Whereby three criteria under knowledge, on-site practices, and human resources management factor. Next, two additional criteria from material and equipment factors. Further, five additional criteria are from the regulation factor, and finally, one criteria are under the technology factor. On the other hand, based on the semi-structured interview, seven challenges faced by the construction practitioners, especially the lack of awareness, attitude, and behaviour of the construction practitioner and insufficient funds.

The study determined recommended practices in construction waste management and give a high implication toward achieving long-term sustainability. This paper also contains information that construction practitioners can use to establish waste management strategies and compare their waste management performance.

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A REVIEW ON WASTE MANAGEMENT PRACTICE IN HIGHER EDUCATIONAL INSTITUTIONS

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Abstract
Waste management has always been related to the construction industry as it become a major generator of waste. However, higher educational institutions (HEIs) are also major contributors to municipal solid waste (MSW) such as packaging materials, papers, electronics, plastics, rags, other fabrics, dust, ash, and a variety of combustible and non-combustible substances. The key problems faced by the institutions due to solid waste generation are (i) lack of resources and faced municipal budget constraints, (ii) less safety concerns and most municipalities had a tough time in finding new disposal sites (iii) inadequate and inefficient services provided by local authorities as far as waste management practices. Therefore, appropriate collection and disposal of generated solid waste are crucial in MSW management in HEIs. Nowadays, educational institutions focus on minimizing the amount of waste generated and maximizing the value-added products extracted from them. Hence, this paper primarily aims to review higher educational institution practices and initiatives toward the management of solid waste in educational institution operations. The findings provide a basis for understanding the concepts of the practice. Identifying the practices of managing solid waste will be beneficial to the HEIs management to decide the suitable practices for their institutions.

Keywords: *Waste management in university; solid waste management; educational institutions*

INTRODUCTION

Solid waste is defined as the generation of waste that is produced by residential, commercial, institutional, and industrial activities. Certain types of wastes that cause immediate danger to exposed individuals or environments are classified as hazardous. Solid waste management is one of the three major environmental problems in Malaysia. It plays a significant role in the ability of nature to sustain life within its capacity.

In Malaysia, the population is increasing rapidly, reaching 32.8 million in 2021, generating a tremendous amount of solid waste, which is estimated to be 38,427 metric tonnes per day in 2021 (1.17 kg/capita/day). Hence, the amount of Municipal Solid Waste collected would be 14 million metric tonnes per annum, enough to fill the Petronas Twin Towers every seven days by year 2022.

Meanwhile, the Solid Waste Corporation (SWCorp) reported that the recycling rate Malaysia achieved in 2020 is 30.67% and is lower than other developed countries such as Singapore (59%), Korea (49%) and Taiwan (60%). The establishment of the Department of National Solid Waste Management is one of the catalysts for the government to achieve the recycling rate target set by the National Green Agenda of 40% by year 2025.

If the present rate of solid-waste production goes on without effective supervision and disposal methods, there will be a substantial negative impact on the quality of our environment. Furthermore, the lack of awareness and knowledge among the Malaysian

community about solid waste management (SWM) issues and ignorant about the effect that improper SWM has worsened the problem.

LITERATURE REVIEW

Types of Construction Waste in Educational Building

In the construction industry, especially in the context of educational building projects, various types of waste can be generated. These waste types can have environmental, economic and sustainability implications.

Table 1. Types of Construction Waste in Educational Buildings

Types	Description
Construction and Demolition Debris	This category includes materials generated during the construction and demolition phases, such as concrete, bricks, wood, metals, drywall, and roofing materials.
Packaging Waste	Construction materials often come packaged in cardboard boxes, plastic wrap, and other packaging materials. This packaging waste can accumulate quickly during the construction process.
Hazardous Waste	Construction sites may produce hazardous waste materials such as lead-based paint, asbestos-containing materials, and chemicals used in construction processes. Proper handling, removal, and disposal of hazardous waste are critical.
Electronic Waste (E-waste)	Educational buildings often require a significant amount of electronic equipment, such as computers, monitors, and printers. The disposal of outdated or non-functional electronic equipment can contribute to e-waste.

(Source: Trevor & Danial, 2019)

Construction waste in educational buildings refers to the various types of waste materials generated during the construction, renovation, or demolition of educational facilities such as schools, colleges, universities, and research centres. Managing construction waste in educational buildings is essential for environmental sustainability, cost control, and compliance with regulations.

Lew et al. (2022) highlighted the most current practice adopted in the Malaysian construction industry is recycle, reduction and reuse construction waste. However, they also found that the site management failed to adopt these practices due to insufficient storage material on site and lack of communication between the site management team. Hence, it has been discovered that waste reduction is often not the primary concern during the strategic planning for a construction project in Malaysian construction industry (Cheng and Mydin, 2018). In addition, it was found that waste management in Malaysia is still under-developed as contractors do not generally practice on-site sorting (Soon et al., 2022).

Overview Solid Waste Management in Higher Educational Institutions

The rapid expansion of higher education in Malaysia effectively began in the early 1990s. Based on current data in Malaysian Higher Education and Economic Growth that released in October 2022, the proliferation of higher education saw student enrolment increase 25-fold from 46,596 in 1980 to 1.2 million in 2020. Hence, the total number if higher educational institution also increases to 595 numbers in 2020.

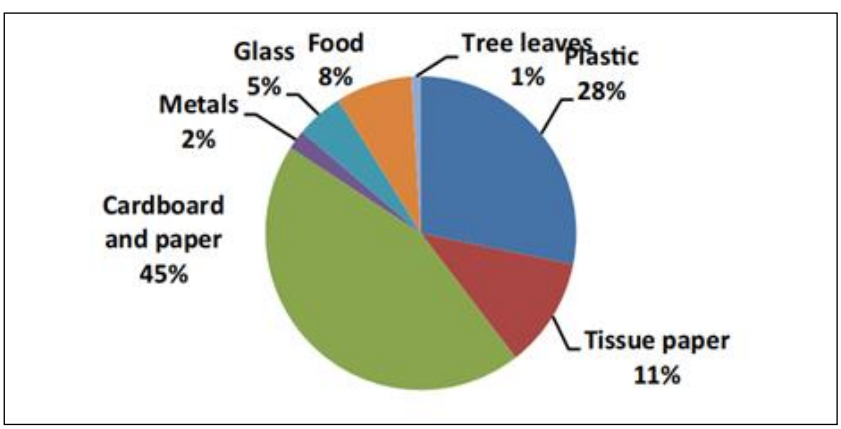
Table 2. Number of Higher Education Institutions, 1980-2020

Year	1980	1990	2000	2010	2020
Public Universities	7	13	24	117	160
Private Institutions	13	140	616	476	435
Total	20	153	640	593	595

(Sources: MOHE (various years))

The increasing rate of population growth served by higher educational institutions will lead to an increment number of waste generated from these institutions. Separately from the area to be covered, the volume of waste generated, and the number of persons involved, the transient nature of the population in the institutions creates their own limitations for successful waste management.

A university is a place where thousands of students, teaching, and supporting staff come every day and spend a significant amount of time for academic and research purposes. Apart from construction and demolition wastes, high amounts of solid wastes are generated daily from several sources in the university such as offices, classrooms, laboratories, restaurants, residence halls, and other facilities (Adeniran et al., 2017; Gallardo et al., 2016; Moreira et al., 2018; OES, 2011; Tian et al., 2013).



(Source: Dahlawi & Sharkawy, 2020)

Figure 1. Categorization of MSW Generated in IAU Campus

Figure 1 shows that 73% of the total amounts of solid wastes were a mix of paper, cardboard, and plastic. This high composition of potentially recyclable waste indicates that effective recycling strategies in different organizations and educational institutes are needed. Paper products usually make up a small percentage by volume, while plastics make up a higher percentage (Dahlawi & Sharkawy, 2020). Hence, C.O. Ugwu et al. (2021) derived the type of waste and their characteristic produced by university campuses as shown in Table 3.

The role played by Higher education institutions (HEIs) in the promotion of sustainability and cleanliness has been recognized as vital (Aleixo & Leal, 2017). It is mandatory that all the members of the institution cooperate for the sustainability of the clean and green campuses (Jayaprakash & Jagadeesan, 2020). In the developed world, the management of solid waste produced from educational institutes is an essential part and parcel of the full management plans (Espinosa et al., 2008; Savely et al., 2007).

Table 3. Waste Generated by University Campus

Type	Characteristics	Items Considered	Source/Origin
Paper/cardboard	Combustible when dried and biodegradable when continuously wet	Papers and allied packages-carbon papers, tissue papers, cement bags, cartons, wrappers, and cardboards.	Domestic and industrial waste and may result from lecturer quarters and hostels, lecture rooms, photocopying centres, offices, and mini markets
Garbage	Organic and biodegradable; and combustible when dried	leftover from food, soups, sauces, meat and cheese, bread, cakes, uneaten sandwiches, peel and leaves from fruits and vegetables, eggs, and dead animals.	Domestic and may result from lecturer quarters and hostels, bread/cake production, and consumption from kitchens/ refectories/restaurants, and markets.
Plastics, polythene and packaging foils	Not biodegradable and when burnt, their residue hardly decays	Plastic materials-cans, caps, bags, bucket, waterproof bags, syringes beakers, pipettes, and burettes, spoilt plastic chairs, automobile tyres, tubes, cables, and ball pens	Domestic and industrial wastes and may result from the markets, medical centres/hospitals, and laboratories.
Metals/Junks	Neither combustible nor biodegradable	Disused cars, lorries, buses, automobile junks, metal cups, cans, plates, buckets, spoons, plates, pots, boxes, aluminium	Majorly industrial waste and may result from quarters, hostels, guest houses, markets, and vehicles (very plenty at works department).
E-Waste Made up	Made up of different components that are non-biodegradable. While some parts are combustible like the rubber, plastic, etc., some are not like the metal parts	Electric cables, printer's cartridge, phones accessories	Domestic and industrial wastes from electrical appliances/ parts and results from quarters, hostels, and commercial areas
Sanitary waste	Non-biodegradable	Pads, diapers, and cotton wools	Mostly from the quarters and the hostels

(Source: C.O. Ugwu et al., 2021)

Several previous kinds of research studied the management practices of MSW in university campuses. A recent study in the School of Engineering, Moi University, Kenya (Starovoytova, 2018) revealed that the largest amount (37%) of the total university waste was food waste, while cumulative 62% were recyclables, or waste materials, that have the-potential to-be recyclable.

De Vega (2008) concluded that nearly 65% of the university MSW is recyclable, and he recommended an effective program for beneficial use of this waste starting from its segregation and recycling before the final decision of disposal. Nagawiecki (2009) revealed that the proper management actions can significantly diminish the waste generation of the University of Idaho and reduce waste disposal expenditures.

RESEARCH METHODOLOGY

This paper primarily aims to review higher educational institution practices and initiatives towards management of solid waste in educational institution operations. Within this purpose, a review of relevant literature was performed. In the first stage, the author selects establish publishers such as Emerald Insight and Elsevier. Then, from the publication databases, the

initial search was done using the "waste management in university campus" and “waste management in higher educational institutions” as a keyword. Hence, the literature content is manually identified by author the management practices towards solid waste. Lastly, these literature findings were discussed to demonstrate the practices on waste management in higher educational institutions.

FINDINGS AND ANALYSIS

This review demonstrates relevant empirical articles published in different journals. All the journals published related to "waste management in university campus" and “waste management in higher educational institutions are published in Emerald and Elsevier databases. The journals retrieved from the publisher total 80 articles based on topic suitability, then the review on the literature was done manually and resulted in 30 articles related empirical research (Figure 2). These journals then were categorized into the practices and implementation of management of solid waste in university campus. The articles are selected and arranged from the years 2016 to 2022. Among these journals, the International Journal of Sustainability in Higher Education has published the highest number of 12 articles. Table 4 shows the distribution of article according to various journals.

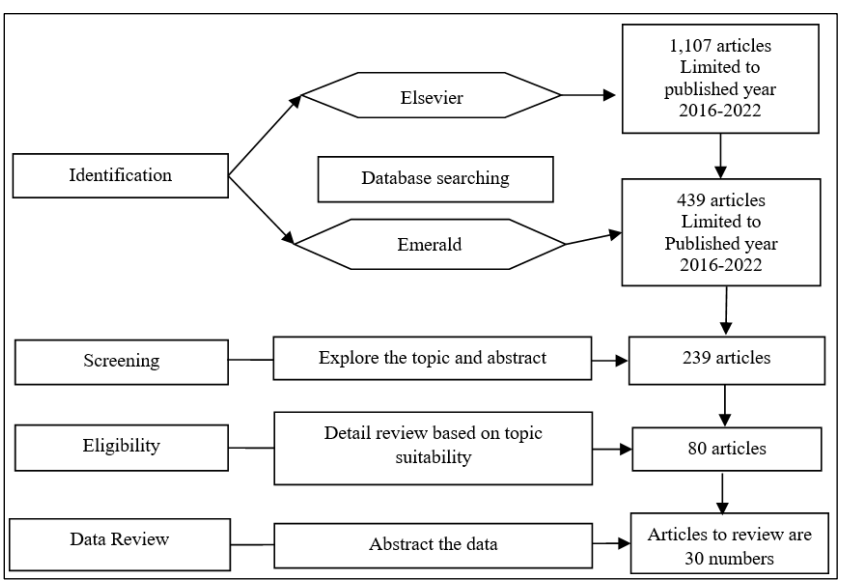


Figure 2. Methods of Data Collection

Table 4. The Distribution of Articles by Journals

No	Journals	No of Articles
1	International Journal of Sustainability in Higher Education	12
2	Journal of Cleaner Production	3
3	Management of Environmental Quality: An International Journal	2
4	In Tech	2
5	International Journal of Contemporary Hospitality Management	2
6	International Journal on Advance Science Engineering	2
7	Fuel Communications	2
8	International Journal of Business and Society	2
9	Others	3

RESULT AND DISCUSSION

Table 5 shows literature on management of solid waste that implemented and practices by higher educational institutions. The study of waste management structures, along with a regular assessment of environmental awareness and recycling behavior of campus individuals, can aid universities in reducing landfill waste and operational costs and promotes their reputation and role within surrounding communities.

Table 5. Literature on Implementation of Solid Waste Management in Higher Educational Institution

No	Sources	Solid Waste Management practices in Higher Educational Institution
1.	Sustainable Waste Policy 2021, UTM	Implementation of Integrated Waste Management in **Universiti Teknologi Malaysia (UTM)** a) Waste HUB Facilities UTM ***UTM Recycling Center*** (paper, glass, plastic, and aluminum Bio-Recycling Station (food waste and landscape waste). b) Food Waste Utilization Food wastes from the arcades or cafeterias within the campus will be collected, and to be sent to the UTM Orchard of Dusun for further processing. The process of converting the raw food waste into usable end products, such as animal feeds and compost fertilizers will usually take one to three days ferment. c) Waste Separation Awareness and Procurement UTM ***Food waste separation*** is important to facilitate fertilizer and animal feed making processes. Inorganic materials such as the plastics, drinking straws and food wrappings should be removed from organic waste such as fish bones, rice, vegetables, and fruit peels. Sources of food wastes are the arcades and cafeterias within UTM. d) No polystyrene and no plastic bag policies Enforcement of banning the use of polystyrene containers and plastic bag on campus. Instead, using a more environmentally friendly approach by using food wrapping papers. e) Program “Bring Your Own Container” In the effort of reducing plastic waste on the campus, the “Bring Your Own Container” program is an initiative that requires students to bring their own containers for takeaways.
2	(Bashir et al., 2020)	The ***waste segregation program*** helped to improve the student’s awareness and behaviour toward residential SWM at **Universiti Tunku Abdul Rahman**, UTAR’s Westlake and Harvard student hostel area in Kampar, Perak, Malaysia. There was an increase of awareness and practice of waste segregation among UTAR students from 69.1 to 75.3% and from 38.7 to 44.7%.
3	Sustainability Annual Report, 2019	**Universiti Teknologi Mara** campuses announced the 4R concept of sustainable waste management that are ***Reduction, Reuse, Recycling, Recover***. Also launched the initiatives for sustainable waste management in UiTM campus: a) Recycling programs for campus waste b) Programs to reduce the use of paper and single-use plastic on campus c) Organic waste treatment d) In organic waste treatment The objective of having sustainable waste management in UiTM campus is to avoid final disposal to the landfill.
4	Tiew et al., 2019	**University Malaya** Launched Zero waste campaign (ZWC) in November 2010 under funding by CIMB foundation. ZWC has started several projects such as ***food waste segregation***, anaerobic digestion, composting, and waste segregation at source. In this case, PRO bin (waste segregation at source) will be discussed more compared composting method. ZWC provided more than 80 sets of PRO bins in University Malaya campus. The purpose of PRO bins is to nurture university citizen practice waste separation at source. ***PRO bins recyclable*** collection categories are paper and cardboard, aluminum can, plastic bottles and other plastics and metals.

No	Sources	Solid Waste Management practices in Higher Educational Institution
6.	Green Campus Initiatives 2021, UMK	**Universiti Malaysia Kelantan** a) The No Single Used Plastic campaign is one of PPKJ's initiatives to support the University's aspiration to make UMK a Green Campus. The No Single-Used Plastic campaign is a practice to ensure the use of disposable plastics including drink straws, plastic food packaging and plastic bags. The campaign started with a practice at the Oryzza Cafeteria at UMK Jeli Campus. All cafeteria operators are instructed to no longer supply drink straws, food packaging and bags made of disposable plastic. b) Recycle Right Campaign ***Recycling*** is one of the initiatives implemented by PPKJ to ensure that UMK Kampus Jeli supports the University's aspiration to become a green campus. For a start, PPKJ has provided one (1) set of ***recycling bins*** placed near the Oryza Cafeteria. One (1) set contains five (5) multi-purpose bins namely Yellow (Aluminum), Blue (Paper), Red (Plastic), Brown (Organic Waste) and Green (Other waste).
5	Ebrahimi et al., 2017	**Appalachian State University** Implemented awareness-raising program, sustainability integrated into all dimensions of university activities, food systems and waste production emphasized, identified new locations for placing bins, integrated logos, and stickers on all ***campus recycling containers***, developed education and outreach plan, developed tailgate ***recycling program***, conducted comprehensive waste audit, mini bin system implemented in faculty offices, environmentally preferable purchasing program.
		James Madison University Develop sustainable procurement policy implemented, community not permitted to bring non-recyclable waste to campus, green procurement guidelines for food services developed, increased number, and relabelled ***recycling bins*** on campus, provide composting bins at dining halls, replaced dining take-away packaging with compostable packaging, improving and distributing ***recycling guidelines*** across the campus, developed environmental courses.
		Arizona State University Apply single-stream waste collection, ***recycling program*** managed under grounds services, training offered for anyone involved with waste management, Each waste project developed with detailed description, number of required employees to achieve, tasks for project roles and required logistics identified/developed, waste-related programs for food and dining services created, ***Surplus Store and Recycling Center*** joined with the Office of Campus Sustainability to form a comprehensive waste reduction and sustainability team.
		Michigan State University Service as their own waste management provider, ***hand sorting*** plastics conducted, compost/organics collection options available for campus waste, participate in national programs such as RecycleMania and Game Day Challenge Green Steward/Spartan EcoReps Program being developed to specifically engage faculty and staff in the sustainability initiatives.
6	Tangwanichagapong et al. (2017)	**King Mongkut's University of Technology Thonburi** Implemented "no plastic foam for food" initiative on the campus in 2005 and promotes the use of personal reusable mugs and tumblers under its waste management policy.
		Thammasat University Established a ***recyclable waste bank*** and launched ***waste separation campaigns*** under its sustainable university action plan in 2014-2017 Thammasat.
		Mahidol University Declared its ***3R policy*** to reduce plastic bag use; and implemented a tumbler project that encourages the use of personal beverage containers for discounted merchandize and a ***waste segregation project.***
		Chulalongkorn University Initiated a styrofoam food-packaging reduction initiative and established a ***central waste management recycling center*** to promote waste separation as part of their green university policy in 2011.

Table 6. Result of Practices and Implementation of Waste Management in HEI

Practices/ Implementation of Waste Management in HEIs	UMK Green Campus Initiatives 2021	UTM Sustainable Policy 2021	Bashir et al. (2020)	Jayaprakash & Jagadeesan (2020)	Uitm Sustainability Annual Report 2019	Tiew et al. (2019)	Ebrahimi et al. (2017)	Tangwanichagapong et al. (2017)	Shankar & Khandelwal (2017)	James Madison University 2017	Abdul Hamid et al. (2015)	Appalachian State University Office of Sustainability (2012)	The Sustainable Endowments Institute (2011)
Waste Segregation		√	√	√		√	√	√		√	√	√	√
3R Principles (Reduce, Reuse, Recycle)	√			√	√		√	√	√	√		√	√
Waste Recycle Centre	√	√		√		√	√	√		√		√	√

There are several attributes that have been derived from the list of practices and implementation of waste management in Table 6. Based on the literature, the attributes are waste segregation, 3R (reduces, reuse, recycle) principles and waste recycle center.

The Conceptual Framework Solid Waste Management in Higher Educational Institutions

Several essential attributes have been derived from the list of implementation and practices solid waste management in higher educational institutions (Table 6). The essential attributes that are most practices in higher educational institutions are waste segregation, 3R principles and waste recycle center. Hence the essential attributes of solid waste management practices in higher educational institutions are conceptualized into a conceptual diagram as shown in Figure 3.

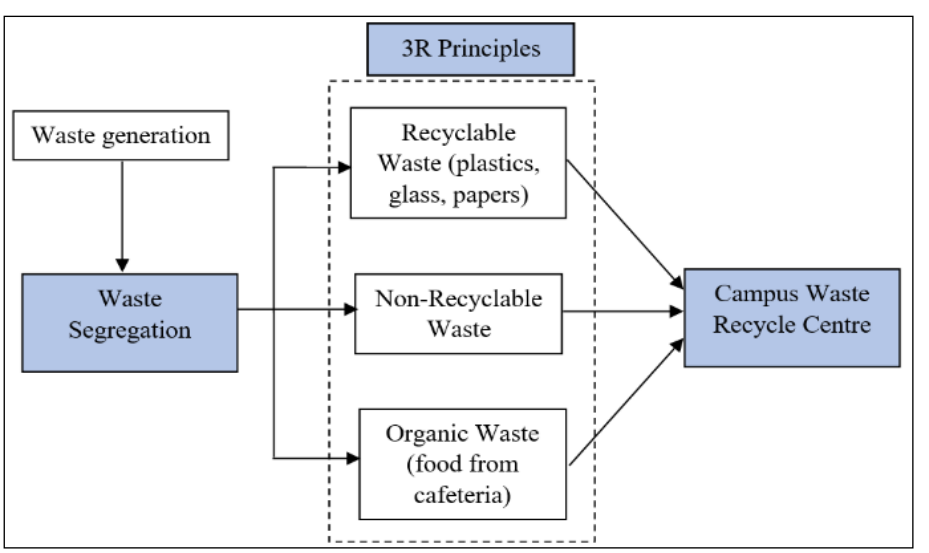


Figure 3. Conceptual Diagram of Implementation and Practices of Solid Waste Management in HEIs

Waste Segregation

Waste segregation is the sorting and separation of waste types to facilitate recycling and correct onward disposal. It reduces the amount of waste that reaches landfills, thereby taking up less space. Pollution of air and water can be considerably reduced when hazardous waste is separated and treated separately. It is essential that waste is put in separate bins so that it can be appropriately dealt with. The effectiveness of the on-campus waste management strategy would depend on source segregation, and this requires the cooperation of all stakeholders.

3R Principles (Reduce, Reuse and Recycle)

Reduce also known as waste prevention, means reducing waste at the source. It can take many different forms, including reusing or donating items, buying in bulk, reducing packaging, redesigning products, and reducing toxicity.

Reuse defined as re-employment of materials to be used in the same application or to be used in lower grade application. To reuse is to use an item more than once. This includes conventional reuse where the item is used again for the same function, and new-life reuse where it is used for a different function.

Recycle includes using waste material for another purpose, treating, and reusing it in the same process. Recycling is a series of activities that includes the collection of used, reused, or unused items that would otherwise be considered waste; sorting and processing the recyclable products into raw materials; and remanufacturing the recycled raw materials into new products.

There are some tips for effective practice of 3R's that highlighted by Sreenivasan et al. (2012) which are avoid purchasing items that are over packed, reduce the amount of waste created by the household by shopping smartly, reuse items around your home, recycle all paper, cardboard, rigid plastic, aluminium, steel cans and glass bottles and jars and compost the household's green and organic waste.

Hence, the most important factor to engage a Higher Educational Institutions community in 3R practices is continuous communication of 3R activities, along with information about waste management results and achievements. To cultivate a 3R culture in a society, it is important to train groups of people by creating an awareness programme towards implementing 3Rs initiative (Hashim, 2011).

Waste Recycle Centre

Educational institutions require services and infrastructure, including waste management at the scale of a small city (Tangwanichagapong et al., 2017). This is due to their large size, population and the complex activities that occur on campuses. To achieve the goal of campus sustainability, there is a need to build a recycling infrastructure and making it convenient for people to practice waste segregation. Creating a waste recycling center on campus not only contributes to sustainability but also fosters a sense of environmental responsibility among

students, staff, and visitors. It can be a valuable educational tool and a positive step towards reducing the campus's carbon footprint.

CONCLUSION

This study concludes a framework based on previous researcher on the best practices adopted in waste management for higher educational institution that focus on waste segregation, 3R principle and campus waste recycle centre. It is recommended that the universities should pursue proper waste segregation methods, consider efficient collection and transport of waste, as well as resource recovery, and safe disposal (Soni et al., 2016). The proper management of solid waste in HEIs will not only create awareness among students and employees but also help improve work efficiency by improving hygienic conditions at workplaces through the reduction of waste handling. To achieve best solid waste management practice in the educational institutions, Dahlawi & Sharkawy (2020) recommended to adopt environmentally friendly approaches especially for paper and food wastes. This should include a clear policy for resource recovery by implementing sustainable waste management approaches. Therefore, waste management in the HEIs should not be considered a problem but should be seen as an opportunity.

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AN EMPIRICAL STUDY ON THE CURRENT IMPLEMENTATION OF INNOVATIVE TECHNOLOGIES IN THE MALAYSIAN CONSTRUCTION INDUSTRY - A PILOT STUDY

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Abstract
Around the world, Innovative Technologies have appeared as key contributors in improving productivity quality and safety in Construction, including Malaysia. Innovative technologies or Construction 4.0 technologies have already been in the construction industry for quite a while and innovative technologies are on different levels of maturity. Technologies such as BIM, Cloud Computing, and Modularisation have developed significantly while other technologies such as Augmented, Virtual and Mixed Reality are still being enhanced. Unlike other industries, despite the acknowledged benefits, the construction industry has been slow and is still slow in implementing innovative technologies and has certainly never undergone a major transformation. Consequently, productivity of construction industry has stagnated over the last 40 years, or in some cases, even declined, although innovative technologies are and will eventually transform the Construction Industry. In addition, the present unexpected COVID-19 pandemic has been an eye-opener to the construction industry on how technologies can support construction companies to survive during this pandemic. Thus, the researchers piloted a study to examine the current implementation of innovative technologies with a small sample of decision makers of construction organisations within the Malaysian context before proceeding with the main data collection with a larger sampling size. Findings indicate that the current implementation of innovative technologies in the Malaysia Construction Industry is still low. Pilot study findings also suggest that Clients/Government need to change the norm of continuous search for the lowest price to award projects that limits creativity and critical thinking, to promote the use of innovative technologies. Even though Modular & Prefabrication and BIM technologies have been in the industry for quite some time now and reached the maturity level, the statistic shows the opposite trend. It can be concluded that the Malaysian Construction Industry has yet to stretch out and comprehend the opportunity of the innovative technologies implementation.

Keywords: *Innovative technologies; Emerging Technologies; decision making; decision-making model; technology adoption; Construction 4.0; Construction Industry*

INTRODUCTION

The construction sector is considered as a backbone of the economic growth of any country; therefore, it influences every sector's role on all levels in an economy (Musarat et al., 2020; Muller et al., 2020; Alaloul et al., 2021). Overall, the construction sector accounts for USD 1.7 trillion worldwide, and in most countries, it impacts 5–7% of the total GDP (Kenny, 2007; Alaloul et al., 2021). However, according to World Economic Forum report in 2018, unlike other industries, the construction sector has certainly never undergone a major transformation and productivity of construction industry has stagnated over the last 40 years, or in some cases, even declined. The empirical analysis of Malaysia statistical data between 1970 and 2011 found significant positive correlation between construction productivity and economic fluctuations in the 1985-1998 and 1998-2009 construction cycles. Construction labour productivity between 1970-2011 was stagnant (0.00%). Recently, the Department of Statistics (2020/2021) reported that, the minimum growth of overall GDP was recorded in

quarter (Q)1'2019 at just RM 341.6 billion as compared to the maximum of RM 370.1 billion in Q4'2019. The percentage change shows a maximum growth of the Malaysian economy in Q3'2017, while from Q1'2016 to Q3'2019, there was not such a significant change in the percentage of overall GDP. However, a considerable fall in GDP production in Q1'2020 and Q2'2020 occurred because of the lockdown situation due to COVID-19, with a reduction of 17.1% in Q2'2020, whereas in Q3'2020, a reduction percentage was recorded as being 2.7%. It is undeniable evidence that even before COVID-19, the Construction Industry's performance had been dissatisfactory compared with other industries (Mckinsey & Company, 2020). The current COVID-19 pandemic makes it even worse for the Construction Industry.

Latham (1994) showed a link between productivity, cost, and technology through to economic growth. Discussion on Economic growth through increasing productivity has been going around for instance, in Australia, it is believed that a 10% efficiency increase in the construction industry productivity would in turn increase the economy's gross domestic product (GDP) by over 2.5% (ICCPM, 2014). Similarly, in New Zealand, 1% increase in sector productivity would generate an increase in GDP of around $139m annually (PWC, 2016). If construction productivity were to catch up with the total economy, the industry's value added could rise by $1.6 trillion a year (Mckinsey Global Institute, 2017). Nonetheless, the construction industry is associated with issues ranging from the more common problems, such as delays and cost overruns, to more inter-connected and complex, such as conflicts, safety, client satisfaction, quality, value for money and many more (Riazi et al., 2020) that wedged the industry's productivity. The Malaysian construction industry is facing various problems, like shortages of manpower, environment solutions, quality of the work, and a dearth of productivity, which have raised many challenges (Kamar et al., 2010; Alaloul et al., 2021). Approximately 17.3% of contract projects from the Malaysian government in 2005 experienced delay and some were abandoned (Tahir et al., 2018; Wee et al., 2022). One of the contributing factors that hinders the performance of the construction Industry in Malaysia is the conventional construction approach (Alaloul et al., 2021) or inadequate adoption of modern technologies and practices (CIDB, 2017). Likewise, Chowdhury et al., (2019) stated that one way of improving productivity is through the use of innovative technologies. Thus, increasing the use of innovative technologies would mean increasing the industry's productivity and subsequently the nation's gross domestic product (GDP).

Studies on integration of IR4.0 technologies into Construction Industry has been gaining much attention all over the world and the interest in Industry 4.0 and Construction 4.0 has grown in recent years (Müller et al., 2018). In recent years, these technologies have gradually entered many fields of the construction industry (Bilal et al., 2016; Ma et al., 2019) to support efficient design optimization, performance evaluation, resource management, risk monitoring, energy saving, emissions reduction, and project delivery. Unfortunately, although there is an awareness of the acknowledged benefits that could transform the Construction Industry, numerous previous researchers all around the world for the past 7 years suggested that construction industry is still in a nascent stage and lag behind other industrial sectors and far reaching the whole construction industry (Oesterreich & Teuteberg, 2016; Protchenko et al., 2018; Alaloul et al., 2019; Maskuriy et al., 2019; Hwang et al., 2022).

Eventually, the unexpected COVID-19 pandemic has been a major turning point in the adoption and implementation of innovative technologies in the construction industry as part of its survival plan during this pandemic. In the case of Malaysia, the Malaysian Construction

Industry Development Board (CIDB) has recently launched the Construction 4.0 Strategic Plan (2021–2025), the aim is to embrace the Fourth Industrial Revolution (IR 4.0) in ways that would transform its productivity and competitiveness by accelerating technological advancement in the Construction Industry. The recent introduction of Construction 4.0 Strategic Plan 2021–2025 was specifically created to accelerate the application of innovative technologies by focusing on Strategic Plan that is separated into four strategic thrusts, which has replaced the previous Construction Industry Transformation Plan 2016–2020. They are Capacity Building, Excellence in Research, Innovation, Commercialization and Entrepreneurship (RICE), Smart Integrated Technologies, Innovation and Infrastructure, and Enhanced Business Environment.

Previous studies also have been limited in their focus on a single technology case or individual technology such as building information modelling (BIM) (Lee et al., 2020), Automation & robotics (Cai et al., 2020), Industrialised Building System (Subramaya et al., 2020), Big Data (Bilal et al., 2020), 3D printing (Hossain et al., 2020), RFID (Mabad et al., 2021), internet of things (IoT) (Gbadamosi et al., 2019) and etc rather than exploration on a holistic understanding of the new and emerging technologies that have had proven benefits for construction projects. Moreover, most studies that conducted in the local context, focusing on review of literatures without any empirical data provided to portray the current implementation of the innovative technologies in the Malaysian Construction Industry. In summary, not much specific research has documented the implementation of innovative technologies in the Malaysian construction projects. Therefore, this research aims to fill the gap by providing an empirical data on the implementation of Innovative Technologies among the Malaysian Construction organisations. The objectives are 1) to explore the current trend of construction innovative technologies implementation in Malaysia - to what extend has the Malaysian construction industry implemented innovative technologies, including how do the construction organisations perceived innovative technologies implementation in their construction projects and their intention to use those technologies in the future 2) to investigate the benefits/perceived benefits of the implementation in their construction projects.

This research will be important to academic researchers and construction organisations in Malaysia. It will help Construction organisations to understand the current scenario of innovative technologies implementation as well as the huge potential benefits of innovative technologies to the construction industry. Porta (2008) defined a pilot study; a small-scale test of the methods and procedures to be used on a larger scale. The advantage is that pilot study findings may offer some indication of the likely size of the response rate in the main survey, however, it should be recognised pilot studies may also have a limitation as other issues may not become obvious until the larger scale study is conducted.

REVIEW OF LITERATURE ON RELATED WORKS

As the fourth wave of technological advancements, known as Industry Revolution 4.0 (IR 4.0), continues to evolve, it becomes imperative for construction organisations to adopt and implement innovative technologies to remain competitive – much like the Darwinian mantra, the companies must adapt or die (El Jazzar et al., 2020). This statement is supported by Lau et al. (2019) in previous research that the one who refused to keep up with the rapid changes in the present technology will be eliminated and left behind. Although the construction

industry is often labelled as conservative regarding potential advancements in technology, it has been experiencing a growing use of a wide range of 4.0 technologies (El Jazzar et al., 2020). Yet, the construction industry is considered as a latecomer in this revolution and has yet to fully realize the benefit of it, even though this sector provides a significant contribution to the country's GDP (Lau et al., 2019).

According to the Handbook of research on technologies for improving the 21st-century workforce, innovative technologies are defined as technologies that are either newly invented or are being utilized in new ways. Innovative technologies discussed in this research are based on research by Forcael et al. (2020), CIDB Malaysia (2020), Maskuriy et al. (2019) and Oesterreich & Teuteberg (2016). They are Modularisation and Prefabrication (M&P), Building Information Modelling (BIM), Automation and Robotics (A&R), Cloud Computing (CC) – Equipment/material connectivity tracking, Internet of Things (IoT) – Mobile Technology, platforms, Virtual Reality/Augmented Reality (VR/AR), Big Data (BD) – Integrated real-time data and analysis, and reporting, Additive Manufacturing (AM) – 3D printing/ Laser Scanning /Photogrammetry, Human-Computer/Robot Interaction (HCI/HRI), RFID and Simulation and Algorithm (S&A) – Drone. The identified innovative technologies are then divided into 3 main clusters namely Smart Factory Cluster (C1), Simulation and modelling Cluster (C2), and Digitisation and Virtualisation Cluster (C3). Based on the previous review of recent studies, many innovative technologies could be applied throughout the construction stages such as Modular Construction, Prefabrication, BIM, RFID, Robotic and Automation, Simulation technologies (Drone), VR/AR.

Rapid growth of demand in exploiting technology is globally identified (Shibeika and Harty, 2016), as challenges with productivity, cost and quality achievement are endemic in the building industry (Li et al., 2014). Schoenborn (2012) linked these challenges with a slow uptake of new technologies. Globally, the industry has lagged behind most other industries in technology adoption and implementation (Stewart et al., 2004; Construction Industry Institute, 2008; Hooper and Haris, 2010; Sepasgozar et al., 2016; Oesterrich & Teuteberg., 2016; Sepasgozar et al., 2018; Lau et al., 2019; Chowdury et al., 2019; Alaloul et al., 2020; Wyk et al., 2021; Hwang et al., 2022) and construction is recognized as a rather lowtechnology sector (Noktehdan et al., 2015; Alaloul, 2020) despite the benefits they have to offer – increase productivity, reduce dependency on foreign labours, increase effectiveness and efficiency, reduce risk, enhance safety & health, save time, improve quality and cost saving (Sepasgozar et al., 2018; Aripin et al., 2019; Nnaji et al., 2020).

Based on the result from review of literatures carried out using Scopus and WOS search engines, most of the research papers contributed by the authors in the United States of America (USA), Australia, United Kingdom, China, Hong Kong, Finland, India, Netherlands, Singapore, and Taiwan. For instance, Nnaji et al. (2019) studied influential predictors of safety technologies in construction in the USA, while Sepasgozar et al. (2015) studied on technology adoption in construction focusing on the vendor-customer relationship in Australia. Chen et al. (2021) undertaken a systematic review on the implementation of technologies in the construction industry. Few studies focused on the Asian countries were identified among others, Hwang et al. (2022) addressed the challenges and strategies for the adoption of smart technologies in the Singaporean Construction Industry, whereas Wong et al. (2015) performed a study on a vision of the future construction industry of Hong Kong that presents state-of-the-art of technologies adopted in the Hong Kong construction industry

and highlights the challenges ahead of driving innovations in the industry. Amid these Asian-based studies, Malaysian authors such as Maskuriy et al. (2019), Alaloul et al. (2020) and Aripin et al. (2019) reported that past studies of this subject matter in Malaysia was inadequate. Those authors produced review papers instead of an empirical study. Maskuriy et al. (2019) stated that findings show a clear, active, and unfinished discussion about Industry 4.0 in the construction industry. This review demonstrates the lack of a complete understanding on what Industry 4.0 entails for the construction industry as the number of original papers are limited.

In 2016, KPMG International carried out a Global Construction Survey on technology to enhance project performance in the USA. Results indicated that a sizeable minority (42%) use drones to monitor construction status, one third (30%) use robotics or automated technology, 65% use remote monitoring on sites, 30% use RFID to track equipment and materials on site, only 7% use smart sensors to track people on site and 61% use BIM on majority of their projects. (Respondents = 218 Senior Executives, 119 from major project owners, 99 from a range of engineering and construction companies). The study concluded many firms have yet to reach out and grasp the opportunity. Driven by the pressure to improve productivity, reduce costs, improve safety, and increase sustainability, there is growing momentum to introduce new technologies into the construction industry (Loosemore, 2014; Sepasgozar et al., 2020). Yet, up to this point, empirical research undertaken to examine the current state of Construction 4.0 Innovative Technologies implementation among the Malaysian Construction Organisations is very limited. Nowotarski & Paslawski (2017) in their studies noted that the interest in this research areas is growing steadily from 2015 for construction industry. The current study also shows a vital theoretical contribution to the sympathetic of IR 4.0 influence and challenges in the construction industry. The construction industry is on the border of an innovative industrial era (Alaloul et al., 2018). Therefore, there is a need to investigate to what extend has the Malaysian construction organisations implemented innovative technologies by conducting a pilot study to start with.

Looking at the significant amount of existing literatures on IR4.0 technologies or innovative technologies integration in construction, it is clear that we are lacking of empirical studies pertaining to innovative technologies adoption and implementation in the construction industry (Oesterrich & Teuteberg, 2016; Wee et al., 2022) as such most of the existing literature was conducted in the form of desktop study (e.g. Dallasega et al., 2018; Wu et al., 2016) instead of research-based study. The present state of research calls upon more empirical research so as to acquire a more reliable data and result especially within the Malaysian context. This highlights that future studies in Malaysian construction industry are necessary to provide construction stakeholders sufficient information on the benefits using innovative technologies into construction industry and to promote the implementation of innovative technologies as they are very useful for all type of small- and large-scale construction projects. (MIG, 2018).

Finally, due to the limited scope of the study, the most prominent countries promoting advancement in Construction 4.0 were identified, but considerations about the local contexts were not included in the study. More research is deemed necessary to clarify how Construction 4.0 is being implemented in each country considering also the local regulatory framework and the practices of the construction industry.

METHODOLOGY

In achieving the objectives of this study, a quantitative in the form of questionnaire survey was utilised. The data was collected by distributing the online questionnaires created by Google Survey Form within September 2022 to January 2023. The purposive sampling technique was employed for this study. William, Barry & Mitch (2013) opined the sample size for pilot study should be between 25–100 subjects. Thus, 100 sets of questionnaires were distributed to the targeted respondents. In return, 31 respondents responded. This figure constitutes 31% of overall response rate. This low response rate was mainly due to the nature of the survey and the unit of analysis. Still, this response rate is acceptable according to past researchers. In the research by Carter et al. (2004), the overall response rate for online surveys was 32.6%, while for paper surveys it was 33.3%.

In the same way, Akintoye et al. (2003) and Dulaimi et al. (2022) argued that survey response for the construction industry is usually within the range of 20–30 %. Hence, the response rate in this study is justified and acceptable. The target population for the study was decision makers of construction organisations in Malaysia namely real estate as well as property developers, G6 and G7 contracting firms registered under Construction Industry Development Board (CIDB). A questionnaire survey was deemed the most appropriate to this study in order to achieve the research objectives which required the collection of responses on perceptions, knowledge and experiences of respondents regarding the implementation of innovative technologies in construction and benefits out of the implementation. It was built in a form of closed-ended questions by using five-point Likert scale viz-a-viz: strongly disagree = 1; disagree = 2; neutral = 3; agree = 4 and strongly agree = 5. Likert scale rating system has been successfully utilized by several researchers in their studies, such as Mhando et al. (2017). The questions are set out for the respondents to circle the possible answer which best resembled their opinion. According to Groves (2011), a survey with closed-ended questions is convenient to obtain feedback from a large number of people and ease the researcher with the process to analyse the statistic as compared to the open-ended question which offers the respondents to provide their own answer without having a limitation in giving their information, in closed-ended question is comprehensive and exclusive as the respondents are only required to find one best answer based on the choices given in the range from “strongly agree” to “strongly disagree”.

A pre-test is carried out on eight (8) experts in the research field for face and content validity. Changes are made according to expert recommendations and suggestions. Finally, a pilot survey was conducted to determine the face and construct validity. In this study, the questionnaire consists of three (3) main sections only: Section A, B and C. Section A describes the respondents’ demographic profile, which made it possible to define the types of organisation, working experience, designation, projects’ involvement and also organisations’ annual revenue; Section B resides overviews on the current implementation of innovative technologies in Malaysian Construction Industry and finally, Section C depicts the perceived benefits in implementing of innovative technologies in the construction industry.

RESULTS AND DISCUSSION

Descriptive Analysis

The distribution of the respondents is as follows, Project Managers (32%), General Managers (19%), Construction Managers (16%) and Senior Managers (Project) (13%), Technical Director (3%), Chief Executive Officer (3%), Chief Operating Officer (3%), Director (3%), Technology Manager (3%) and Associate Project Architect (3%). Almost half of the respondents have more than 20 years of experience in the construction industry (14%), followed by those having 11-15 years of experience (10%). The number of employees ranges between 101 to more than 1,000 people. The respondents' involvement ranged from civil & infrastructure works, residential, commercial, highways, marine, and industrial projects.

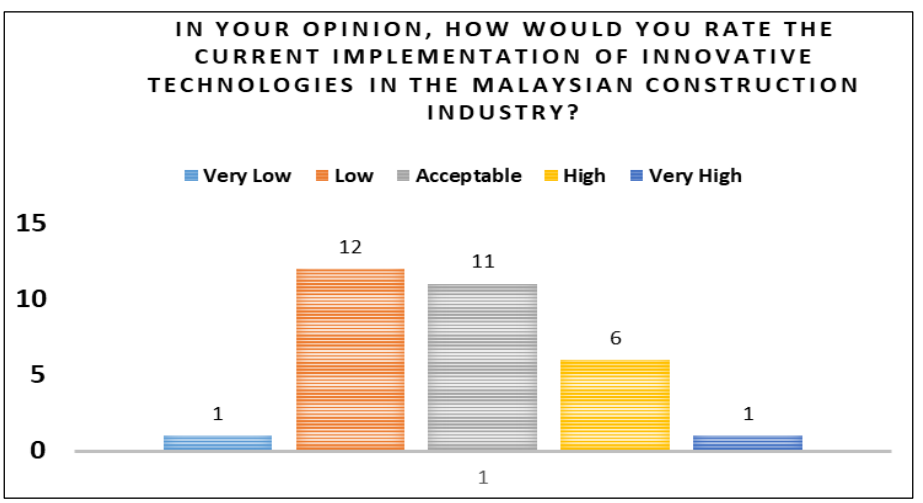

Figure 1. Current Implementation of Construction Innovative Technologies

The respondents were asked on the current implementation of innovative technologies in the Malaysian Construction Industry and majority of the respondents (39%) rated the current implementation as low (refer Figure 1). This result is parallel with the existing literatures and past research in the other countries affirming that the Construction Industry is mainly a technology laggard as compared to the other industries such as manufacturing and services.

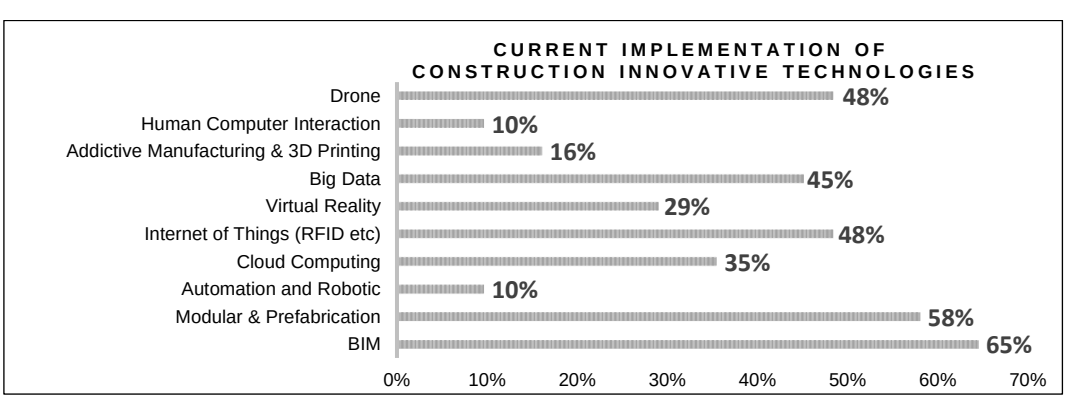

Figure 2. Distribution of The Current Implementation by Technologies

In terms of the current implementation of innovative technologies in the Malaysian Construction Industry, survey data shows that 58% use modular & prefabrication in their projects, 65% use BIM in the majority of their projects, 48% use drones to monitor their construction projects, 35% use cloud computing, 45% use big data, 16% use Addictive manufacturing (AM) and 3D printing, only 10% use automated or robotics, 29% use virtual reality to foresee their ongoing projects' status and only 48% use internet of things to monitor their construction sites or to track equipment and materials on site. Identically, Maskuriy et al. (2019) and Forcael et al. (2020) in the previous research mentioned that essential technologies to understand Construction 4.0 at present time: Computer-aided design technologies (BIM), 3D printing, Big Data, Virtual and augmented reality, Internet of Things, and Robotics. BIM is regarded as the most implemented innovative technologies in the Malaysian Construction Industry parallel to Dodge Data & Analytic report in 2020, Building information modelling (BIM) has become the most commonly used technology in the construction industry. 73% of United States contractors utilizing BIM, with 79% of those using it on more than 30% of their projects. In addition, Dodge's report also obviously shows that prefabrication and modular construction are providing significant improvements and efficiencies and charting a new course in our industry. This is not surprising as BIM technologies and Modular & Prefabrication have been in the industry for quite some time now and reached the maturity level. However, in Malaysia, even Modular & Prefabrication as well BIM topped the list, the figure is not something to be proud of as, the statistic shows the only 58% use modular & prefabrication and 65% use BIM in their construction projects. It can be concluded that the Malaysian Construction Industry has yet to stretch out and comprehend the opportunity of the innovative technologies implementation.

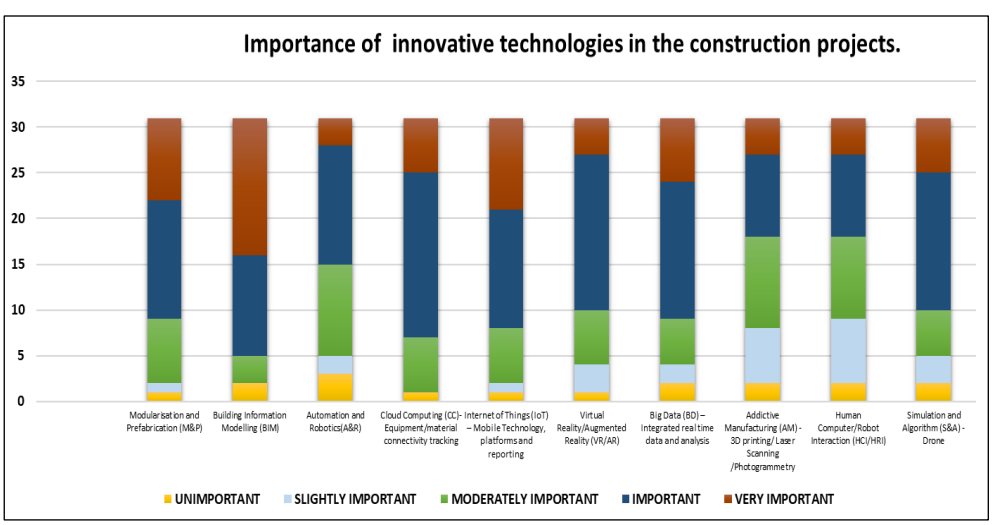

Figure 3. The Importance of Innovative Technologies Implementation in Construction Projects

Table 1 and Figure 3 above show the innovative technologies implementation that perceived as important in the construction projects by the respondents based on the median value. The result point out these technologies scored the median of 4 – BIM (mean value = 4.19), Internet of things-IoT (mean value = 3.97), Modular & prefabrication (mean value = 3.90), Cloud computing (mean value = 3.90), Big Data (mean value = 3.74), Virtual & Augmented reality (mean value = 3.65), and Simulation & Algorithm (mean value = 3.65) perceive as important, whereas Automation & robotics, Addictive Manufacturing and Human

Computer/Robot Interaction perceive as moderately important scored median value of 3 in their construction projects. This could be due to innovative technologies' different levels of maturity as Maskuriy et al. (2019) stated that innovative technologies or Construction 4.0 technologies have already been in the construction industry for quite a while and innovative technologies are on different levels of maturity. Technologies such as BIM, Cloud Computing, and Modularisation have developed significantly while other technologies such as 3D printing, Robotics, Augmented, Virtual and Mixed Reality are still being enhanced therefore the awareness on these technologies is still ambiguous. Whilst the use of BIM technology represents one of the most progressive approaches in construction projects (Mesaros et al., 2022).

Table 1. The Innovative Technologies Perceived as Important in Their Construction Projects by Construction Organisations

ITEM	INNOVATIVE TECHNOLOGIES	Median	Mean	Std Deviation
1	Modularisation and Prefabrication (M&P)	4	3.9032	.97826
2	Building Information Modelling (BIM)	4	4.1935	1.07763
3	Automation and Robotics(A&R)	3	3.3548	1.08162
4	Cloud Computing (CC)- Equipment/material connectivity tracking	4	3.9032	.83086
5	Internet of Things (IoT) – Mobile Technology, platforms, and reporting	4	3.9677	.98265
6	Virtual Reality/Augmented Reality (VR/AR)	4	3.6452	.95038
7	Big Data (BD) – Integrated real time data and analysis	4	3.7419	1.09446
8	Addictive Manufacturing (AM) -3D printing/ Laser Scanning /Photogrammetry	3	3.2258	1.11683
9	Human Computer/Robot Interaction (HCI/HRI)	3	3.1935	1.13782
10	Simulation and Algorithm (S&A) - Drone	4	3.6452	1.11201

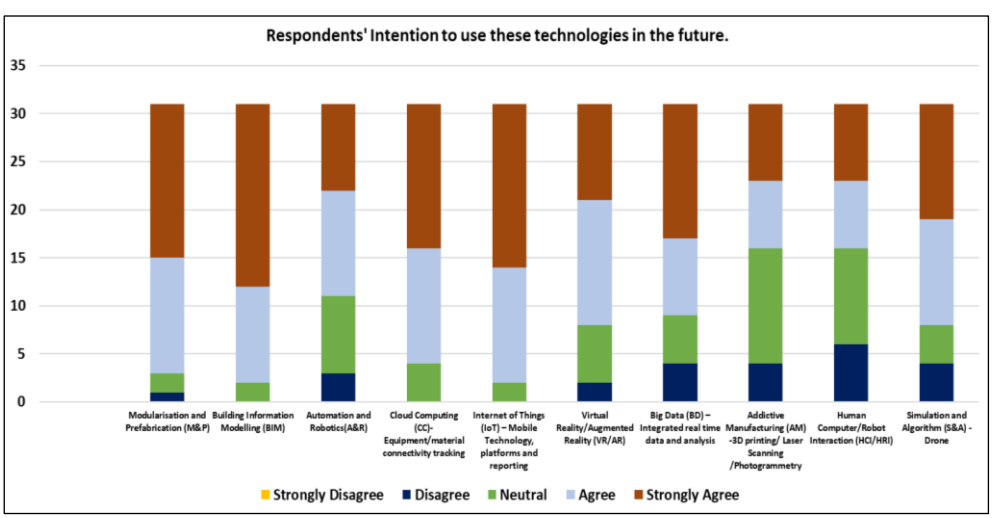

Figure 4. Future Intention of Innovative Technologies Implementation in Construction Projects

Captivatingly, the respondents have the intention to use all the technologies perceived as important in the previous section in the future. However, they are undecided (neutral) on those robotics-related technologies they rated as moderately important previously due to the current setting where most of the activities are in research level and very limited real-world implementation as mentioned by Krishnakumari et al. (2022). Some of the real-world implementation could only be seen specifically in Japan (dam construction) and Netherland

(3D printed bridge construction). This finding also reflects on the lack of exposure and knowledge of the Malaysian construction industry on certain innovative technologies. As a matter of fact, as reported in Bernama news, 3D construction printer had just arrived in Malaysia in September 2021, and Sarawak Consolidated Industries Bhd (SCIB) is working together with CIDB to carry out research and development (R&D) in the area of establishing standards and regulations for 3D printing buildings or structures in the country. It is predicted that the statistical data on the importance and future intention to use these technologies possibly different after introduction, roadshow, and promotion on these technologies by the regulatory body were done.

Table 2. Future Intention of Innovative Technologies Implementation in Construction Projects by Construction Organisations

ITEM	INNOVATIVE TECHNOLOGIES	Median	Mean	Std Deviation
1	Modularisation and Prefabrication (M&P)	4	4.3871	.76059
2	Building Information Modelling (BIM)	4	4.5484	.62390
3	Automation and Robotics(A&R)	3	3.8387	.96943
4	Cloud Computing (CC)- Equipment/material connectivity tracking	4	4.3548	.70938
5	Internet of Things (IoT) – Mobile Technology, platforms, and reporting	4	4.4839	.62562
6	Virtual Reality/Augmented Reality (VR/AR)	4	4.0000	.89443
7	Big Data (BD) – Integrated real time data and analysis	4	4.0323	1.07963
8	Addictive Manufacturing (AM) -3D printing/ Laser Scanning /Photogrammetry	3	3.6129	1.02233
9	Human Computer/Robot Interaction (HCI/HRI)	3	3.5484	1.09053
10	Simulation and Algorithm (S&A) - Drone	4	4.0000	1.03280

Table 3 shows the innovative technologies implementation in construction projects from the perspective of construction organisations. The respondents agreed (median value of 4 out of 5) on all the benefits listed in statements 1 to 7. The results are parallel with past researchers' findings that innovative technologies implementation can increase construction industry's productivity, can help to reduce risk and enhance safety & health in construction projects, innovative technologies have more benefits more than disadvantages i.e. cost & time saving, the use of innovative technologies can improve the quality of construction projects, Innovative technologies can help in reducing strategic mistakes and assure clients' satisfaction, innovative technologies can reduce dependency on foreign labours and can increase the efficiency and effectiveness in construction projects as stated by Alaloul et al. (2020) that he implementation of IR 4.0 within the Construction Industry would drive the industry's performance to match with their industry counterparts such as the manufacturing and automotive industry. The respondents seem to be neutral on the threat that innovative technologies might replace workers and small contracting firms have short term contracts that do not require the use of innovative technologies. This could be due to innovative technologies are useful for all type of small- and large-scale construction projects. (MIG, 2018). The respondents also agreed that Innovative technologies are very heavily dependent on the use of and expanding of information technology across the construction industry. As we are concern, information technology is centred around innovative technologies thus without a good information technology, innovative technologies implementation cannot be realised. Lastly, all the respondents agreed that that Clients/Government need to change the norm of continuous search for the lowest price to award projects that limits creativity and critical thinking, to promote the use of innovative technologies. This finding is supported by

World Economic Forum (2016) suggested that the government needs to act, and it can influence the speed and direction of technology development and diffusion.

Table 3. Innovative Technologies Implementation in Construction Projects from The Perspective of Construction Organisations

ITEM	STATEMENTS	Median	Mean	Std Deviation
1	The use of Innovative technologies can increase Construction Industry Productivity.	4	4.387	0.558
2	The use of Innovative technologies has more benefits rather than disadvantages i.e., cost and time saving.	4	4.0968	1.07563
3	Innovative technologies could help to reduce risk and enhance safety & health i.e., robotics could decrease human need in high-risk activities and the incidence of trauma disorders in construction activities	4	3.8387	1.12833
4	The use of Innovative technologies can improve the quality of construction projects	4	3.9032	1.01176
5	Innovative technologies can assure Clients/end users satisfaction by reducing strategic mistakes	4	3.871	0.76341
6	The use of Innovative technologies can reduce dependency on foreign labours.	4	4.194	0.654
7	Innovative technologies implementation can increase efficiency and effectiveness in construction projects	4	3.871	0.84624
8	Clients/Government need to change the norm of continuous search for the lowest price to award projects that limits creativity and critical thinking, to promote the use of innovative technologies	4	4.0968	1.07563
9	Innovative technologies might replace workers and seen as a threat (fear of job loss)	3	3.1613	1.09839
10	Small size contracting firms have short term contracts that do not require the use of innovative technologies	3	3.2258	1.11683
11	Innovative technologies are very heavily dependent on the use of and expanding of information technology across the construction industry	4	3.871	0.84624

CONCLUSION

Generally, innovative technologies are likely to be plateful in increasing the construction industry's productivity as they are in other industries. The slow uptake of the use of innovative technologies in the construction industry needs to be accelerated as low productivity continues to be a major issue. Therefore, it is time to fill in the knowledge gap in the field of construction innovation by providing empirical data on innovative technologies implementation among construction organisations in Malaysia. This will create awareness on the current innovative technologies' implementation in construction projects by construction stakeholders thus the implementation can be expedited.

This empirical data of this pilot study results reveals that, the Malaysian construction industry is still at the low level in innovative technologies implementation. It can be concluded that even though certain innovative technologies such as Modular & Prefabrication and BIM technologies have been in the industry for quite some time now and reached the maturity level, the statistic shows the opposite trend. The Malaysian construction organisations perceived robotics-related technologies as moderately important and still being undecided or neutral about the future intention to use them due to the maturity of these technologies. To conclude, all benefits listed in the implementation perspectives by the

construction organisations are important based on their median values. Finally, Clients/Government need to change the norm of continuous search for the lowest price to award projects that limits creativity and critical thinking, to promote the use of innovative technologies. Innovative technologies have been associated with high cost upfront hence the way of doing things in awarding projects should be rethink to boost up the implementation of innovative technologies.

This pilot study set a significant foundation in Construction 4.0 topic specifically in the Malaysian Construction Industry, however, as this is a pilot study, in the future, a larger sample size is needed to generate more accurate results. This study anticipated to serve as a basis for construction industry stakeholders on technological adoption and implementation. It will also help to facilitate the use and stimulate higher implementation of innovative technologies. Future research will be focusing on triangulation in order to obtain a better and more comprehensive research output.

ACKNOWLEDGEMENT

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THE INFLUENCE OF PANDEMIC OUTBREAK TOWARDS EMPLOYABILITY OF FRESH GRADUATES IN MALAYSIAN CONSTRUCTION INDUSTRY

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Abstract

Employment helps the expansion of the world economy. Unfortunately, the COVID-19 pandemic has resulted in declining construction activities while the job market became limited. For graduates to seize job opportunities, it is important to understand the effects of the pandemic on the job market. Therefore, this study aims to analyse the influence of pandemic outbreak on the employability of fresh graduates in the Malaysian construction industry. Hence, the objectives of this research are to identify factors influencing the demand for fresh graduates and to suggest strategies in enhancing employability among fresh graduates in the Malaysian construction industry during the pandemic outbreak. The research methodology applied in this research was a quantitative method using a questionnaire survey. Furthermore, the respondents in this study were consultant firms. Upon completing the data collection, the data were analysed using Statistical Package for Social Sciences (SPSS) version 26.0. There were 217 sets of questionnaires distributed and 159 responses were received at 73%. The result obtained from the research study indicated that the factors influencing the demand for fresh graduates are graduate attributes, expectations of employers, employability skills and external factors. Meanwhile, the strategies of employability showed soft skills set, graduates attributes, and curriculum design as strategies to charm employers. By incorporating practical learning, working with industry partners, improving employability skills, and adjusting to shifting hiring preferences from the epidemic age, universities may better prepare graduates for the construction industry. Further study is to suggest the study on this topic by interviewing employers for more precise results.

Keywords: *Employability; Fresh Graduates; Influence; Pandemic Outbreak*

INTRODUCTION

As stated by an accounting organisation, the construction sector plays a prominent role in national economic growth from building and civil works since it generates job possibilities not only for the construction sector but also for other linked industries directly around the world, Klynveld Peat Marwick Geordeler India (KPMG) (2020). Other industries and subsectors, such as education, healthcare, mining, and tourism, rely on the construction industry to operate. Under the heading of civil works, the construction sector also creates highways to connect one location to another. Given that, roads make a massive contribution to economic development and growth through the transportation of services and products within the nation (Ke et al., 2020). As the Malaysian economy started to get better at the end of the 2010s from the financial crisis, the world was startled by the US-China Trade War. Abruptly, the outbreak of the COVID-19 pandemic has invisibly attacked the world, which causes many deaths until many countries implied a lockdown to break the chain of spreading this virus (Diop, 2020).

Although Malaysia was experiencing some pandemic events before this, such as the Swine Flu pandemic H1N1 virus (2009), the latest COVID-19 pandemic has killed many lives, and the statistics keep increasing day by day. The virus was detected in December 2019 in Wuhan and recorded 16,500 confirmed cases during the first month of the outbreak (Khan et al., 2020). The Prime Minister enforced the Movement Control Order (MCO) under the Prevention and Control of Infectious Diseases Act 1988 and the Police Act 1967 to control the spike of the Coronavirus in Malaysia on 16th March 2020. The MCO or lockdown prevents movement and mass assembly throughout Malaysia, including suspension of construction works. Along with this order, Gamuda reported that most of the construction works have been suspended in compliance with the order except for the project related to public concern (The Star, 2020).

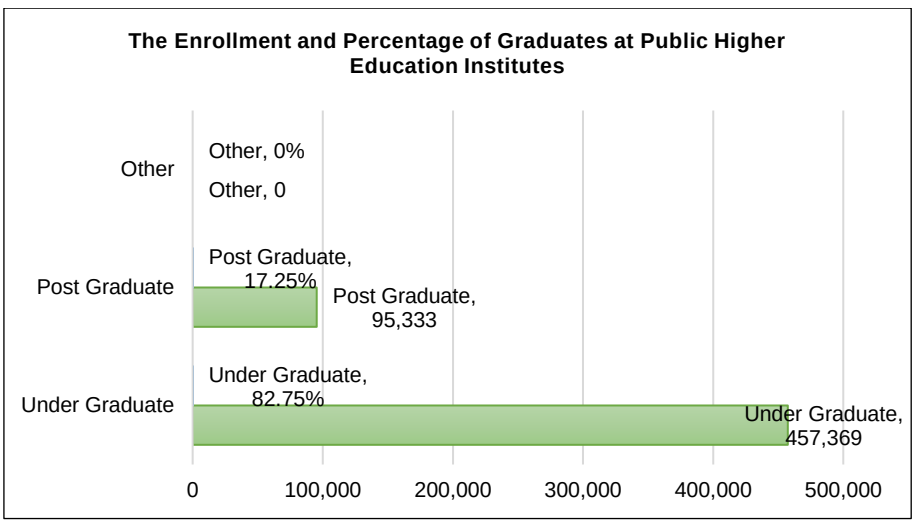
According to an employment analysis by the International Labour Organization (ILO) (2020), the corona virus's economic and labour crisis could raise global unemployment by nearly 25 million. The ILO also anticipated that underemployment and labour poverty would increase significantly due to reduced working hours and wages caused by the COVID-19 pandemic outbreak worldwide. In terms of unemployment, Bank Negara Malaysia (BNM) expects Malaysia's unemployment rate to be 4% from 3.3% in 2019 amid the COVID-19 virus outbreak (Lim, 2020). Additionally, Ismail (2020) affirmed that the Malaysian Institute of Economic Research (MIER) predicted the total Malaysian unemployment rate would be at 9.2% due to Covid-19 effects. The prediction is expected to get higher if the Covid-19 outbreaks rise worldwide.

Besides, the Academy of Sciences Malaysia found that fresh graduates' employability has been an unsolved issue in the labour market for years (Kamel, 2020). The unemployment of fresh graduates remains a headline in the local newspaper as New Straits Time (2020) reported the situation of unemployment among graduates as a university graduate no longer promising a job has become a matter of concern. Previously, research conducted in 2018 by the Graduate Tracer Study of the Malaysian Ministry of Education found that 60 per cent remain unemployed one year after graduation. As of 31st October 2019, the Ministry of Education Malaysia (2019) recorded 457,369 students' enrolment of undergraduate in public tertiary education.

With the pandemic's presence, the construction industry has to limit their activities, causing workers from professional to site labour and other related workers to lose their working routine in the industry. They need to adopt the new working normal, as the alternative for this new era (Buheji & Buheji, 2020; Friedman, 2020). The estimated unemployment rate is very worrying among fresh graduates and students about to graduate from construction-related programs, as there is no way construction can be done virtually. This is because some businesses have to restructure their workforce, which forces the retrenchment to survive in the new normal (Tay & Partners, 2020).

The engineering, manufacturing and construction field recorded 127,970 students' enrolment on 31st December 2019 in a statistic by the Ministry of Education Malaysia (2019). Due to this reason, the competition among fresh graduates to penetrate the job market is very high. Previous studies discussed the challenges of the construction industry without tackling the employment issue among graduates in the construction sector, especially in a pandemic

outbreak situation. A concise study should be conducted to discover the influence of pandemic outbreaks on the employability of fresh graduates in the Malaysian construction industry.



(Source: Ministry of Education Malaysia, 2019)

Figure 1. The Enrolment and Percentage of Graduates at Public Higher Education Institutes

This research aims to determine the influence of pandemic outbreaks on the employability of fresh graduates in the Malaysian construction industry from the consultant firms that are involved in both pre- and post-contract stages. The view from the consultant team can help the fresh graduates to prepare themselves in facing the uncertainty in the construction industry. Furthermore, the employability of fresh graduates indicates the effectiveness of the syllabus and study in the universities. Thus, it would help the universities in reviewing and improving their syllabus.

The ground of the research is to fulfil the research objectives:

1. To identify factors influencing the demand for fresh graduates in the Malaysian construction industry during the pandemic outbreak.
2. To suggest strategies in enhancing the employability among fresh graduates in the Malaysian construction industry during the pandemic outbreak.

Furthermore, Department of Statistics Malaysia (2020) recorded that the unemployment rate in Malaysia from January 2020 until March 2020 has shown a significant increase due to the COVID-19 situation in Malaysia. It is very worrying specifically for the fresh graduates. Although the employment issue is a huge topic in Malaysia, it is impossible to study all sectors due to the limitation of time and cost. Therefore, this research focuses on the employment of fresh graduates in the construction industry. The scope of this research is a specific consultant firm that involves during pre- and post-contract stages. Kamel (2020) stated that Selangor is the centre of economic activities and makes it the most suitable area for the study. Furthermore, Selangor also recorded the highest number of consultancy firms on the Treasury Malaysia website. Hence, this research is to be carried out in Selangor, Malaysia while the respondents are chosen within employers involved in the pre- and post-contract stages, which are architecture, civil engineering, and quantity surveying firms.

Hence, this study would show a firm understanding of the effects of the pandemic on the employability of fresh graduates in the Malaysian construction industry; the employers' perspective. This research also can be used as a basic guideline for fresh graduates to improve their performance to serve and stay employed in the industry regardless of economic condition and uncertainty of events while revealing the most affected profession in the pandemic.

LITERATURE REVIEW

Factor Influencing Demand for Fresh Graduates

Hossain et al. (2018) found that fresh graduates who do not fulfil the appropriate demand are likely to face unemployment due to the oversupply of graduates in the labour market. Additionally, in a professional career, the fulfilment of the expectations of the employers will positively represent the skills and abilities of graduates in the construction industry (Shayan et al., 2019). The employability competency that Buheji and Buheji (2020) stressed in COVID-19 focused on the readiness of universities to provide graduates that fulfil the future market demand. Besides, Kadir et al. (2020) described the failure of fulfilling the demand of industry caused job mismatch and unemployment among graduates. Therefore, in an unfortunate event such as a pandemic outbreak, expert workers are highly demanded to overcome many more issues related to the COVID-19 (Esa et al., 2020). Following are the factors influencing demand for fresh graduates:

Employer Expectation

Several authors have **recognized job-related knowledge and skills** as a factor influencing demand for fresh graduates. The construction industry may become a severe victim of the economy. However, the construction activities are likely not to stop despite the economic condition where the construction industry always welcomes skill shortages to join the construction industry to fulfil specialised needs (Haupt & Harinarian, 2016). Additionally, the labour market demands a graduate that has the desired working skills and knowledge to secure a job (Hossain et al., 2018; Harry et al., 2018). Therefore, skills and knowledge are important aspects during the COVID-19 crisis as firms tend to retrench the current work and some are not hiring at this moment (Kniffin et al., 2021).

Furthermore, Römgens et al. (2019) supported that human capital aspects such as specific expertise skills and knowledge have a positive insight into the labour market as they broaden the opportunities and career competencies in a professional occupation. In addition, Buheji and Buheji (2020) and Esa et al. (2020) mentioned that recruitment during COVID-19 focuses on employability competency which suits the specific skills and necessary behaviour needed in the industry. Although COVID-19 might reduce the opportunities of graduates in the labour market, Rahman et al. (2020) argued that fresh graduates must use their knowledge and skills to explore new jobs such as freelancers or other jobs.

Besides, factors such as **less demanding salaries** are also discussed by the latest research after the COVID-19 attacks. Kadir et al. (2020), Rahman et al. (2020), Esa et al. (2020) and Kniffin et al. (2021) agreed that graduates shall not be too demanding in the uncertainty of the economy due to the COVID-19 pandemic. Rahman et al. (2020) stated that, if the

graduates got the desired jobs, the firms might pay a lower salary due to the economic condition.

Although English proficiency during COVID-19 is not the main factor in securing a job, Farhadi et al. (2020) believed that graduates with better English could understand more technical terms. This is because the construction field usually uses English terms or English language as the means of interaction, especially for international projects.

Employability Skills

The literature review found that communication skills are equally important both before and after the COVID-19 crisis. This is because communication has a great contribution to understanding the technical work between the employee and employer in the construction industry (Tonnon et al., 2017; Römgens et al., 2019). In the meantime, communication skills became critical for continuity of communication during working in restriction situations and emergencies in COVID-19 situations (Buheji & Buheji, 2020). Kniffin et al. (2021) also supported that virtual communication is widely used in the construction industry as a communication platform during performing jobs.

Lastly, the least factor discussed in previous studies is problem-solving skills, achievement during the study, ability to learn from experience, practical experience obtained through the field of placement, ICT skills and soft skills. Buheji and Buheji (2020) proposed their competencies toolkit in the new normal where problem-solving skills are useful skills to adapt to the new normal.

Furthermore, the ability to apply skills and education will open more job opportunities (Farhadi et al., 2020). However, Kadir et al. (2020) argued that the qualification alone is unable to help fresh graduates securing a job, but additional skills such as communication skills and soft skills will help them compete in the labour market. It is supported by Rahman et al. (2020) that even with the right qualification, the graduates may not get the desired job during the COVID-19 pandemic. Rahman et al. (2020) kept mentioning that one could survive in this condition by participating in the training program to stand out among recruiters.

Graduate Attributes

Apart from that, only Shayan et al. (2019) and Hassan and Varshney (2019) realised the willingness to learn new skills as a factor influencing the graduates' employment before the COVID-19 pandemic. However, this is becoming a great concern after the pandemic attack. Farhadi et al. (2020) urged the graduates to learn new skills as an evolution to the current standard as they are highly demanded during the COVID-19 crisis. Buheji and Buheji (2020) also proposed the same solution to increase the competency of an employee in the new normal. Hence, graduates must be ready to learn whatever skills to cope with the constraint throughout a pandemic outbreak (Kniffin et al., 2021).

After that, previous studies discuss the attitude of graduates as one of the factors influencing the demand for fresh graduates. For sustainable employability in the construction industry, employers expect an employee who has a proactive attitude and is ready to share the responsibility in a firm (Tonnon et al., 2017). In a study by Shayan et al. (2019), they

mentioned that there was an expectation of higher line managers on professionals to upgrade the current practice whichever is suitable with their new roles and responsibilities in the Malaysian construction industry. On the other hand, Hassan and Varshney (2019) stated that graduates who are demanding a higher salary likely would not get a job due to the poor self-presentation while seeking a job.

External Factor

There have been stated in most of the studies found by the authors on the influence of economic conditions on the labour market. A study by Haupt and Harinarain (2017) mentioned that the construction industry is always afflicted by declining economic conditions resulting in lesser career opportunities. Furthermore, Hossain et al. (2018) in their study found that the market condition highly influenced the employment opportunities in Malaysia as the changes in labour market conditions causing uncertainty in the job market. Besides, it was previously reported that the labour market consistently looks for subject-specific expertise and skills before providing opportunities in each economic condition (Römgens et al., 2019; Shayan et al., 2019).

It was found that the curriculum syllabus was identified as one of the factors influencing the demand for fresh graduates. The previous research by Hossain et al. (2018) mentioned that the syllabus studied has a significant contribution to the unemployment rate among Malaysian fresh graduates. Concerning curriculum issues, Harry et al. (2018) reported that the designation of the curriculum in the universities could help them to market themselves in the labour market through their relevant skill studied in the degree program. Thus, Hassan and Varshney (2019) urged that higher educational institutions must update their syllabus to meet the requirements of the industry. While Farhadi et al. (2020) stated that many university students believed that university training is not aligned with the practices in the industry resulting in poor recruitment among graduates. Farhadi et al. (2020) also agreed that the current curriculum is outdated due to the lack of cooperation between industry and universities resulting in educational systems that are not updated based on the current technology.

Strategy in Securing Employability among Fresh Graduate in the Malaysian Construction Industry

After COVID-19, Hite, and McDonald (2020) asserted the turbulence of economic conditions might have reduced the employment chances but with the skills and positive attitudes, one might be able to get a job. The other researcher stated that the employment competency has changed as a result of the pandemic, but graduates can be ready with the job-related input, the transferable skills as employers prefer this kind of individual during recruitment (Buheji & Buheji, 2020). Rahman et al. (2020) pointed out that the graduates' unemployment during the COVID-19 outbreak can be reduced by equipping themselves with skills, knowledge, and persistence attitudes that are demanded now. Following are the strategy in securing employability among fresh graduate in the Malaysian construction industry:

Curriculum Design

In the case of a pandemic, Buheji and Buheji (2020) suggested that modification of the curriculum that focuses on specific assignments available will assist graduates to market themselves during emergencies. Due to this reason, Farhadi et al. (2020) revealed that the syllabus in higher education must be evaluated again to make sure it fits the demands. Additionally, Kadir et al. (2020) emphasised the importance of restructuring the educational system as they provide good attributes in intensifying the opportunities in future employment. Therefore, the educational system should be polished in preparing the quality graduates needed in the Malaysian construction industry (Moshood et al., 2020).

Not only that, but some works of literature also stressed designing a new curriculum that adapts pandemic situations as a strategy to enhance the quality of graduates during the pandemic outbreak. After that, Fraser et al. (2019) suggested fresh graduates mastering thinking skills as it reckons with the art of deciding by evaluating the problem and figure out the way out from a problem. Therefore, Abelha et al. (2020) and Buheji and Buheji (2020) stated that problem-solving skills are needed in facing challenges in the working environment during the declining stake of the economy due to COVID-19.

With the rising of employability issues during the virus pandemic, most of the literature supported that universities should improve their learning, teaching, and assessment projects to fit the current COVID-19 situation (Bahrim et al., 2019; Römgens et al., 2019; Abelha et al., 2020; Buheji & Buheji, 2020; Rahman et al., 2020; Farhadi et al., 2020; Moshood et al., 2020; Kadir et al., 2020). Besides, Römgens et al. (2019) stated that the quality of education is measured through the curriculum provided by the schools to amplify the students' employability. Meanwhile, Bahrim et al. (2019) mentioned that the government should focus on vocational education to lessen the skills mismatch in the Malaysian labour market as vocational education prepares their students for a working environment.

Soft Skills

Communication and teamwork skills are considered part of transversal skills stated by Abelha et al. (2020) to increase the competencies of graduates that simultaneously open up more employment chances. Fraser et al. (2019) stated that besides a positive attitude, communication skills and teamwork are strategies to enhance the employability skill where it contributes to a better relationship as both traits are connected. Apart from that, teamwork and communication are generic skills needed in enhancing networking in the workplace (Römgens et al., 2019). Hence, Kadir et al. (2020) explained that additional skills such as communication skills are part of employability skills needed towards employment security.

Move on to the next strategy, the graduates suggested enhancing networking for better career competencies. Networking is part of career competencies as the ability to expand the network gives an advantage to graduates to pave their way in career development (Römgens et al., 2019; Kamaruddin et al., 2020). Hite and McDonald (2020) also agreed that strong career networks are the strategy for a sustainable career during COVID-19.

Besides, innovation skills are also considered as strategies to enhance the employability of fresh graduates. A study by Fraser et al. (2019) mentioned that innovation happened due to the ability of graduates to solve a problem and the innovation happening during the process. The recent coronavirus outbreak has made many people aware of the importance of innovative approaches in the current curriculum setting to develop graduates' employability (Abelha et al., 2020). Therefore, competencies employability proposed by Buheji and Buheji (2020) stated that the intense innovative approach as a mechanism for better employment opportunities during the COVID-19 pandemic.

Then, entrepreneurship skills are considered the last choice to survive in unstable economic conditions as the employment chances are getting low. Fresh graduates are advised to generate their own business during the pandemic outbreak to avoid further unemployment (Rahman et al., 2020). The work-life balance for a healthy working environment is also suggested by previous literature, which is connected to the emotional intelligence skills in facing the problem (Römgens et al., 2019; Hite & McDonald, 2020). Lastly, Bahrim et al. (2019) and Hite and McDonald (2020) mentioned that the government should take action in enforcing training programs after graduates and reducing the retirement age as an initiative to minimize the rate of unemployment among graduates.

Besides, considering the COVID-19 situation, many researchers believe that emotional intelligence skills as an important aspect to help graduates survive in the pandemic era. Equipped with this trait, it is believed that graduates will be able to cope with the pressure of the work while maintaining their psychological health (Bahrim et al., 2019). Employers are expecting graduates to be mentally ready (Abelha et al., 2020). Therefore, Buheji and Buheji (2020) revealed that the emotional intelligence skills were previously ignored but are now considered as a great help to the organization where the team will look after their teammates to support them against burnout and overstress conditions.

Graduate Attribute

At the same time, graduates are expected to accept the challenges and find a way to recover from the weakness (Fraser et al., 2019). In the context of competency, Abelha et al. (2020) pointed out the readiness to work within a certain situation will improve the employability of graduates, but the job mismatch situation is getting severe. The adaptation and persistence traits among graduates are considered important during a pandemic outbreak (Hite & McDonald, 2020; Buheji & Buheji, 2020). Thus, the graduates are advised to adapt to the changes in the national situation with their positive attributes to secure some jobs during the pandemic outbreak (Kadir et al., 2020).

Proceed with the next strategy, the employers are expecting graduates to learn through training or indirectly willingly to fit in a company (Fraser et al., 2019; Hite & McDonald, 2020; Kamaruddin et al., 2020; Rahman et al., 2020). Fraser et al. (2019) defined willingness to learn as a graduate that is eager to improve his skills and ready to learn new tasks and information by asking for guidance from others. Besides, Hite and McDonald (2020) mentioned that innovation in the working process could be developed through direct or indirect training which is subject to sustainable employment.

In most of the research, it was found that graduates must be competent or in other words, they must meet the expectations of employers in terms of knowledge, skills, and attitudes as a strategy to combat unemployment issues among fresh graduates. Along with this suggestion, Bahrim et al. (2019) that graduates must improve their skills especially soft skills and communication skills as they are significant skills claimed by the occupation providers instead of focusing on only a good grade during the study to be competent. Fraser et al. (2019) in their study stated that the knowledge, skills, and attitudes must be parallel to create graduates that meet the industry standards.

RESEARCH METHODOLOGY

Instrument for Data Collection

Research methodology is a systematic process to solve a problem that arises in researching in achieving the research objective. This research adopted a quantitative data approach where the quantitative data collected became primary sources through using questionnaires survey. The questionnaire questions were built by a systematic literature review (SLR) to capture the scenario on employability of fresh graduates.

Table 1. Questionnaire's Structure

Research Objective	Variables	No. of Items	Total Frequency	Example
1) Factors	i. Employers' expectation	5	40	"I feel that fresh graduates must fulfil the demand of the construction industry"
	ii. Employability skills	7	37	"I believe that problem-solving skills are needed while working in a pandemic situation"
	iii. Graduates' attributes	4	20	"I feel that graduates should be able to adapt to the new normal"
	iv. External factors	4	15	"I feel that graduates from technical institutions are more exposed to the working environment"
2) Strategies	i. Curriculum design	2	12	"I believe that the new curriculum should implement uncertainty as preparation during a difficult time"
	ii. Soft skills	10	33	"I am expecting a graduate who possesses communication and language skills"
	iii. Graduates' attributes	6	32	"I feel that fresh graduates who have mental readiness can perform well"
	iv. Government initiative	1	2	Not applicable

The Systematic Literature Review (SLR) is applied in this research as a systematic process to collect, analyze, evaluate and synthesis the data. SLR was used to gain the literature on a major issue on the employability of fresh graduates. The research paper selected is in the last six years (2016-2021) and focuses on research papers published after the pandemic COVID-19 in relation to objective 1 and 2. The last step under SLR is arranging the data for the factors and strategies found in the literature and categorized them into several independent variables. The tabulated information is used as the basis for questionnaire questions as shown in Table 1.

The questionnaires cover; demographic information, factors, and strategies on employability of fresh graduates. All main scale items are based on a five-point Likert scale ranging from strongly disagree (1) to strongly agree (5) except demographic information.

Population and Sample

The overall population was chosen based on a consultant firm registered under the Ministry of Finance with a total of 1,451 registered architecture, civil engineering, and quantity surveying consultant firms in West Malaysia. These respondents must be people who are directly involved in construction projects respectively to their expertise. Although there are many consulting firms, only Selangor was chosen as Selangor recorded the highest number of consultant firms in Malaysia with a total of 511 consultant firms. According to Krejcie and Morgan (1970), the sample size for a population of 511 is 217 respondents. Therefore, 217 respondents were chosen among the employers for this research.

Analysis of Data

From the 217 sets of questionnaires distributed to the respondent, only 159 returns were received. Then, the process followed by assessing numerical data before analysing the data using SPSS version 26 from the respondents' responses. The descriptive statistics and tabulation analysis were used to connect the variables, and comparisons shall be made during the analysis process.

FINDINGS AND DISCUSSION

Analysis of Respondents

From the analyses, the number of male respondents is dominating this survey at (66.7%) while female respondents only (33.3%). This shows most of the employers in Selangor are male. However, the involvement of female employers is considered high. Next, the majority of employers held a bachelor's degree as their highest academic qualification followed by professional qualification (Ar, Ir or Sr) at (42.8%) and (41.5%) respectively. Besides, the analysis has also shown that 109 firms have been operating for more than 10 years in Selangor. Hence, they are familiar with the recruitment of fresh graduates. Furthermore, the respondent profile was starting with engineering firm at (39.0%), followed by quantity surveying firm at (34.6%) and lastly architectural firm at (26.4%). There were (21.4%) employers laid off their staff during this difficult time and only (29.6%) firms recruit new staff after MCO 1.0. (16.9%) respondents agreed that there were no changes in salary offered before and after MCO 1.0, which are (5.0%), both at RM 2001-RM 2500 and more than RM 3000 for fresh graduates.

Objective 1: Factors Influencing Demand for Fresh Graduates in The Malaysian Construction Industry during the Pandemic Outbreak

According to Table 2, the first category that was highly affected by the factor was 'Graduate attributes' (mean=4.52) which took the first rank under the factor section. This category achieved a 'strongly agree' level from the respondents. Furthermore, the second-ranked factor fell under 'Expectations of employers' (mean=4.40) followed by

'Employability skills' at the third rank (mean=4.38). The fourth category identified was 'External factors' (mean=4.14) that received the least positive responses. However, the overall view on factors displayed shows that the respondents acknowledge the factors listed above as the issue faced during the pandemic.

This research analysis and the significant factors agreed by respondents were graduate attributes whereby this factor attracts the job provider to recruit fresh graduates in the Malaysian construction industry during a pandemic outbreak. This finding is supported by Shayan et al. (2019) that the labour market consistently looks for subject-specific expertise and skills before providing opportunities despite changes in an economic climate such as the COVID-19 situation. Besides, Farhadi et al. (2020) in their study suggested that universities must interfere in planning a quality education to broaden the graduate's job opportunities in the construction industry even in worse economic conditions. Since the graduate attributes category is crucial during a pandemic, the employers have crowned this category as a 'highly agree' factor of demand for fresh graduates.

Table 2. Factor Influencing the Demand for Fresh Graduates

No.	Categories	Mean	Perception Level	Rank
A.	Expectations of employers	4.40	Agree	2
B.	Employability skills	4.38	Agree	3
C.	Graduate attributes	4.54	Strongly agree	1
D.	External factors	4.14	Agree	4

Expectations of employers took second place in the listed factors of demand for fresh graduate's categories identified in this research study. The employers were expecting fresh graduates equipped with the attributes concerning the new normal in the construction industry because of the pandemic attack. These findings are supported by several authors; Shayan et al. (2019), Buheji and Buheji (2020), Esa et al. (2020), Farhadi et al. (2020) and Kniffin et al. (2021) that employers always looking forward to seeing graduates with the skills that are still scarce in the industry. However, as expected, the employers assumed that graduates should be able to accept the lesser salary, especially in uncertain economic conditions. Aligned with the discovery by Rahman et al. (2020) that graduates shall not be too demanding in the uncertainty of the economy and be ready to apply for the lower job that might not match their qualifications.

Besides, the third-place vote fell under the employability skills category in this research study. The employability skills have been classified with the related skills in the construction industry and the new normal practices. The study has found that technical skills, communication skills, and problem-solving skills as the important skills needed while working in a pandemic situation as overall those items received only a slight difference mean scale from 4.47, 4.38, and 4.35 respectively. Esa et al. (2020) and Kadir et al. (2020) highlighted that employers need workers with specific skills to overcome COVID-19 related issues that supported these findings. However, contradicting a study by Rahman et al. (2020) discovered that even with the right qualification and skills, graduates might be unemployed in the current pandemic situation.

Lastly, external factors were found to be the weakest factor contributing to the employment of fresh graduates in the Malaysian construction industry. The external factors category focused on the opinion of employers on the universities' initiatives. They agreed with the topic stated but the type of institution did not affect the recruiters enlisting fresh graduates as much as syllabus and practical training. Therefore, Farhadi et al. (2020) stressed that university subjects have a significant impact on the ability of graduates in exercising the new normal work.

Generally, overall results show it is valuable for educational institutions and job seekers in understanding the perceptions and priorities related to graduate employment. In summary, fresh graduates should focus on developing the right attributes and skills, understanding employer expectations, and tailoring their job search and application strategies accordingly. Flexibility, continuous learning, and adaptability are key as the job market evolves, and employers seek well-rounded candidates who can contribute effectively to their organizations.

Objective 2: Strategies in Enhancing Employability among Fresh Graduates in The Malaysian Construction Industry During the Pandemic Outbreak

According to Table 3, 'Soft skills set' (mean=4.40) took the first rank among other categories. Meanwhile, 'Graduate attributes' (mean=4.36) category became the second choice of the respondent with a slight difference in mean score recorded. Lastly, the least vote category was 'Curriculum Design' at a mean score of 4.09. Overall, the strategies provided were applicable during the pandemic outbreak from the view of employers.

Table 3. Strategies for Enhancing Employability Among Fresh Graduates

No.	Categories	Mean	Perception Level	Rank
A.	Expectations of employers	4.40	Agree	2
B.	Employability skills	4.38	Agree	3
C.	Graduate attributes	4.54	Strongly agree	1
D.	External factors	4.14	Agree	4

The first-ranked strategies category recorded was the soft skills set which have received the highest vote. Indeed, soft skill is a crucial strategy whereby 'In my opinion, teamwork value is very important for a sustainable career' earned the most voted variable placed under 'strongly agree' perception level in this research study. The other items listed under the soft skills set also obtained positive feedback from the respondents. This research divided the soft skills elements into eight related statements that highly corporate skills are needed by fresh graduates. The top three soft skills set found were teamwork, critical thinking, and communication skills. These findings are supported by Fraser et al. (2019), Römgens et al. (2019), Abelha et al. (2020) and Kadir et al. (2020). These authors lined out that teamwork and communication skills are the transverse skills that increase the competencies of graduates that simultaneously allow more employment chances.

Proceed with the second-ranked strategies category found was graduate attributes as the next impeccable suggestions category in enhancing the employability among fresh graduates in the Malaysian construction industry during the pandemic outbreak. The study found that most of the respondents agreed with the variables stated which include the willingness to learn, undergo training, and have a mental readiness mindset as strategies to get employment

during the hardest time. From these findings, several researchers; Fraser et al. (2019), Hite and McDonald (2020), Kamaruddin et al. (2020) and Rahman et al. (2020) agreed that willingness to learn from the bottom and ready to learn through training or indirectly practical training in the office were desirable as they can fit the demand of employers. Meanwhile, Römgens et al. (2019) and Abelha et al. (2020) stated that the employers also expected graduates to be mentally ready as it promotes positive emotions against mental breakdown in the uncertainty of the economy.

Next, curriculum design also has been determined as strategies that contributed to the employability of fresh graduates in the Malaysian construction industry. This research study found that 'I am confident that graduates can perform better if they apply the knowledge learned' as the most voted statement under curriculum design. This shows how the way of learning influences the ready-to-work graduates in Malaysia. It can be through the new curriculum design that is more suitable to the current situation such as the COVID-19 situation or a learning scheme that teaches the student to handle difficult times. It is aligned with the finding by Buheji and Buheji (2020) and Kadir et al. (2020) suggested that modification of the curriculum that focuses on specific assignments would assist graduates in paving some way during emergencies through subjects, skills, and moral approaches.

Generally, educational institutions can enhance graduate readiness for the construction industry by integrating practical exercises and industry-specific scenarios into curricula. Collaboration with industry representatives, feedback mechanisms, and internships align education with employer expectations. Developing employability skills through experiential learning, group projects, and industry partnerships is crucial. Graduates and institutions must stay informed about external factors like industry trends and regional demands, fostering adaptability. Coordinated efforts between educational institutions, graduates, and industry stakeholders are essential to translating these concepts into actionable strategies. This approach can better position graduates for success in the construction field.

CONCLUSIONS

In summary, knowing the requirement of employers after completing a bachelor's degree study is one of many approaches to improve employability among fresh graduates during a pandemic epidemic. However, there are a number of factors that influence fresh graduate employment in the Malaysian construction business. Fresh graduates, on the other hand, are seen to be able to break into the labour market with the correct techniques. On the basis of the research objectives, the entire analysis and results were summarised. Graduate attributes are ranked first among the elements provided under Objective 1, indicating that the way graduates prepare themselves to participate in the labour market has a beneficial impact on their employability. The findings are slightly contradicted with Rahman et al. (2020) said that due of the COVID-19 epidemic, even graduates with specific talents may face unemployment. Nonetheless, the overall results are supported by Shayan et al. (2019), Buheji and Buheji (2020), Esa et al. (2020), Farhadi et al. (2020) and Kniffin et al. (2021). This research analysis also revealed that soft skills are critical skills among fresh graduates to secure a job right after graduation under Objective 2. The result was consistent with the previous study, as mentioned by Fraser et al. (2019), Römgens et al. (2019), Abelha et al. (2020), Kadir et al. (2020) and Yaakob et al. (2023), soft skills effectively increase the competencies of graduates to allow more employment opportunities. The overall benefits of this research have received positive

feedback, with the majority of respondents agreeing with the fresh graduate employability methods stated in this study. It may be inferred that graduate attributes, employer expectations, employability skills, and external factors all influence the demand for new graduates. Meanwhile, strategies in enhancing employability among fresh graduates are soft skills set, graduate attributes, and curriculum design accordingly.

With the results obtained in this study, the fresh graduates can comprehend the new normal hiring preferences among employers while establishing strategies to stay employed during the pandemic season as the study has given a clear picture of the upcoming challenges in the job market. Further research is suggested to study the influence of pandemic outbreaks on the employability of fresh graduates by interviewing employers to get a more precise perception.

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CRITICAL CHALLENGES TOWARDS EFFECTUATING SUSTAINABLE CONSTRUCTION: A SYSTEMATIC REVIEW

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Abstract
Green building construction can be influenced by various factors such as the type of buildings constructed, materials used and the energy efficiency of their operation. In Malaysia, the Green Building Index (GBI) is a rating system that aims to promote energy efficiency. Sustainable construction in building development has been shown to have a clear positive impact on the environment, as it has also been highlighted as the current trend in environmental protection. However, some problems that occur are discouraging the contractors from implementing sustainable construction in their projects. Therefore, this paper aims to identify the critical challenges in effectuating sustainable construction among contractors in Malaysia. The literature findings reveal that there are nine (9) challenges which are identified as the main contributing factors which hinder the implementation of sustainable construction. The findings can serve as added value to the existing practice, which has previously been more concerned with matters pertaining to design and benefit. Thus, this research will also help to improve the current local sustainable construction practice, especially in ensuring that the contractors are being exposed to the advantages and incentives given to sustainable construction practices in the country.

Keywords: *Challenges; Critical Challenges; Contractors; Sustainable; Sustainable Construction*

INTRODUCTION

The concept of sustainable development has been introduced by the Malaysian government since 1996 after realizing that problems caused by pollution have spread all over the country. Few campaigns have been introduced such as 'Love Our Rivers' (Cintailah Sungai Kita) and 'Recycle' (Kempen Kitar Semula). Most of these campaigns focus on the natural resources such as rivers, forests and air quality that are connected to environmental sustainability. Sustainable development is a simple idea to ensure a better quality of life for everyone, now and for generations to come. It also means that such development aims to achieve social, economic and environmental objectives at the same time (Esa, 2018; Fahimnia et al., 2015; Yee et al., 2020). Although sustainable development has been the 'buzzword' since the 1980s, the concept is not new for Malaysia because it has been applied in Malaysian Development Plan since the 1970s. The concern for sustainable development has been echoed by the subsequent five years plans. How the construction industry is developed, planned, designed, constructed, and used will largely determine humans' quality of life. A well planned and designed built environment will consider the natural environment and validate it as intrinsically important and necessary to people's well-being.

However, the green movement in Malaysia is still in its infancy. Sustainable projects are mostly at the pioneer stage (Zainul Abidin, 2010). Moreover, there are several challenges in adopting technologies in the Malaysian construction industry (Sim & Putuhena, 2015). The cost is the main priority of sustainable development (Lim, 2015). The construction companies

will face the problem of higher initial cost and obstacles to find material that fulfils the green criteria or sustainable construction. According to Lim (2015), the government is concerned about sustainable construction in Malaysia, therefore it has been promoting sustainability initiatives since 2000. Meanwhile, according to Sim and Putuhena (2015), the Association of Consulting Engineers Malaysia (ACEM), and Pertubuhan Arkitek Malaysia (PAM) have also developed Green Building Index (GBI) to promote sustainability in built environment.

Of all these initiatives, there is still lack of incentives given. This is because the incentive that the government provides do not attract the construction practitioners to develop sustainable buildings. Chan et al. (2014), stated that when the government and private sector share the same concern and goal, Malaysian construction industry may be progressive and become more sustainable. This shows that both private and governments need to cooperate to adopt green technology in construction industry. Furthermore, there is also lack of understanding, awareness, and application about sustainable construction concepts in the construction industry (Lim, 2015). Therefore, the construction practitioners need to attend seminars independently, either local or international, which discuss to the importance to sustain the environment, economy and social well-being for the future generations especially in promoting the sustainable construction concepts to the contractors.

Hence, this study aims to identify the critical challenges in effectuating sustainable construction among contractors in Malaysia. Findings of this research are presented to achieve the objective as well as provide added value to existing practice, which has previously been more concerned with the aspects of design and benefit (Rosman et al., 2022). To achieve this aim, previous studies on sustainable construction criteria, and their relation to the critical challenges towards effectuating sustainable construction, have been explored in both local and international contexts.

OVERVIEW OF SUSTAINABLE CONSTRUCTION

Sustainable development has been promoted to the Malaysian manufacturing sector since the beginning of the Ninth Malaysia Plan 2006-2010 (Hsu et al., 2013). However, the willingness of construction stakeholders to implement green practices is not as positive as it was initially thought (Zailani et al., 2015). Green initiatives have long been introduced to the local construction industry, but there are still small number of construction projects and completed buildings which adopt green practices in their operation (Liu et al., 2012). Zainul Abidin (2009) stated that sustainable construction dubbed ‘green construction’ explains the responsibility of the construction industry in achieving sustainability. The term sustainability has been adopted as an effective remedy for developmental change. The concepts of sustainability must be applied into the construction industry to influence the way a project is to be carried out to achieve a balance between preserving the environment and maintaining prosperity in development.

Sustainability is a new concept in developing countries, including Malaysia. Most of the industry stakeholders such as contractors and developers do not understand the benefits of implementing sustainable construction. Hence, the implementation in the sustainable building remains limited. According to Zainul Abidin (2009), the criteria of sustainability in building and construction were focused on issues such as limited resources in particular energy and on method to minimise the impacts of development on the natural environment which emphasis

on technological issues such as materials, building components, construction technology and design principles which are related to energy. The criteria of sustainable construction govern three main pillars namely environmental protection, social well-being, and economic prosperity.

Sustainable Construction Criteria

Green Building Index (GBI) is developed by Pertubuhan Arkitek Malaysia (PAM) and the Association of Consulting Engineers Malaysia (ACEM). This association is an initiative to lead the construction industry towards environment-friendly concepts. Sustainable buildings are designed to reduce the negative impacts on the environment while increasing the occupant's health by forwarding these five categories: sustainable site planning, safeguarding water and water efficiency, energy efficiency, conservation and the reuse of materials and improved health and indoor environmental quality. According to Mohd Shafiei et al. (2013), the GBI is where a rating system is applicable for all buildings. There are six criteria rated by GBI for a certified green building which are:

i. Energy efficiency
ii. Indoor environmental quality
iii. Sustainable site planning and management
iv. Material and resources
v. Water efficiency
vi. Innovation

Energy Efficiency

Energy efficiency covers the way building design deals with the distribution of energy and its consumption. According to Shafii and Othman (2007), as result of growing energy cost and global warming both the private and governmental sectors in Malaysia show an increase in the recognition of energy efficiency as an element of sustainability. Next, energy efficiency improves and reduces energy consumption adhering to the criteria of Green Building Index (GBI). For example, GBI dictates that buildings used active and passive designs such as solar photovoltaic system, high energy efficiency lights, LED lights, or natural skylights, Variable Refrigerant Flow (VRF) system, Chilled Water storage (CWS) system, Variable Air volume (VAV), proper placement of windows, the use of architectural features like atrium, applying appropriate insulation and high-performance, as well as Low-E windows (Azmi et al., 2021).

Indoor Environmental Quality (IEQ)

Good indoor environmental quality plays an important role in the guidance for Green Building Index (GBI). Indoor Environmental Quality (IEQ) is a critical component of people's health and well-being, particularly in schools, where vulnerable sections of the population spend a significant amount of time (Karapetsis & Alexandri, 2016). Better indoor environmental quality can improve tenants' lifestyles, raise the property's market value, and minimise liability for building owners. By doing this, we can reduce energy expenditure and decrease carbon footprint. Passive design features for instance building orientation, double

skin envelope, sun-shading device, large overhang can be observed to create a good indoor environmental quality of a building (Azmi et al., 2021).

Material and Resources

Material and resources in the criteria of green building means to encourages the use of environment-friendly products produce from renewable resources, as well as recycling. According to Nizarudin et al. (2010), this includes implementing the appropriate construction waste management by storing recyclables, collecting them, and reusing building formwork and trash. Hence, by reusing and recycling existing materials, it may avoid the need to manufacture new ones and lowering carbon emissions as well. According to Khaderi and Yub (2021), each organization's purpose may consider purchasing materials from the green supplier that include environmental measures, such as using recycled material, using eco-labelling products, ensuring suppliers' environmental compliance certification, as well as conducting auditing for suppliers' internal environmental management.

Sustainable Site Planning and Management

According to Green Building Index (2023), selecting suitable locations involve factors such as planned public transit, community services, open spaces, and landscaping. By redeveloping existing lands, developers can avoid and save environmentally sensitive regions. Implementing adequate construction management, storm water management, and lowering the load on existing infrastructure capacity are all important considerations. Storm water management is necessary to have an ecological construction site (Chau et al., 2014). Besides, blending open space design with vegetation, and implementing rooftop landscaped garden in a building can reduce its negative impact. This design element must be planned at the early stage of the project, as improper landscape design can have significant negative effects such as excessive potable water use and erosion (Azmi et al., 2021).

Water Efficiency

Water efficiency refers to employing water-recycling technologies and installing water-saving fittings in the building's pipes to avoid excessive water waste. It also covers techniques such as rainwater collecting and used water waste filtering. When compared to pumping new water, recycling water uses less energy. Furthermore, using water efficiently will help ensure reliable water supplies today and for future generations. Water efficiency is significant to a green building since it helps lessen the amount of potable water consumed in buildings. Yudelson (2008), suggested reducing the use of potable water on the site that is unnecessary and wasteful, while optimising water recycling and reuse, including harvested rainwater and storm water. This is in line with the United Nations Sustainable Development Goals (SDGs) 2030 target, which is to ensure access to clean water and sanitation for all can be achieved. In addition, Azmi et al. (2021) addresses the application of greywater treatment system, and the installation of low flow fixtures at toilets and ablution area can also be effective to achieve water-efficient-building.

Innovation

Innovative design is one of the requirements which is needed to adhere the criteria of Green Building Index (GBI). Innovation functions as the medium to create a sustainable building. It would be a motivator for individuals and professionals to use a sustainable approach during the construction process and in their everyday lives (Wan Zin et al., 2012). The examples of innovation for sustainable construction are bamboo reinforced concrete, LED lighting, and breath block. Meanwhile, some building may adopt Building Automation System (BAS), Automated Fire Fighting System, Intelligent Building Management System and Energy Management System (EMS) to optimise the building performances by reducing energy cost (Azmi et al., 2021).

Challenges Towards Effectuating Sustainable Construction

Various research has proven the benefits of implementing green building approach. Such benefits include the reduction of GHG emissions, and enhancement of occupants' health and productivity (Darko & Chan, 2016; World Green Building Council, 2019). However, some people may relate green building as a developmental approach that leads to high construction cost. As a result, many are reluctant to invest in green building. The key to moving forward in going green is to address all challenging and all parties, including the government, owners, designers and contractors would need to embrace the concept to make it works.

Hence, this section highlights the challenges derived from previous researchers regarding the implementation of sustainable construction. It was found that many studies were conducted to identify sustainable construction implementation issues such as the design approach, benefits, characteristics, and installation requirements, in both local and international contexts. However, only a few studies have focussed on the sustainable construction, particularly in Malaysia. By exploring and understanding the viewpoints of past studies, the challenges in effectuating sustainable construction can be ascertained, and better result will be attained. Therefore, this paper is addressed as an exploratory step and initial identification in assessing the significant challenges towards effectuating sustainable construction that can be used in this study.

A study carried out by Ahmad Zaini and Endut (2018), pointed out factors such as limited support and incentives from the government, lack of regulation from the relevant authority, high initial cost, demand of green building which is considered new in Malaysia, and contractor's lack of knowledge as the challenges in implementing sustainable construction. Meanwhile, Jacob and Patrik (2023), highlighted challenges namely high initial cost, require more time and cost investment, unqualified construction practitioners, contractor's lack of knowledge and unfamiliarity with the performance technologies in the study. In addition, Hwang et al. (2017) emphasize the challenges of high initial cost and the unfamiliarity with the performance technologies for sustainable construction.

Other than that, Marsh et al. (2020), stress more on limited support and incentives from government, lack of regulation from the government, contractor's lack of knowledge, and the challenges which come from being unfamiliar with the performance technologies for sustainable construction. Meanwhile, a study by Mohd Nordin et al. (2017), analyses the challenges of limited support and incentives from the government, high initial cost, lack of

awareness, demand of green building which is considered new in Malaysia, and contractor's lack of knowledge as the main challenges in implementing sustainable construction. Another research underlines the challenges of high initial cost, lack of awareness, demand of green building, which is considered new in Malaysia, contractor's lack of knowledge, and the unfamiliarity with the performance technologies for sustainable construction (Elias & Lin, 2015).

Moreover, Yee et al. (2020), discuss the challenges of limited support and incentives from the government, lack of regulation from the authority, lack of awareness, demand of green building is considered new in Malaysia, and contractor's lack of knowledge in the study. Meanwhile, unqualified construction practitioners in sustainable construction is the factor mentioned by Chau et al. (2014). According to Wong et al. (2021), a research analyses leads to the findings that the challenges are high initial cost, lack of awareness and demand of green building is considered new in Malaysia. Lastly, Ershadi et al. (2021), emphasize on the challenges of limited support and incentives from the government, lack of regulation by the relevant authority and unqualified construction practitioners.

Based on the above literature, the findings are further compiled and summarised, as shown in Table 1 and 2. Table 1 listed nine (9) challenges and descriptions, as indicated by abbreviations. These challenges are deemed to be the significant factors or critical challenges that should be highlighted and given attention to in the sustainable construction practices.

Table 1. Abbreviation and Description of Challenges Towards Effectuating Sustainable Construction

Abbreviation	Challenges in Effectuating Sustainable Construction
A	Limited support and incentives from the government
B	Lack of regulation by the relevant authority
C	High initial cost
D	Require more time and cost investment
E	Lack of awareness
F	Demand of green building is considered new in Malaysia
G	Unqualified construction practitioners
H	Contractor's lack of knowledge
I	Unfamiliarity with the performance technologies

From the description of the challenges and their abbreviations, Table 2 gives a summary of previous research that concern the challenges in effectuating sustainable construction.

Table 2. Summary of Challenges Towards Effectuating Sustainable Construction

Sources	Challenges in Effectuating Sustainable Construction								
	A	B	C	D	E	F	G	H	I
Ahmad Zaini & Endut, 2018	Ö	Ö	Ö			Ö		Ö	
Jacob & Patrik, 2023			Ö	Ö			Ö	Ö	Ö
Hwang et al., 2017			Ö						Ö
Marsh et al., 2020	Ö	Ö						Ö	Ö
Mohd Nordin et al., 2017	Ö		Ö		Ö	Ö		Ö	
Elias & Lin, 2015			Ö		Ö	Ö		Ö	Ö
Yee et al., 2020	Ö	Ö			Ö			Ö	Ö
Chau et al., 2014							Ö		
Wong et al., 2021			Ö		Ö	Ö		Ö	
Ershadi et al., 2021	Ö	Ö					Ö		

Both compilations address the challenges in effectuating sustainable construction in both international and local contexts. The compilation is highlighted as an initial identification of the critical challenges towards effectuating sustainable construction in Malaysia.

METHODS

The study was conducted through an extensive analysis of the literature on sustainable construction and the challenges towards effectuating sustainable construction. The resources for the study were mostly journal articles, conference proceedings, and existing guidelines from leading databases such as Scopus, Web of Science, Taylor & Francis, Google Scholar, and Academic Search Premier. These were mainly drawn from the period 2014 to 2023 to ensure only the most up-to-date data on sustainable construction were used. They were compiled from both international and local contexts since research which are conducted in Malaysia regarding this field is rather limited. The article search was then limited to the challenges in effectuating sustainable construction in the global and Malaysian contexts. Based on the review of the current scenario and existing literature, the challenges towards effectuating sustainable construction were then analysed. The four most frequently described challenges by previous studies, based on the reviewed articles were chosen as the critical challenges in effectuating sustainable construction for this study, from both international and local sources.

DISCUSSION OF THE FINDINGS

Based on the analytical review of the literature, it was found that the results had several similarities with the challenges found in previous studies. It was also found that one challenge was closely related to the other. Therefore, based on the preliminary findings, the researcher decided to use the common challenges based on the mode or frequency values identified in the previous studies in identifying the critical challenges towards effectuating sustainable construction in Malaysia as tabulated in Table 3 below.

Table 3. Rank of Identified Challenges Towards Effectuating Sustainable Construction

No.	Challenges in Effectuating Sustainable Construction	Frequency	Rank
1.	Limited support and incentives from the government	5	3
2.	Lack of regulation by relevant authority	4	5
3.	High initial cost	6	2
4.	Require more time and cost investment	1	9
5.	Lack of awareness	4	6
6.	Demand of green building is considered new in Malaysia	4	7
7.	Unqualified construction practitioners	3	8
8.	Contractor's lack of knowledge	7	1
9.	Unfamiliarity with the performance technologies	5	4

From the findings, it is significant that out of the 9 listed challenges, 4 were most referred to in the reviewed articles and they comprised the critical challenges towards effectuating sustainable construction. These were:

i. Contractor's lack of knowledge
ii. High initial cost
iii. Limited support and incentives from the government
iv. Unfamiliarity with the performance technologies

Contractor's Lack of Knowledge

According to Ahmad Zaini and Endut (2018), stated that the challenges in effectuating green building are mainly the lack of knowledge and expertise from the contractors. This statement is also supported by Goh et al. (2013), who stated that most parties in the construction sectors have no expertise in sustainable housing. Therefore, the contractors need to be prepared with the current knowledge regarding green construction, especially on the method and technology used in green construction. Meanwhile, the green building business is too risky, as Malaysia lacks expertise in green building (Elias & Lin, 2015). Mohd Nordin et al. (2017), has also agreed with the statement that the challenge in implementing green building is lack of knowledge among the stakeholders. This happened because the stakeholders were not aware of the importance of sustainable development towards the country.

High Initial Cost

The implementation of sustainable design and construction in the built environment also has its own challenges and barriers. Many challenges and barriers have been described in the literature since mitigating them can encourage sustainable practices in the built environment. Based on the literature, one of the main challenges is cost. This is because sustainable buildings require high initial construction cost compared to conventional buildings. Another challenge is the widespread perception that sustainable buildings are higher in cost than the marketplace is willing to pay. Hayles and Kooloos (2008), described that 'the barriers to developers choosing high performance buildings centre on the perception of higher first-dollar costs, and that the maker is not willing to pay them; furthermore, there are no reliable cost models to assist developers to understand the true costs and benefits of high-performance buildings.' It is also identified that the most serious challenges in sustainable design and construction were the lack of expressed interest from clients, including owners and developers. These challenges correlate with the high initial cost of a sustainable building and the lack of knowledge related to the benefits of sustainable design and construction. This is in contrast with Rosman et al. (2022), who stated that sustainable construction in economic aspect should bring cost savings as the building are appropriately planned and designed in sustainable way consequently decreasing environmental damage costs.

Limited Support and Incentives from Government

The government should play a significant role to implement green developments in Malaysia. According to Yee et al. (2020), the government's lack of concern for this issue and failure to lead the green building market by providing financial assistance or incentives discourages the development of green building technology in the country. due to the lack support and incentives, the developer of green building will not thrive. Ahmad Zaini and Endut (2018) and Goh et al. (2013), also agreed that lack of government support is one of the major challenges in implementing sustainable construction. The government should provide incentives to the public to support the development of green building. Lack of incentives from the government has resulted in the lack of government support in this matter.

Unfamiliar with the Performance Technologies

According to the Hwang and Tan (2012), green technologies has posed a certain challenge to the construction practitioners. Due to the lack of products, materials and technologies, the performance in construction will be below the par. Furthermore, the material cost for green development is higher than the material cost for conventional development. The green technologies also require complicated techniques and construction development. Implementing green building is very challenging as the stakeholders are unfamiliar with the performance of sustainable technologies used, and this factor is supported by Hwang and Tan (2012) in their studies. Moreover, the materials and technologies are limited because Malaysia is still new at this green construction concept. Therefore, there are some unknown obstacles towards green building concepts and its materials and technologies. This creates the barriers in sustainable development efforts (Yee et al., 2020). Hence, Rosman et al. (2022), stated that it is the government's responsibility to promote sustainable development technologies, since there is a lack of strategy to increase such development.

CONCLUSION

The outcome of this study has focused on the sustainable construction in identifying the critical challenges that need to be overcome towards effectuating sustainable construction in Malaysia. These are considered appropriate and significant in the context of sustainable construction in Malaysia. It is a positive starting point for those construction firms that wish to practice or are already practicing green to minimize the pollution to the environmental impacts while increasing their organizations' performances by referring to and studying this study. Inevitably, the challenges should be well acknowledged by the practitioners before sustainable construction is implemented.

To conclude, the construction industry in Malaysia is facing the same main challenges found in other countries which is the high initial cost. However, there are still other obstacles such as contractor's lack of knowledge in green concepts and practices, limited support and incentives from the government, and the unfamiliarity with the performance technologies related to sustainable construction (Hwang et al., 2017; Lim, 2015). These should be overcome by related parties to increase the implementation and adoption of sustainable construction in Malaysian construction industry. A future study path will outline the initiatives and strategic ways as an improvement for the current sustainable construction practice in Malaysia.

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EXPLORING THE CRITICAL SUCCESS FACTORS OF VALUE MANAGEMENT FOR SUSTAINABLE PUBLIC HOUSING IN MALAYSIA: FINDINGS FROM A PRELIMINARY STUDY

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Abstract
Housing is becoming a global issue in urban development, particularly housing shortages for the urban poor in developing countries. The Malaysian government knows the situation and builds low-cost housing, particularly for the urban poor. However, many issues and problems arise when it comes to the sustainability of the houses. In the National Housing Policy (NHP) 2018-2025, the Ministry of Housing and Local Government recently emphasised the importance of housing quality and sustainable enhancement. The sustainability factor will significantly increase the value of construction projects, particularly public housing projects. As a result, value management (VM) is one of the most effective tools for ensuring public housing's sustainable success. Despite establishing the framework for integration, the possibility of such integration within the Malaysian VM protocol for public housing projects remained unclear. Thus, this paper aims to contribute to a better and more comprehensive understanding of VM's critical success factors (CSFs) for public housing projects. A systematic literature review was conducted to understand the key topics better, and the findings were validated using a qualitative method involving semi-structured interviews with three personnel from a VM consultant in Malaysia. Previous studies provided the CSFs for VM, which were then contextually adjusted based on the semi-structured interviews. As a result, stakeholders & knowledge, effective workshops and culture & environment play a significant role in CSFs implementation VM. The findings outlined in this paper could be vital for the future framework of VM that can act as drivers to provide sustainable public housing. The framework could also guide decision-makers looking to maximise value for money and improve sustainability in Malaysian public housing projects.

Keywords: *Sustainability; Value Management; Public Housing Projects*

INTRODUCTION

Housing is an essential need in daily life. People have been migrating from villages and small towns to ever-expanding cities worldwide due to better-paying jobs in urban areas (Construction Industry Development Board [CIDB], 2019). Land scarcity has forced property prices to rise as the urban population increases, making housing increasingly unaffordable and less sustainable for people (Construction Industry Development Board [CIDB], 2021). Providing decent public housing is a significant difficulty for all emerging countries as demand grows yearly (Rahman et al., 2019). In Malaysia, affordable housing is an important issue in tandem with the country's urbanisation development. With a rate of 4.0 per year, the urban population growth rate is among the highest in East Asia (Ministry of Housing and Local Government [MHLG], 2018). Even though 76.7 per cent of affordable housing units had been constructed by the end of 2016, the housing crisis remains, particularly in the case of newly finished houses (Ismail et al., 2012; Rahman et al., 2019). The government is aware of this scenario and tries to provide high-value and sustainable public housing from time to time. The government currently urges construction key players to promote sustainable development, especially in public housing projects (Lee, 2021). Recently, the National

Housing Policy (NHP) 2018-2025 emphasises the need to improve quality and sustainability in Malaysian housing development (MHLG, 2018). In the 12th Malaysia Plan, the project delivery method must be improved to ensure on-time completion, value for money, and sustainability (Malaysia Economic Planning Unit, 2021b). The 'sustainability' term does not always depend on green construction but needs to focus on the overall sustainability criteria including social, economic and environmental (Fellows, 2023). The need to increase sustainability are driving force that can also assist the widespread adoption of VM in the development (Farouk et al., 2021; Fewings & Henjewele, 2019). As a result, VM is one of the most effective tools for assisting the Malaysian construction industry in achieving sustainable public housing (Yu et al., 2018).

VM is an effective tool for managing a project's life cycle, from inception to completion. It may be used at any stage to address the project's planning, design, and operation (Farouk et al., 2021). According to Alshehri (2020), the ultimate goal of VM is to achieve "value for money" by optimising the project's functional performance and embracing its essential functions while minimising its secondary functions, hence enhancing the quality and avoiding excessive expenditures. VM's benefits are widely recognised. However, the majority of its applications are found in developed countries. Previous studies on VM have revealed a significant variation in VM application across developed and developing countries (M. M. Thneibat & Al-Shattarat, 2021). According to prior research, VM has been used for an extended period in nations such as the United Kingdom, the United States, Hong Kong, and Australia. However, implementation in developing countries is still low (S. Y. Kim, 2018). As a result, it is critical to figure out what makes VM work in developing countries. This study responds to prior recommendations for more research into virtual reality in developing countries since VM adoption differs from developed nations (Bowen et al., 2010; Zhou et al., 2014). The current study is the first step in a series of studies aimed at increasing VM usage in Malaysian public housing projects, one of which will evaluate the CSFs in VM that will enhance the application.

CRITICAL SUCCESS FACTORS (CSFS) IN VM

VM has become a popular method for solving construction difficulties in many developed countries, but it has yet to get the same level of attention in most developing countries, including Malaysia (S. Kim et al., 2016; Kineber et al., 2020). Concerted efforts toward examining the procedures for implementing VM in Malaysian public housing projects are still lacking (Jaapar et al., 2009; Othman et al., 2020). This gap has also been highlighted by Jaapar et al. (2018). It is reported that standard VM implementation is still low and needs more exposure. Additionally, recent surveys reveal that most construction professionals do not use VM in their projects (Farouk et al., 2021; Othman et al., 2020). Implementing the VM standard in public housing projects is essential because sustainable development is significant and aligned with government agendas to provide sustainable housing and value for money (Lee, 2021; Malaysia Economic Planning Unit, 2021).

To make the VM implementation successful, the question "what is the requirement needed to implement VM in Malaysian public housing projects successfully?" arises. Therefore, it is crucial to identify the VM's CSFs to ensure project success (Mohamad Ramly et al., 2015; M. M. Thneibat & Al-Shattarat, 2021). Lin & Lin (2006) identifies CSFs as the area or factors that will lead to project success. Added by Gunduz & Almuajebh (2020) that

identifying CSFs will lead to a critical management preparation and action fields for ensuring the success of projects. Thus, it is vital to identify the CSFs of VM to ensure the successfulness of VM implementation in Malaysian public housing projects.

Numerous CSFs were identified throughout the literature analysis as being critical to the proper implementation of VM, which is also essential for the success of construction projects. To achieve the VM's goal, knowledge and awareness of the VM technique are required, including life-cycle costing, innovative thinking, and the Function Analysis System Technique (FAST) diagram (Ilayaraja & Zafar Eqyaabal, 2015). In addition, excellent and proper training in VM will help to enhance the application (Aghimien et al., 2018). This training should be comprehensive and include all methods needed to implement VM. This will facilitate the rapid adoption of VM in the construction sector. Furthermore, Olawumi et al. (2016) argue that construction professionals need to be trained in VM for it to be used. Training methods may also include hiring VM specialists from developed countries to provide and guide on the VM tools and techniques. Training construction professionals in VM will help alleviate the construction industry's shortage of VM specialists (S. Kim et al., 2016).

Several studies indicate a possible way to enhance the efficiency of VM study by using information technology. This aligns with the argument of Coetzee (2009) on using electronic VM exercises to improve the teaching of VM. This technique takes advantage of technical developments, such as video conferencing, which differs significantly from the traditional physical team-based workshop. Rather than that, the VM team does its workout through the internet and uses emerging technology. According to Shen & Liu (2003), 23 CSFs were listed based on a systematic literature review on VM studies in the construction sector. Farouk et al. (2021) further classified it into 4 sets of items; Stakeholder and knowledge, culture and environment, workshop dynamic, and standardisation which have the most critical impact on VM performance. Table 1 summarises the VM CSFs identified in the existing literature and had been modified and enhanced based on interview suggestions.

METHODOLOGY

This preliminary study focused on the CSFs of VM in the context of public housing projects. This study mainly involved two stages of the data collection method. First, a Systematic Literature Review (SLR) is done by clearly articulate research question and objective. Followed by identifying the database from relevant sources such as PubMed, Scopus, Web of Science, Google Scholar to develop a comprehensive search strategy. It takes careful preparation, dedication, and attention to detail to undertake a systematic literature review in social science research. It's a rigorous approach that enables you to expand on your understanding and add to the scholarly dialogue in your field of interest. To gather all the CSFs from the previous survey by numerous authors. Analysis of CSFs in VM is critical to make sure successfulness of VM implementation in Malaysian public housing projects. Supported by Farouk et al. (2021); Sharma & Srikonda (2021), analysing VM CSFs will positively impact and contribute to successful VM application. The past research was used to build the theoretical structure of the CSFs in this study. Other than producing new ideas, this paper will utilise the organisational standards required to test the existing concepts. This research assisted in re-examining and exploring the facts, as well as the existing CSFs theories in a local public housing context to be used for the main survey in the next stages of research.

Table 1. CSFs in VM

Item	Coding	Factors	Authors
Stakeholders & Knowledge	SK1	Multidisciplinary VM team	(Male et al., 1998; Shen & Liu, 2003; Mohamad Ramly, Shen, & T.W.Yu, 2015)
	SK2	Competence of VM facilitator	(Palmer, 1992; Male et al., 1998; Mat, 2010; Mohamad Ramly, Shen, & T.W.Yu, 2015)
	SK3	Effective communication among participants	(Hwang et al., 2015; Aigbavboa et al., 2016)
	SK4	Ability to conduct VM workshop	(Nebojsa Surlan, Zoran Cekic, 2016; M. Thneibat et al., 2021)
	SK5	Professional knowledge and experience of participants on VM	(Shen & Liu, 2003; Shen et al., 2012; Alshehri, 2020)
	SK6	Willingness to accept changes and innovations	(Lin & Lin, 2006)
	SK7	Precise definition by different backgrounds of experts	(Mohamad Ramly, Shen, & Yu, 2015; Tanko et al., 2018; Farouk et al., 2021)
	SK8	Public housing end-user participation	Interview
Effective Workshop	EF1	A proactive, creative and structured approach	(Mohamad Ramly, Shen, & Yu, 2015; Farouk et al., 2021)
	EF2	Analyse function based on similar completed projects	Interview
	EF3	VM feedback mechanism by experts and end-users	Interview
	EF4	Awareness on the part of clients on value optimisation role of VM	(Lin & Lin, 2006; Mohamad Ramly et al., 2015)
	EF5	The commitment of all stakeholders to VM workshop	(Shen & Liu, 2003; Aigbavboa et al., 2016; Farouk et al., 2021)
	EF6	Adequate timing of VM workshop using online platform.	(Coetzee, 2009; Nebojsa Surlan, Zoran Cekic, 2016; Farouk et al., 2021;) & Interview
	EF7	Background information collected	(Mohamad Ramly, Shen, & T.W.Yu, 2015; Farouk et al., 2021)
	EF8	Orientation meeting	(Norton & McElligott, 1995; Aigbavboa et al., 2016; Farouk et al., 2021)
Culture and Environment	CE1	Clients' active participation and support	(Shen & Liu, 2003; Mohamad Ramly, Shen, & T.W.Yu, 2015; Aigbavboa et al., 2016; Nebojsa Surlan, Zoran Cekic, 2016; Farouk et al., 2021)
	CE2	Input and information from the relevant government departments	(Chen & Liao, 2010; Farouk et al., 2021)
	CE3	Regular attendance of decision-maker	(Male et al., 1998)
	CE4	Creative and sustainable VM study plan for implementation	Interview
	CE5	Government initiative to implement VM	(Kim et al., 2016; Farouk et al., 2021)
	CE6	The ability of the client to communicate requirements to the design team	(Shen & Liu, 2003; Farouk et al., 2021)

As for the preliminary study, A semi-structured interview was conducted from January to February 2022 with VM's experts. A set of questions has already been emailed to them earlier to give the interviewees an overall view of the research. This study approach, which contained several questions, is intended to provide detailed information about VM CSFs in public housing and to identify any weaknesses in the questions that would be the major survey

in future research. All the interviewees were chosen and mainly participated in the earlier survey before this. They have experience in VM more than 10 years and have knowledges of VM in the Malaysian construction industry. All interviewees were well informed about the survey's objective and aims, which helped to create confidence and trust during the data collection procedure. The interviewees' confidentiality and integrity were scrupulously upheld, and codes were issued to each of them. The interviewees include the Senior quantity surveyor (R1), Senior executive VM (R2), and Project executive (R3). They are highly involved in the whole VM process and construction industry. All the discussions of R1, R2, and R3 were based on construction projects, particularly housing projects.

From the methodology, a set of 18 CSFs were developed and considered suitable for implementing VM in housing projects. The qualitative approach, which consisted of 3 semi-structured interviews, was then used to review and modify the factors selected from the previous studies. As a result, four new factors were added from the experts interviewed, making 22 CSFs of VM, as shown in Table 1.

RESULT AND DISCUSSION

This article adds to the existing body of knowledge on the subject. Skilled VM consultants collaborated on the development of a questionnaire that would be used to collect the essential data for the study. In essence, the report summarises the participants' perspectives. We performed extensive literature reviews and preliminary studies to establish a comprehensive questionnaire with 22 chosen CSFs for VM studies.

Demographic Study

The sample characteristics of interviewees can be shown in Table 2 below. The level of working experience for all respondents exceeds 10 years and expert in VM fields. Two respondents (R1 and R2) are working in the private sector and R3 is from the government sector. All the respondents were involved in construction projects including housing, infrastructure, and others. All of them had been involved in supervising projects above MYR 50 million. This shows that the interviewees have a good and strong background to participate in this study to determine the right CSFs of VM in the Malaysian public housing.

Table 2. Respondents Characteristics

Respondent	Working Experiences	Sectors	Projects
R1	More than 10 years	Private	Above MYR 50 million
R2	More than 10 years	Private	Above MYR 50 million
R3	More than 10 years	Government	Above MYR 50 million

CSFs of VM in Malaysian Public Housing

This preliminary study was carried out to present the CSFs of VM implementation by past research from different countries and areas. We considered all the factors gathered from past research and necessary alterations were made to make them more comprehensive. The findings will be used in the development of the questionnaire. Using interview input, the literature study on CSFs was modified to ensure that all context-related aspects of the Malaysian construction sector were covered and that the survey questions were understandable.

Most of the CSFs and survey items were adapted from a comprehensive study by Shen & Liu (2003). Indeed, many recent studies on VM in construction have acknowledged their text as benchmark research since it was based on assessments from experienced construction experts in the United States, the United Kingdom, Egypt, and Hong Kong. For example, Mohamad Ramly, Shen & Yu (2015) research is about VM CSFs workshop in Malaysia and refers to a study by Shen & Liu. Hwang et al. (2015) investigate the CSFs in the Singaporean construction industry and most of the items referred to Shen and Liu's study. Furthermore, the study by Farouk et al. (2021) categorized the CSFs of VM in the Egyptian construction industry, and many of the factors referred to Shen & Liu's study. To suit in Malaysian construction industry context, the present studies require judgments from experienced construction professionals in Malaysia. Therefore, interviews with experts were conducted to make the data more reliable and comprehensive. All interviewees had checked the factors and approved them. For this research, the CSFs are also collected from recent studies by Farouk et al. (2021); Mohamad Ramly, Shen, & Yu (2015); Nebojsa Surlan, Zoran Cekic (2016); M. M. Thneibat & Al-Shattarat (2021).

The CSFs gathered and altered from literature reviews and interview is classified into three sets; Stakeholder & Knowledge (SK) with 8 factors, Effective Workshop (EF) with 8 factors, and culture and environment (CE) with 6 factors respectively. The interviewees, therefore, add 4 suggestions for the CSFs to be included in the main questionnaire in the Malaysian public housing context. Public housing end-user participation, analyse function based on similar completed projects, VM feedback mechanism by experts and end-users, and creative and sustainable VM study plan for implementation is the four new factors suggested by interviewees.

All this data gathered will be further used for the development of the questionnaire for the VM implementation framework in Malaysian public housing projects.

CONCLUSION

Identifying and analysing the CSFs of VM is significant for the enhancement of VM implementation (Farouk et al., 2021; Gunduz & Almuajebh, 2020). This study serves as a preliminary study for the main survey to identify the CSFs of VM in Malaysian public housing projects. Based on the findings, it is discovered that all the interviewees are an expert in VM and public housing from their organizations. All of them are familiar with the VM approach in the Malaysian construction industry.

As for the preliminary study, the CSFs analysed are categorized into 3 sets that had been adopted through literature review and enhanced by the interviewees; Stakeholder & Knowledge, Efficient Workshop, and Culture & Environment. The data gathered from this study will be then used for further research to develop a framework for VM implementation in Malaysian public housing projects. Most of the interviewees agreed with the CSFs from past research and then add another four factors to suit the Malaysian public housing context. Like many other developing countries, Malaysia has suffered problems with the quality and sustainability of public housing projects. According to Tanko et al. (2018), VM can create sustainable development while removing unnecessary costs, enabling the inclusion of sustainability into projects while staying within budget. Thus, Using VM as a sustainability driver will provide significant benefits to clients and end users in public housing.

The successful use of VM need a wide range of knowledge (CSFs in VM) in conjunction with a sufficient level of understanding of VM from diverse stakeholders. Hence, this preliminary study paper aims to identify the CSFs of VM in Malaysian public housing projects to make them more clear and more understandable. These findings could assist the government to provide better quality and sustainable public housing in the Malaysian construction industry. Findings could also be essential to promote sustainable construction, especially in public housing projects. This aligns with the Malaysian government's agendas to enhance the sustainability of public housing and give better satisfaction to end users towards public housing provided. The results reported in this paper could be essential for a future framework of VM that can act as drivers to provide sustainable public housing.

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CLOUD COMPUTING FOR BETTER CONSTRUCTION PROJECT MANAGEMENT PERFORMANCES

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Abstract
The construction industry has been treated with rigid, lack of integration and high complexities in project management due to the involvement of various stakeholders in a construction project. Therefore, adopting technology in the construction industry increases the productivity and effectiveness of project management to ensure that the available resources are well utilized. Cloud computing is one of the latest technologies developed through the Industrial Revolution (IR 4.0). Cloud computing provides a platform to support access to applications, information and services via the Internet platform. The implementation of cloud computing in the construction industry in Malaysia is still new and faces various challenges. Therefore, this paper aims to discover the effectiveness of cloud computing implementation for better construction project performances with the following objectives: to identify the awareness of construction practitioners on the implementation of cloud computing, to examine the cause of failure of cloud computing implementation in the construction industry, and to investigate the effectiveness of cloud computing implementation towards better construction project management performances. The study focuses on the construction practitioner from the background of developer, consultant, main contractor, and sub-contractor experiencing cloud computing in their project in the Klang Valley area only. The study was conducted through a quantitative method and descriptive analysis, which included frequency and mean scores to interpret the data. The research findings show that cloud computing effectiveness can be achieved from operational, financial, and environmental performances. Cloud computing can contribute to high productivity, good financial return, and efficiency and environmental efficiency of the construction project.

Keywords: *Cloud computing; Construction project management; Performance*

INTRODUCTION

The world has been urged with the transformation toward automation and digitalization in various industries, named Industrial Revolution 4.0 (IR 4.0). IR 4.0 offers an intelligent system and technology to ease an organization's operation, process and management. Industrial Revolution 4.0 (IR 4.0) is no longer uncommon in Malaysia. Nowadays, the evolution of technology is rapidly mentioned and undergoes an adaptation process in various sectors. The construction industry is also not excluded from this technology evolution. The construction industry is still behind other industries in recognizing the importance of utilizing Information Technology (IT) applications to increase the probability of project success in an integrated project environment. In addition, there are trust issues in adopting cloud technology (Gavali & Halder, 2020). It happened due to a need for more understanding of construction companies' readiness for the Industrial Revolution (IR 4.0) (Oesterreich & Teuteberg, 2016). The functionality offered by cloud computing can be utilized optimally only when the user is aware of the benefits of the established system.

The adoption of this new technology collated with a few challenges, such as the selected approach in introducing the system, lack of acceptance, lack of awareness of the advantages of the system, lack of knowledge and expertise, lack of safety and security, lack of document standards, and lack of robustness in connectivity (Gamil et al., 2020). Meanwhile, network data and information security can challenge successfully implementing cloud computing

(Gupta & Misra, 2016). Successful implementation of cloud computing relies upon the appropriate management style, reducing and mitigating the risk linked to cloud computing (Bashari Rad et al., 2017). The anxious feeling and fear of the technology have a negative impact without their understanding and push away the system's benefits that they gain from it, as well as the effectiveness of the system towards project management performances. Besides that, the construction industry has been treated in a fractured environment, with a lack of integration and vital complexities during the execution of work or management of the project, which would ultimately negatively impact the technology's success (Goh et al., 2019).

Moreover, the construction industry is well-versed in its strong and inflexible culture and its high resistance to change (Oesterreich & Teuteberg, 2016), which append to the evolution rejection. This paper highlighted various problems that lead to failure in the implementation in the construction sector. Thus, the cause of the failure of cloud computing in the construction industry was examined thoroughly.

Cloud computing technology is an essential tool that makes managing a project much more efficient throughout the execution process. In the first place, implementing cloud computing technology is to overcome the difficulties and hazards inherent in dynamic and information-intensive construction projects, which ultimately serves the purpose of high work efficiency, effectiveness, and productivity of a construction project (Rawai et al., 2013). Cloud-based platforms can efficiently improve collaboration and communication across company borders (Oesterreich & Teuteberg, 2016). Thus, the purpose of technology's existence is obviously to ease human beings and provide an efficient system to the user. Hence, a study to investigate the effectiveness of cloud computing implementation from the construction industry perspective should conducted.

LITERATURE REVIEW

Implementation of Cloud Computing in the Construction Industry

Internet of Things (IoT) develops a virtual platform for a business that combines sensors like RFID, cloud application, and business intelligence technology (Oesterreich & Teuteberg, 2016). This integration system allows analysis of performance data to be conducted when sensors are embedded in the equipment and machinery, such as cranes and dozers. In the construction industry, the reactive maintenance of heavy machinery can be avoided and helps reduce maintenance costs since the machinery is maintained before its breakdown. In the construction industry's league, the construction practitioners' current approach in a cloud system is to manage, control and update the latest information, drawings and project documents (Goh et al., 2019). Furthermore, implementing a cloud system allows access to drawings and blueprints from mobile devices, enabling a real-time update, better information sharing, and reducing the volume of paper drawings (Oesterreich & Teuteberg, 2016).

Document Digitalization

In the construction industry, using paper in documentation is a traditional method with many areas for improvement, as the information might be missed or misplaced due to poor document control. The nature of the sector with various stakeholders' involvement needs the information and communication medium to be well delivered and organized. The use of cloud

computing enables construction practitioners to easily access information from any communication device with the availability of the internet, such as file-sharing for viewing, managing, distributing and collaborating the construction documents in real-time (Oesterreich & Teuteberg, 2016). According to Goh et al. (2019), these problems cause friction, financial expenses, and delays. Therefore, modern project management approaches and tools have been invented to overcome such problems. Technological advancement seeks to improve project durations, cost, productivity, efficiency, and effectiveness in the entire building lifecycle (Fadzil & Rahman, 2017).

Building Information Modelling (BIM)

Building Information Modelling (BIM) adoption and implementation in the construction sector, such as in the USA, UK, and Scandinavian region, are widely implemented and considered global leaders in BIM technology. BIM is envisioned to capture multi-dimensional CAD information systematically to support multidisciplinary collaboration among various stakeholders in the construction project (Bilal et al., 2016). Besides, BIM is also considered the centre of technology for simulating and modelling used in the construction industry (Wesam et al., 2020). BIM technology can provide project schedules, cost estimation, material inventories, and technical information about the project designs or building elements that allow the project stakeholders to collaborate efficiently throughout the construction life cycle (Popov et al., 2010).

Digital collaboration with cloud computing infrastructure becomes one of the key enabling factors that bring the success of BIM. According to Oesterreich & Teuteberg (2016), the full benefit of BIM technology can be utilized with the accompanies of cloud computing and digitization of information flows within the company, also agreed by Osunsanmi et al. (2020) and Priyadarshinee et al., (2017). An innovation becomes applicable by utilizing and integrating it with other technologies to gain the full benefits. In visual analytics, BIM technology must produce a cloud-based BIM system for design visualization and exploration (Bilal et al., 2016). Bilal et al. (2016) found that cloud computing is also used for energy data management, design data storage and exploration, context-aware computing, Google Sketch Up and e-procurement platform.

Supply Chain Management (SCM)

With the substantial advances in Information Technology (IT) and digital communication platforms over the past decade, there is moving awareness that supply chain performance could be improved with the successful adoption of technologies (Giannakis et al., 2019; Hsu et al., 2014; Qrunfleh & Tarafdar, 2014). According to Giannakis et al. (2019), cloud-based services can provide infinite computing scalability that enables supply chain management (SCM) systems to quickly and cost-effectively scale up and down to match dynamic process volumes. Cloud computing enables a flexible many-to-many SCM management system to decide which type of information can be shared with whom (Maestrini et al., 2017). He added that powerful business intelligence enables more robust data analysis and performance calculation and is finally easily managed through the cloud platform.

Cloud computing enables organizations to access quickly and can globally provide a manufacturing service model for the supply chain partners regardless of where they are

located. Helo and Hao (2017) added that rapid deployment and flexible information sharing enable supply chain participants to coordinate and collaborate to match changes in business processes and the community of trading partners. Figure 1 shows an overview of a cloud-based system implemented in supply chain management (SCM). Giannakis et al.'s (2019) research suggest that the cloud-based system approach for SCM can be deployed as a secure community cloud to ensure security and data privacy. Thus, they aim for an organization with close business relationships and the same objectives and concerns as their client.

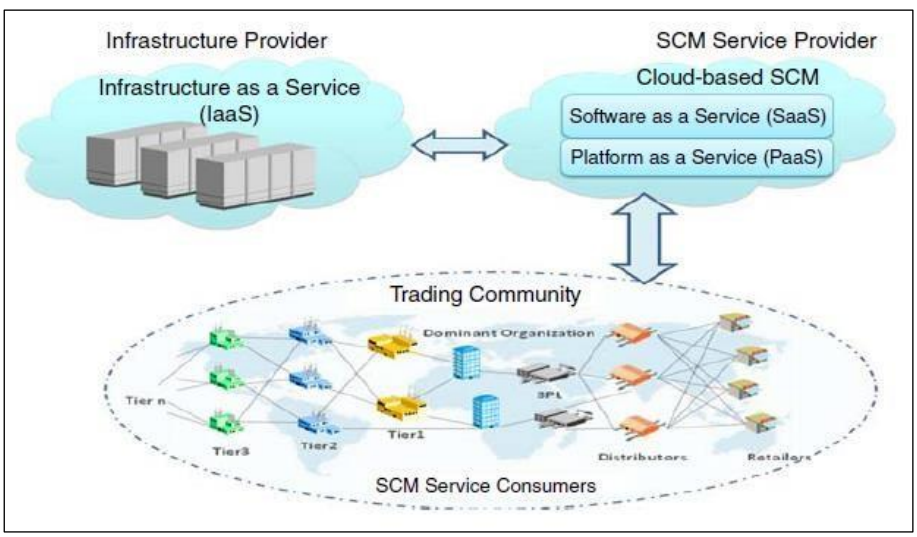

Figure 1. Example of A Cloud-Based System Implemented in SCM

Furthermore, the integration between cloud and SCM provides features that can manage the workforce, requests, documents, stock and fleets through controlled communication hubs with IT. According to Dallasega et al. (2018), other studies also state that cloud integration with SCM may improve material flow, real-time information sharing and communication, coordination, technical support and associated safety issues. Thus, this innovation can reinforce coordination and relationship between contractors and suppliers while simultaneously solving the issue of the unwillingness of subcontractors to participate, the complexity of the construction process and the lack of adequate software (Dallasega et al., 2018).

Awareness of Cloud Computing in the Construction Industry

The development of technology shall follow the development of all sectors. Undoubtedly, technology growth is the fastest and has yet to be readily accepted and adopted. As for the construction sector, the growth of technology plays a big part in the changes. Various techniques and tools were tested and implemented to reduce project duration and cost while improving construction projects' quality, productivity, efficiency and effectiveness. A client requests better value for money, higher-quality products, a shorter construction period, and accessibility to valid and up-to-date information at any time in the project life cycle (Fathi et al., 2012). Therefore, technology engagement as such cloud shall be studied thoroughly to identify the technology status in the construction industry.

Understanding cloud computing operations by construction practitioners is vital for the system to work efficiently towards its goals and functionality. The project team must be fully involved from the requirements and implementation stages until the maintenance stage (Garrison et al., 2012). In the context of getting the involvement and understanding of the implementation of cloud computing by construction practitioners, awareness is one of the crucial factors in exposing the technology to the user. Awareness is human behavior that requires time and method to be present. Awareness could be developed through workshops and seminars for construction professionals besides introducing the technology benefits to the users and organization (Osunsanmi et al., 2020).

Malaysian construction practitioners must gain more awareness of implementing cloud computing in the construction industry (Goh et al., 2019). He found that the cloud-based concept still needs to get a complete understanding from the construction practitioners in Malaysia at this stage. Research conducted by Mahmud et al. (2018) claimed that construction practitioners are aware of the presence of the technology. However, the usage rate still needs to be higher than the knowledge of the application, and the technology needs to be utilized in the construction industry. Mahmud et al. (2018) also agreed that the construction practitioner is aware of the presence of this technology, although the usage is still low. It may be due to the high rate of the evolvement of technology surrounding us without realizing how significant its growth is.

Training and workshops are vital actions for new technology to increase the awareness being accepted by the user. Awareness among construction practitioners can be built by providing adequate training. Besides, the complexity faced by the user can be reduced by attending a training or workshop session (Shammar & Zahary, 2019). According to (Gupta et al., 2018), sufficient training would result in a more efficient system as constant communication on the system's benefits to the construction practitioner. It would familiarize the construction practitioner and build more trust with the system, resulting in better construction project performance.

Cause of Failure of Cloud Computing System in The Construction Industry

New technology innovation is only partially producing a perfect product for the usage of human beings. It is unusual for any innovative technology to have some lack or barrier to the innovative system. For instance, an organization also faced issues with the system's update and extension to align with business development and project management during emerging technology (Shao, 2019). Puad et al. (2019) found that the challenges in adopting cloud computing are security concerns, difficulties in learning the cloud, high bandwidth cost and IT equipment's lifespan. Wesam Salah Alaloul et al. (2020) and Oesterreich & Teuteberg (2016) mentioned that the problems that cause technology failure include complexity, uncertainty, fragmented supply chain, short-term thinking and culture. They believe construction projects are complex due to the number of stakeholders involved. Based on the previous research, various other challenges cause cloud computing failure as the following:

Accessibility

Cloud computing is to work efficiently with the availability of a strong internet connection. Cloud computing only requires an internet connection for the user to use (Goh et

al., 2019). Therefore, the poor ability of data and information accessed by the user is also considered an issue that could be faced by construction practitioners, which causes system failure (Oesterreich & Teuteberg, 2016). The internet infrastructure should be fast and reliable connectivity. Oesterreich and Teuteberg (2016) added that a lack of access to high-bandwidth connectivity for system usage would be meaningless. For instance, the cloud system is incapable of the enormous size of documents such as drawings, reports, etc. If the system requires a long time to run, it will save time for the user and directly cause the work to be conducted efficiently.

Furthermore, the lack of internet accessibility causes the incapability of the cloud system to communicate and share services (Gamil et al., 2020). Bello et al. (2021) also stated that some construction sites need better network connections because the project might be in a rural area, tunnel or underground. Gamil et al. (2020) strongly opine that the level of connectivity of construction sites could be better and remains a challenge to construction practitioners. According to Shammar Zahary (2019), a cloud system enables users to connect, collect and interpret the data easily. He added that Gubbi et al. (2013) expected the growth of cloud-based analytics and visualization platforms would increase and succeed in future by providing centralized infrastructure to support storage and analytics. Therefore, an analysis of whether the outcomes of the cloud computing used in the construction industry result as expected shall be conducted to justify this aftermath outturn.

Technical Support and Selection of Vendor

Cloud computing requires a high-speed, reliable internet connection with sufficient bandwidth, high latency and security. The technical expert of cloud computing shall be able to provide these needs to the user diligently. According to the National Institute of Standards and Technology (NIST), the cloud system must be stable with minimum error, and service-provider interaction is essential to maintain the user's engagement with the system. The dynamic nature of cloud computing becomes one of the challenging factors for the service provider (Wang et al., 2016). Therefore, various factors should be considered in selecting the cloud system platform and vendor selection.

Garrison et al. (2012) state that the effectiveness of the cloud system can be obtained by selecting a trusted vendor or cloud system developer. The lack of competence of cloud providers can cause system failure and inefficient systems (Abolfazli et al., 2015). He added that expert vendors and skilled personnel could eliminate the risk and reduce the in-house IT expenses. The vendor also must ensure that the system is well implemented. Garrison et al. (2012) added tones of misunderstandings between the organization and the vendor about the scope and implementation of services that can cause the technology investment to become wasted. A wrong choice of a suitable system can only cause the work to be inefficient and non-optimizing the goods of technology. Besides the functionality of system selection, Priyadarshinee et al. (2017) did mention that Kłos & Trebiina (2014) believe the management of the selection of cloud systems should also be considered. Therefore, selecting the vendor or service provider is essential to ensure the system is feasible and friendly to the user and can operate efficiently.

Data Security and Data Protection

Data security and data protection are vital concerns in implementing cloud computing. Users need a system that protects them from cyberattacks, privacy violations and information disclosure. (Abolfazli et al., 2015). Lack of data security and protection makes the user vulnerable to external attacks (Gamil et al., 2020). According to Bello et al. (2021), there is a perception among construction practitioners that thought that unauthorized persons could access the stored data. He added that the data leakage might occur due to construction practitioners using a personal mobile application for work purposes, leading to a high potential for hacking the device. Moreover, Oesterreich et al. (2016) stressed that a company should protect its data against unauthorized access and misuse through centralized cloud-based user identity, access management, device management and data protection tools. Cloud computing allows the sharing of resources such as storage, data, and programs among different users will have the potential for a breach of data confidentiality. Besides, cloud computing has a problem with unauthorized users' illegal access to data or accounts (Bashari Rad et al., 2017). It has become a significant concern to the cloud computing user.

Knowledge

"Technological innovations drive businesses, but knowledge helps achieve excellence". This powerful phrase (Gupta et al., 2020) shows the importance of knowledge in business operations and adopting technologies. According to Oesterreich & Teuteberg (2016), the lack of knowledge also causes the reluctance to adapt to technology employees and workers. The construction practitioner's resistant attitude to change can also indicate a low level of knowledge, conservatism, and inability to adapt to changes. The lack of knowledge also occurs due to the need for educational resources on the technology invented (Mahmud et al., 2018).

The construction projects are unfixed and unpredictable. The temporary nature of the construction project and its fragmented characteristics of the construction value chain are other factors for the need for codified, shared project knowledge and limited standards for knowledge management (Oesterreich & Teuteberg, 2016). Therefore, it will be challenging to create and establish a standard for knowledge management within the organization and achieve a mutual understanding of the system's excellent and essential for the project operations. Gamil et al. (2020) also mentioned that a lack of document standardization occurs due to cloud computing being a new technology requiring more policies and standardization to operate at the highest efficiency level. Knowledge has become one of the barriers to cloud computing implementation; as Goh et al. (2019) found in their research, most construction practitioners need better knowledge of cloud computing technology. He added that no one was found to be an expert in implementing cloud computing in his limitation of research correspondence, which causes the waste of technology innovation.

Communication

Communication is one of the essential elements for the smoothness of organization management. According to Bello et al. (2021), communication and coordination problems culminate in low construction quality. He said that the miscommunication and improper data transfer would result in a communication problem in the construction project. Poor

communication in task management will increase complexity, which is unhealthy for an organizational environment (Rawai et al., 2013). Besides, the information is easily manipulated and exchanged, which may lead to unproductivity. An organization or project requires a method to eliminate the risk and, thus, improve the coordination, collaboration, and communication between various parties involved. According to Jacobs, Yu & Chavez (2016), effective communication ensures employee quality and aligns with the organization's goals and objectives for better Performance in work coordination.

Administrative and Organization Structure

The technology can only work at its best efficiency with the social acceptance of the implementation. Technology can only proceed with cooperation among the users. The construction industry is well known for its strong resistance to changes and new technologies (Majrouhi Sardroud, 2012) as well as conservatism and inability to adapt the staff members of its company (Smith, 2014). Cloud computing introduced a system that can reduce the workforce requirement, support care staff, technical engineers, and marketing and advertising staff since the system could occupy most job positions (Bashari Rad et al., 2017). In Oesterreich & Teuteberg's (2016) study, he also found that the employees have an issue with adapting and refusing to adapt to the technologies as they are afraid of losing their position (Bashari Rad et al., 2017) since they believe that machines, computers or robotics might replace them.

Furthermore, the construction sector is well-known for the participation of various parties or stakeholders in a construction project. The adoption of cloud computing is facing difficulties because the involvement of multiple stakeholders in a construction project could lead to uncoordinated execution by the stakeholders, inadequate business and technical awareness, and data security (Garrison et al., 2012). According to Osunsanmi et al. (2020), the complex nature of construction projects, the uncertainty of construction projects and the site-based nature of construction are some of the causes of failure in adopting cloud computing technology, which requires a higher level of specialist knowledge. Oesterreich & Teuteberg (2016) also emphasized that the entire construction value chain is highly affected by tight collaborations with customers, subcontractors and other stakeholders.

Financial and Economic Viability

According to Oesterreich et al. (2016), the adoption of cloud technology investment becomes limited since the construction industry consists of many small and medium-sized enterprises. Therefore, they are hesitant to invest in technology even though introducing the innovative system might benefit them in the long run. Other than that, the high cost of the software, hardware, training, education and external consultation fees could cause failure to adopt (Oesterreich & Teuteberg, 2016). Plus, the unclear cost benefits, expected cost savings and lack of consistent fiscal benchmarking to evaluate business improvement are other causes of the failure of cloud-based system implementation in the construction industry.

Effectiveness of Cloud Computing System Implementation in The Construction Industry

The penetration of technology in the construction sector industry is an eye-opening opportunity if appropriately implemented and adopted, ultimately leading to high productivity, efficiency and effectiveness in the construction industry. (Rawai et al., 2013) The cloud system allows construction practitioners to cooperate and work efficiently. The effectiveness of technology implementation, such as cloud computing, results in different organizational performances depending on how they leverage their resources and imitable organization competencies (Garrison et al., 2012). The advancement of cloud computing technology offers construction organizations a vast potential to develop a collaborative and integrated environment for construction management (Rawai et al., 2013). The system implementations' effectiveness can also be measured in three essential elements: operational, financial, and environmental. According to Xing, Qian, & Uz (2016), the cloud-based platform can also catalyze supplier integration, leading to better financial, operational and environmental performance.

Operational Performances

Good communication and relationships among construction practitioners or stakeholders are crucial to completing the project correctly. It can be achieved by maintaining reasonable project management control in all areas, regardless of department and position. Each person shall be responsible for practising good communication with others. Cloud computing enables to work efficiently even with high numbers of participants in the construction project and improves collaboration and communication across company borders (Oesterreich & Teuteberg, 2016). According to Patel et al. (2015), cloud computing creates a medium to enhance efficiency, storage, and energy. Besides that, cloud computing can also be used to share project schedules, drawings, inventory totals, receipts, invoices and other information among the various stakeholders (Goh et al., 2019). This easy accessibility of data and files allows construction practitioners to create and share information among organizations. In addition, the construction practitioner can collaborate on updating and reviewing important information while work is ongoing with related stakeholders involved. The construction industry is very well known for its harsh and fast working environment and low level of document digitization. Therefore, this industry's digital transformation can help improve document management and productivity (Oesterreich & Teuteberg, 2016).

Moreover, the cloud system is a crucial tool to support the construction industry and is currently available on desktops, internet networks, tablets, smartphones and laptops (Rawai et al., 2013). It allows a massive amount of information to be easily accessible by the construction practitioners, including consultants, contractors, designers, suppliers, engineers, architects and the owner. All data and information can be easily accessed, thus improving productivity. Technology will help construction practitioners to perform their work more efficiently. Cloud computing not only would advantage an organization in its management and increase the efficiency of the organization but would further enable it to embark on competitive advantage (Garrison et al., 2012) within the industry. The construction industry must also not be excluded as it must evolve with the current trends and needs. The construction industry should observe beyond its norm and old methods, thus utilizing each resource they have.

Financial Performances

The cloud-based system is considered economical as the customers pay for what they use. The fixed cost associated with software and hardware has been eliminated since the cloud system only requires an internet connection (Goh et al., 2019). Fook Ming, Kim On, Rayner, Tse Guan, & Patricia (2018) mentioned that cloud computing offers organizations various benefits such as low entry costs, enhanced flexibility, wide-ranging access, and scalability (Goh et al., 2019). Cloud computing technology is cost-effective and energy-efficient and supports software applications, information and services, including networks, hardware infrastructures and servers, without restrictions on time and place by only internet connection (Patel et al., 2015; Rawai et al., 2013). Moreover, the stakeholder can save on operational, maintenance, and purchasing costs via cloud computing implementation (Goh et al., 2019).

Cloud computing is economically reliable to the construction user. National Internet of Things (IoT) Strategic Roadmap (2014) also added that a cloud-based system provides many economic advantages, such as eliminating administrative tasks in the computer system and associated costs. Cloud computing can function for small and large organizations. Most organizations are currently moving towards using cloud computing technology due to its capabilities to provide low expenditure on IT infrastructure and maintenance costs while redirecting the resources (Garrison et al., 2012). Not only that, Gupta et al. (2018) and Hashem et al. (2015) also highlighted on the same page that the cloud offers less infrastructure maintenance cost better efficiency in management and user access since it offers less human resource involvement.

Environmental Performances

Cloud computing technology is an extensive distributed standard whereby a pool of virtualized, scalable, available and manageable computing resources, such as networks, servers, storage, software, hardware, application and data, could be achieved, utilized and managed minimally (Rawai et al., 2013). Sustainability can be achieved through three elements: environmental, social and economic. The evolvement of technology enables the formation of a sustainable environment and eventually helps the development of a country itself. A business or organization can be highly optimized by adapting sustainability characteristics. Cloud computing is also beneficial as it is environmentally friendly to the user, offering a low carbon footprint in long-term operation and promoting a green data centre (Patel et al., 2015). Thus, the effect of cloud computing on construction project management performance can also be measured via environmental performances. Besides that, the construction project's level of waste can also be controlled (Wesam et al., 2020).

Consequently, cloud computing technology in the construction industry can contribute to a healthy environment where energy consumption and carbon dioxide emissions can be reduced, providing financial return and environmental benefits (Patel et al., 2015; Rawai et al., 2013). They added that a practical tools approach with inserting the element of sustainable development could result in better green construction management, which eventually ensures the delivery of applicable and reliable information to enhance collaboration with the construction supply chain and the project stakeholders. According to Wesam Salah Alaloul et al. (2020), environmental Performance can be achieved by executing multiple methods that help with energy consumption.

METHODOLOGY

Data Collection

The early phase of the research began with reviewing literature reviews of published articles, reports and texts to get an overview of the current evolution of Industrial Revolution 4.0, especially on cloud computing technology. Then, the ability to gather and integrate massive amounts of information and data with the cloud system development in Malaysia is highlighted and focused to suit the research study purposes. Cloud computing technology opens a new economic opportunity for Malaysia to obtain a strong economy and follow the world changes on the Internet of Things (IoT) development. This research aims to discover how far the cloud system is implemented and accepted in the construction industry with the following objectives: to identify the awareness of construction practitioners on the implementation of cloud computing, to examine the cause of failure of cloud computing implementation in the construction industry, and to investigate the effectiveness of cloud computing implementation towards better construction project management performances. Issues and problem statements of this research are collected from reading through newspapers, online journals, and articles.

The data was also obtained from the distributed questionnaire survey to the participants and will be analyzed accordingly. The data is collected through a survey of questionnaires distributed among construction practitioners, developers, consultants, and contractors who experience cloud computing technology in their project operation procedures to obtain ample information. All the relevant information related to the research topic will be collected and compiled from the database for the analysis phase. The questionnaire survey will be analyzed thoroughly using SPSS software. All the analyzed data will be presented in the form of a table. Valuable and informative data will be analyzed using the SPSS software.

The questionnaires were distributed to the respondents of, construction practitioners with experience in using cloud computing in their construction projects. This questionnaire consists of four sections: Section A: Demographic Profile; Section B: Awareness of Cloud Computing Technology; Section C: Cause of Failure of Cloud Computing in Construction Industry; and Section D: Effectiveness of Cloud Computing Implementation Towards Construction Project Management Performances.

Table 1. Organization of the Questionnaire

Section A	Demographic Profile
Section B	Awareness on Cloud Computing Technology
Section C	Cause of failure of Cloud Computing in The Construction Industry
Section D	Effectiveness of Cloud Computing Implementation Towards Construction Project Management Performances

The questionnaires were distributed to 108 respondents, and 75 respondents returned their responses and feedback by completing the duly answered questionnaires. The percentage of return questionnaires is 70%. A total of 108 questionnaires were sent out to the construction stakeholders from Developers, Consultants, Main contractors and Subcontractor companies in the Klang Valley area through random sampling. It is because there is no sampling database to identify the exact population of the construction project implementing cloud computing.

All the research findings analysis established based on the data collected from the respondents who cooperate in the survey. The data is obtained and then analyzed using SPSS software analysis. Therefore, each question has been analyzed and explained in sequence. The data obtained were then transferred into tables to simplify the findings.

ANALYSIS AND FINDINGS

The analyzed data presented in the previous section in the form of a table will be discussed and summarized in this section. All the obtained data are crucial and significant to the research objectives achieved.

Section A: Demographic Background

Based on the result in Section A, the background professions are from the senior executive/ engineer level. Besides, most of them come from a leading contractor company. In terms of years of working experience, most respondents have experienced seven years and above in the construction industry. Most respondents have less than one (1) year of experience with cloud computing. It might be due to the implementation of cloud computing technology in the construction industry being still new. Thus, this data is eligible to be collected to get feedback on the technology from the user's perspective. Furthermore, all the respondents who answer the questionnaire have experience in cloud computing, proving the research response's validity.

Section B: Awareness of Cloud Computing Technology

The available factors in Table 2 help identify the awareness of cloud computing in the construction industry. The researcher found that the highest mean score among the available factors is awareness of cloud technology in general, with a mean score high (*M=3.5767*), and the lowest factor that contributes to the awareness of cloud computing in the construction industry is training/ workshop session with a mean score (*M=3.0267*). It might happen due to no manual provided, or they are unable to understand the system introduced by the trainer or system developer. Lastly, the total average mean score shows that the awareness of construction practitioners in implementing cloud computing in the construction industry is moderate at (*M=3.3407*).

Table 2. Mean Score for Section B

Awareness of Cloud Computing	Mean Score
Cloud Computing	3.5767
Adoption CC	3.4187
Training/Workshop	3.0267
Total Average Score	**3.3407**

Table 3 shows an analysis of the relationship between the workstation of construction practitioners and the awareness of cloud computing implementation in the construction industry. It shows that the awareness of cloud computing implementation in the construction industry for construction practitioners that work at the office and site is moderate, with an average mean score of 3.2396 and 3.3826, respectively.

Table 3. Awareness of Cloud Computing Vs Workstation

Location of Workstations	Average Mean Score
Office-Based	3.2396
Site-Based	3.3826

The awareness of cloud computing among construction practitioners based on their years of experience using a cloud system is shown in Table 4. Those who experience 2-3 years using the cloud are the most aware of this technology innovation. The mean score of construction practitioners with more than four years of experience is lower than those have 2-3 years of experience using the cloud. It might be due to the number of respondents that replied to this questionnaire being only 16 compared to the construction practitioners that have been using cloud computing for 2-3 years, which is 25 respondents. Meanwhile, construction practitioner with less than 1-year of experience with cloud computing has the slightest awareness of cloud computing technology.

Table 4. Awareness of Cloud Computing Vs Year of Experiences Using Cloud

Year of Experience Using Cloud	Average Mean Score
Less than 1 year	2.9354
2-3 years	3.8224
4 years and above	3.4490

Section C: Cause of Failure of Cloud Computing Implementation in The Construction Industry

From the literature review mentioned, the researcher found seven (7) factors that might cause failure in implementing cloud computing in the construction industry. The collected data will be analyzed further in this section to show the research outcome from various perspectives. Comparison Mean analysis is conducted to explore the outcomes of the research. In Table 5, the most significant cause of failure in implementing cloud computing in the construction industry is communication, with a mean score of (*M=3.6833*). Communication is a vital feature in the construction industry to reduce misconduct. The nature of the construction industry, with the participation of various parties and stakeholders, needs good communication skills and medium to ensure the information is well delivered and understandable. Poor communication can lead to misleading information and affect the quality and relationships between the stakeholders. The rest of the causes of failures are considered moderate, which might be reduced by improving the lack of the implemented cloud system to suit the needs of the construction industry.

Table 5. Mean Score for Section C

Cause of Failure/Challenges	Mean Score
Accessibility	3.1511
Technical Support / Services and Vendor Selection	3.2489
Data Security & Data Protection	3.3667
Knowledge	3.6213
Communication	3.6833
Administrative & Organization Structure	3.4267
Financial & Economic Viability	2.8578
Total Average Mean Score	**3.3365**

Besides that, the researcher also analyses the relationship between the position of construction practitioners with factors that become the cause of failure and challenges of cloud computing implementation in the construction industry, as shown in Table 6. By conducting this comparison, we would see the problem faced by construction practitioners based on their position—a position level of a person in a company able to show their level of acceptance. Based on the analysis, the Top Management Level agreed that knowledge is the highest cause of failure of cloud computing implementation in the construction industry, with a high mean score (*M=4.6000*). Since cloud technology is considered a newly invented technology in the construction industry, the Top Management Level also think that financial and economic viability is not the main issue that leads to the failure of cloud computing implementation with a mean score (*M=2.6667*).

Table 6. Cause of Failure Vs Position Level

Factors Cause of Failure of Cloud Computing Implementation in The Construction Industry							
Position Level	**Accessibility**	**echnical Support Services and Vendor**	**Data Security and Protection**	**Knowledge**	**Communication**	**Administrative and Organisational Structure**	**Financial and Economy Viability**
Top Management	3.3333	3.3333	4.0000	4.6000	4.0000	3.4000	2.6667
Senior Manager	3.0556	3.8333	4.0000	3.4000	3.5000	3.4667	2.8889
Manager	3.2273	3.2879	3.5227	3.7091	3.9545	3.3818	2.8485
Senior Executive/ Engineer	3.0000	3.1056	3.0667	3.4267	3.5667	3.4533	2.8556
Junior Executive/ Engineer	3.2803	3.3712	3.6250	3.7182	3.7841	3.4636	2.8636
Non-executive	3.2619	3.1429	3.1429	3.8286	3.4286	3.2571	2.9048

The high score of knowledge factor among top management level might happen due to the construction practitioner's seniority. In Table 7, most of the Top Management Level focuses on managing the organization instead of executing the physical work. Therefore, they have an issue operating the system by themselves and always need assistance to assist them. They also preferred that the work is executed in a traditional method involving hardcopy. They also strongly agree that cloud computing is not suitable for the nature of temporary construction projects. They also agree that it is nearly impossible to create a standard for knowledge management within the construction organization.

Table 7. Cause of Failure (Knowledge) Vs Position Level

Position Level	**Mean score**				
	RQ4C_1	**RQ4C_2**	**RQ4C_3**	**RQ4C_4**	**RQ4C_5**
Top Management	4.0000	5.0000	5.0000	5.0000	4.0000
Senior Manager	3.3333	3.6667	3.3333	3.0000	3.6667
Manager	4.1818	3.7273	3.7273	3.2727	3.6364
Senior Executive/ Engineer	3.3667	3.5000	3.4333	3.2667	3.5667
Junior Executive/ Engineer	3.9091	3.8636	3.6364	3.5455	3.6364
Non-executive	3.7143	4.2857	4.1429	3.7143	3.2857

Meanwhile, the Manager level, Senior Executive/ Engineer level and Junior Executive/ Engineer level agreed that communication is the highest factor that causes the failure of cloud computing implementation in the construction industry with a mean score (*M=3.9545*), (*M=3.5667*) and (*M=3.7841*) respectively. It might be because most of the construction with this position is critical for physical and documenting work. Communication becomes the key factor that contributes to the failure of the system.

Section D: Effectiveness of Cloud Computing Implementation Towards Better Construction Project Management Performances

Based on the literature review mentioned in Chapter Two (2), the researcher found three (3) factors that can contribute to the effectiveness of cloud computing implementation towards better construction project management performances. The collected data will be analyzed further in this section to show the outcome of the research.

Table 8. Mean Score of Section D

Effectiveness of Cloud Computing	Mean Score
Operational Performances	3.4152
Financial Performances	3.5200
Environmental Performances	3.8533
Total Average Mean score	**3.5962**

The implementation of cloud computing was the most effective in terms of Environmental Performance, with the highest mean score (M=3.8533) (Refer Table 8). As mentioned by (Rawai et al., 2013), cloud computing technology offers great potential for developing a collaborative and integrated environment for construction management as it can reduce CO2 emission and energy consumption. However, all three (3) listed factors can lead to the effectiveness of cloud computing implementation towards better construction project management as all the mean score is high. It shows that the benefit of cloud computing in the construction industry is improving quality and operation, bringing better cost-benefit and helping the environment by reducing the environmental problem caused by the construction project.

CONCLUSION

This study is expected to discover the effectiveness of cloud computing implementation for better construction project performance. The cloud system used in the construction industry shall be a particular standard and accepted by the company auditor. A relevant body that responds to create a standard shall plan thoroughly on the implementation to eliminate double handling work. A friendlier system or platform provided for all ages shall be developed by the system vendor or provider to increase the acceptance of cloud computing by the construction practitioner. Integrating cloud systems with Enterprise Resources Planning (ERP) can also enhance or innovate cloud computing technology. This innovative technology gives construction companies a complete view of their financial, procurement and construction work progress. Cloud ERP allows the construction practitioner to access their report and work dashboard via phone, tablet and laptop. This technology has been invented in other countries such as China, India and more.

Besides that, the industry shall be more open and accepting of the technology to let the country grow, not only in terms of Industrial Revolution 4.0. Technological advancement can improve Malaysia's economy as all countries have an economic crisis. The economy can also be improved via many start-up companies offering a social system to suit the construction industry's needs—the invention and innovation of technology can create a competitive edge between Malaysia and other Asian countries. It is recommended that future studies cover the topic as follows: to look at the benefits of cloud computing for construction organizations during the pandemic, the critical success factor of cloud computing in the construction industry, and the implementation of a Cloud-based ERP system in a construction project.

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THE EMPLOYERS' EXPECTATION TOWARDS SOFT SKILLS COMPETENCIES OF QUANTITY SURVEYING GRADUATES IN MALAYSIA

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Abstract
Modernising technology in the construction industry will create a changing demand for Quantity Surveying (QS) skills. As the number of QS graduates keeps increasing each year, competition for employability is high amongst graduates. Both hard skills and soft skills are extensively demanded in the job industry. However, the job market is leading QS graduates to acquire competitive soft skills such as leadership, communication, problem-solving, and teamwork. Although soft skill competencies are acknowledged to increase graduates' employability, the specific expectations of employers towards Quantity Surveying graduates remain unknown. This research aims to bridge this gap by exploring the employer expectations towards soft skills competencies of quantity surveying graduates. This research is carried out to determine the soft skills development in Malaysia, the employer expectation of soft skills amongst QS graduates and the challenges of soft skills amongst QS graduates. A set of questionnaires has been distributed to 132 registered quantity surveyor consultant firms in Selangor. The findings show that the most preferred soft skills are willingness to learn and integrity skills, followed by ethical behaviour and teamwork skills. Thus, the soft skills competency of QS graduates in Malaysia should be reviewed and improved to cater to the construction industry's needs.

Keywords: *Employer's expectation; soft skills; QS graduates*

INTRODUCTION

In the evolving landscape of the construction industry, the role of Quantity Surveyors (QS) is undergoing a significant transformation. Modern technologies and methodologies are changing not only the technical demands of the profession but also the interpersonal ones. As the global industry shifts towards increased collaboration and integration, the need for soft skills in QS professionals becomes even more pronounced.

The gap between employers' expectations and the reality of what today's graduates bring to the labour market is widening. Today's young graduates may have the most up-to-date technical skills, but they often lack the crucial characteristics for workplace success, referred to as "soft skills." (Joseph et al., 2020). The quality and standards of the QS profession in Malaysia are sustained through a quality syllabus from university education, expectations and criteria given by professional bodies. The QS graduate will be equipped with the essential soft skills from the course content the universities offer them to begin their first profession in the construction industry. In Malaysia, institutions such as the Royal Institution of Surveyors Malaysia (RISM) and the Board of Quantity Surveyors Malaysia (BQSM) aim to monitor and maintain the quality of university programmes by articulating proper professional practices and evaluating and accrediting university courses (Hassan et al., 2011). Although the syllabus content is closely monitored, there have been issues and concerns regarding employers' expectations of soft skills competencies among graduates in Malaysia (Hasbullah &

Sulaiman, 2002). The QS graduates have strong hard skills but lack soft skill competencies. Thus, this creates a gap for further improvement of these aspects. Nowadays, the rapidly changing need for various levels and types would be stimulated by the modernisation of technology and the construction industry among countries. Graduates must adjust their approach, system, or technique to acquire a specific soft skill. As a result, hard skills should be checked, and the importance of soft skills criterion should be enhanced among QS graduates. Thus, this research aims to investigate the employers' expectations towards soft skills competencies of QS graduates in Malaysia.

LITERATURE REVIEW

Soft skills supplement a person's hard skills and can improve interactions, performance, and career advancement. Personality qualities, friendliness, language fluency, and personal habits are examples of soft skills. A career's needs typically include adding soft skills to hard talents, mainly if the profession engages extensively with others (Noah & Abdul Aziz, 2020). The literature review also found a rising trend in understanding the relevance of human elements or soft skills such as trust, cooperation, and dedication to the success of a construction project, in addition to the usual measurements of time, cost, and quality (Yong & Mustaffa, 2017). Thus, soft skills are primarily intended to support and improve work performance, which explains why people who exhibit them are considerably more appealing to employers (Noah & Abdul Aziz, 2020). Table 1 shows the definitions of soft skills from various authors in the management field.

The emphasis on soft skills in the professional realm has been growing among researchers, educators, and industry professionals. This literature review delves into the significance of soft skills, the challenges faced in their development, especially among QS graduates, and the evolving demands of the construction industry. Due to recent changes in education and labour market policies, universities are under growing pressure to produce marketable graduates. Employability skills are not just for having employment status but also to help the graduates visualise and improve weaknesses, develop a stable career, and keep a company progressing (Bridgstock, 2009). In this rapidly rising period, quantity surveyors are in high demand in the construction business, but the issue of quantity surveyor graduate unemployment remains. Because of the wide range of job options, Quantity Surveyors must be prepared with employability skills to compete in today's competitive market (Yaakob, Azrina Md; Pan, John Jun Yiu; Kamarazaly, Myzatul Aishah; Loo, 2022).

In recent years, there has been a growing desire from industry for students to possess more soft skills than technical knowledge. However, because the industry operates in a real-world environment, there are delicate skill components that universities cannot supply. To address this issue, universities must create simulated environments. The new generation's QS education must address industry demands. Professional bodies, councils, and associations can guide curriculum design, accreditation, professional competency evaluation, and continuous professional development (Yap et al., 2022). This method could effectively instil the necessary soft skills (Hasbullah & Sulaiman, 2002). Soft skills impact positive interpersonal behaviour and working relationships between people (Mohd Adnan et al., 2012). Soft skills cannot be learned directly, but practising them daily will improve through experience, naturally and spontaneously. The primary function of higher education is to produce a batch of well-rounded. They possess technical skills competency and skills such as long-life

learning, communication, critical thinking, ethical value, practical aptitude, business acumen and solution synthesis abilities that meet the employer's expectations.

The literature underscores the growing importance of soft skills in the professional realm, particularly in the construction sector. While the need for soft skills is universally acknowledged, effective strategies for their development, especially in the Malaysian context, remain areas of active research and discussion. This research aims to contribute to this discourse, focusing on the employers' expectations of soft skills among QS graduates. The objectives of this research are the soft skills development among QS graduates in Malaysia, the expected soft skills required by employers, and the challenges of soft skills implementation among QS graduates.

Table 1. QS Soft Skills Matrix

Soft Skills	Definitions	Reference
Leadership	A leader is a person who is in charge and motivates people in his groups by having strong leadership skills to succeed in their goals, leading the order and being inspired.	(Susan Ward, 2019)
Charismatic	Charismatic skill is significantly linked with positive emotion and mood towards people.	(Bono & Ilies, 2006)
Communication	Communication skills are the ability to realise communicative goals while behaving socially appropriately.	(Brown & Edmunds, 2019)
Teamwork	Two or more persons who associate and adaptively cooperate to achieve goals, ideas and aims that are specified, mutual, and valued.	(Salas & Cannon-Bowers, 2001)
Integrity	Integrity is having the constitution, or individual do the right action when no one else is around.	(Salas & Cannon-Bowers, 2001)
Flexibility	Flexibility in the profession includes the sincerity and ability to respond positively to changes in the surroundings and occurrences with acceptance, as Alison Doyle (2019) stated.	(Doyle, 2019)
Critical Thinking	Critical thinking includes the component skills of analysing arguments, making inferences using inductive or deductive reasoning, judging or evaluating, and making decisions or solving problems by applying, analysing and synthesising the evidence that supports it and the further reasoned conclusions to which it tends	(Lai, 2011)
Professionalism	Professionalism is a critical concept in the sociologies of work, occupations, professions and organisations.	(Evetts, 2013)
Time Management Skills	Time management is the speciality of coordinating, sorting out, appointing and planning students, the ideal opportunity for creating more suitability of work and efficiency.	(Gul et al., 2021)
Interpersonal Skills	In face-to-face interactions, Goal-directed behaviours bring about a desired state of affairs.	(Frost, 2009)
English Proficiency	Self-assessed ability to read and write very well in English.	(Posel & Casale, 2011)
Lifelong Learning	Lifelong learning is a socio-personal process and a personal fact.	(Posel & Casale, 2011)
Entrepreneurship skills	Entrepreneurship is the capacity of a person to turn ideas into practice. It requires imagination, ingenuity, risk-taking, and the ability to organise and execute projects to attain goals.	(Pardo-Garcia & Barac, 2020)

Soft Skills Development Among Quantity Surveying Graduates in Malaysia

Even though Malaysian graduates are well-educated in their subjects, the prevailing view among Malaysian employers is that they need more soft skills. Employers frequently want graduates with communication abilities (Khalid et al., 2014). Malaysian graduates need more language and communication abilities. One of the attributes of work skills graduates require to enter the labour market successfully is the ability to communicate. To avoid and resolve conflicts, good communication skills and the ability to transmit and receive information and interpret the audience (Ting et al., 2017).

Various authors' views regarding the best skill for QS graduates lead to multiple consequences. As a result, academic institutions will likely produce a graduate that employers see as failing to fulfil their expectations. This leads to complications with extended levels of gap between employer and graduate dissatisfaction and difficulties in early career development for the QS graduates. Much research has investigated the skills employers expect from graduates. In a study by Malhi & A. Wahab Bakar (2008) and Robles (2012), researchers listed several soft skills employers need. Some of their shared result lists are integrity, teamwork, communication, and flexibility skills required for the workplace. Based on previous studies, Hassan et al. (2011) also found behavioural competency to 'soft skills' behaviours that support technical skills to perform the job effectively among QS. The five soft skills required by the QS are Communication, Adaptability to the job, Teamwork, Critical Thinking and leadership and Discipline and punctuality. Thus, to remain relevant in a fast-changing world, the QS profession must acknowledge the current critical competencies that are the core strengths for current and future commercial success in the built environment (Yap et al., 2022).

Interestingly, while graduates often prioritise the technical content of their educational programs, the industry's inclination is shifting. There's a growing demand for graduates fortified with soft skills competencies, often overshadowing the need for technical prowess. This evolution underscores the importance of a holistic educational approach, ensuring graduates are well-rounded and adept in technical and interpersonal domains.

The Expected Soft Skills Required from Employers Towards Quantity Surveying Graduates

The Quantity Surveyor's profession has continually evolved from being just a skill for architecture to independent full-fledged honours degrees, as do employers' requirements towards Quantity Surveyor's skills (RICS, 2013). In the past, quantity surveyors were equipped with limited soft skills. However, the modern QS profession demands more versatile capabilities, like critical thinking, especially with potential arbitration roles on the horizon. Reflecting the dynamic needs of the construction industry, many QS firms have diversified their services (Chong, Lee & Lim, 2012), now encompassing facilities management, arbitration, and many more.

Each employer looks for different traits and experiences depending on the job's scope or goals. To match these unique core competencies, there are specific soft skills every employer looks for in a QS's graduates. Soft skills have their definition and value. They are closely related to personal qualities, interesting attitudes, habits, and social graces that make someone

a good employee and friendly. Employers emphasise soft skills because the research shows they can be as significant an indicator of job performance as hard skills (Alison Doyle, 2019). In new global industrialisation, cooperation in large organisations with people in different fields is required, putting a new incumbent on people skills and relationship-building.

The Pacific Association of Quantity Surveyors (PAQS) have documented several essential skills, half of which are soft skills. Furthermore, they claim it is a vital aspect and needs to be acquired by fellow Quantity Surveyors (PAQS, 2001). These are quantification or measurement, communication Skills, personal and interpersonal skills, business and management skills, professional practice, computer and information technology, construction technology, and construction law and regulation. Four of them are soft skills: communication skills, personal and interpersonal skills, business and management skills, and lastly, professional practice. In another research by Mahbub (2001), most employers want to employ graduates with social and communication skills, initiative to work and learn, total commitment, mental and physical endurance, and the ability to communicate and write in English. This sentiment is echoed by Shafie et al. (2014), who found that most employers in QS organisations seek graduates with critical thinking, problem-solving, decision-making skills, fluent communication, and the ability to work autonomously. Furthermore, they believe professional ethics, morals, and self-confidence are indispensable for successful QS roles.

The Challenges of Soft Skills Among Quantity Surveying Graduates

Due to the rapid transformation of technology advancement and the complexity of construction projects, the job scopes for Malaysian quantity surveyors have entirely changed. Graduates must expand and broaden their job scope from not just doing tendering and contracting documents, measurement, variation order and other traditional jobs (W. Y. Tan & Chan, 2016). QS graduates enter the labour market without the required employability abilities or soft skills (Joseph et al., 2020). Thus, many challenges are faced to strategies' the soft skills issues among QS graduates. This section delves into QS graduates' multifaceted challenges, rooted primarily in their soft skills proficiency.

The Uses of Conventional Course Content and Curriculum by Universities

Modern industries, especially the rapidly evolving construction sector, demand graduates with a multifaceted skill set. However, several universities continue to rely on traditional course content and curricula that may not align with these contemporary needs. Employers have voiced concerns about the mismatch between graduates' academic preparation and the job market's practical requirements (Zakaria et al., 2006). Furthermore, data in Malaysia suggest that the outcomes of fresh graduates from higher education institutions, notably universities, still need to meet the demand for employment vacancies, with 30% of graduates needing help finding work after graduation (Azmi et al., 2018). Institutions must advance to a new system that produces diverse skills and attributes contributing to employability (Harvey et al., 2002). The failure of universities to deal with this issue could create an unnecessary negative perception, which could lead industries to become more selective in recruiting capable graduates to work for them.

Changing Demand for QS Graduates' Soft Skills Due to Modernisation

The construction industry is undergoing rapid modernisation. With technological advancements and the rise of digital tools, Quantity Surveyors (QS) roles and responsibilities have expanded significantly. The growing dissatisfaction that the business expresses with the competencies of current graduates is a significant threat to the QS profession today. All these changes in the job that may occur will demand future graduates to have new and diverse skills and abilities to successfully carry out the obligations that the industry expects of them. As a result, there is an immediate need to define the competencies that the industry expects graduating QSs to develop. (Yogeshwaran et al., 2018). Harvey et al. (2002) state that nowadays, employees and graduates need various work settings due to the complexity of the modern workplace. With the construction industry becoming more globalised, there's a heightened emphasis on soft skills that facilitate international collaboration. QS graduates are often expected to work with diverse teams from various cultural backgrounds, underscoring the importance of cultural sensitivity, language proficiency, and effective interpersonal communication.

Changing of QS Graduates' Roles Toward Industrial Revolution 4.0

Industrial Revolution 4.0 has been around in the construction industry for a while, and the technologies are at various stages of maturity. Alaloul et al. (2020) pointed out that QS has experienced significant changes over the past decade regarding the scope and type of services provided within and outside the construction sector. Soft skills have become even more critical in this era of digital transformation. As automated systems and AI-driven tools take over routine tasks, QS graduates must cultivate skills that machines cannot replicate. This includes critical thinking, creativity, emotional intelligence, and the ability to collaborate across diverse teams and stakeholders. The nature of employability keeps changing; graduates need to be informed by long-term studies and attitudes toward graduate employment and career paths. A. Tan et al. (2017) stated that, with a thorough understanding of IR4.0 evolution and implementation, it appears critical for higher education to introduce IR4.0 at an early stage of QS education. The introduction of IR4.0 could allow higher institutions to position themselves and prepare future QS capable of meeting industrial demand. (Lim et al., 2023).

Diversification in A Career Path in The Construction Industry

As the construction industry developments grow in complexity and size, the QS jobs are changing and diversified from preparing the Bill of Quantities to providing project and building management services (John Wong, 2002). In other words, the roles and functions of QS are currently multi-disciplinary within the construction industry's perspective. QS studies include various elements, which include management, Information and Communication Technology (ICT), law, economics, and technology: administration and operational research. The roles of quantity surveyors have also been diversified in areas such as oil and gas, insurance valuation, taxation and several other regions (Zakaria et al., 2006). Thus, QS should be prepared for the future new era of the QS profession.

The Priorities of Hard Skills Over Soft Skills by Universities

Despite the shifting demands of the job market, many universities continue to prioritise hard skills in their curricula. While technical knowledge remains vital, an overemphasis can lead to graduates needing to be equipped to handle the challenges of the modern workplace. Employers globally have recognised this gap, with many citing a lack of soft skills among recent graduates as a significant concern. In the present climate of rapid change, universities could have been more successful in providing the construction industry an expected employee as they are reluctant to emphasise soft skills and prefer to focus on hard skills. Furthermore, they needed to prepare the graduates to embrace actual workplace conditions and challenging situations where they need more soft skills and high mental discipline rather than hard skills (Zakaria et al., 2006). Hence, universities need to be aware of the necessity to develop a long-term integrating strategy for employability that fulfils employers' demands, drives employability skills in the curriculum, and makes a closer relationship between central services and programmed-based initiatives (Harvey et al., 2002).

The Lack of English Proficiency

English proficiency is undeniably pivotal in today's globalised world, influencing educational outcomes and career prospects. For many professions, especially those that operate on an international scale, like the construction industry, a command of English is not just an advantage. It's a necessity. A statistic from the government of Malaysia in 2006 identified that nearly 50,000 university graduates were jobless because one of the main reasons was lack of fluency in the English Language (Phang, 2006). A lack of English proficiency can significantly hamper a graduate's employability. Many employers view it as a fundamental skill, given its importance in tasks like report writing, presentations, and client interactions. For Quantity Surveyors and other professionals in the construction industry, the ability to understand contracts, technical documents, and international standards often written in English is crucial. Graduates who need help with English may find themselves at a distinct disadvantage when competing in the job market.

The Reluctant Employers Trained the Employees

Many corporate training departments are reluctant to provide soft skills training because they view the concept of training soft skills as a motivational seminar that motivates employees and provides little benefit to the company that pays for the activity (Onisk, 2011). Although some money is used to train managers to comply with workplace rules and teach them the basics, sometimes little care is given to soft skills training (Robles, 2012). While valid concerns might make employers hesitant to invest in training, the long-term benefits of a well-trained workforce, increased productivity, adaptability, and employee retention often outweigh the short-term costs. Addressing these concerns and highlighting the value of training can help shift perceptions and encourage more employers to prioritise employee development.

RESEARCH METHODOLOGY

Research design is crucial because it helps the various research activities go smoothly, resulting in more efficient research that gives maximum information with the least amount of work, time, and money (C.R., 2004). The data collected from the questionnaire survey is analysed using Statistical Packages for Social Science (SPSS) for this research. The sample is limited to Selangor, Malaysia. The small sample size was primarily due to the need for help accessing the target population within the allocated time frame. The response rate is 22%, with 28 respondents out of 132 consulting quantity surveyor firms in Selangor, Malaysia. The data gathered is relatively tiny compared to the general population. Due to this limited sample size, the findings may need to be more generalisable to the broader population. However, it's worth noting that the small sample represented a diverse group regarding age, gender, and experience, providing a varied perspective. Thus, future research should include a more extensive and diverse sample to enhance the generalizability and robustness of the findings. Besides, this research provides preliminary insights into the employers' expectations towards soft skills competencies of QS graduates in Malaysia, paving the way for more extensive research in this area.

DATA ANALYSIS AND DISCUSSION

Objective One – Soft Skills Development Among QS Graduates in Malaysia

Based on Table 2, the mean value shows that the QS surveying graduates who need assistance from colleagues ranked the highest mean. The graduates needed support, guidance and motivation from colleagues, primarily from seniors or employers. Besides, the graduates may need time to improve their soft skills. The average preferred skills will be the positive soft skill development among QS graduates. This result shows on the overall summary that the employer could be keener but still agrees that there is positive development among graduates. The insufficient university QS module offers the lowest weighted mean ranking. This indicates that the institution may not be the main reason for soft skills development among graduates.

Table 2. Soft Skills Development Among QS Graduates in Malaysia

Soft Skills Development	Mean	Ranking
QS's graduates need help from colleagues to develop their soft skills	4.18	1
QS's graduates take time to improve their soft skills	4.00	2
Employers will hire QS graduates who acquire good soft skills	3.93	3
QS's graduate's soft skills are constantly improving on their first job	3.79	4
Hard skills are more important than soft skills	3.79	5
Hard skills alone will not guarantee the QS graduates best performance	3.64	6
Soft skills are hard to acquire	3.64	7
There is a positive soft skill development among QS's graduates	3.61	8
Some soft skills are essential, and some are not relevant	3.43	9
The University QS's module is not sufficient to provide soft skills that meet employer's expectation	3.21	10

Objective Two – The Expected Soft Skills Required from Employers Towards QS Graduates

The first eight (8) soft skills were considered highly expected as they are more than (>3.50 mean value); meanwhile, the rest of the soft skills are moderate expectations. The soft skills expected and preferred by the respondents are willingness to learn, integrity skills, ethical behaviour, and teamwork skills. This is due to the working environment requiring all soft skills needed. Furthermore, graduates will deal with many stakeholders and require very high integrity. The third highest expectation is accepting criticism and working well under pressure. The respondents believe these soft skills will meet QS's firm's requirements. Most respondents agreed that these soft skills and traits are the most important for QS graduates to improve their performance. The last and least expectation from employers is entrepreneur skills, with a moderately weighted mean but nearly 'low expectation' weighted mean.

Table 3. The Expected Soft Skills Required from Employers Towards QS Graduates

Soft Skills	Mean	Ranking
Willingness and continuous learn	3.86	1
Integrity value	3.86	2
Ethical and moral behaviour	3.79	3
Teamwork skill	3.79	4
Ability	3.75	5
Working well under pressure	3.75	6
Adaptability skill	3.68	7
Self-Confidence behaviour	3.61	8
Communication skill	3.43	9
Charismatic value	3.39	10
Interpersonal skill	3.32	11
Professionalism skill	3.32	12
Time Management skill	3.32	13
Leadership value	3.21	14
Proficiency Language skill	3.21	15
Critical thinking and problem-solving skills	3.14	16
Entrepreneur skill	2.75	17

Objective Three – The Challenges of Soft Skills Towards QS Graduates

Based on Table 4, it is found that most of the respondents agree that the most challenging factor for the graduates is being introverted. Diversifying career paths in the construction industry is also the most challenging part for graduates. Entrepreneur skill is the least expectation for a quantity surveyor's firm. Still, the ability to promote a product is capitalised in another career path, such as big developer companies with the quantity surveyors needed to convince a client to accept the proposed project. The uncertainty of QS roles in the future is also a new challenge for graduates. Employers also agreed that English proficiency is also a challenge for graduates. Both challenges ranked number two. Diversification in career path changes in Quantity Surveyor's role and changing demand for soft skills towards quantity surveyors are the most minor challenges. This may be because the probability of changing demand is relatively low, based on the employer's experience.

Table 4. The Challenges of Soft Skills Towards QS Graduates

Challenges of Soft Skills	Mean	Ranking
Being an introverted person in a university and working environment	3.75	1
Diversification in a career path in the construction industry	3.75	2
The lack of English proficiency among QS's graduates	3.64	3
Changing of QS's graduate's roles towards Industrial Revolution 4.0	3.64	4
The soft skill exposed is not provided enough by the university	3.54	5
Being unemployed for quite sometimes	3.54	6
Changing demand for QS's graduate's soft skills due to modernisation	3.54	7
The unnecessity priorities on hard skills rather than soft skills development	3.25	8
Lack of support from the employer to improve QS's graduate's soft skill	3.07	9

CONCLUSIONS

The research unequivocally highlighted the increasing importance of soft skills in the construction industry. While technical skills remain foundational, the findings show that the willingness to learn, followed by ethical behaviour and teamwork skills, has become paramount for QS professionals. A significant gap was discovered between the soft skills training supplied by universities and the industry's requirements. There is an urgent need for educational institutions to rebalance their curricula by incorporating more extensive soft skills training to prepare graduates for real-world difficulties better. Universities and employers have a role to play in fostering the holistic development of graduates. On-the-job training, internships, and mentorship programmes were indicated as helpful opportunities for young professionals to develop their soft skills further.

This research is limited to quantity surveyor consultancy firms. As a result, broadening the analysis to incorporate the contractor's perspective as a recommendation for future investigations is beneficial. This is because the roles of quantity surveyors in consulting firms, developers and contractors varied slightly. Furthermore, additional research into ways to develop the soft skills of quantity surveyor graduates is needed. Finally, this research offers an intriguing opportunity to measure and comprehend the demand for quantity surveyor graduate employability, and the study also emphasises the importance of adapting to changing circumstances, ensuring that the next generation of QS professionals is equipped with technical expertise and the soft skills required to flourish in a quickly changing world.

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REVOLUTIONIZING QUANTITY SURVEYORS: UNLEASHING COMPETENCY IN CONSTRUCTION 4.0 – A PILOT STUDY IN MALAYSIA

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Abstract
Competency plays a pivotal role in the effectiveness and efficiency of professionals across various fields. The advent of enabling technologies in Construction 4.0 has led to a demand for new competencies and skills in many professions, including Quantity Surveyors. To address this, the research aims to develop a competency model for Quantity Surveyors equipped with the enabling technologies that have emerged in Construction 4.0. To achieve this objective, a pilot study was conducted using a quantitative survey approach. The study involved distributing questionnaires to fifty Quantity Surveyors using purposive sampling, and three key constructs were measured; i) non-technical competency, ii) technical competency, and iii) enabling technologies in Construction 4.0. The collected data underwent rigorous analysis for reliability, validity, and descriptive statistics. The findings from the pilot study indicated that a significant number of respondents acquired both technical and non-technical competencies. However, the integration of enabling technologies in Construction 4.0 was observed to be limited to specific technologies that are highly demanded and extensively utilized in Quantity Surveying practices. Additionally, the research instrument also demonstrated sufficient internal consistency and validity. Based on the positive outcomes of the pilot study, the research is deemed feasible and can proceed with the main data collection phase, which will involve a larger sample of targeted respondents. This expanded study will provide more comprehensive insights into the competency model for Quantity Surveyors in the context of Construction 4.0, enabling them to adapt effectively to the technological advancement in their profession.

Keywords: *Competency; Construction 4.0; Quantity Surveyors; Pilot Study; Revolutionizing*

INTRODUCTION

The term ‘competence’ has been subjected to diverse interpretations over time, with scholars offering various definitions. Some researchers, such as Prahalad & Hamel (1990), Stalk, Evans, and Shulman (1992), and Tampoe (1994), referred to competence as a ‘core competency,’ encompassing a comprehensive array of vital technologies and critical capabilities that ensures an organization’s competitive advantage. This perspective on competence tends to be more organizationally oriented rather than individual-focused. Conversely, other scholars, including Boyatzis (1982), Schroder (1989), and Buryone (1993), emphasized the ‘individual’ aspect of competence. This is frequently employed in human resources management to provide clearer descriptions. Langdon & Whiteside (2004) defined competence as a combination of skills, knowledge, and attributes leading to high performance in a professional domain. On the other hand, Dragnidis and Mentzas (2006) characterized competence as a blend of tacit and explicit knowledge, behavior, and skills that empower an individual to excel in task performance. Essentially, competency equips professionals with the necessary skill sets to take responsibility for the prescribed body of knowledge, enabling them to effectively apply their expertise (Shafie, Khuzzan, and Mohyin, 2014).

The advent of Industry 4.0, also known as Industrial Revolution 4.0 in Malaysia has significantly impacted the requirements for professional competence in performing assigned tasks. Updating skill sets has become imperative to ensure the continued viability and sustainability of current professions within a competitive market. Industry 4.0's influence is not limited to the manufacturing sector; the construction industry has also been compelled to embrace Industry 4.0 principles, as evidenced by the Construction Industry Development Board (CIDB) Malaysia's initiatives in launching the Construction 4.0 Strategic Plan: 2021-2025. Hence, as for the construction industry, this industrial revolution is specifically termed Construction 4.0 to emphasize the revolution in the construction field (CIDB, 2020). This strategic plan aims to transform the Malaysian construction landscape into a smart and sustainable sector, while also fostering programs to enhance the construction industry's capacity in the context of Industry 4.0 (CIDB, 2020). Therefore, to accomplish this, Construction 4.0 is driven by four key enablers that collectively form a comprehensive ecosystem to address these transformative changes.

Consequently, this research embarks on a pilot study to assess the level of competence among Quantity Surveyors (QS) within the construction domain and to identify the enabling technologies related to Construction 4.0 utilized in QS practices. As of to date, the current competency highlighted by professional bodies is limited to only one technological advancement in digitalization deriving from Construction 4.0 waves (BQSM, 2016). Hence, this research seeks to shed light on the preparedness of QS professionals to navigate the evolving landscape of Construction 4.0 and its associated technological advancements.

METHODOLOGY

A purposive sampling technique was employed to select a sample of thirty Quantity Surveyors who fulfilled specific criteria, namely, having undertaken Quantity Surveying courses at the basic education level and having completed such courses at local universities in Malaysia (either public or private HEI). This sampling technique was chosen due the circumstances in which the researchers were able to select participants who had specific criteria to ensure the sample consisted of individuals with relevant educational backgrounds and expertise in this field, which and eventually to provide invaluable insights into the research objectives. Accordingly, for this pilot study, fifty questionnaires were distributed to the Quantity Surveyors' population that met the specific criteria above. However, after the data cleaning was performed, only thirty questionnaires were usable for further data analysis process. In short, this value contributes to the response rate of around sixty percent. In order to assess competency in Construction 4.0, an instrument was developed based on an extensive literature review and document analysis. The instrument encompassed seven (7) non-technical competencies, ten (10) technical competencies, and three (3) clusters representing enabling technologies in Construction 4.0. The construct validity of the instrument was ensured through a content validation phase, where expert panels evaluated its relevance and accuracy. The Content Validity Index (CVI) was then calculated to gauge the extent of the overall validity of the measurement tool (Yusoff, 2019). Subsequently, the validated instrument, along with one open-ended question, sought respondents' recommendations on the essential skills Quantity Surveyors should acquire to maintain competitiveness in the construction industry and was administered to the targeted respondents. The data collected from the respondents were then compiled, and statistical analysis of descriptive, mean, and standard deviation was performed using the IBM SPSS Version 26 software to derive

meaningful insights into the competence levels of Quantity Surveyors with regards to Construction 4.0.

DISCUSSION AND KEY FINDINGS

Reliability and Validity Results

A reliability test is an assessment of the consistency between multiple measurements of a variable. The commonly used measure of reliability is internal consistency. Internal consistency is expressed based on acceptability (Amrina & Yusof, 2011). Accordingly, Cronbach's alpha reliability coefficient normally ranges between 0 and 1 where the closer the Cronbach's alpha is to 1.0, the greater the internal consistency of the items in question in the scale. Ursachi, Horodnic, and Zait (2015) mentioned that the generally accepted rule is that an alpha of 0.6 – 0.7 indicates an acceptable level of reliability while a result that is greater than 0.8 is deemed to be at a very good level. Meanwhile, Streiner (2010) suggested that Cronbach's alpha 0.5 is considered acceptable reliability. Hence, the researcher agreed that if the acceptable Cronbach's alpha for this study sits between > 0.5 to 0.9, it would then be deemed as acceptable. The summary of the reliability is given in Table 1 below:

Table 1. Reliability Results

Variables	No. of Items	Alpha Value
Non-Technical Competency	18	0.967
Technical Competency	35	0.988
Enabling Technology in Construction 4.0	36	0.956

Validity is an important measure of a survey instrument's accuracy. Yusoff (2019) stated that validity should measure the content of the item the way it is intended to be measured. In this study, the content validity of the questionnaires was conducted through a Content Validity Index (CVI) calculation based on the experts' panel validation. First, the developed questionnaires were based on the variables derived from an extensive literature review and document review from six (6) Quantity Surveyors' professional bodies and (CIDB, 2020) by Construction Industry Development Board (CIDB) of Malaysia. In the next stage, the questionnaires have been sent to six (6) expert panels, who are either as Professional Quantity Surveying (industry practitioners) or Doctorate holders in the Quantity Surveying field (academicians). According to the feedback from the panels, CVI was calculated to refine the questions to be in a state where it remained, improved, or eliminated. Therefore, the instrument developed for this study is considered achieving its content validation.

Analysis of Questionnaire Survey

Non-Technical Competency Measures

In this section, the researchers aimed to rank the importance of competency measures among the Quantity Surveyors by utilizing a five-point Likert Scale, where respondents indicated their competency level for each measure. The scale ranged from 1 = no competence to 5 = advanced competence. The mean competency score for each measure is presented in Table 2, while Figure 1 illustrates the seven competency measures.

The findings from Table 2. and Figure 1. shed light on the most crucial non-technical competencies possessed by Quantity Surveyors. The top-ranked competency was teamwork skills, which hold a significant importance in the Quantity Surveying profession. Quantity Surveyors interact with multiple parties, such as engineers, project managers, site supervisors, clients, contractors, and architects, during various stages of projects. However, research conducted by Md Yaakob, Meng Lim, Hashim, and Ai Ling (2023) did not consider teamwork skills as part of the prioritized soft skills that were needed in their research. The reasons for not explicitly listing such skills may be due to the varied terminology, which some scholars may alternative labelled teamwork skills as collaborative skills and/or interpersonal skills. Hence, in line with this, Md Yaakob et al. (2023) listed interpersonal skills as a part of the priority competency among Quantity Surveyors.

Table 2. Non-Technical Competency Importance Level

Measures	Mean	Rank
Teamwork Skills	3.80	1
Lifelong Learning	3.78	2
Professional Ethics	3.66	3

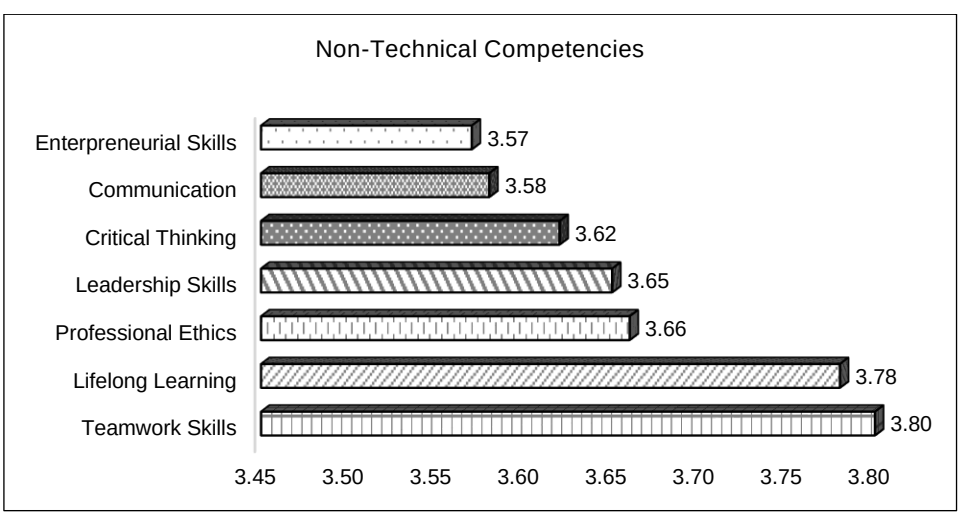

Figure 1. Non-Technical Competencies

The second most ranked competency was lifelong learning, which is crucial for this profession. The dynamic nature of the construction industry and the rapid technological advancements, such as CostX, Revit, and Buildsoft applications, necessitate continuous learning to ensure that Quantity Surveyors remain up to date with the latest knowledge and skills. This commitment to lifelong learning ensures the profession's sustainability and enhances adaptability to changing technological trends. Ideally, lifelong learning helps individuals prevent their expertise from becoming outdated, ensuring their continued relevance in their chosen fields (Wong, Low, Wong, and Janarius, 2022). Meanwhile, the competency that ranked third was professional ethics. It was evident that Quantity Surveyors, both Professional and Provisional, are bound by the Quantity Surveyor Act 1967 (Amendment Rules 2016) and are required to adhere to the Code of Professional Conduct outlined in Part IV, Clause 26 and Clause 27 (BQSM, 2016). This finding confirms that the majority of respondents are considered professional in their roles as Quantity Surveyors, adhering to the ethical standards prescribed by the governing regulations.

The other four competencies, namely leadership skills, critical thinking, communication, and entrepreneurial skills, also received relatively high mean scores, with close margins between them. These competencies are moderately possessed by Quantity Surveyors, suggesting that while they have reasonable proficiency in these areas, there is still room for improvements. Overall, this section provides a comprehensive understanding of the competency landscape among Quantity Surveyors. It highlights the critical role of teamwork, the importance of lifelong learning to adapt to technological advancements, and the commitment to professional ethics. Additionally, the moderate possession of leadership skills, critical thinking, communication, and entrepreneurial skills indicates potential areas for further development and training within the Quantity Surveying profession.

Technical Competency Measures

Figure 2 presents the technical competencies of Quantity Surveyors, with Quantification, Information Technology, and Procurement emerging as the top. Three highly ranked competencies were possessed by most respondents in this pilot study. Conversely, Economics and Finance, as well as Law and Regulations, were perceived as the least possessed competencies, with percentages of 67.8% and 68.7% respectively. Despite being the lowest ranked, these values can still be considered moderate, indicating a reasonable level of competency in these areas among the respondents. Based on Table 3, the finding shows that Quantification or Measurement is the most crucial competency that aligns with the historical roles of Quantity Surveyors, as mentioned by Moss (2004) and Md Yaakob, Yiu Pan, Kamarazaly and King Loo (2022). This emphasizes the importance of the core responsibility of Quantity Surveyors in accurately quantifying and measuring project components, such as materials, labours, and costs, which form the basis for effective project management and cost control (Md Yaakob et al., 2022; Md Yaakob et al., 2023).

Table 3. Technical Competency Importance Level

Measures	Mean	Rank
Quantification	3.84	1
Information Technology	3.69	2
Procurement	3.65	3

Continued with that, Information Technology (IT) emerges as the second most ranked competency, reflecting its vital role in the Quantity Surveying profession. The aspects of understanding and application of basic computer skills are necessary for Quantity Surveyors to manage data, perform calculations, and effectively use software tools (Ling, 2014). Moreover, in the context of Construction 4.0's digitalization trends, basic computer proficiency becomes a prerequisite for professionals across various industries, including Quantity Surveying, making IT competence a vital attribute. Procurement, listed as one of the historic roles of Quantity Surveyors by Moss (2004), also stands out as significant competency possessed by most respondents. This finding underscores the importance of Quantity Surveyors' knowledge and understanding of procurement processes, as it plays a crucial role in project delivery and cost optimizations. Besides, it is also in line with the research by Md Yaakob et al. (2023) which clearly highlighted that both the employer and student perspectives prioritize procurement competency as important for Quantity Surveyors.

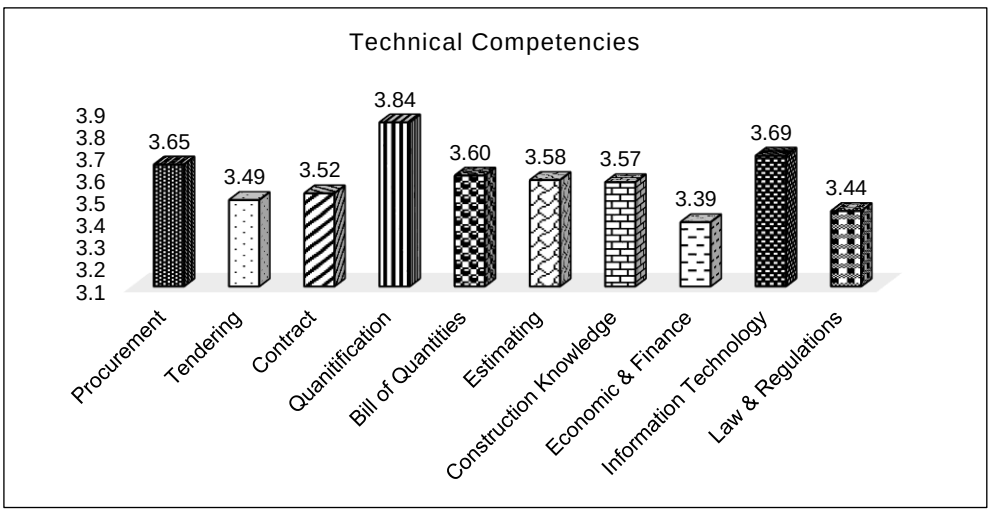

Figure 2. Technical Competencies

While, Economics and Finance, Law and Regulations, and the other seven technical competencies are considered moderately possessed by the respondents, it is noteworthy that all competencies scored above the value of 3.00, indicating a competency level between average and above average. This suggests that most of the respondents are competent as Quantity Surveyors, demonstrating proficiency across various technical competencies. The findings from this pilot study align with previous research by Smith (2004) and McGraw (2007), which highlighted that despite significant changes in roles and scope of services, traditional services such as cost engineers and builders' quantities remain essential aspects of the Quantity Surveying profession. The study emphasizes the importance of maintaining a strong foundation in these core competencies while embracing the evolving demands of the industry. These findings contribute to the understanding of the competency landscape among Quantity Surveyors in the context of Construction 4.0 highlighting the relevance of traditional roles and the significance of embracing technological advancement in the construction field.

Enabling Technologies in Construction 4.0 Measures

In this section, the enabling technologies were divided into three (3) clusters namely Cluster 1: Simulation and Modelling; Cluster 2: Digitalization and Virtualization, and Cluster 3: Smart Construction, following the categorization adapted from the Construction Industry Development Board (CIDB, 2020). The data collected indicated that Cluster 3 was often ranked highest, followed by Cluster 2 and then Cluster 1. The items under each cluster demonstrated the potential usage of enabling technologies in supporting the roles of Quantity Surveyors. In Cluster 2, the Internet of Things (IoT) and Artificial Intelligence (AI) emerged as the highest potential usage technologies. Respondents reported predominantly using the Internet to store data centrally, employing cloud computing in large-scale projects. The findings on artificial intelligence were aligned with research by Basaif, Alashwai, Mohd Rahim, Abd Karim, and Loo (2020), which observed the uptake of AI in risk analysis for construction projects. Additionally, the application of IoT for information sharing through platforms like Google Drive and Dropbox was also a shred of evidence.

Table 4. Enabling Technologies in Construction 4.0 Importance Level

Measures	Mean	Rank
Cluster 3: Smart Construction	2.25	1
Cluster 2: Digitalization and Virtualization	2.24	2
Cluster 1: Simulation and Modelling	2.11	3

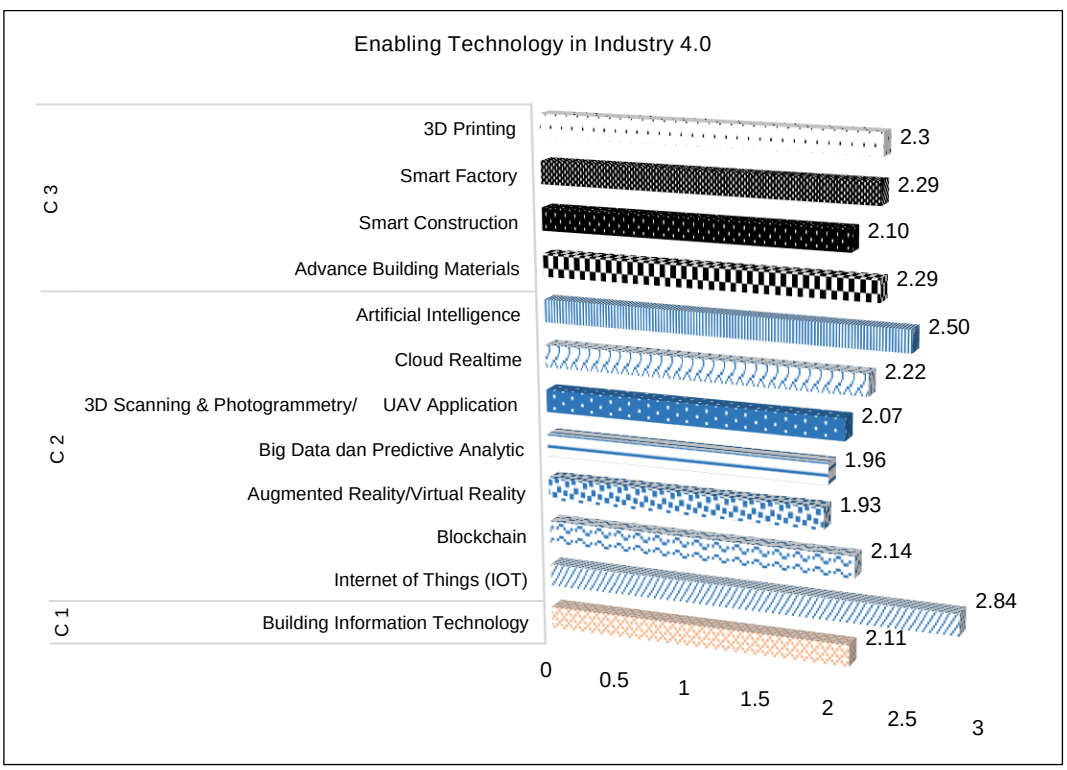

Figure 3. Enabling Technologies in Construction 4.0

Interestingly, research by Angle Cezar, Kamarazaly, Seong King, and Mbachu (2023) highlighted the benefits of augmented reality in the construction profession which implies that the skills to use augmented reality becoming important and might become crucial in the foreseeable future. Meanwhile, Pei Sin, Fah Choy, and Fung (2020) in their research emphasized the potential application of Big Data in the construction field which also supports the need of enabling technology competency related to big data in the construction field. On the other hand, in Cluster 3, 3D Printing stood out as a significant enabling technology for respondents, indicating its relevance in construction projects where additive manufacturing has shown potential for efficiency improvements and cost savings.

In Cluster 1, which exclusively comprised Building Information Modelling (BIM), respondents were generally familiar with the usage of BIM applications in projects and have experience in generating data using BIM tools. However, in terms of producing detailed cost plans based on the design developed in BIM, respondents reported limited usage of BIM for that specific task. Overall, the results from this section suggest that most respondents in this pilot study are well-acquainted with certain enabling technologies under Construction 4.0 revolution. The higher rankings of Cluster 3 and Cluster 2 indicate that Smart Construction technologies and Digitalization/Virtualization technologies are particularly relevant and

ideally utilized by Quantity Surveyors. However, the limited application of certain BIM functionalities in producing detailed cost plans reveals potential areas for further explorations and improvements.

Therefore, this pilot study provides an initial insight into the potential usage of enabling technologies among Quantity Surveyors, with Smart Construction and Digitalization/ Virtualization technologies being more prominently ranked. The research underscored the relevance of certain Construction 4.0 technologies to the Quantity Surveying profession and highlights the opportunities for further research and development to optimize the integration of these technologies in QS practices. It is essential to acknowledge that this research serves as a pilot study with a limited respondent population. As such, the findings may not be fully representative of the broader population of Quantity Surveyors. The main data study, with a larger and more diverse sample size, is likely to yield more comprehensive and nuanced insights.

CONCLUSION

In summary, this pilot study has concluded invaluable insights into the competency levels of Quantity Surveyors (QS) in the context of Construction 4.0. The main findings indicate that the majority of QS demonstrated a common possession of technical and non-technical competencies, falling within the range of average to above-average competence. As a result, the overall level of competency possessed by QS can be concluded as average. Moreover, the study revealed that enabling technologies from Construction 4.0 are not yet extensively adopted in QS practices. Only a limited number of enabling technologies are highly demanded and currently being utilized by QS professionals. This finding highlights the need for further exploration and adoption of Construction 4.0 technologies in the field of Quantity Surveying to unlock its full potential. The research instrument used in this study demonstrated adequate internal consistency, reaffirming its reliability and suitability for measuring competency and enabling technologies in the context of Construction 4.0 among QS professionals. As such, it can be said that the instruments are valid to proceed with the main data collection involving the actual number of the targeted population.

This research makes a significant contribution to the understanding of the competency landscape in the construction industry, specifically among Quantity Surveyors in the era of Construction 4.0. By addressing both technical and non-technical competencies and their alignment with enabling technologies, the study sheds light on the preparedness of QS professionals to adapt to the changing demands of the modern construction environment. One major limitation of this pilot study is the relatively small sample size of thirty respondents. While the findings provide valuable initial insights, a larger and more diverse sample of QS professionals could enhance the generalizability and robustness of the results. In relation to that, to enhance the research's comprehensiveness and applicability, future studies should consider expanding the sample size to include a more diverse pool of Quantity Surveyors from various regions and sectors of the construction industry. Besides, investigating the barriers and challenges faced by QS professionals in implementing Construction 4.0 technologies would provide valuable information for crafting effective strategies to overcome obstacles and foster technology adoption for the construction industry would be a valuable area of future research.

In conclusion, this pilot study serves as a steppingstone toward a more comprehensive understanding of the competency and the integration of enabling technologies in the construction industry. By addressing the limitations and building on the findings of this study, future research can contribute to equipping Quantity Surveyors with the necessary competencies to thrive in the era of Construction 4.0 and drive innovation in the construction sector.

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APPLICATION OF BIOPHILIC DESIGN CONCEPT IN THE MALAYSIAN CONSTRUCTION INDUSTRY: ARCHITECTS' PERSPECTIVES

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Abstract
The connections between humans and nature are not something new. Thus, Biophilia is defined as an innate affinity that has a connection between human beings and nature until the concept of biophilic design integrates with construction design that is occupied by humans. The presence of nature is crucial and has influenced many design buildings in Malaysian Construction Industry including residential, offices, hotels and schools. Therefore, this research aims to investigate the application of the biophilic design concepts in the Malaysian Construction Industry. The objectives were to identify the application of biophilic design in a building and to determine the importance level of having biophilic design components in a building. An extensive literature review was done to obtain the general concept of biophilic design in a building. Questionnaire surveys were distributed via an online platform to know in depth the application of biophilic design concept and the importance level of having it in a building in the Malaysian context. A total of 41 responses among certified architects were obtained and analysed by using SPSS software. Findings revealed that most of the respondents agreed that the biophilic design concept offers many benefits to buildings and their environment especially in terms of health, both physically and mentally. Moreover, it also plays a vital role as a crucial element in the design for new project developments. The concept of biophilic design highlights the importance of having nature-concept relation with humans. In addition, this concept has been recommended by professionals from a construction background to start to implement this biophilic design as many as possible in buildings, especially for public use that fits into climate change and surroundings.

Keywords: *Biophilia; Biophilic; Design concept*

INTRODUCTION

Every individual wants to live healthy every day, especially in this modern era. However, many people live in a building without integration with nature. This could lead to an increase in sick people, especially when we live in the new norm with the pandemic virus. According to (Wu, Nethery, Sabath, Braun & Dominici, 2020), people who live in a neighbourhood that experiences bad air pollution due to the absence of greenery of nature have proven to state a high number of the death. Numerous studies have proven that reveal to nature can help us reduce stress and boost our mood, immune systems and productivity. In fact, many developments have embedded with nature especially in the medical field, agriculture and even in the construction industry. (Russell et al., 2013) mentioned that the ecosystem has provided many of the material building blocks for well human beings. Malaysia is a country that is blessed to be rich with natural resources. However, there is still a gap between our desire for nature, our everyday lives and sustainable conduct (Andreucci et al., 2021). This shows that there has been a love-hate relationship history of the connection between nature and the construction of buildings (by humans). Several concepts involving nature have started to be implemented in both the external and internal of a building.

Biophilic design is one of the nature-based concepts that has started to implement in modern buildings and other latest projects. The construction industry plays an important for

long-term development and the building sector is responsible for almost 40% of carbon dioxide emissions and consumption of energy (United Nations Environment and International Energy, 2017). Biophilic design is also related to the theory of biophilia. The purpose is to give a pleasant feeling to the occupants of that building. Thus, this is to deny the fact that nowadays human interaction with nature is often lacking due to the rapid growth of urbanisation, changes in social trends, architectural design and people's lifestyles over the years. According to (Mydin, Sani & Taib, 2014), they stated that "the construction industry in Malaysia is experiencing a migration from conventional methods to a more systematic and mechanised method known as the Industrialised Building System (IBS)". For instance, building components that are commonly used in IBS projects are walls, floors, beams and staircases (Abdul Kadir et al., 2005). One of the benefits of using the IBS construction method can reduce the wastage of resources. Furthermore, the evolution in several fields including the construction industry has developed many innovations and concepts implemented for new buildings.

Therefore, biophilic design is one of the famous concepts that are now being implemented in modern buildings. The evolutionary approach of biophilia soon influenced several major research including architecture and the built environment (Abdelaal & Soebarto, 2018). One of the importance that is, it helps to improve mood and health. The biophilic design concept has continued to develop over the past decade to employ the conditions and elements of nature that have been implemented to promote physical, social, intellectual and psychological wellbeing.

THE APPLICATION OF BIOPHILIC DESIGN CONCEPT IN A BUILDING

A growing interest in rediscovering nature has evolved in the last decade, driven by a fascination and interest for nature as well as aspirations to improve health (Zhong, Schröder & Bekkering, 2021). It is not a coincidence to say that humans and nature are both depending on each other. The human relation with nature is very strong as humans are also part of nature. Human acts as the centre of natural exploitation and the built environment, a belief that has existed since the beginning of civilization when human started adjusting to the natural environment and also expressing nature in the built environment (Wu et al., 2020). Biophilic design acts as a theoretical outline for understanding nature in architecture and discussing how it can help sustainability in the long term (Zhong, Schröder & Bekkering, 2021). The application of this biophilic concept in construction has increased the demand from the investors. This is because they were attracted to this concept. This concept needs to be well maintained and managed.

Biophilic Design Pattern

Biophilic design can be studied by using biophilic design patterns (Hui & Bahauddin, 2019). According to (Alexander et al., 1977), patterns have the potential to recommend solutions to almost all problems across a variety of scenarios, settings and user groups. (Ryan & Browning, 2020) added that a biophilic design pattern acts as description of natural pattern that causes humans to have a positive biological response. Designed to educate, guide, and aid in the design of the built environment. This is why patterns are better suited than metrics, as they are less rigid and respond to the local conditions with an appropriate response.

Nature in The Space

Nature in the space addresses the direct, physical and ephemeral presence of nature in a space or place. This includes plant life, water and animals as well as breezes, sounds, scents and other natural elements. For example, butterfly gardens, fountains, aquariums, courtyard gardens, green walls, etc. The nature of space has direct connections with natural elements through multisensory interactions and diversity. Nature in the space comprises seven biophilic design patterns.

Natural Analogues

Natural analogues mostly consist of non-direct connections to nature (Terrapin Bright Green, 2014). Hence, natural analogues address organic, non-living and indirect evocations of nature. These natural analogues recognised objects, materials, colours, shapes, patterns and even sequences as a form of artwork in a built environment. Nature analogues consist of three biophilic design patterns. Natural analogues have less effective responses as compared to direct contact with nature but they offer strategic potential in spaces that provide limited resources for nature to thrive (Salingaros, 2012).

Nature of The Space

The nature of the space addresses spatial configurations in nature. The strongest nature of space is engaging with spatial configuration, which combines with patterns of both natures in the space and natural analogues. The nature of the space is made up of four biophilic design patterns. This category encompasses the various psychological and physiological responses triggered by different spatial configurations (Ryan & Browning, 2020).

Table 1. Biophilic Design Pattern in Built Environment

Biophilic Design Pattern	Components
Nature in The Space	• Visual connection with nature • Non-visual connection with nature • Non-rhythmic sensory stimuli • Thermal & airflow variability • Presence of water • Dynamic & Diffuse light • Connection with natural
Natural Analogues	• Biomorphic Form & Pattern • Material connection with nature • Complexity & order
Nature in The Space	• Prospect • Refuge • Mystery • Risk/Peril

Table 1 indicates the 14 patterns of biophilic design in improving health and well-being in the built environment. The patterns were also called components/concepts of biophilic design and were classified into three main categories. Each category has its advantages. The categories explain how spaces can be fully used and designed as restorative to meet the spatial configuration and semantic representation.

Importance of Biophilic Design

Biophilic Design Offers Positive Respond to Human Needs

When identifying what could biophilic designs can offer, some may think that this nature concept is all about plants, natural lighting and many more. However, it is not necessarily true because the implementation of biophilic designs is more than that. Art on the walls and the sound of birds chirping are other examples which are part of biophilic. By just looking at nature is the key relief that can help a person to relax especially during a pandemic.

This concept of nature helps in the construction industry. Some public buildings need to have a unique design that applies the biophilic design concept. For example, a safety corridor at the hospitals suggested having a space for natural green areas that allow patients to be cheerful and boost their mood. This is due to an increase in the bonding of relation between humans and the natural environment. Hence, the application of natural lighting and ventilation can also increase the 'mood' of a building (Beute et al., 2020).

Biophilic Design Encourage the Element of Nature in Buildings

Bonding between humans and nature can be a positive relationship if humans do not simply destroy nature due to irresponsibility. The whole population need to always be aware and take care of the beautiful nature out there to be preserved. This is to prevent negative effects on the human body and surroundings. When there is no connection between humans and nature, it could give a bad impact on physical and mental health (Andreucci et al., 2021). Some of the buildings today are built and designed in isolation from nature rather than the buildings being part of it.

The biophilic design does not only applicable to the exterior of a building but is also suitable for the indoor environment. Several types of research show that nature can help to improve performance for better concentration (Choudhry et al., 2015). The indoor environment needs natural lighting so that it cans lights up spaces inside a building. For instance, there are many restaurants today that decorate their interior with biophilic elements such as water features and a large area for dine-ins.

In addition, the biophilic design also gives advantages to building occupants during this period of a global pandemic outbreak. During the pandemic, there is an increment in anxiety around indoor environments and an urgent focus on creating spaces is essential to promote both emotional and physical health (Peters & D'Penna, 2020). For example, concerns about the mental health of elderly people, teachers and students need to be considered. There were many complaints about having online classes or even working from home as they feel less motivated. Preference studies found that students prefer natural colours like green, blue, and yellow and wood materials for furniture in workspaces (Kaya, 2004; Ridoutt et al., 2002).

Biophilic Design Improves Human Health and Productivity

The integration of nature in buildings has affected the building occupants too. (Andreucci, Loder, Brown & Brajkovic, 2021) mentioned that biophilic design can be defined as a framework or method for connecting humans to nature through design that stimulates sensory

engagement, emotion, meaning, beauty and compassion. Applying biophilic design in the office can increase workers' productivity respectively up to 8% - 13% of creativity. It does help to increase their mental health and productivity. There were also studies on the effects of nature on the human body and brain that can be searched. For example, those who like to place a small plant indoors can also increase their productivity daily. They may feel calm and stimulate their body to stay positive and energetic throughout the day. It will be critical to address these underlying beliefs and perceptions, to create effective biophilic design interventions as well as build a good connection with nature (Andreucci et al., 2021).

RESEARCH METHODOLOGY

Research methodology is an approach to solving the research problems, aims and objectives. It provides genuine techniques than are reliable to obtain searched data based on which type of method is used (Nimehchisalem, 2018). The methodology is not only assisting to understand the product but also the process itself. The scope of the study will concentrate on the parties involved in designing buildings which were certified architects to gain their perception regarding the application of biophilic design in a building.

There are 2051 certified architects as listed by the Board of Architects Malaysia (LAM) and the sample size for the population is 354. The questionnaire survey was used to acquire the primary data since it was the most efficient technique to collect large amounts of data to meet the research objectives. A total of 354 surveys were distributed via two online platforms and the collection of data was done twice due to low feedback. Out of the sample size, only 41 responses were obtained which contributed to 17%. This is due to the pandemic situation that hit Malaysia and the enforcement of the Movement Control order (MCO) contributed to slow responses obtained within the stipulated time outlined. It has affected the process of collecting the information from the respondents and due to limitation of time, the data analysis needs to be proceeded.

A software package called Statistical Packages for Social Sciences (SPSS) is used to interpret the quantitative data from this study. This method is useful for the study of broad survey data sets. When all the respondents completed the questionnaire, the package was utilised to interpret the data. All questions would be evaluated separately, taking all the variables available into consideration, and assisted with descriptive and inferential analysis. After the questionnaires were returned from the respondents, the data started to be analysed using table form to get the outcome result on the objectives of this research. All questions would be evaluated and considering all the variables available, and also assisted with descriptive analysis. This method is useful for the study of broad survey data sets. SPSS can also generate an adequate result for the primary source of data. SPSS tools were used to calculate the frequency, and percentage of the response. By obtaining the percentage for each factor carried out by the survey, the rank of each factor was able to be gained.

FINDINGS AND DISCUSSIONS

Demographic Profile

This section covers the respondent's profile, and the result was tabled as per Table 2. There were three items in the demographic section which included the respondent's position

in the company, age and years of experience in construction works. Out of those who responded, 56.1% (23 respondents) were aged 50 years old and above. This shows that more than half of the respondents were in this category. There were 24.4% (10 respondents) and 12.2% (5 respondents) in between the range 41 – 50 years old and 31 – 40 years old respectively. 7.3% equivalent to 3 respondents lies within the range of 25 years old and below. However, there was no respondent aged 26 – 30 years old range. The data collected shows that majority of the respondents were from the older generation since many of them are the directors and principals of their own companies.

Table 2. Respondents' Background

Descriptions		Frequencies	Percentage (%)
A.	**Age**		
	< 25 years	3	7.3
	26 -30 years	0	0
	31 - 35 years	5	12.2
	36 - 40 years	10	24.4
	> 40 years	23	56.1
B.	**Position in the company**		
	Principal	14	34.1
	Deputy, Senior Architect	27	65.9
C.	**Years of Experience**		
	Less than 5 years	4	9.8
	6 - 10 years	0	0
	11 - 15 years	5	12.2
	16 - 20 years	6	14.6
	More than 20 years	26	63.4

Table 2 also portrays the respondents' designation. A few of them are principals with 34.1% (14 respondents), followed by other positions like deputy directors, senior architects etc summed up the remaining percentages, of which the respective respondents were currently working with an architect firm. It can be concluded that the majority of them are currently in the top positions in their company. For the component of working experiences, most of the respondents 63.4% (26 respondents) have been involved in the construction industry for more than 20 years. While 14.6% (6 respondents) had 16 – 20 years of working experience. The rest of the respondents had working experience of 11 – 15 years (12.2%, 5 respondents) and less than 5 years (9.8%, 4 respondents). Thus, the number of years (working experience) can relate to the age scale from the first question. Most of the respondents can be considered from the older generation because the majority of them have more than 20 years in the construction field.

The Pattern of Biophilic Design

Table 3 explained the three (3) patterns/components of biophilic design in a building accordingly. For pattern of nature in the space, there were four components involved. For the component of space with a good visual connection with Nature can be stimulating or calming, the respondents' level of agreement on this statement differs. Referring to the table, the majority of the respondents contributed 61% (25 respondents) chose strongly agreed. While 34.1% (14 respondents) agree and only 4.9% (2 respondents) were neutral whether agree or disagree. No respondents answered neither disagree nor strongly disagree. Next, most of the

respondents chose to agree, 46.3% (19 respondents) to the statement stated that space with a good non-visual connection with nature can make one's feels relaxed and comfortable. A few examples of non-visual connections with nature are birds chirping and natural breezes. Followed by 29.3% (12 respondents) strongly agreed, 12.2% (5 respondents) were neutral and 9.8% (4 respondents) chose to disagree. Whilst 1 respondent makes up to 2.4% strongly disagrees with the statement. Since the responses were all positive, so it can be proven that the effects of vibrations and noise can help a person process thought.

For a space with good thermal and flow, variability that allows refresh and pleasure to building occupants, more than half of the respondents strongly agree with the statement above that amounting to 56.1% (23 respondents). Another 39% (16 respondents) chose to agree that solar heat and shades can give freshness to them. While the remaining 4.9% (2 respondents) decided to choose neutral regarding the statement. Another component for pattern 1 indicated the presence of water enhances one's perception of a place by allowing one to see, hear or touch. From the survey, only 2 options of answer were chosen by the respondents. The total 49 respondents were quite balanced. 51.2% (21 respondents) strongly agreed while another 48.8% (20 respondents) agree with the statement. The difference in the number of respondents for both options is only 1 person. The graph clearly shows that all respondents agreed that the presence of water, like water features can stimulate their senses to see, listen and touch. The results above can conclude that the presence of water provides happy emotional responses when there were water elements in the surrounding area.

Table 3. The Patterns of Biophilic Design in a Building

Descriptions	Percentage (%)					Perception Level
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
Nature in The Space						
A space with a good Visual Connection with nature			4.9	34.1	61	Strongly Agree
A space with a good Non-Visual Connection with nature	2.4	9.8	12.2	46.3	29.3	Agree
A space with good Thermal and Flow Variability			4.9	39.0	56.1	Strongly Agree
The Presence of Water enhances one's perception of a place				48.8	51.2	Strongly Agree
Nature Analogues						
A space with good Biomorphic Forms and Patterns		2.4	19.5	46.3	31.7	Agree
A space with a good Material Connection with Nature			12.2	41.5	46.3	Strongly Agree
A space with good Complexity & Order			14.6	48.8	36.6	Agree
Nature of The Space						
A space with good prospects surrounding			2.4	48.8	48.8	Strongly Agree/Agree
A space with good refuge conditions			7.3	61	31.7	Agree
A space with good mystery condition		2.4	24.4	51.2	22	Agree

Pattern 2 refers to nature analogues which have 3 components under the pattern. 46.3% (19 respondents) were to agree with the statement that space with good Biomorphic Forms and Patterns feels fascinating. Besides, 31.7% (13 respondents) chose to strongly agree and 19.5% (8 respondents) were neutral, while 2.4% (1 respondent) disagree with the following statement. The example that portrays the components; application were the wallpaper designs and fine furniture details that received sun rays from outside can increase the spark to spaces in a building. Moreover, the lighting that enters space can also give impact to physical, mental and behaviour of the occupants.

For the results of space with a good material connection with nature can feel "originality", 46.3% (19 respondents) recorded the highest percentage that chose to strongly agree with the statement. Thus, a total of 17 respondents' equivalent to 41.5% chose to agree and followed by the neutral option with only 12.2% (5 respondents). Examples of this component were materials used for interior surfaces, façade materials and many more. When natural elements blend in with furniture for instance can give positive feedback to the environment. From the survey for a space with good complexity and order able to give balance integration between dull and overwhelming conditions, the majority of respondents 51.2% (21 respondents) were agree with the statement, while 36.6% (15 respondents) chose to strongly agree. The pattern of complexity and order was easily predictable based on its relation that blends in with nature. The least percentage is 14.6% with only 6 respondents. Hence, the 6 respondents were neutral with the statement. No respondents chose to disagree and strongly disagree with the statement as mentioned earlier.

Pattern 3: nature of the space was divided into 3 components. For the components of space with good prospect surrounding feels open and free, the total number of respondents that chose agree and strongly agree are equal with 40 respondents. The percentage for agreeing and disagree was 48.8% (20 respondents) each. Only 2.5% (1 respondent) selected neutral for this statement. The space with a good prospect means a large area in a building such as open floor plans and open balconies. Next, a space with a good refuge condition can make one's felt safe and protected received various responses from the respondents. 61% (25 respondents) were to agree with the statement while another 31.7% (13 respondents) were firm with their answers by selecting to strongly agree. The rest of the respondents that make up 7.3% (3 respondents) were neutral with the following statement. A space with good refuge conditions indicates that the area is possibly suitable for activities like mediation and self-reflection.

In addition, whether a space with good mystery condition offers a sense of curiosity, the majority of the respondents, a total of 51.2% (21 respondents) chose to agree while 24.4% (10 respondents) were neutral with the statement. Of the remaining respondents, 22% (9 respondents) chose strongly to agree and only 2.4% (1 respondent) decided to select neutral. The mystery pattern's characteristics were determined by visual preference and perceived risk. The mystery condition was not always applied to buildings. A partially reveal peek-a-boo window can be one examples to illustrate a 'mystery' element in a room. This type of window was usually small in size that allows natural lighting to enter the room or spaces. The brain responds to 'mystery' with a strong pleasure response that may be equivalent to a certain part of emotion involving anxiety.

Importance of Biophilic Design

Table 4 shows the importance of having the biophilic design in a building. For the factor of biophilic design offers a positive response to human needs, more than half of the respondents, 23 participants (56.1%) strongly agree that biophilic design can help to reduce stress and enhance their mood for instance. The instances mentioned earlier relate to biophilic design that offers an approach to creating buildings and spaces that respond to our human needs. While a total of 39% (16 respondents) chose to agree with the statement. Of the remaining respondents, 4.9% (2 respondents) were unsure about the statement so they decided to choose neutral.

Table 4. Importance of Having Biophilic Design in a Building

Descriptions	Percentage (%)					Perception Level
	Not Important at All	Not Important	Neutral	Important	Extremely Important	
Biophilic Design Offers Positive Respond to Human Needs *The biophilic design offers an approach to creating buildings and spaces that respond to our human needs. (e.g., reduce stress, enhance mood)*			4.9	39.0	56.1	Strongly Agree
Biophilic Design Encourage the element of Nature in Buildings *Biophilic design encourages the element of space, natural lighting, water and landscape in the building.*				34.1	65.9	Strongly Agree
Biophilic Design Improves Human Health and Productivity *Biophilic design in buildings is needed to improve the human health and productivity of the building occupants (e.g., in the workplace).*			7.3	39.0	53.7	Strongly Agree

Another important of biophilic design implementation was it encouraged the element of nature to buildings. The element of nature to buildings in biophilic design involves space, natural lighting, water and landscape. Besides, the biophilic design also stressed the application of greenery to the interior and exterior of a building. 65.9% (27 respondents) out of 100% were all to strongly agree with the statement mentioned earlier which makes it the highest percentage above agree, 34.1% (14 respondents). This shows positive responses among the respondents as there are zero results at neutral, disagree and strongly disagree options.

As the biophilic design that improves human health and productivity, it is a concrete statement to say that many Malaysians especially those who work in big cities spent more time at the office daily for five days a week. The issue has arisen when many of them faced things like traffic jams and a lack of confidence level almost every day. So, this question is to determine whether the application of biophilic design in a building can boost human health and productivity in workplace. The result indicated that the majority of the respondents, 53.7% (22 respondents) chose strongly to agree with the statement, 9% (16 respondents) to agree and the remaining 7.3% (3 respondents) are neutral. No respondents were disagreeing with the following statement.

Consequently, to improve the application of the biophilic design concept to buildings, it is essential to promote the concept in design among the general public and exposure in the early stages of education. This is because in order to ensure the public to understand this term, they need to be exposed with it since academic learning. Moreover, understanding on predictive future respond between built environment and natural environment will suggest better solution for biophilic approaches. It is proven that Malaysia is a country that experiencing unexpected weather. Hence, there are need to constantly relate to nature as much as possible in all design, whether the concept of biophilic design is suitable to all type of buildings in this country or the other way round. So, it is a must to create awareness and readiness of biophilic concept first before can fully utilise the concept to buildings.

In addition, it is suggested to make biophilic design information a mandatory such as revision in UBBL. UBBL is an acronym to a statutory requirement, called Uniform Building By-Laws. This is important to establish a more conducive environment at work and home. Hence, those who are involve with designs can study the connection between health and biophilic design to convince more end users to understand this concept at the first place. In order to apply this concept, "Local Authorities Guidelines and involvement should also be the main focus.

CONCLUSIONS

The biophilic design was a good approach to connecting the relationship between humans and nature. The patterns of biophilic were proven to be the core points to this. Indeed, the biophilic concept can be implemented in the exterior and interior of buildings. Many buildings all around the world implement this concept. Examples of natural elements include the natural lighting of the sun that enters spaces inside a building, the presence of water, natural air ventilation from the blowing winds etc. The implementation of biophilic design components in buildings is very crucial regardless of how the weather keeps on changing unexpectedly. This concept was able to keep a building stay in good condition for a longer time due to the natural elements that have already been applied to the building. It is proven that biophilic design has slowly been implemented to buildings in Malaysia such as in modern buildings like shopping malls, offices and luxury condominiums. This shows that more buildings should apply this concept soon. The three main patterns/components play an important role in the application of this concept to buildings, especially in the Malaysian construction industry. It changes the style and condition of buildings. However, to ensure the biophilic design concept was widely implemented, there is a need to expose this term and implementation to the public. This will increase peoples' understanding regarding this nature concept because it offers many benefits to the building itself and the occupants as well. It could be such a waste if architects and building designers do not apply biophilic design to building for future development. That is the reason why the recommendations from professionals are crucial to improving the concept of biophilic design.

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RECONCEPTUALISING THE CONSTRUCTION PROJECT MANAGEMENT BODY OF KNOWLEDGE FOR MALAYSIAN CONSTRUCTION INDUSTRY

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Abstract
The realm of Construction Project Management (CPM) is in a constant state of evolution, reshaping the approaches taken in project management. Nonetheless, this Body of Knowledge (BoK) often grapples with ambiguities, misunderstandings, and ongoing debates, impeding the progress of project management research and development. In the context of the Malaysian construction industry, the existing comprehension of CPM falls somewhat short in comprehensively addressing the specific duties essential for successful construction management practice and learning. This study re-examines the project life cycle, its various phases, and the associated activities within these phases. By drawing insights from the Morris Management of Projects Model, a multi-layer thematic analysis was employed to reassess the precise conceptualisation of project management. The outcomes suggest that the project management Body of Knowledge (BoK) is optimally perceived through the lenses of both Construction Project Management and Construction Management. Within CPM, there exist 24 distinct work processes spanning the five phases of Inception, Design Development, Tendering, Construction, and Closeout. On the other hand, Construction Management (CM) comprises 13 work processes encompassing the stages of Tendering, Site Mobilisation, Construction, and Handover. Insights from the findings provide a more comprehensive and contextually grounded understanding of conceiving CPM, which is very significant for grasping the nuances of project management and its underlying processes. This underscores the significance of tailored implementation models that cater to the distinct demands of CPM, particularly in the Malaysian construction industry.

Keywords: *Body of Knowledge; Construction Management; Construction Project Management; Project Manager; and Competency*

INTRODUCTION

The Malaysian Construction Industry Scenario

The subpar performance of construction projects in Malaysia has consistently been emphasised in several reports (National Audit Department, 2018; Khuzaimah, 2019; Noorasiah et al., 2021; Economic Outlook, 2023). The audit report from the Auditor General regarding public projects revealed that numerous projects suffered from lateness, exceeding budget limits, and failure to meet standards. Khuzaimah (2019) reports that the Public Works Department pointed out that contractors and project management officers (PMOs) incompetence is a major contributor to these issues. This department identified a knowledge gap among PMOs, lack of coordination, inadequate control and monitoring, and ambiguous client directives as factors contributing to the problem The Construction Industry Transformation Plan (CITP) also recognized the recurring problem of insufficient project management skills, knowledge, and professionalism in Malaysia. The CITP emphasized the urgent necessity of increasing the number of qualified project managers (CIDB, 2019).

Collectively, these reports indicate a systemic challenge in delivering construction projects effectively in Malaysia.

Numerous scholars have also drawn attention to the persistent industry issues, including subpar quality, labour intensive practices, low productivity, delays, and exceeding budget allocations (Abdul Kadir et al., 2005; Sambasivan & Soon, 2007; Shehu et al., 2014; Kaleem et al., 2016). Yap & Chow (2020) posit that most to these problems emanate from human and managerial factors resulting from inefficient construction project management practices. Following this, several researchers have emerged with proposed remedies to tackle this concern. Haron et al. (2017) expounded upon the significant influence of the people implementing the project management practices on the success of projects. They underscored the indispensability of senior management's dedication to the application of these practices and the enhancement of the current approach.

In providing insights into the issue, Kamal et al. (2017) identified a discrepancy between the training content of Malaysian public project management and the prerequisites of the industry. Their recommendation included the establishment of a universally acknowledged reference framework to guide the management of public projects. Numerous studies have approached the issue from different perspectives, with Abdullah et al. (2018) advocating a structured framework outlining 16 essential technical competencies for construction managers, which encompass tasks such as supervising personnel, ensuring safety compliance, managing finances, and scheduling projects. Additionally, Alias et al. (2014) suggests more emphasis be given on the importance of focusing on project management actions, procedures, human factors, external considerations, and project-related factors, while Hassan et al. (2011) recommend adopting best practices in scope and time management, including controlling the quality of contract documents and schedules to prevent project failures. Abdou et al. (2016) propose considering project complexity factors in project management, and Al-Tmeemy et al. (2011) propose incorporating project success criteria encompassing project management success, product success, and market success for building projects.

When considering these propositions, it becomes apparent that there is a lack of research dedicated to exploring the epistemological aspect of construction project management, particularly which involves the differentiation of project lifecycles, definitions, and deliveries, leading to distinct contextual perspectives, as each phase demands varying skills and expertise. Ignorance of the multiple stakeholders in construction projects often results in overlapping roles in project management, leading to a fragmented perception of these responsibilities. This fragmented view of project management among diverse professionals tends to create gaps in comprehension, which in turn contributes to an incomplete grasp of the essential knowledge needed for effective construction project management. This study asserts that examining this issue through this epistemic lens is crucial as it provides a deeper and more comprehensive insight into the fundamental nature and underlying knowledge structures inherent in construction project management.

This paper aims to relearn the Body of Knowledge (BoK) for Construction Project Management, encompassing all stages of the construction lifecycle. By employing Multi-layer Thematic Analysis, this study undertakes the task of reconceptualising the BoK for construction project management. This re-evaluation holds significant significance as it provides the stakeholders with a comprehensive understanding of the context necessary for

the achievement of successful project management. (CIOB, 2014). A profound understanding of a project's context empowers stakeholders to make well-judged decisions and actively contribute to its successful outcome.

Body of Knowledge for Construction Project Management

Construction project management (CPM) activities involve managing activities in various phases, from the inception to the completion of a project. This skill set is unique compared to other professions because it integrates people, manpower, machinery, and resources to achieve the project objective. This integration can improve communication, efficiency, decision-making, risk management, and morale, leading to successful projects. The skill set of management is known as the Body of Knowledge. In every profession, it is important to have a body of knowledge to justify the work boundaries and activities, as it provides a basis for the regulation of professionals (Wagner et al., 2021). A body of knowledge is a statement explaining the work procedures and responsibilities that can benefit educational, training, and institutional establishments and justify the duties and tasks of a qualified professional.

The investigations revealed that within the Malaysian construction industry, there is a prevalent inclination to perceive project management predominantly through the lens of earlier frameworks proposed by architectural and engineering professional bodies. These frameworks are heavily influenced by the Project Management Institute's (PMI) 10 Body of Knowledge (BoK). However, there is limited effort to adapt or contextualise this BoK to suit the specific needs of consultancy construction project management and the practical aspects of construction project management. Unlike other professions, such as architects, engineers, quantity surveyors, and others, who have specific boards and institutions governing them, project management does not have such institutions. This absence results in unclear work responsibilities and expertise for the job title, resulting in anyone claiming to be a project manager (Kamal et al., 2012). This can lead to discrepancies and unclear duties and tasks compared to other established professions. In echoing the views of Construction Extension to the PMBOK® Guide produced by PMI, Radujković & Sjekavica (2017) maintains that it is imperative that project management knowledge and practices must be contextualised towards the construction project needs by strengthening the people and organizational competence.

Morris & Geraldi (2011) proposes an expansive perspective on project management by extending the framework from the Project Management Institute (PMI) into the Management of Projects (MoP). They do this by adopting a three-level approach: Technical, Strategic, and Institutional. The Technical level, rooted in positivism, focuses on executing operational projects and developing project management tools. The Strategic level deals with managing projects as organizational entities and extends into value definition and process development. The Institutional level sets the context to support project management effectively. Morris extension introduces three phases: Project Strategy, Project Definition, and Project Delivery, each with specific concerns such as finance, technology, supply-chain management, ethics, sustainability, and more. As the project definition becomes clearer, the project delivery phase encompasses initiation, planning, execution, control, and close-out. Morris & Geraldi (2011) note that this approach offers a broader and more comprehensive understanding of project management activities and interfaces for project success.

The MoP Model proposed by International Project Management Association (IPMA) to contextualise the UK construction industry was adopted by this research. This was on the justification that by adopting a well-established framework like the MoP Model, the study would be able to recognise best practices, thereby lending credibility and robustness to its findings and conclusions. This adoption also facilitated a more systematic and structured approach to analysing the intricacies of construction project management within the specific context under investigation. Figure 1 shows the Management of Projects model adopted from Morris.

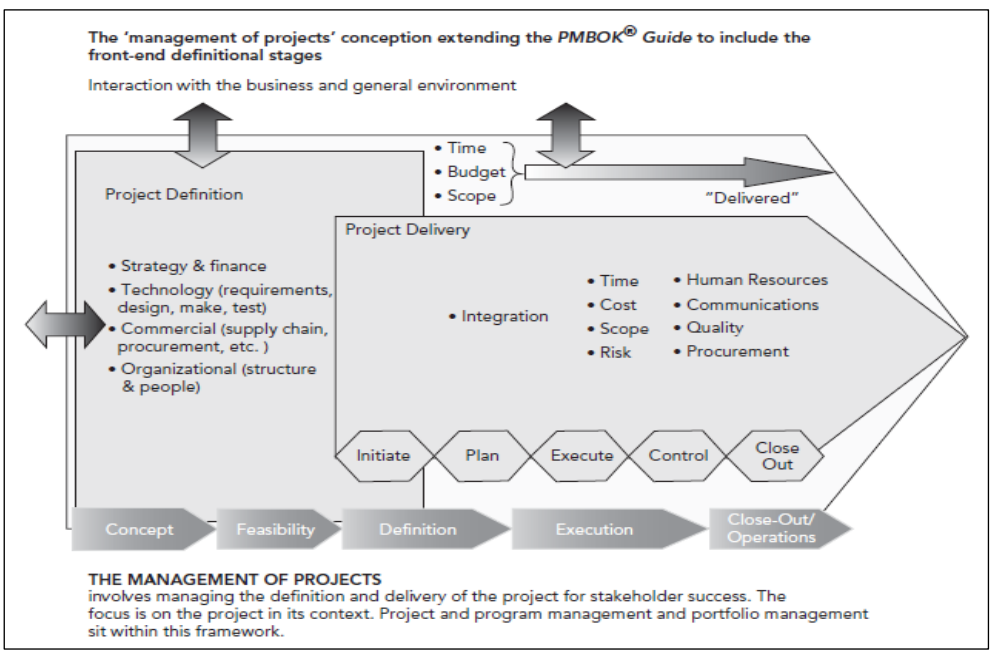

Figure 1. The Management of Projects Adopted from (P. W. G. Morris, 2013)

METHODOLOGY

A multi-layered thematic analysis was adopted for this study. This approach was adapted from Mohammad et al. (2016), who developed the analysis framework based on Creswell's work (2018). Every layer within this approach was meticulously refined, contributing to a comprehensive and meaningful outcome that plays a crucial role in reshaping the body of knowledge pertinent to construction project management. The traditional project management process model was chosen due to its foundational nature, serving as a framework that can be applied to various project delivery systems that encompass both design and build components. This method encompasses four distinct layers, commencing with the establishment of boundaries, followed by the filtration of technical activities associated with management roles in both design and construction aspects of the project – termed as the 'Construction Project Manager (CPM)' and the construction production aspects at the projects site – termed as 'Construction Manager (CM)'. Subsequently, an in-depth analysis is conducted, focusing on the essential knowledge and skills necessary for the project. This culminates in the synthesis and clustering of these findings, in relation to the MoP Model (P. W. G. Morris, 2013).

The process of formulating the body of knowledge for construction project management and construction management follows a four-layered approach. In the initial layer, the study's scope is outlined, taking cues from the project lifecycle and distinctions between project definition and project delivery. This step establishes a clear context for the efficient management of construction projects. Progressing to the second layer, a meticulous document analysis from Construction Industry Competency Standards (CICS) for CPM and CM is undertaken concerning the technical activities encompassing both Construction Project Managers (CPMs) and Construction Managers (CMs) (CIDB, 2019b, 2019a). This scrutiny sheds light on the required knowledge and skills for these dual roles. The third layer involves a detailed dissection of the responsibilities inherent to managerial roles within the field. This dissection aids in pinpointing the precise knowledge and skills crucial to each role. Finally, the pertinent knowledge and skills are structured into clusters, aligning with the MoP model. This integration results in a refined body of knowledge tailored to the unique demands of construction project management. A visual representation of this comprehensive approach is provided in Figure 2, illustrating the authors' adoption of the methodology.

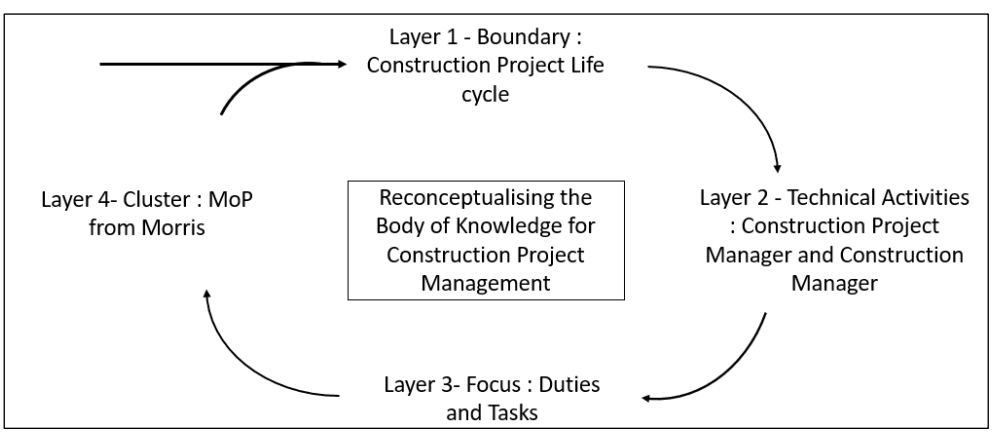

Figure 2. Multiple Loops for Reconceptualised the Construction Project Management Using Multi Layered Thematic Analysis

RESULTS AND DISCUSSIONS

The findings suggest that the difference between the roles of a Construction Project Manager (CPM) and a Construction Manager (CM) exists within the construction project life cycle. or the CPM, this entails engagement across five phases which include (i) Conceptual, (ii) Design Development, (iii) Tendering, (iv) Construction and (v) Close Out. Conversely, the CM's involvement encompasses four phases, which involves (i) Tendering, (ii) Site Mobilisation, (iii) Construction, and Handover. This is summarised in Table 1, Table 2, Table 3, and Figure 3.

The role of a Construction Project Manager (CPM) requires a more strategic perspective. This encompasses the meticulous assessment and selection of procurement system tailored to the project's needs, a decision that profoundly influences the project's trajectory. This demanding responsibility requires the oversight of 24 intricate work processes, each contributing to the shaping of the project's procurement strategy implementation. Conversely, a Construction Manager (CM) is tasked with orchestrating the construction "production" process, pivotal for on-site execution following the tendering phase. With a focus on efficient

resource utilisation and precise execution at the project site, a CM manages 13 distinct work processes to ensure seamless on-site construction activities.

Table 1. Summary of Knowledge and Skills for Construction Project Manager

Managing Conceptual Process	Managing Design Process	Managing Tender Process	Managing Construction	Manage Project Close Out
• Initiate the Project • Establish Project Brief & Viability • Develop Preliminary Estimate • Develop Conceptual Design • Establish Procurement Strategy • Project Implementation Planning & Control • Establish Project Financial & Control Process	• Establish Project Quality Planning & Control Process • Establish Project Health & Safety Planning & Control Process • Establish Project Environmental Planning & Control Process • Administer Value Management • Obtain Local Authorities Approval	• Tender, Evaluate and Award the project	• Monitor & Control Project Progress • Monitor & Control Project Finances/ Cashflow • Administer Construction Contract • Monitor and Control Project Health & Safety • Monitor & Control Environmental Requirement Compliance	• Testing and Commissioning • Establishing Operation & Maintenance Plan

Table 2. Summary of Knowledge and Skills for Construction Manager

Construction Project Tendering	Construction Site Mobilisation	Construction Management phase	Project Handover
• Evaluate, Price and Submit Tender	• Administer Project Award • Administer Site Possession • Establish Site Layout and Preliminaries	• Sundry Construction Management - Preliminaries, Site office • Construction Resources Management - Material - Project staff and team - Plant & Machineries - Subcontractors • Construction Objectives management - Time - Cost - Quality - Health & Safety - Environmental • Third Parties Management - Public, Authorities & Third Parties - Client and Consultants • Contract Administration	• Testing and Commissioning • Handover • Defect Liability Period Management • Final account & Close out

Table 3. Difference Between Construction Project Manager and Construction Manager Based on CICS

Characteristic	Construction Project Management (CPM)	Construction Management (CM)
Nature	Strategic	Implementation and Execution
Scope	Design and Construction	Construction activities at site
Project Lifecycle	Sequential	Sequential and concurrent
Number of Phases	5	3
Number of Work Processes	20	13
Number of Knowledge Areas	16	17

The contrasts between these roles underline the comprehensive understanding required of CPMs, spanning across project design, construction, and operational phases. Guiding the project's definition direction necessitates a comprehensive understanding of intricacies of managing the inter-related activities within the project phases in meeting diverse stakeholder's expectations. This strategic orientation aligns with the broader perspective of CPMs who guide the project's overall trajectory. The complexity deepens for CPMs as they

navigate the project lifecycle's five phases: conceptualisation, design, tendering, construction and handover & project close-out. Successfully steering the project through these multifaceted stages requires an adept comprehension of project management processes and a capacity to adapt to evolving circumstances.

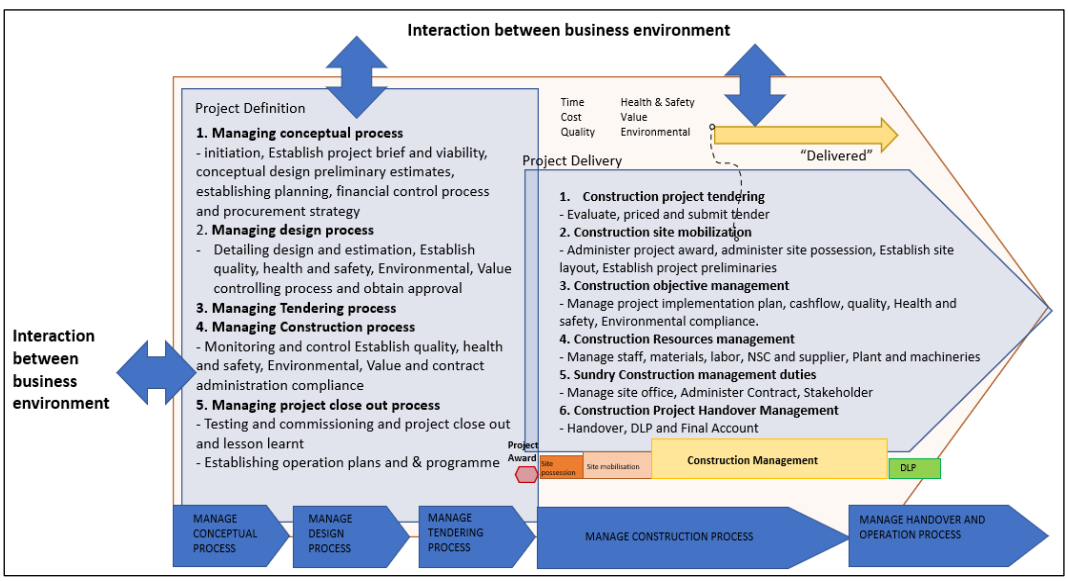

Figure 3. Re-Conceptualisation Body of Knowledge for Malaysian Construction Project Management

In contrast, the Construction Manager (CM) functions on the front lines of the construction project, directly at the project site. Their primary focus revolves around the execution of construction activities. Operating within a four-phase project lifecycle—tendering, site mobilisation, construction, and project closeout—their core responsibility lies in translating project blueprints into tangible outcomes. This involves skilful coordination of resources such as materials, machinery, subcontractors, and labour with the building team to ensure successful construction outcomes.

CONCLUSION

The objective of this paper was to re-evaluate the Body of Knowledge (BoK) associated with Construction Project Management across the construction project lifecycle. The paper has uncovered fresh insights that could prove immensely valuable in supporting project management learning and practice, especially for the Malaysian construction industry. These insights provide a comprehensive and contextually grounded understanding, which is essential for grasping the distinctions of project management and its underlying processes. The findings of this study delve into the intricate contextual intricacies of projects, offering valuable guidance to project participants in structuring a more systematic approach to project implementation. Additionally, the research carries significant weight in advancing the landscape of education and training in project management, as it introduces innovative dimensions of knowledge that enrich the educational journey for emerging professionals related to this field.

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THE EFFECTIVENESS OF CENTRALISED LABOUR QUARTERS (CLQ) IN MALAYSIAN CONSTRUCTION PROJECT

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Abstract
Construction labourers are a valuable asset for construction firms, especially for the contractors. In order to enhance the productivity and ensuring the labourers are motivated, labours' welfare and wellbeing need to be taken care. By providing hygiene, comfortable accommodations with adequate facilities, it is credence to be able to look after the labours' welfare. In contrast what is happening in Malaysia, most of the labours living in poor amenities and deplorable accommodation provided by the employer which led to social and environmental problems. Construction Industry Transformation Plan (CITP) highlighted this issue under strategic thrust- to improve and uplift the living condition of the construction workers. To align with the strategy, the standard guideline to improve the facilities and amenities for construction workers accommodation has been introduced. This paper aimed to study the effectiveness of CLQ in achieving first strategic thrust in CITP- Quality, Safety and Professionalism. In order to achieve the aim, the objectives of this paper are, to investigate the standard guideline of worker's accommodation and features of existing CLQ and to survey the construction workers' satisfaction on the quality of accommodations and facilities in the CLQ. A mixed of qualitative and quantitative measures has been adopted in this research, by interview session with CLQ manager and a set of questionnaires survey distributed among the construction workers who live at the CLQ. From the findings, the labours that have been placed at the CLQ majority rated good on the amenities and facilities provided and ease their daily activities. Moreover, the best practices that have been adopted in CLQ are to maintain the facilities with maintenance framework and follow standard operation procedures. Shifting to CLQ may reduce risk especially on the health, contagious disease, safety, security, social aspect and furthermore enhance labours' productivity. In the nutshell, CITP's aim to transform our national construction industry can be achieved.

Keywords: *Centralised labour quarters; CITP; Organizational management*

INTRODUCTION

One of Malaysia's most important economic drivers is the construction industry. There is a need to increase the number of construction employees to satisfy the need for construction sector growth as a result of increased development. There are numerous foreign employees on the construction site, however. Local residents have no desire to work on construction sites. According to Khamis et al. (2017) research, businesses must ensure that all employees, including those from other countries, have access to suitable housing and other amenities (Workers Act, 446). In addition to being a significant accelerator for the nation, its positive spillover effects have fostered an infusion of foreign workers to assist the building sector (Ofori, 2015). Currently, the construction industry employs almost 2.1 million individuals (excluding management personnel), the majority of whom are from foreign countries (Pook, 2016). In light of the situation, it is of the utmost importance that the responsible parties provide suitable accommodation and amenities for the employees (Department of Standards Malaysia, 2015).

To improve the quality of workers' temporary housing on building sites, Malaysian authorities have enlisted the help of the Construction Industry Development Board (CIDB). According to the CITP's plan to improve the quality and well-being of Malaysia's construction industry, this was a good fit.

The Construction Labor Exchange Centre Berhad (CLAB), a subsidiary of the CIDB, has launched the first Centralized Labor Quarters (CLQ) to improve the living circumstances of building workers, particularly at the construction site. CITP's goal is to enhance industrial workplace security and worker comfort, and this project is a component of that effort. CLAB made a difference in the lives of international construction workers in Malaysia by setting a new standard for living quarters. As a result, Malaysia's image as a developing country can be preserved.

Construction Labours

In general, construction labours are characterised as fully utilized human resources (Md Junus, 2002). According to Section 2 (1) of the Employment Act of 1955, a domestic worker is a person who is a citizen of this nation and is hired in exchange for a remuneration. Indirectly, these categories are the same for the vast majority of foreign construction workers (e.g., Indonesians, Bangladeshis, Burmese, Vietnamese, etc.), with the exception of their citizenship, which distinguishes them from native construction workers. Their presence in this country is largely attributable to the construction industry's need to deal with a growing number of projects, and to a lesser extent, a severe shortage of Malaysian labour (Malaysian Government, 2012) Despite the fact that local workers were given priority and recruitment efforts prior to any move to acquire foreign workers, labour shortages have persisted, making their influx necessary (Jaffar et al., 2011). Aside from that, construction employees in Malaysia can be divided into three (3) major categories: skilled worker, semi-skilled worker, and unskilled worker (Hamid and Singh, 2011) (Jabatan Imigresen Malaysia, 2004). However, only unskilled and semi-skilled labourers are considered foreign workers (Wei, 2002).

The definition of a skilled worker is one who is efficient, possesses great talents, and is able to use modern equipment to complete assigned tasks (Ismail, 2003). Typically, it takes between five (5) and ten (10) years to obtain the position. Semi-skilled workers, meanwhile, are classified as those who possess skills in one or more branches of building trades but have not yet attained the same degree of skills as skilled employees (Ismail, 2003). Typically, they serve as assistants to experienced workers, although there are situations when they can produce work of comparable quality to skilled workers, particularly when their cumulative years of service are greater. Semi-skilled foreign workers are frequently connected with those who have been staying in Malaysia for a brief period of time and whose employment is dependent on past experiences and average skills. Unskilled construction labourers are the final category of construction personnel. Typically, they do fundamental tasks on building sites, such as carrying goods and cleaning (Ismail, 2003).

Considered to be newbies, unskilled foreign workers consist of foreigners who arrived in Malaysia without any fundamental education or systematic construction skills (Wei, 2002). Given the paucity of continuing advanced training, they often learned by observing how they performed routine tasks.

Temporary Workers' Accommodation and Amenities

Temporary workers accommodation provides foreign labour with adequate furnished rooms, dining rooms, and shared living rooms, among other amenities. In the interim, there are facilities for communication, recreational activities, medical care, effective and security. Temporary workers accommodation and facilities should be managed by a facility contractor specialist who supplies and maintains its care and responsibility standards through an approved facility manager. Every effort must be made to reduce the negative impacts of temporary housing and facilities on the area and its inhabitants (Department of Standards Malaysia, 2015). Consequently, based on typical considerations for initial commencement of such respective move, there are several aspects of characteristics that must be considered, namely; type of workplace, work-related location, type of work to be performed, number of employees in the workplace, party that is responsible for work and accommodation, working period (i.e., standby, shifts, etc.), and availability of disabled/unfortunate worker (Lembaga Penyelidikan Undang-undang, 1990).

Standards of Temporary Construction Site Workers' Amenities and Accommodation in Malaysia Construction Industry- Code of Practice (MS 2593:2015)

Since 2013, CIDB has led the development of MS 2593: 2015, which was released in December 2015 (Department of Standards Malaysia, 2015). The purpose is to provide official explanations of the requirements for temporary facilities, including the welfare of construction workers and the safety and health of employees, which are regarded suitable and organised. In addition, it gives references and assistance for the provisions for the implementation of appropriate temporary conveniences. In MS 2593: 2015, Malaysia aims to provide improved accommodations and facilities to construction site employees in exchange for a variety of incentives, thereby paving the way for the appropriate gazetted legislation. In this document, ten (10) sections with associated sub-components were used to present comprehensive guidance. For example; room (with beds, wardrobes, lighting, and natural ventilation), sanitary facilities (with toilets, bathrooms, etc.), kitchen and dining area, water supply, toilet (including proper discharge of used water, sewage, and solid particles), drainage, electrical generation, medical facilities and first aid, social and recreational facilities, and availability of signboards. In addition, the guideline describes in detail the substantive needs that should ideally be met in each particular convenience.

METHODOLOGY

The research conducted are focusing on the quality of the accommodations of CLQ in Malaysia. The study should use any appropriate guidelines in Malaysia regarding to the quality of temporary accommodations for the construction workers. In order to achieve the objective, the research conducted at the CLQ for project of LRT3 by WCT Berhad located at Bandar Pinggiran Subang, Subang, Shah Alam. The data will be collected through a questionnaire survey and semi-structured interviews with the relevant parties and experts. For the qualitative method, most of the information obtained from semi-structured interview with the manager or whoever is in charge of the CLQ's amenities and management. To compare the standard guideline MS2593: 2015 with the condition of CLQ, researcher need to carry out observation and document analysis. All of the information retrieved during the interview will

be encrypted into a form by the assessment categories before data to be analyses. In other hand, the quantitative data is collected by distributing set of questionnaires to construction labours who occupied the CLQ. The questionnaire is aimed to survey the feedback from the workers' satisfaction on the quality of accommodations and facilities in the CLQ. The survey conducted face to face at the CLQ among the labours who lives there. 100 labours participated with this survey accompanied by WCT staff act as translator. The data was then analyzed by the aid of SPSS. Descriptive analysis was adopted to evaluate the mean rank, mode of respondents' satisfaction on CLQ.

RESULTS AND DISCUSSION

Applications of Standard Guideline of Worker's Construction Accommodations of CLQ

Overall, WCT CLQ has achieved the effectiveness towards achieving the CITP first strategic thrust to uplift the deplorable condition living for temporary accommodations by satisfying the requirements stated in the MS 2593:2015 and in line with the aim to transform our national construction industry into a responsible and developed country. Most of the assessment categories are compliant with MS 2593:2015. Photo captured on site also visualizing the compliant of each category.

Table 1. Applications of Standard Guideline of Worker's Construction Accommodations of CLQ

Assessment Categories	MS 2593:2015 Clause	Number of Compliance	Not Relevant/Exist
Section A: Specification for Temporary Workers' Amenities and Accommodation			
Building	Clause 3.2	4/4	
Room and Dormitory	Clause 3.3	9/10	1
Sanitary Facilities	Clause 3.4	11/11	
Cooking and Dining Area	Clause 3.5	9/9	
Water	Clause 3.6	2/2	
Water Disposal	Clause 3.7	4/4	
Drainage	Clause 3.8	2/2	
Electricity	Clause 3.9	1/1	

Figure 1. CLQ at WCT Construction Berhad, Bandar Pinggiran Subang, Selangor

The Effectiveness of The Management and Welfare in CLQ

Most of the respondent votes on the YES answer for the statement. The management in the CLQ was still in a good condition and well managed. The most effective management in the CLQ is on sickbay and first aid facilities, the transportation provided to the construction site, the workers safety, the training for fire emergency in and the workers also has a freedom on practicing their religion with 98% of "YES" answer.

Table 2. The Effectiveness of The Management and Welfare in CLQ

MANAGEMENT CRITERIA	Yes	No
Managers Responsibility	84.3%	13.7%
Sickbay Availability	98%	2%
Transportation	98%	2%
Workers Safety	98%	2%
Fire Emergency Training	98%	2%
Religion Practice	98%	2%
Workers Motivational	87.3%	10.6%

Respondent's Satisfaction on The Facilities Provided in CLQ

The descriptive analysis was used to analyze the satisfaction of the workers occupied in the CLQ by using the mean average is a method used to identify the central point in the dataset. According to the Table 3, the first ranked is the facilities on the First Aid and Medical facilities. All the respondents agreed that the facilities of the First Aid and Medical Facilities in the CLQ with the mean of 5.00. On the other hand, the second ranking with the mean of 4.86 is a sufficient of water supply provided were sufficient for daily use. The water tank was provided so that the water supply is sufficient in case of disruption of water supply while the cleanliness of the CLQ (mean: 4.78) ranked third. It is because the daily housekeeping in the CLQ makes the accommodation always keep clean. Room and the bedroom furnishing were list on the most bottom ranked with the mean of 3.27 and 3.59 respectively.

Table 3. Respondents' Satisfactions on The Facilities Provided in CLQ

FACILITIES AND AMENITIES IN CLQ	Mean	Std. Deviation	Mean Ranking
Sickbay and First Aid	5.0000	0.00000	1
Water supply	4.8600	0.34874	2
Cleanliness	4.7800	0.54272	3
Kitchen	4.7700	0.42295	4
Drainage	4.7600	0.42923	5
Electric Supply	4.7400	0.44084	6
Toilet	4.5800	0.53522	7
Ventilations and Lighting	4.3700	0.70575	8
Signboards	4.1800	0.71605	9
Garbage Dumps	4.0100	0.52214	10
Sports and Leisure Facilities	3.7700	0.78951	11
Room Furniture's	3.5900	0.49431	12
Room Dormitory	3.2700	0.60059	13

CONCLUSIONS

In a nutshell, this research found that the circumstances of the dormitory rooms at the WCT CLQ are superior to those at the MLQ, although there is room for improvement, particularly with regard to the room furnishings and sports facilities. WCT CLQ is essentially consistent with the standards outlined in MS2593: 2015. Thus, it is also confirmed by the results of the questionnaire survey, in which the majority of respondents (occupants of CLQ) agreed that the management in CLQ is effective. Based on the data, it can be concluded that the objective of the study on the effectiveness of CLQ in accomplishing the first strategic thrust of CITP on Quality, Safety, and Professionalism was attained.

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