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Organised by:
Research Management Unit
Faculty of Architecture, Planning & Surveying
UiTM, Shah Alam



Editors:

HAMIMAH ADNAN
ANI SAIFUZA ABD SHUKOR
ANIS SAZIRA BAKRI
NURZAFIRA ZAINUL ABIDIN
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PREFACE

IIIDBEEEX 2020 (International Invention, Innovation, and Design Exposition for Built Environment and Engineering: Conference and Publication 2020) organized by the Faculty of Architecture, Planning and Surveying (FSPU), Universiti Teknologi MARA (UiTM), Shah Alam, was successfully held on 11th Nov 2020. The conference was carried out in the form of a virtual conference due to the impact of COVID-19. There were 66 numbers of poster presentations by participants, which brought great opportunity to share recent research results and exchange knowledge. In conjunction with this conference, forty (40) IIIDBEEEX 2020 Conference Proceeding Papers compiled them into the proceedings after rigorously reviewed them. These papers feature the following topics but are not limited to Contract & Procurement, Estate Management, Sustainable and Project Management. All the papers have been through rigorous review and process to meet the requirements of the international publication standard. I would like to express my sincere gratitude to the Chairman, the Editors, the Participants, and all the authors who submitted their papers. Gratitudes and appreciations for all the reviewers who helped us maintain the high quality of manuscripts included in the proceedings. I would also like to extend our thanks to the organizing team members for their hard work and a great thank you for the enormous support of the Faculty of Architecture, Planning & Surveying for supporting the conference and publication. May the readers enjoy gaining some valuable knowledge from it, and the readers will find it helpful, exciting, and inspiring.

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CONTRACT & PROCUREMENT

CONTRACT MANAGEMENT APPROACH BY OIL AND GAS EPCC CONTRACTOR IN MALAYSIA – AN EXPLORATORY STUDY

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Abstract

An effective contract management approach is one of the vital key factors towards the successfulness of every oil and gas project. The probability of a project lead by an EPCC contractor to be exposed to various risks are relatively high and may jeopardize the project performance thus, causing dispute among the involved parties. Despite of all this, stakeholders often close one's eyes on this issue and unaware of the major catastrophe that can disrupt the project execution, financial stability and the contractor's overall performance. Therefore, the main research aims to establish a revolutionary and improvised contract management that consists of the best practices and act as a proper guideline for the EPCC contractor in deciding tender participation, common procurement and subcontracting methods and the best approach to still operate despite of the ongoing global crisis. The outcome of this research will be significantly valuable to the oil and gas industry players especially to the EPCC contractors in developing better approach, practice and tools of contract management. This paper, however, which is based on the exploratory interview conducted via online where the respondents are the client and EPCC contractors, is to gauge and explore the current issues and challenges within the oil and gas industry. This interview was conducted in the month of May and July 2020. The initial findings include establishing the current contracting practices that are being adopted in the industry whilst recommendations were given by respondents on the methods used by them to minimize disputes, delay and cost overruns, upgrading the employee's level of understanding and competency. The issues mentioned in this research is considered as the common challenges faced by the oil and gas industry due to the volatility of the crude oil price and these challenges have become more immense with the sudden Covid-19 pandemic outbreak.

Keywords: *Contract management; Engineering, Procurement, Construction and Commissioning (EPCC); delay & cost overruns; minimising disputes*

INTRODUCTION

The current oil and gas industry especially in the upstream business has been practicing and implementing the Engineering, Procurement, Construction and Commissioning (EPCC) contract to award the project to the appointed EPCC contractor by the client i.e. the Malaysian national oil company, Petroliaam National Berhad (PETRONAS) and it's Petroleum Arrangement Contractor (PAC) often referred to as the "turnkey" to develop the project from the commencement of the project until the final completion within the specified period of time. EPCC contractor has been custodied to take full responsibility of the assigned project and in most cases, they have the rights to delegate separate agreements to sub-contractors, vendors and suppliers of service-related products in accordance to the contract awarded by the client.

The nature of this industry is highly technical and sensitive. In addition, implementation of a particular project in remote areas require different levels of communication as the degree of technical complexity is high. Project deferment is one of the most common predicaments in the construction industry worldwide (Ruqaishi and Bashir, 2015). According to Abdul-Malak, Ali H. Srouer and Farah S. Demachkieh (2020), conflicts are unavoidable owing to the differing interests and goals of the various parties involved in the construction process. There is a profusion of similarities from the mentioned statement is identified in the Malaysia's oil and gas industry where some of the projects are still in plague with disputes and the situation becomes detrimental when the dispute remains unsettled leading towards the pursuant of litigation e.g. Kebabangan Petroleum Operating Company (KPOC) has filed a RM125mil claim against Malaysian Marine and Heavy Engineering Holdings Berhad (MMHE) over a dispute on the oil field north of Sabah (Joseph Chin, 2019).

Zulhafiz and Rahman (2020) stated that the absence in the Malaysian law to regulate imbalance risk allocation and unfair indemnity and hold harmless clauses in the oil and gas service contracts should be perceived as a serious problem. Apart from that, many authors have performed their research in various aspects for that purpose. For instance, the analysis revealed that the characteristics of cloud computing in relation to the adoption of Engineering, Procurement and Construction contract allowing oil and gas companies to operate in a highly automated environment, enhancing the upstream oil and gas performance, minimizing financial risks and schedule delay as well as improving the quality of the project (Mohd Said et al., 2020). It is suggested that the Malaysian Parliament should pass a special law such as the Oilfield Anti-Indemnity Act. It would be an ideal and practical solution to have a proper legal framework to control the abuse of imbalance risk allocation and indemnity and hold harmless clauses in Malaysia. (Zulhafiz and Rahman, 2020)

In this research, a brief categorization has been adopted which outlines the elements of contracting strategy by several EPCC contractors such as the level of understanding, tendering and subcontracting approach and identifying the cause and effect of disputes, delay and cost overruns with the aim to address the grey areas of the current circumstances by closing the gap with the best contract management practice.

BACKGROUND

This study utilizes a combination of exploratory study and literature review that focuses mainly on the upstream business involving EPCC contractor in Malaysia where this contractor is required to be fully equipped and deliver a complete facility to the client in order to kick-start the whole operation. The concept of awarding a project to the EPCC contractor is that the project awarded is based on the agreed fixed lumpsum price and date of completion as per agreed by both the client and contractor. Should there be a situation where the EPCC contractor fail to comply with any requirements spelled out in the contract, one of the primary consequences are that it will lead to monetary liabilities. Hence, the risk and responsibility of the EPCC contractor is very crucial and a thorough deliberation has to be properly evaluated and considered in order to manage the contract in the right flow and manner. With this, the author aims to discuss about the contract management approach by EPCC contractor in handling the risk and responsibility of handling EPCC contract.

ISSUES / PROBLEM STATEMENTS

Poor Contract Management that resulted in Dispute, Delay or Cost Overruns

EPCC contractors are required to strategically execute and complete the project within the given period of time and budget in lump sum basis. Therefore, EPCC contractors should do their very best to avoid any dispute that might cause project delay or cost overruns. Integrated drilling services with the “one down, all down” concept has become a trend in PETRONAS especially in the volatile oil price environment (Linda, 2019). This concept has also been adapted by other services e.g. Transportation and Installation (T&I) and Hook-up and Commissioning (HUC) when the project has been awarded to the contractor with a single point responsibility and accountability.

Lack of Competency in Handling EPCC Contract

As the EPCC contract being awarded as a single point responsibility to an EPCC contractor, there are many possible risks to be considered and the understanding and competency level of their manpower is very crucial when it comes to handling the awarded EPCC contract. Due to the incompetency of the manpower, poor actions like misinterpretation and negligence are bound to occur in managing the contract in the project execution and the failure of identifying these bad traits at an early stage may cause a domino effect towards the overall project.

OBJECTIVES

1. To investigate the contract management approach by EPCC contractors.
2. To identify EPCC contractor's level of competency when dealing with the EPCC contract.

RESEARCH METHODOLOGY

A mixed of qualitative and quantitative research technique is being utilized for this research by conducting an online interview between the period of May and July 2020 with four (4) respondents from prominent EPCC contractors and one (1) from the client. The respondent's different job functions i.e. the employee who is in-charge of the contract administration unit and outside the contract administration unit e.g. project management, engineering, quality, safety and risk management may result in variety of responds to cover each critical contractual requirement in performing an EPCC contact in upstream business.

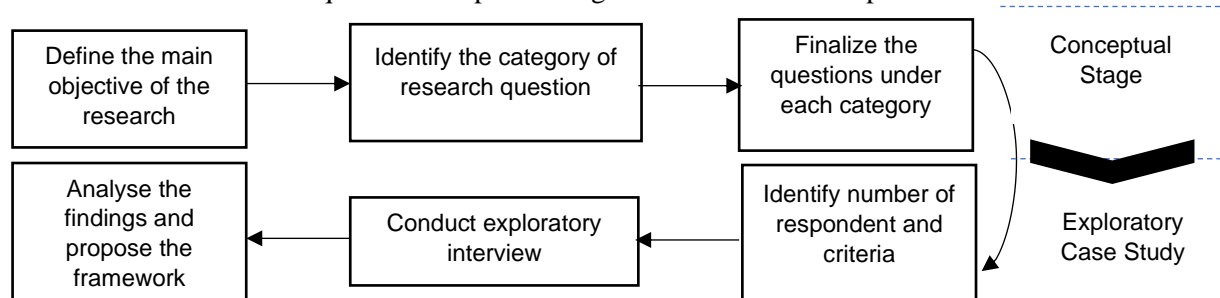


Figure 1. Research task performed on case study with the respondents

Research questions have been divided into five (5) main categories:

Table 1. Research questions during exploratory interview

Item	Category	Questions
1	Client's tender participation	<ul style="list-style-type: none"> • What are the main factors that will convince/influence the management in deciding to participate in tender?
2	Competency level	<ul style="list-style-type: none"> • What would be the level of understanding/awareness of the stakeholders in the company on procurement and contracts and contract management? Scale 1-10? • Does your company conduct a procurement/contract review session?
3	Dispute, delay and cost overruns	<ul style="list-style-type: none"> • Does your company has ever encountered any dispute arising from the contract within the contract period? • Does your company has ever encountered any delays or cost overruns? • What would be the common cause for the disputes, delays or cost overruns?
4	Procurement/Subcontracting strategy	<ul style="list-style-type: none"> • What are the common types of procurement method used by the company?
5	Best practice approach	<ul style="list-style-type: none"> • Does your company seek any expert advice from other industries to mitigate any issues pertaining to contract management? • Do you feel that a Best Practice approach of contract management can somehow help and sustain the company in previous, current and post stages of this oil price depression and C-19 pandemic crisis?

Similar set of questions in the above Table 1 was used in all the online interview sessions conducted to obtain feedbacks and inputs on ways that an EPCC contractor can perform to improve the competency of the personnel and the efficiency of the process. An actual case study of the current global situation and project execution was highlighted with iterative guides from the literature review by using content analysis of the primary data sources. Data mining on the interview transcripts were conducted to provide qualitative findings and conclusion.

FINDING AND DISCUSSION

Client's Tender Participation

Many EPCC contractors often conduct thorough deliberation by involving the stakeholders namely tender committee to brainstorm several key factors to minimize contract risks and provide a constraint-free working environment during project execution.

Table 2. Factor to be considered in tender participation decision

Companies	Factors in Tender Decision
A	<ul style="list-style-type: none"> • Client's credibility and capability • Type of tender either direct or sub-contract • Percentage of chances • Scope size and demarcation • General clauses on payment terms, liquidated damages capping, insurance requirement and limit of liability • Percentage of margin
B	<ul style="list-style-type: none"> • Quality, Health, Safety and Environment requirement and regulation • Percentage of margin
C	<ul style="list-style-type: none"> • Percentage of margin • Payment terms • Duration of contract
D	<ul style="list-style-type: none"> • Previous experiences • Percentage of margin • Financial level • Payment terms
E	<ul style="list-style-type: none"> • Financial reward • Percentage of margin

Understanding the condition of the contract are the initial factors to be considered in deciding to participate in the tender as shown in Table 2. The condition of the contract must be defined properly by the client as all the clauses are inter-related with other factors. The type of tender, scope size and demarcation are the key elements in preparing the planning package and change order claim if an additional work being requested by client during actual execution. Liquidated damages (LD) and Limit of Liability (LOL) will trigger the amount of risk to be taken and some EPCC contractor will allow some contingency to cover this expense as consequence management. Should the contractors require an Extension of Time (EOT), they must prepare all the related supporting documents to avoid LD being imposed by the client.

The duration of contract and the current financial level will provide an indication to the EPCC contractor to plan their healthy cashflow and indirectly decide the duration of the project financing with the financial institution. The contractors should also perform a proper analyzation on the client's Quality, Health, Safety and Environment (QHSE) technical requirements and ensure that the stated requirements can be complied and fulfilled by the EPCC contractors. Commercial factors and percentage of margin are the two popular factors that most of the clients implement and look into when determining the successfulness of the project. When all the mentioned factors have been taken into thorough consideration and deliberation, a prediction on the probability of the company to win the contract can be determined along with the sustainability of the EPCC contractor to deliver the project on time and the generation of revenue to the company.

Competency Level

The accountability of the contract related matters is the responsibility of the person in-charge which is the contract administrator. Nonetheless, a good cooperation and strong teamwork among the employees can further enhance their level of understanding as well as increase their level of competency.

Table 3. Contract review/training session conducted

Companies	Contract Review Session	Training Conducted
A	Ad-hoc basis in the pre-contract and post-contract with Project Manager and Head of Department	Internal training, lesson learnt from previous project and focus on important clauses in contract, terms and condition and administrative procedures
B	Ad-hoc basis in the pre-contract and post-contract with all function leaders	<ul style="list-style-type: none"> • Internal training, lesson learnt from previous project and focus on important clauses in contract, terms and condition and administrative procedures • Training also focus on the understanding of the technical terms
C	Ad-hoc basis in the pre-contract and post-contract with Project Manager, all function leaders and staffs related to the project	<ul style="list-style-type: none"> • Internal training is provided, lesson learnt from previous project and focus on important clauses in contract, terms and condition and administrative procedures • One of the training focuses on the commercial management by the technical personnel
D	Ad-hoc basis in the pre-contract and post-contract with Project Manager and Head of Department	Internal training is conducted religiously bi-weekly basis on the general training and lesson learnt from previous project and focuses on the important clauses in the contract, terms and conditions and administrative procedures.
E	Conducted with all the function leaders and staffs in-charge for each contract <ul style="list-style-type: none"> • Prior to the contract award • 4-5 months prior contract expiry • Lesson learnt once a year and at the end of the contract 	Internal and external training are conducted once a month for general training and lesson learnt from previous project and focus on important clauses in contract, terms and condition and administrative procedures

According to the responses obtained in Table 3, there are various approaches being exercised by the EPCC contractors to embed the awareness of contract understanding among the employees.

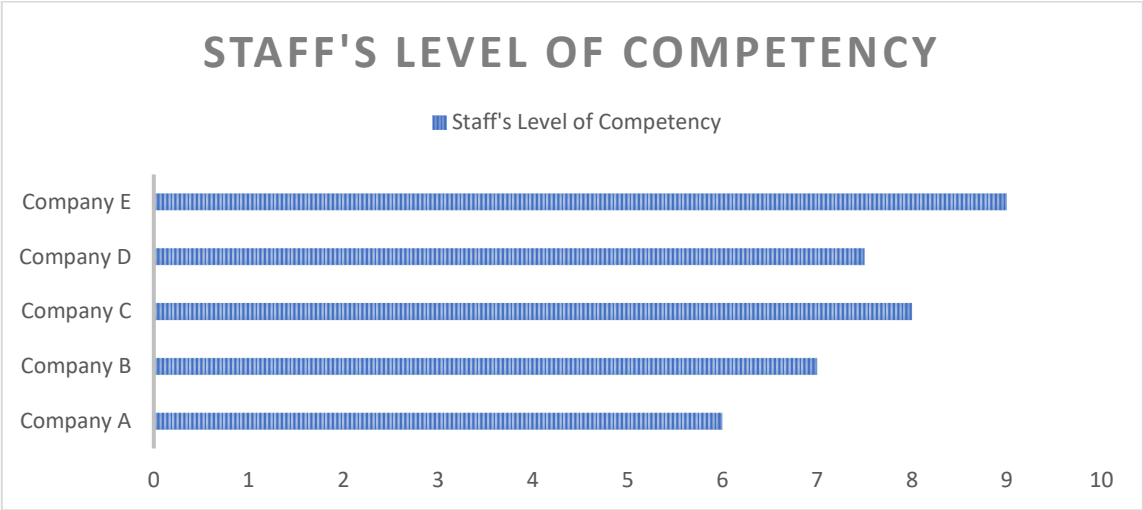


Figure 2. Staff's level of competency

The type of approach used by companies also contributes to the competency level of the employees. The several important factors to determine the competency level is by analysing the demeanour of the audience and the frequency of the sessions held. The impressive outcome on the numbers of the participating audience and the regularity of the sessions being conducted for the contract review and training session will produce a significant positive impact to the level of competency among the employees as shown in Figure 2. The employees in Company C and E are the most competent with the score of 8 and 9 out of 10.

Procurement/Subcontracting Strategy

Table 4. Procurement/subcontracting method used

Companies	Procurement Method	Technical Evaluation	Contract duration	Bidder List
A	2-tier	Client involvement and internal team	Ad-hoc basis	SWEC code
B	2-tier	Internal team only	Ad-hoc basis	SWEC code
C	2-tier	Appoint engineering company and internal team	Ad-hoc basis	SWEC code
D	2-tier	Client involvement and internal team	Ad-hoc basis	SWEC code
E	2-tier	Internal team only	Long term contract minimum 2 years	SWEC code

Based on the categorization stated in Table 4, all EPCC contractors and PAC must strictly comply and abide to the SWEC code given by PETRONAS to invite vendors/subcontractors

to participate in the bidding process. According to the outcome of the questionnaires, all respondents gave their recommendations on establishing a standard method of procurement for ad-hoc basis specially for the awarded contract of the 2-tier method which the technical and commercial proposals prepared by vendors shall be submitted to EPCC contractor that acts as the main contractor and a separate submission and evaluation shall be performed whereby the technical evaluation is presented first then the commercial part comes in later after the initial stage of finalizing the technical requirement.

The technical acceptance is usually endorsed by the technical evaluation committee that includes the client participation along with the internal technical team. Then, the commercial proposal will be opened based on the accepted technical specifications and the commercial evaluation committee will handle the rest of the process to select the lowest bidder that is technically acceptable by the committee as the winner to supply the requested goods or services after a successful negotiation process. This method is to ensure that the EPCC contractor is able to obtain the best prices that meets the client and end user requirements and also contributes to the maximum cost saving for company

Dispute, Delay or Cost Overruns

The high volume of disputes and implications that are being discussed in this paper is dispute, project delay and cost overruns effecting the project in today's oil and gas industry.

Table 5. Dispute, delay or cost overruns

Companies	Dispute within Contract Period	Delay and Cost Overruns Encountered	Common Cause for Dispute, Delay and Cost Overruns
A	Yes	Yes	<ul style="list-style-type: none"> • Different interpretation and expectation of contract • Operational constraints e.g. weather condition, dependency on another contractor schedule • Delay in getting resources and material delivery • Incompetent and shortage of manpower supply • Design and specification difference between Issue for Review (IFR) and Approved for Construction (AFC) drawing
B	Yes	Yes	<ul style="list-style-type: none"> • Different interpretation and expectation of contract • Not deliberately challenge on grey areas • QHSE incident

C	Yes	Yes	<ul style="list-style-type: none"> • Different interpretation and expectation of contract • Error in estimation prior mobilization • Technical reference not according to approved specification
D	Yes	Yes	<ul style="list-style-type: none"> • Different interpretation and expectation of contract • Lack of expertise of manpower • Delay in getting resources and material delivery
E	Yes	Yes	<ul style="list-style-type: none"> • Different interpretation and expectation of contract • Important clauses being left out in contract

Every contractor is dealing with different kind of disputes for different contract and client. The quantum of dispute can be one of the factors to be considered in the future tender participation decision. The main factors of the mentioned implications are the different interpretation and expectation of the awarded contract including difference in design, specification and technical reference are not according to approved specification. For instance, the Approved for Construction (AFC) is the most accurate document to refer to for the approved specifications, quantities and requirements of materials. However, most of the projects utilize the Issued for Review (IFR) drawing as a basis to commence the procurement process. As a result, EPCC contractor has to endure the losses due to incorrect materials purchased and additional expenses to procure the right materials that leads to deferment of project mobilization and the Non-Productive Time (NPT) is subjected to be charged by the client.

Some projects are poorly executed due to lack of technical and non-technical expertise and the shortage of manpower supply. The employees who have failed to understand the contract is oblivious on the potential negative impact of their wrongdoings that they are unaware and have lack of knowledge of. Prior to the tender submission to the client, the tender team has to ensure that they are able to cover all aspects of the contract but there are some grey areas that are not deliberately challenged such as the important clauses being left out from the contract that will affect the provision of the site survey creating disputes during the engineering design phase. The common mistake that an EPCC contractor always make is the incorrect prices and quantity quoted due to insufficient study and preparation in planning and budgeting the estimation of cost. Before the initiation of the mobilization by the EPCC contractor, the responsible planner is required to prepare the planning package and propose the work schedule to the client for their written approval. The planning has to be done in a detailed manner to ensure a well-ordered execution of the project.

Some of the operational constraints that are inevitable and beyond their control such as weather condition, dependency on other parties when dealing or working with other contractors on the same platform, QHSE accidents and delay in deliverables. The offshore oil and gas operation are periodically facing extended downtime due to unpredictable weather conditions that leads to financial losses to either the client or contractor and they should be aware of the Waiting on Weather (WOW) clause stated in the contract. Failure to comply to the QHSE policies may lead to the potential risk of any form of accident and this will cause

several major consequences such as bad reputation to the company, losses and additional expenses to perform corrective actions and paying the penalty. This will affect the client’s decision with regards to the contractor’s reputation and rating for the future tender bidding.

Best Practices Approach

Table 6. Best practices approach during oil price depression and global pandemic crisis

Companies	Best practice approach during oil depression and globalpandemic crisis
A	<ul style="list-style-type: none">• Notify client on the constraint and the best approach• Sourcing from local vendors• Keep the evidence, record, slip and receipt and write an official correspondence to client on the constraint and the impact• Manage change order properly
B	<ul style="list-style-type: none">• Perform proper cost estimation and planning during bidding process• Alert and take extra precaution on the quality and safety• Improve contract awareness
C	<ul style="list-style-type: none">• Notify client on the constraint and the best approach• Keep the evidence, record, slip and receipt and write an official correspondence to client on the constraint and the impact• Prepare for the contract negotiation with vendor and client
D	<ul style="list-style-type: none">• Initiate cost saving initiative
E	<ul style="list-style-type: none">• Propose to add up more clauses and matrix related to the uncertain condition during crisis• Ensure insurance coverage is enough to fulfil the contract

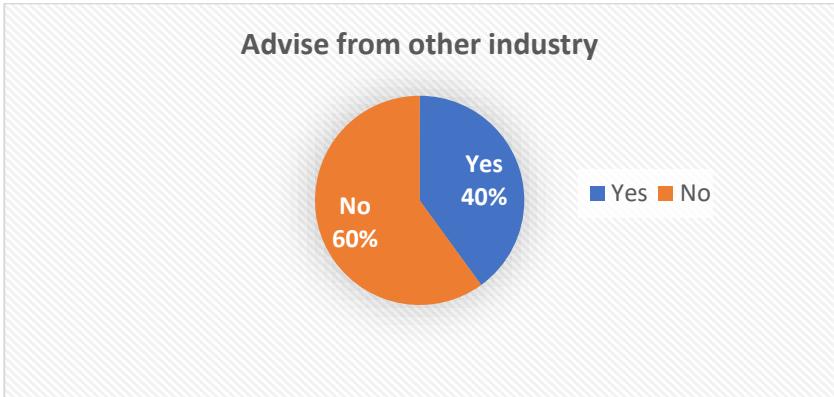


Figure 3. Seek advice from other industry

Based on the figure shown in Figure 3, there are only a percentage of 40% respondents seeking advice from other industries. As a matter of fact, the fundamental of contract management consists of the elements that can be the appropriate solution to any issue pertaining to the contract management based on their independent views, knowledge and experiences for the similar issues or cases occur in their own industry.

The frequent occurrence of the oil prices depression and the sudden outbreak of the Covid-19 pandemic are the unexpected and inevitable phenomena that emits a vast impact to the global market. The frequent occurrence of the oil prices depression and the sudden outbreak of the Covid-19 pandemic are the unexpected and inevitable phenomena that emits a vast impact to the global market.

Based on the best practices of contract management listed in Table 6, EPCC contractor has to manage the change order properly by writing an official correspondence to inform client regarding any shortage of goods and services and safeguarding all the important documents such as record, slip and receipt. A part from that, EPCC contractor has to be on standby mode at any time for the negotiation of contract between the client and the contractor in order to come to an agreement of a lower pricing from the contractor. Sourcing from local vendors may help the company to overcome shortage of supplies by substituting the overseas products with the local products of equivalent quality. The action of making the switch is due to the logistic limitation to cross the boundary by the authority in every country.

EPCC contractors are allowed to use an alternative approach to prepare a proper cost estimation and planning for the bidding process, alert and taking extra precautions on the quality and safety matters, improve contract awareness, initiate cost saving initiatives and ensure sufficient insurance coverage to fulfil the requirement in the contract and ensuring the sustainability of the company.

CONCLUSION

Based on the exploratory study conducted, a more in-depth research should be conducted to further identify the root cause of the gap in the oil and gas industry contractual management and intense analysis and improvisation should be done to improve the EPCC contractor's level of competency among the employees who are handling the EPCC contract. It is believed that this research may consist of a powerful module that can potentially be a game changer in the oil and gas industry for contractual management. Along the way in this research, other relevant initiatives will be identified to prevent any risk or failure in the project execution. At the end of this research, it can be expected that the performance of the EPCC contractors will be significant and one of the reasons to the spike of the performance are due to the frequent contract review session and internal training session. Apart from that, the objective of this research is to ensure that the EPCC contractors shall be able to manage the contract with due care and diligence and are able to initiate the framework for the standard guideline of contract management practice prior to the execution of the project within the given timeframe and budget with minimal dispute, delay and cost overruns.

NOVELTY

The result of this research will be significantly valuable to the EPCC contractor to develop better approach, practice and tools of contract management.

COMMERCIALIZATION

This paper can be commercialized to various EPCC contractor in oil and gas industry to provide better control of their EPCC contract as well as ensuring the on-time project delivery within the budget for the sustainability of EPCC contractor.

RECOGNITIONS

A thousand of gratitude to the five (5) respondents from various established oil and gas company for their time spend in the online interview despite their hectic day-to-day job activities and all parties involved in the accomplishment of this paper.

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SUCCESS FACTORS OF NON-BUMIPUTERA BUSINESS ORGANISATION IN THE CONSTRUCTION INDUSTRY

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Abstract

In Malaysia, most of the projects were awarded to Non-Bumiputera. These can be seen on the famous business entrepreneurs that had been conquered by foreign companies. For non-Bumiputera business organisation, to attain success is essential issue for companies to survive. This paper aims to establish the success factors of Non-Bumiputera business organisation in Malaysia construction industry. The objectives highlighted for this paper are to identify success factors of Non-Bumiputera organisations in Malaysia and to determine the issues occur in their business organisations. An extensive literature review was done to obtain the success factors and the issues in business organisations in general. To obtain in depth the success factors and the issues occur in the non-Bumiputera business organisations, 20 questionnaire surveys were distributed and a total number of 15 feedbacks were obtain among top developer in Klang Valley. The data was analysed by using SPSS software. Findings showed that there were four main criteria to achieve success; management and organisation, communications, planning and financing. The issue that can be identified comprises of, but not limited to registration process with the CIDB, financial constraints, risks and communication barriers. The construction industry is continuously changing with the new business approaches and technologies. Therefore, construction organisations must have effective strategies to be more competitive in the construction industry.

Keywords: *Business Organisation; Non-Bumiputera; Challenges; Success Factors*

INTRODUCTION

Non-Bumiputera is a group that not categorised under a group of Bumiputera. Non-Bumiputera also considered as a people's outside of Malaysia. This group are seen most successful in the construction industry. Most of the project in Malaysia was awarded to Non-Bumiputera and these can be seen through the famous business organisations who had been listed were mostly by foreign companies. The nature of construction industry is constantly changing in terms of the advancement of technologies. Construction companies need to be more competitive and enhanced their business strategic to be successful in the construction market. Nowadays, the demand for mega projects in Malaysia continues to be dominated by foreign contractors. Furthermore, the infrastructure projects in Malaysia were awarded to international peers as the main contractors for the jobs. (Laryea, 2016; Yunus, 2017).

THE SUCCESS FACTORS OF BUSINESS ORGANISATION

Successful company business is equal to a successful construction project. In order to achieve success, there are numerous success factor criteria that contribute to a business organisation to become successful. In evaluating success criteria for foreign construction

projects, it can be measured by using several criteria (Alashwal, Fareed, Al-obaidi, 2017). Table 1 shows the component of success factors in Non-Bumiputera business organization in the construction industry.

Table 1. Success Factors Criteria for Business Organisation in the Construction Industry

Success Factor	Description	Author / Year
Management and Organisation	<ul style="list-style-type: none"> • Application of strategic management • The contribution by the organisation in the industry • Product images and clients associations • Leadership and entrepreneurial skills 	Maimun, Abdullah, & Ramly (2019) Esmailpour & Barjoei (2016) Amy et al. (2011) Alashwal, Fareed and Al-obaidi (2017) Abhijeet Gadekar (2013)
Communications	<ul style="list-style-type: none"> • Trust between the corporation and the stakeholders • Ability to communicate with the people within and without the organisation • Clearer and more persuasive marketing messages 	Manager (2017) Kaib (2016) McKenna (2012) School (2017)
Planning	<ul style="list-style-type: none"> • Certify the quality of the product before handing it out to the client • Strategic imperative within organisations • Strategic and tactical planning that involved stakeholders 	Esmailpour & Barjoei (2016) Shafie (2010) Gorgievski, Ascalon, & Stephan (2011)
Financing	<ul style="list-style-type: none"> • Ability to make incomes on an ongoing basis • Secure a bank's funding, attract investors to finance its operation • Understand the importance of profitability in business management organisation • Cash flow management 	Grimsley (2014) Johnson (2019) Abhijeet Gadekar (2013) Bansal (2015) D'Arvor (2017)

ISSUES IN ACHIEVING SUCCESS IN BUSINESS ORGANISATIONS

The construction industry in Malaysia has been experiencing an upward pattern since a decade ago due to the huge increase in the number of projects executed (Abdul-Rahman, Wang, Wood, & Low, 2012). However, for Non- Bumiputera to achieve its success, several issues have been raised. First, the government policy implies for Non-Bumiputera workers. There is no Foreign Workers Act or similar legislation unifying issues relating to migrant workers specific to one law. In conjunction with this, the application for a labour visa for

foreign workers was hard to obtain. Thus, this will be difficult for a certain business organisation since many of the general labour were filled by migrants.

Next issue was related to permit to commence the work. To commence the work, they must have a company bank account (Advisory, 2015). Under Companies Commission Malaysia (CCM) Company Act 2016, it requires all directors to sign company documents and resolutions. The status of a company shall be deemed to be a local company where at least 50% of the company's shares are held by local Malaysians. In which is a business organisation there must be a native Bumiputera where there cannot solely own the business. If they are unable to open a company's bank account, they cannot commence the business. Conjunction for the permit issue, the government has constricted the requirements for work permits and increased the levy on foreign workers based on their employment sector. The Government has decided not to extend unskilled foreign labour's work permits that have been in the country for more than five years and to grant an amnesty to illegal foreign workers an amnesty to returning to their own countries without legal action (Kamal, Haron, Ulang & Baharom, 2012). Moreover, the Construction Industry Development Board (CIDB) has strictly imposed the guideline for the Non-Bumiputera to establish a company. It stated that they must have Bumiputera in their organization which means solely that a Bumiputera also owns a share in their company (Rahmat, 2016). With this, they cannot solely own or exploit the business by themselves.

METHODOLOGY

This paper aims to determine the success factors for Non-Bumiputera organisations in the Malaysian construction industry. An extensive literature review was done and the component of success factors in general and the issues in implementing it were outlined. Additionally, to support the information in the Malaysian construction industry context, a questionnaire survey was done. A total of 20 questionnaires were distributed amongst top developers in Klang Valley and only 15 companies give the responses. The questionnaire was divided into two (2) main sections; the success factors and the issues in implementing it in the business organisation in Malaysia construction industry. For the first objective, there were four main factors outlined. For the second objective, there were five issues outlined for this paper. A five-point Likert scale was used to measure the activities. The data for both objectives were analysed using SPSS software. The Descriptive Statistic: Frequencies-Mean-score method was used to achieve the objectives.

FINDINGS AND DISCUSSION

Success Factors Criteria for Non-Bumiputera Business Organisations in the Construction Industry

Table 2 shows the success factors in the Non-Bumiputera business organisation. There were four main criteria in the success factor; management and organisation, communication, planning and financing.

Table 2. Success Factors Criteria for Non-Bumiputera Business Organisations

Factors	Mean Score	Rank
Management and organisation	4.47	2
Communication	4.18	4
Planning	4.25	3
Financing	4.51	1

Financing factor was one of the success factors in the respondents' business organisations with the mean value of 4.51. They strongly agreed that a financial component was the crucial success factors to achieve success in the business organisation. This can be seen that business success depends on its ability to make incomes on an ongoing basis. Respondents also strongly agreed to the management and organisation factor (mean value = 4.47) as one of the components to achieve success in the construction industry. By showing a positive organisation image and protect their high reputation, the organisation managed to gained trust and established bonding between their business and the clients. Planning and communication were another success factors to business organisation in the construction industry with mean value of 4.25 and 4.18 respectively. Respondents agreed that in their organisations, deeper understanding on the organisations objectives led to a proper planning and gave unique impact for successful business organisation. Effective communication within organisations and also with client can create stronger business relationships that lead to business success.

Issues in achieving Success in Non-Bumiputera Business Organisations in the Construction Industry

Table 3 described the issues faced by the Non-Bumiputera business organisation in achieving success in the construction industry. Overall, there were five main issues outlined and faced by the Non-Bumiputera business organisations in doing the construction work.

Table 3. Issues for Non-Bumiputera Business Organisations

Issue	Mean Score	Classification	Rank
1. Government policy for the Non-Bumiputera	3.60	Agreed	4
2. Labour visa	3.93	Agreed	3
3. Nationalities of the labour	4.00	Agreed	2
4. Permit to commence work	3.53	Agreed	5
5. Registration with CIDB	4.07	Agreed	1

Table 3 indicated that most of the respondents agreed that they have any issues on the registration with CIDB, with the highest mean value of 4.07. With an average mean score of 4.00, the nationalities of the labour became the next issue for the Non-Bumiputera business organisation, followed by the third-place which was the process of labour visa issue with a mean value of 3.93 and a mean score of 3.53 was obtaining the permit to commence work.

Additionally, with an average mean of 3.60, the respondents agreed that government policy for the Non-Bumiputera was one of the issues for them to success.

As a result, the major issue faced by the Non-Bumiputera business organisations in the construction industry was the registration process and procedure with CIDB. The respondents did emphasise on the complex requirement that has been decided by the board of CIDB that made it became an issue for Non-Bumiputera business organisations to set up the company. They had to face all the listed issues above and find the best solutions to overcome the issues, as it could give results in poor performance and give negative impact to the business activities as well as the construction activities.

CONCLUSION

Four criteria are important for organization to success; financing, management and organisation, planning and communication. By having a strong leadership skill to handle the workers and the business, it will increase the business organisation reputation in the construction industry. Moreover, the quality of the product is in the best condition which could lead to other criteria which customer's satisfaction. Therefore, proper planning needs to be outlined in the organisations, to achieve high business performance.

In addition, time and cost are also one of the criteria for the construction organisation to success. The project must be delivered on time without exceeding the client's budget. Most importantly when delivered, the product must meet the client's expectation. During the construction, the top management must ensure the safety of the workers. This is to ensure working towards zero accidents is crucial towards company image. Some studies show great image criteria of the organisation important in business success. Last but not least, an effective communication factor also determines either the organisation stays in business or not. Therefore, a business owner must understand the importance of having good communication to the employees and also to the clients.

This paper only focused on the success factors and issues faced by Non-Bumiputera developers in Malaysia construction industry. Therefore, for further research, the scope area can be implementing by having a study on critical success factors for Non-Bumiputera consultants and contractors in Malaysia construction industry. Moreover, a deeper research on how to expand the Non-Bumiputera business organisations in terms of collaboration with the Bumiputera organisation or investigation on the encouragement factors of Non-Bumiputera business organisations going internationalisation may be done.

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SUCCESS FACTORS FOR THE SUCCESSFUL DELIVERY OF STAKEHOLDER MANAGEMENT IN PUBLIC-PRIVATE PARTNERSHIPS PROJECTS IN MALAYSIA

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Abstract

Public Private Partnerships in Malaysia have been common with both the public and private sectors. PPP manages complex projects and involves multiple stakeholders. Stakeholders in PPP projects need to know the success factors faced by stakeholders at all levels more closely and accurately to every stakeholder management stages. This paper aims to determine the success factors of stakeholder management process for the successful delivery of stakeholder management in Malaysian PPP infrastructure projects. In order to achieve the objectives, a set of questionnaires were conducted on 43 respondents from various stakeholder's background namely public authority, consultants, contractors and financiers. To rank the success factors, a matrix was provided to the respondents and the percentage method was used to allocate the success factors. The result of conclude that the success factors for engaging stakeholders in PPP projects in the achievement of successful projects. Each stage of stakeholder management has its own success factors. After all the success factors have been reached, stakeholder management might be considered to be successful delivery in PPP projects.

Keywords: *Stakeholder Management; Public-Private Partnerships*

INTRODUCTION

Public-Private Partnerships concept have become very popular in recent decades in developing and developed countries (Osei-Kyei & Chan, 2015; 2017; Solomon et al., 2015). Public-Private Partnerships is a relationship between the public and private sector, where aim of carrying the private sector to use their resources expertise and efficiency into a public project to provide services or goods (Liu,et.al., 2015). PPP is seen as partnership to develop public infrastructure with a private entrepreneur collaboration (Singaravelloo, 2010). To achieve a successful project delivery, project delivery stakeholder plays an important role in the construction industry (Eyiah-Botwe,et. al., 2016). The PMI (2004) defines project stakeholder management as system that involved identification, analysis and planning of actions to communicate with and influence stakeholders. El-Gohary et al. (2006) developed a semantic model for stakeholder involvement during the design stage of PPP projects. However, according to De schepper et al., (2014) these stakeholder issues are directly related to the responsibility with ineffective stakeholder management approaches. Although the growing amount of research on stakeholder management (Mwesigwa et al., 2019; Harris, 2010; Yang et al., 2009; Jergeas et al., 2000), little theoretical and empirical attention paid to the success factors of stakeholder management in PPP projects in Malaysia. Lack of studies come out to determine the success factors for PPP infrastructure projects in Malaysia. Therefore, this paper was aimed to identify the success factors of stakeholder management process to the successful delivery of stakeholder management.

STAKEHOLDER MANAGEMENT IN PUBLIC-PRIVATE PARTNERSHIPS

Many researchers have been interested in the area of success factors of construction management that contributes to the success of stakeholder management in construction projects (Reed et al., 2009; J. Yang et al., 2009). Jergeas et al. (2000) recognised two aspects of stakeholder management for construction projects, such as communication with stakeholders and the establishment of common objectives and project priorities. Five factors recognised by Olander & Landin (2008): stakeholder requires analysis, benefits communication, negative impact interaction, alternative solutions evaluation, the project organisation and media interactions. In construction projects, (Yang et al., 2011) studied numerous factors or strategies leading to effective stakeholder management. While these factors/strategies are not particular to PPP projects, they are supposed to use for the development of the conceptual framework in PPP projects. The success factors identified were classified in the main stages of the stakeholder management process: stakeholder analysis, stakeholder engagement, stakeholder management action plan and stakeholder management monitoring.

De Schepper et al. (2014) investigated the application of general stakeholder analysis techniques in PPP projects to carried out with the PPP project scenarios, assessed the impact of the allocation of the responsibilities of the two principal stakeholders in a PPP project and recommended better recommendations on improvement of success for PPP project achievement. From the research carried out by De Schepper et al. (2014), a list of stakeholder management for the success factors to PPP projects success has obtained. Besides, the study carried out by Henjewe et al. (2013) was extracted an additional set of success factors that contribute to PPP projects success. Therefore, a list of success factors for PPP-specific and non-specific stakeholder management was created at the end of the literature review and was used to research the list of PPP practices further. Table 1 presents the literature review's success factors.

Table 1. Identification of Success Factors of Stakeholder Management in PPP Projects

Success factors contribute to stakeholder management	Authors
<u>Stakeholder Analysis</u>	
Formalised stakeholder assessment procedure	
Identify all stakeholders	Elias et al. (2002)
Classify stakeholders	Lim et al. (2005)
Rank stakeholders	Byrson (2004), Yang et al. (2009)
Identify relationships between stakeholders	Olander & Landin (2008), Lim et al. (2005)
Identify concerns of each stakeholder	Byrson (2004), Yang et al. (2009)
Identify longer-term stakeholder issues	Bryson (2004)
Identify relationships among stakeholder issues	Bryson (2004)
Have a good understanding of the objectives of each other	Yang et al. (2009), Zou et al. (2008), Ruuska & Teigland (2009), Yuan et al. (2009), Tang & Shen (2013), Liu et al. (2015)
Identification of stakeholders' expectations	
In-depth analysis of the political opportunity structure	De Schepper et al. (2014)
In-depth analysis of the opposition within stakeholders	De Schepper et al. (2014)
<u>Stakeholder Engagement</u>	
Formalised stakeholder engagement procedure	

Success factors contribute to stakeholder management	Authors
Identify the most suitable strategy to engage with stakeholders	Yang et al. (2009)
Communication in stakeholder engagement	
Communicate and interact with all stakeholders	Zou et al. (2008), Olander & Landin (2008), Yang et al. (2009), Tang & Shen (2013)
Be honest	Tang & Shen (2013)
Early communication with stakeholders on their concerns	Olander & Landin (2008)
Transparency in stakeholder engagement	
Engage with stakeholders in the design of the bid's assessment criteria	Mouraviev & Kakabadse (2015)
Agreement on brief by all relevant parties	Tang & Shen (2013)
Engage with the opposition party during the bidding stage	De Schepper et al. (2014)
Stakeholder management action plan	
Skilled project leader	Ruuska & Teigland (2009)
Employee training	Yuan et al. (2009) Yuan et al. (2012)
Integrate stakeholders into the strategy process	Freeman (1984), Savage et al. (1991)
Populate PPP workshops with experts from overseas	Garvin (2010)
Implement a stakeholder management action plan	Yang et al. (2009)
Stakeholder Monitoring	
Execution of stakeholder management performance evaluation	
Performance measurements each stakeholder category	McAdam et al. (2005)
On-going stakeholder analysis and engagement	
Analysing the change of stakeholders' influence and relationships	Chinyio & Akintoye (2008), Yang et al. (2009a)
Create a system which accumulates the lessons learnt via stakeholder forums	Tang & Shen (2013), Lim et al. (2005)
Ensuring an understanding of 'big picture' through continuous open & balance communication	Ruuska & Teigland (2009)

Stakeholder Analysis

One of the main elements in stakeholder analysis for a project is stakeholder identification (Karlsen 2002; Olander 2007; Walker et al. 2008; Jepsen & Eskerod 2009; Bryson 2004). The majority of stakeholder analysis techniques are based on the expertise of the key stakeholders to recognise other stakeholders of predetermined categories and, based upon the predetermined relationship characteristics and priority to their relative importance. According to Lim et al. (2005) stakeholders should be classified for the better use of the rules of the success factors. Project teams use difference stakeholder classification units based on their stakeholders. Henriques & Sadorsky (1999) categorised stakeholders as regulatory, community, organisational, and media. According to Bryson (2004), reason to identifying and classifying the stakeholder during stakeholder analysis stage was to satisfy every stakeholder during the process. It was necessary to determine how each stakeholder affected the organisation and the needs of every stakeholder. Furthermore, one of the further steps suggested by Bryson (2004) is to assess the significance of stakeholders. Also, Bryson (2004) recognised the significance that stakeholder issues should first identify and that the relationships between stakeholders should predict. The success factors mentioned above are not specific to PPP projects. Nonetheless, these practices in PPP projects are hypothesised to be essential for stakeholder management. De Schepper et al. (2014) proposed to undertake an

in-depth analysis of the policy opportunities and opposition structure within stakeholder groups for PPP specific success factors related to stakeholder analysis.

Stakeholder Engagement

Many scholars have seen the most significant element of an efficient stakeholder management process in construction projects in the efficient and honest communication with the projects' stakeholders (Zou et al., 2014; Olander & Landin, 2008; Tang & Shen, 2013; Yang et al. (2009). It provided the stakeholders in the project a sense of ownership, engagement and involvement. In addition, many challenges in construction projects can be solved by involving stakeholders in early planning and engagement within the project group and by a systematic approach to the analysis and engagement of stakeholders in the project delivery. (Jergeas et al., 2000). In addition to the stakeholder engagement success factors described above, research into PPPs highlighted certain PPP specific practices. For instance, for success with PPP projects, Tang and Shen (2013) stated that agreement by all the parties involved in the project brief is essential. Therefore, the main stakeholders should engage actively from the early phases of the PPP projects and all parties concerned should agree on the outcome of these engagements.

Stakeholder Management Action Plan

The success factors developed and agreed upon by stakeholder management should be applied to maintain the project. An efficient implementation plan should also introduce for the effective implementation of success factors in stakeholder analysis and stakeholder engagement during the project planning phase. The success factors to successful implementation of the agreed stakeholder management plan, therefore, need to be identified. The project leader and the project team's abilities are one such factor. If there is no involvement of the project team, and the project team lacks enough experience to incorporate stakeholder management efficiently. The stakeholder management strategies produced will not operate in actual project scenarios. Because of the involvement of many stakeholders and the complexity of the stakeholder matrix in the PPP environment, the engagement of the project team is essential. Besides, the successful implementation of stakeholder management by many scholars is critical in employee training in effective stakeholder management practice (Yuan et al., 2012, Yuan et al., 2009). Stakeholder management needs particular skills that require some training and effective project engagement. PPP projects have a good concept for the industry. Also, maybe that the project team does not know the real complexities connected with the implementation of stakeholder management in PPP projects (Yuan et al., 2012; Yuan et al., 2009; Ruuska & Teigland 2009).

Stakeholder Management Monitoring

The stakeholder mix can alter as new stakeholders participate when other stakeholders drop out (Elias et al. 2002). It is essential to analyse the changes in stakeholder impact and interactions during the stakeholder management monitoring stage. Freeman recognised this in 1984 as the concept of dynamics of stakeholders. When the project progresses, relations between the project's stakeholders should be evaluated and prioritised. Successful

relationships should be monitored and maintained, whereas ineffective relationships should also carefully investigate in order to improve their relationships.

Tang & Shen (2013) recognised the importance of the lessons learnt from previous PPP projects in the PPP project environment. Therefore, issues relating to stakeholder management can be explored and utilised for case studies and lessons learned for future PPP projects in the background of past PPP projects. This method is referred to as case-based reasoning (CBR), introduced by Noh et al. (2000). It is a technique of solving problems that re-use cases, experiences or tacit knowledge in the past (Noh et al., 2000). CBR is a technique of solving problems. Lim et al. (2005) used CBR techniques and suggested the success factors to help formulate stakeholder management. A similar methodology can, therefore, be used in PPP projects by establishing a system which accumulates the knowledge gained from previous PPP projects, mainly due to the long-term nature of the projects. The importance of developing performance measures that can address the voices of various stakeholders in public sector organisation understood by Neely et al. (2000), Neely et al. (2002), Taket (2004) and McAdam et al. (2005). Besides, Yuan et al. (2009) identified performance objectives based on distinct stakeholder perspectives in PPP projects. These performance measures encourage PPP project performance monitoring throughout the life cycle. Stakeholder management related the performance measure to ensure efficient implementation of stakeholder management.

CONCLUSION

It was found that there are four (4) areas that need the most attention which are stakeholder analysis, stakeholder engagement, stakeholder management action plan and stakeholder management monitoring. Improvement in these areas will lead towards better presentation and improvement of the success factors of stakeholder management process in PPP infrastructure projects in Malaysia. Initiatives to be taken to lessen probability of failure of stakeholder management in PPP projects as well as the success factors for the successful delivery of stakeholder management in PPP infrastructure projects. The literature review can be used to assist stakeholder in the preparation of stakeholder management through the identification of the success criteria for stakeholder management in PPP infrastructure projects in Malaysia. A need for an overall step-by-step process for stakeholder management to improve on successful delivery related to the stakeholder management of stakeholders in PPP infrastructure projects.

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CONCEPTUALISING CONTRACTUAL BEHAVIOUR OF KEY PARTICIPANTS FRAMEWORK IN IMPROVING CIVIL ENGINEERING PROJECT

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Abstract

This paper investigates the contractual behavior of key participants in civil engineering project with an aim to develop an appropriate contractual behaviour framework of key participants for delivering a successful civil engineering project. The purpose of this paper is to identify the common contractual behavior of key participants and to determine the factors contributing them in civil engineering projects in Malaysia. Extensive literature review finds five (5) contractual behaviours of key participants which all this while may hinder the civil engineering project success. They are delay of interim payment, delay of contractor's work progress, delay of issuing project information, delay of site possession and unauthorised instructions. It is also unveiled that the project characteristics, quality of Standard Form of Contract (SFoC), external factors and attitudes of key participants are the factors influencing the contractual behavior of key participants. The severity of contractual behaviors' occurrence and the level of influence of the factors on them are important to be empirically tested in order to understand the constraints faced by the key participants in implementing the civil engineering projects. Hence, the initiatives or proactive preventing actions can be suggested to improve the contractual behavior of key participants and eventually lead to the project success. There are three (3) components used in developing the framework namely: i) the contractual behaviour of key participants, ii) the influencing factors and iii) recommendations for improvement which acts as the guideline in implementing this study. The framework is significant and complete as it contains the list of common contractual behaviour of key participants that impediment to civil engineering project success, the significant factors causing them and the initiatives for improvement. In fact, there are substantial input that can be learned from the framework and hence, the industry can consider the framework as a reference or guideline for improvement of civil engineering project performance.

Keywords: *Civil Engineering; contractual behavior, project characteristics, Standard Form of Contract*

INTRODUCTION

Civil engineering structures are very important to a country for social and economic development support. Therefore, the performance of civil engineering projects has always become the concern of the government. Unfortunately, there has been much critics in the delivery of civil engineering projects in Malaysia where many civil engineering projects have been beset by cost overrun, schedule delays, shoddy workmanship and conflict among key participants (National Audit Department Malaysia 2012, 2016; Ismail, 2015; Utusan Online, 2014; Sinar Harian, 2012; Adnan et al., 2012; Quay & Ting, 2009; Deborah & Kamini, 2008). Since civil engineering structures traditionally are the responsibility of government, the unsatisfactory performance of delivered projects has tarnished the public's trust towards the accountability of the government and failed to deliver facilities as promised to the citizenry.

In literature, it is found that there is consensus among researchers who study the construction project performance regardless whether building or civil engineering projects that most of the problems which hinder the project success are related to the unfavourable contractual behaviour of the project key participants who do not adhere to and comply with the terms of contract in project implementation such as Sears et al. (2008), Ismail et al. (2014), Ling et al. (2014) and Zhao (2012). The contractual behaviour of the project key participants who fail to duly adhere to and comply with the terms of contract contribute largely to conflicts among key participants and increase difficulties in the management of project, hence hinder the project success. Therefore, in light of providing a better performance of civil engineering project, good contractual behaviour of key participants is regarded as one of the best initiatives, considering that their core function in directing towards smooth project implementation. Hence, the main objective of this study is to facilitate the construction industry practitioners in implementing civil engineering project through the establishment of contractual behaviour of key participant's framework, in the hope that this could provide them a reference for smooth project implementation.

LITERATURE REVIEW

The Common Contractual Behaviour of Key Participants in Civil Engineering Projects

Due to many key participants and their respective organisations involved in a construction project, the need for a contract is paramount to ensure good integration and cooperation among themselves in implementing the project. Thus, each of all the key participants must adhere to what is stipulated in the contract during project implementation. The compliance of contract not only smoothen the project implementation but can avoid conflict among them. Hence, in the context of this study, the term 'contractual behaviour of key participants' is referring to an action or conduct of a key participant towards other key participants of the project based on what is stipulated in the agreed contract. In other words, the contractual behaviour of project key participants can be referred to what extent the contract has been implemented by the people who make the decision by the contract (Abdul Aziz, 2012).

One of the common contractual behaviour of key participants that rendered in civil engineering projects is that the delay in interim payment made by the client. The delay in making interim payment to the contractor will cause a big impact on the project implementation and eventually lead to the project failure as have been thoroughly discussed by Sears et al. (2008) and Carmichael (2002). In fact in Malaysian context, the delay in making interim payment was ranked as first in client related cause of project delay (Sambasivan & Soon, 2007). On top of that, the failure of the contractor to comply with the standard construction method (National Audit Department Malaysia, 2016) and failure to comply with the approved work program (Jaffar et al., 2011) are among the factors caused by the contractor that contribute to the project failure. For any types of construction projects, the progress of the construction process on site is very critical to be closely followed according to the approved work program to avoid the occurrence of any delay. This requires the contractor to proceed regularly and diligently with the performance of his obligations under the contract. Hence, the construction activities that duly obey the sequence and time allocated in the

approved work program is very critical and lead to the successful of construction project.

Delay of issuing project information such as drawings and instructions is also one example of unfavourable contractual behaviour of engineer in project implementation and has been reported by many scholars as one of the factors causing disputes and unsatisfactory construction project performance as reported by Zhang et al. (2016), Cheung et al. (2008) and Charoenngam & Yeh (1999). Zhang et al. (2016) and Krma et al. (2007) argued that late approval of drawings and late in giving instructions are the common factor that caused disruption to the regular progress of construction project. Atout (2016) had the same opinion where stating that the delay of providing necessary drawings due to changes of the contract document, late approval and supervision as well as late agreement with contractor highly cause a delay in handing over the project to the client.

Meanwhile, literature is loaded with problems between contractor and client caused by giving site possession at a later time than intended to the contractor. Similarly, Nachatar et al. (2003) suggested that delay in giving site possession causes the contractor frustration to the contract. This delay could severely burden the contractor since the contractor might have been prepared to start the construction work on the site such as advance payment for plants and machinery, labours and other related works. Hence, whenever the date of site possession is postponed to another lengthy date, this will cause the advance payment paid by the contractor to be forfeited. Besides, Bakhary (2019) argued that the failure of the client to timely hand over the construction site to the contractor caused idleness of contractor resources because even when they are made available at the construction site, they were not put into use effectively.

Other unfavourable contractual behaviour of participants of the project such as direct instruction by the client to the contractor (Rahmat, 2008); late in certifying certifications and project information (Nurul et al., 2016); and communication skill of contractors (Mitkus & Mitkus, 2014) also contribute to the project failure.

Factors Influencing Contractual Behaviour of Key Participants in Civil Engineering Projects

One of the determinants that influence the contractual behaviour of key participants of a civil engineering project is project characteristics. For instance, Demirkesen & Ozorhon (2016) observe that large construction project tends to have more uncertainty than smaller projects. Large project size mainly is exposed to uncertain environments such as the uncertainty of the owner's behavior; the uncertainty of the contractor's behavior; the uncertainty of the consultants' behavior; and the uncertainty in the transaction environment and mechanism (Guo, 2016). This uncertainty and complexity, combined with the enormous variety of unforeseen situations that can emerge during a construction project, caused disagreements, conflicts, disputes, change orders, and claims can occur in the construction phase (Guo et al., 2016).

The quality of the Standard Form of Contract is also one of the factors contributing to the contractual behaviour of key participants. Literature is replete with the contractual issues mainly related to completeness and the clarity of the Standard Form of Contract, modification of Standard Form of Contract to suit the type of project and deficiencies of the Standard Form of Contract in governing the construction project. For instance, many previous studies argued that construction contracts lack of clarity and the standard forms have become complex over

time (Rameezdeen & Rodrigo, 2010; Ali & Wilkinson, 2010; Chong & Zin, 2010; Wright & Fergusson, 2009; Cheung et al., 2006). According to Ali and Wilkinson (2010), Chong and Zin (2010) and Wright and Fergusson (2009), the lack of quality of Standard Form of Contract is mainly due to the lengthy sentences and the use of jargon legal terms. On the other hand, Zhang et al. (2016) argued that the other problem associated with the Standard Form of Contract is the fairness and level of trust produced by them. Since the contract is the critical governance of the project, the issues such as lack of clarity, fairness and the level of trust produced by the Standard Form of Contract will adversely affect the relationship between the contracted parties by making it more adversarial and eventually lead to disputes and trigger undesirable behavior of the project participants such as opportunistic behavior (Lu *et al.*, 2016; Rameezdeen & Rodrigo, 2009).

Other than project characteristics and quality of Standard Form of Contract, other external factors such as weather condition (Yong & Mustaffa, 2012; Sambasivan & Soon, 2007; Iyer & Jha, 2005) resources availability (Iyer & Jha, 2005, Jaffar et al., 2011, Yu & Shen, 2013) technological advancement (Songer & Molenaar, 1997), changes in government regulations and laws (Shehu et al., 2014) and bureaucracy in government agencies (Ahmed & Othman, 2013; Shehu et al., 2014) are found to be other important factors that could influence contractual behaviour of key participants in civil engineering project. Although all of the aforementioned scholars relate them with the construction project performance, these external factors seem to have an influence on the contractual behaviour. Therefore, it is interesting to explore and prove statistically whether these external factors do give impact on the contractual behaviour of key participants of civil engineering projects.

Besides, the individual attitude of each of personnel in carrying out their works in the projects sometimes may be unpredictable and may give a significant influence on the contractual behaviour of key participants. Many scholars relate participant's individual attitude factors with the performance of construction projects such as poor in following condition of contract (Shehu et al., 2014), poor in understanding the content of contract (Shehu et al., 2014), opportunistic behaviour (Alkhamali et al. 2010), cooperation in solving problems, commitment to achieve project goal (Nachatar et al., 2003, Iyer & Jha 2005) and competency of contractor and engineer (Shehu et al., 2014, Gosling et al., 2013, Ahmed & Othman 2013). Due to the lack of study relating the participant's individual behaviours with the contractual behaviour of key participants, it should be explored and proven statistically whether these factors do give impacts on the contractual behaviour of key participants of civil engineering projects.

METHODOLOGY

In this study, exploratory research is adopted. Thus, in-depth literature review is conducted which reflected the key concepts employed in this study. The literature review is considered essential in any scientific research. In reviewing the past studies done by other researchers relating to this research, content analysis of journals, books as well as the SFoCs is employed to determine the key concept of the study: i) identification of the common contractual behaviour in construction industry and ii) determination of the possible factors that have influence on the contractual behaviour of key participants.

RESULT AND DISCUSSION

Following the thorough literature review, a framework for this research was formulated, as depicted in Figure 1. According to Sekaran & Bougie (2010) research framework is a travel map and the foundation for the entire research which logically developed and elaborated network of associations among variables deemed relevant to problem being researched.

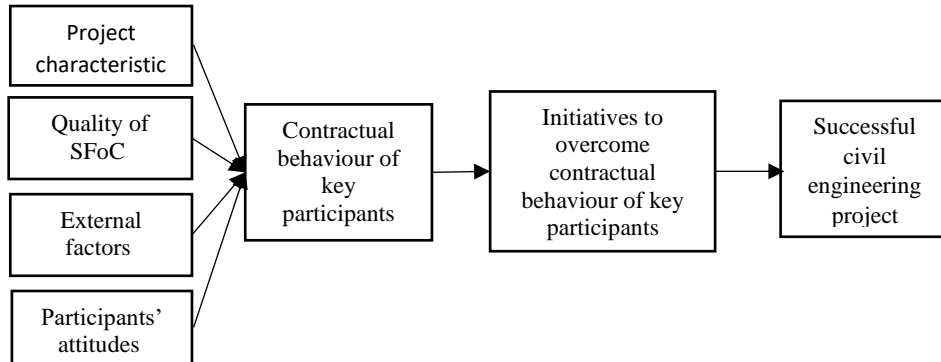


Figure 1. A conceptual framework of the research

This framework is presented by breaking it into three (3) components namely: i) the contractual behaviour of key participants, ii) the influencing factors and iii) recommendations for improvement which acts as the guideline in implementing this study. This research embarked on the assumption that a successful civil engineering project would be possible if all key project participants duly comply with the conditions of the contract in implementing the project. From the literature review, there were five (5) contractual behaviour that commonly occurs in civil engineering projects namely delay of interim payment, delay of providing project information, delay of site possession, delay of contractor's work progress and unauthorised instructions. These five variables are widely discussed in the literature as the major cause of unsatisfactory construction project performance. Due to limited studies conducted focusing on civil engineering project performance, these five variable is important to be explored and statistically proven their severity of occurrence in order to identify the root cause of such unsatisfactory performance. Meanwhile, there were four (4) domains of factors that influence them identified namely project characteristics, external factors, quality of SFoC and the attitudes of key participants. These four domain of factors are very critical to be explored and statistically proven their level of influence on the occurrence of contractual behaviour of key participants focusing on civil engineering projects. Therefore, the initiatives for improvement of each of the contractual behaviours of key participants could be recommended. In fact, this perceived as the elements that contribute to a successful civil engineering project as it contains the initiatives that can be implemented by the industry player to reduce the likelihood of occurrence of unfavourable contractual behaviour of key participants. The findings are significant and complete as it contains the list of common contractual behaviour of key participants that impediment to civil engineering project success, the significant factors causing them and the initiatives for improvement. In fact, there are substantial input that can be learned from the framework and hence, the industry can consider

the framework as a reference or guideline for improvement of civil engineering project performance.

CONCLUSION

From the aforementioned discussion, it is found that there are five (5) contractual behaviour namely delay of interim payment, delay of contractor's work progress, delay of issuing project information, delay of site possession and unauthorised instructions. Meanwhile, since there is limited previous models or frameworks on the factors affecting contractual behaviour of project key participants that can be found in literature, this study adopted an exploratory approach to identify the variables to be used in this study based on four domains found in the literature, namely, project characteristics, quality of SFoC, external factor and attitude of project participants. This research embarked on the assumption that a successful civil engineering project would be possible if all key project participants duly comply with the conditions of contract in implementing the project. Hence, these factors are important to be put more concern and empirically tested to determine their level of influence on the contractual behaviour of key participants. As a result, the initiatives or proactive preventing actions can be suggested to improve the contractual behaviour of the civil engineering project key participants and eventually will lead to the project success.

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ESTATE MANAGEMENT

COASTAL VULNERABILITY ASSESSMENT ALONG SELANGOR COAST USING GEOSPATIAL TECHNIQUES

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Abstract

The length of the coast of peninsular Malaysia is approximately 4,809 km long. Coastal erosion is recognised as the permanent loss of land and habitats along the shoreline resulting in the changes of the coast. Thus, the aim of this study is to determine the vulnerability of erosion of the Selangor coast caused by sea level rise event. In this paper, by using satellite imagery, both manual methods and coastal extraction processing have been examined. Six variables consist of the coastal vulnerability index (CVI), which are coastal geomorphology, coastal slope, erosion and accretion rate, mean wave height, mean tidal range, and the increase in sea level. Vulnerability levels are classified into five vulnerabilities for 8 management units along the Selangor coast which are very medium, medium, moderate, high and very high. The finding reveals that the level of vulnerability of MU 7 Pantai Jeram & Bagan Sungai Janggut is very high because the rate of erosion in the area is higher compared to other areas. Finally, the outcome of this study provides a framework which can be used by decision makers, and relevant authorities to implement mitigation and adaptation measures in the effort to deal with the impacts of climate change on coastal regions.

Keywords: *Coastal Vulnerability Index; Satellite Imagery; Coastal; Mitigation; Adaptation*

INTRODUCTION

Malaysia is situated in Southeast Asia between 1° and 7° North latitudes and 100° and 119° East longitudes. The length of the Malaysian coastline is approximately 4,809 km, which means that Malaysia's coastal resources are rich in natural biodiversity (Tangang et al., 2016 and Mohd et al., 2019). The west coast facing the Melaka Strait in peninsular Malaysia is longer compared to the straighter east coast of the South China Sea. It seems that this richness is an advantage for the country. To maximize the use of such properties, it is very important to manage the coastline itself. The population density tends to grow worldwide along the coast because of the importance of the coastline itself. Coastal erosion has now become a major issue where 29% of the coastline since 1984 has been eroded (Hayrol Azril et al., 2015 & Fazly Amri Mohd et al., 2018).

According to Ashraful Islam et al., (2016) mentioned that field survey techniques are conventionally used to map coastal patterns in small areas. The coastline mapping and extraction methods were also labour-intensive and time-consuming operations using conventional methods. Other than that, in traditional shoreline surveillance, aerial image and ground survey methods may also be combined. It is more practical and cost-effective due to

the vast operational area and the high resolution of satellite imagery (Pendleton et al., 2010; Kumar et al., 2010; Kumar & Kunte 2012; Mohd et al., 2019)

To map the relative sensitivity of the coast to future sea-level rises, a coastal vulnerability index (CVI) was used (Pendleton et al., 2010). This method is very helpful for long-term coastal planning in the decision-making process. As for the research on this coastal erosion, the recently used methods had been improvised and have developed some additional data verification and data collection techniques. Therefore, the present study is to highlight that the vulnerability of erosion of the Selangor coast to sea level rise by using six parameters. Thus, proper planning and protection strategies for the Selangor coast must be taken by coastal management and policy makers to sustain the coastal ecosystem and livelihood

STUDY AREA

The study area focuses on the coastal area from Bagan Nakhoda Omar to Port Klang, seen on the Malaysian map in Figure 1. The distance covered is approximately 196 km and is split into eight management unit (MU) regions. MU is the division focused on the coastal relationship with the beach's natural process and land use activities. The MU, separated by a river, encounters another coastal river. In the western part of Peninsular Malaysia, coastal regions are well known for their muddy coastal areas.

METHODOLOGY

Collection of research data collected from fieldwork and secondary information by the Management Unit Division (MU) along the Bagan Nakhoda Omar coast to Port Klang. The methodology adopted in the present study is in accordance with the procedure set by the United States Geological Survey (USGS) (Gornitz et al. 1991 & Hammar and Thieler, 2001). Six variables were selected to calculate the CVI, and each variable represents a specific characteristic of coastal vulnerability. Most of the variables are dynamic in nature along the coastal region and vast amounts of data and information have to be gathered from different sources, then processed and analysed.

The CVI parameters are based in accordance with the USGS procedure published by Voudoukas et al. (2016), which outlines the specific characteristics of coastal vulnerability based on the coastal conditions of the study area. The management units (MU) within the study area were assigned a risk rating for each variable, and the CVI was then calculated as the square root of the results of the ranked variables divided by the total number of variables (Pendleton et al., 2010) as shown in Equation 1:

$$CVI = \sqrt{((a*b*c*d*e*f)/6)}$$

Equation 1

Where a = geomorphology, b = coastal slope, c = rate of shoreline change, d = rate of sea level rise, e = Mean Significant wave height, and f = mean tidal range. The composite index of the selected study area was calculated by their weighted averages by combining the individual parameters (Boruff et al., 2005). In the present vulnerability analysis, equal weight is assigned to each variable, an approach that is the commonly used in the literature (Boak & Turner, 2005 and Voudoukas et al., 2016). The selected parameters of CVI divided and ranked into five categories based on the level of risk, namely very low, low, moderate, high

and very high risks using natural break classification technique which indicates that class boundaries tend to place large numbers of similar values in the same class (Pendleton et al., 2004).

RESULT AND ANALYSIS

Geomorphology

The results of the analysis show that the morphology of the Selangor coast is quite varied. Only four areas in the Selangor coast are highly vulnerable (red colour) while four areas, i.e. MU2, MU3, MU7 and MU8, have high vulnerability respectively as shown on Table 1.

Table 1. Coastal geomorphology

No	MU	Location	Geomorphology
1	MU1	Bagan Nakhoda Omar	The coastline is filled by mudslides. The soil is greyish brown, and in texture, the surface is smooth. The topography of the coastline is gently sloping. This part of the coast is visible at low tide. The back of the beach is covered by a concrete frame (1-1.5 m) in height. On both the right and left of the shore, there are mangrove trees.
2	MU2	Bagan Sungai Pulai	The front of the beach was designed to minimize the effect of waves on the coast for 1-2 km with a "T" shaped rock defense system. The 1 m high fort protects the back of the beach. There is a small mangrove tree on the estuary of the river and to the right and left of the shore. The coastal geomorphology of this coastal region is distinguished by soil that is muddy and gently sloping.
3	MU3	Kg Hj. Dorani	A sandy beach that's mixed with sand and mud. Coastal flooding occurs on the right side of the sea, causing the death of many mangrove trees. The soil is greyish grey and has a smooth surface texture. It's a little sandy and grey and brown at the back of the beach and the sand is a little dense. The coastal slopes are very low.
4	MU4	Sg Nibong	Dense, greyish-gray mudstones with a fine texture on the surface define the coastline. The rear of the beach is covered along the coast by rocky cliffs. The beach gradients are very tiny.
5	MU5	Sungai Burong	There is dirty grey soil in front of the beach and the texture is delicate. Beach conditions with a low slope. There are coarse sand beaches on the coastline which are light grey. There are plants like coconuts and mangroves that grow along the coast. The beach gradients are highly slow. The action of the waves in front of the beach.
6	MU6	Bagan Pasir	The beachfront is defined by greyish grey mud. The coastline consists of fortifications (1.5-2 m in height), boulders and tyres to keep the beach from overflowing. Shoreless conditions on the beach. The waves move parallel to the shore.
7	MU7	Pantai Jeram & Bagan Sungai Janggut	There is relatively coarse sand (light grey and slightly brown) and a thick soil texture on the sandy beaches. The beach in line with the beach has a wave-reflecting motion and is covered by beach defence structures, including forts and rock blocks. Along the shoreline, crops such as mangroves and shrubs flower. There is a beach erosion at the mouth of the river at the Janggut River map that causes mangrove trees to die.
8	MU8	Port Klang	The coastline is made of coarse-grained sand and greyish-gray mudstones. Shoreless conditions at the beach. There are mangrove trees on the banks of the shore. The harbour as a Protected Area (Limited) also includes the coast.

Coastal Slope

The data on the coastal slope is collected from the Google Earth application where it contains a slope reading tool at any spot. Five readings were taken for coastal slope readings for each area and would be combined to calculate the slope for each area. In the MU6 Bagan Pasir and MU7 Pantai Jeram & Bagan Sungai Janggut areas, the areas with the highest slope measurements ranged from 2.3 to 2.6 percent. The level of coastal vulnerability in an area where the area is heavily sloping and not easily affected is limited. Furthermore, due to the usual gradient of the coast, the MU4 Sungai Nibong and MU8 Pelabuhan Klang areas are at moderate levels, while the level of beach vulnerability in the MU2 Bagan Sungai Pulau region is high. Finally, there are gently sloping beach areas in the MU1, MU3 and MU5 areas, creating high levels of coastal vulnerability within these regions as shown on Table 2.

Table 2. Coastal Slope (%) in each MU

No	MU	Location	Coastal slope (%)	Vulnerability level
1	MU1	Bagan Nakhoda Omar	1.20	
2	MU2	Bagan Sungai Pulau	1.57	
3	MU3	Kg Hj. Dorani	1.29	
4	MU4	Sg Nibong	1.92	
5	MU5	Sungai Burong	1.18	
6	MU6	Bagan Pasir	2.37	
7	MU7	Pantai Jeram & Bagan Sungai Janggut	2.58	
8	MU8	Port Klang	2.01	

Rate of Erosion and Accretion

Data acquired by the SPOT satellite image digitization process for erosion and accretion readings. Based on Table 3, MU1 Bagan Nakhoda Omar, MU3 Kg. Hj. Dorani, MU4 Sg Nibong and MU5 Sungai Burong provide examples of areas of low vulnerability. This is because, relative to erosion, the area has a lot of development. Moreover, at MU 2 Bagan Sungai Pulau, there is a region of medium vulnerability. The erosion rates and accretion rates are not high in the MU2 Bagan Sungai Pulau region. Finally, MU6 Bagan Pasir and MU7 Pantai Jeram & Bagan Sungai Janggut are two areas of great vulnerability. This is because a high erosion rate compared to accretion has been experienced in the region. These two places are, in other words, at high risk.

Table 3. Vulnerability Level of Erosion and Accretion

No	MU	Location	Rate of Erosion and Accretion (m/yr)		Vulnerability level
			Erosion (-)	Accretion (+)	
1	MU1	Bagan Nakhoda Omar	-	13.3	
2	MU2	Bagan Sungai Pulau	1.4	0.3	
3	MU3	Kg Hj. Dorani	3.6	9.7	
4	MU4	Sg Nibong	0.6	1	
5	MU5	Sungai Burong	0.5	3.9	
6	MU6	Bagan Pasir	0.05	5.3	

7	MU7	Pantai Jeram & Bagan Sungai Janggut	19.2	7.1	
8	MU8	Port Klang	5.8	5.5	

Mean Tidal Range

Tidal readings were obtained from JUPEM 's tidal station provided by the Tidal Book near the study area of Bagan Datuk, Permatang Sedepa and Port Klang. Bagan Datuk and Permatang Sedepa tidal stations are used in the MU 1 to MU 7 areas, while MU 8 is near Permatang Sedepa and Port Klang tidal stations. The vulnerability rate is high for coastal areas in Selangor. Visual Ship Observation (SSMO) waveforms obtained using SSMO data for directions 150 °, 180 °, 210 °, 240 °, 270 °, 300 ° and 330 ° from the Department of Irrigation and Drainage Malaysia were generated using MIKE-21 software. The coastal area of Selangor has a low degree of vulnerability based on the results obtained from wave height measurements, where the wave height only records between 0.91 meters and 0.99 meters (Jeofry & Rozainah 2013). However, there is only one area, Bagan Pasir (MU 6), which has a very low level of coastal vulnerability. Overall, for the Selangor coastal areas, the wave height factor only has a low effect. This finding shows that the wave height is lower than that of the east coast of the west coast.

Rate of Sea Level Rise

One of the indicators used to assess the extent of coastal risk is the amount of sea level rise. By the process of interpolation, the readings of sea level rise are obtained by Inverse Distance Weight (IDW). The higher the increase in sea levels, the greater the visibility and marking of high value to coastal areas (Gill et al. 2014). The level of coastal vulnerability in the Selangor region falls within the lower class of parameters of sea level rise.

CVI MAPPING ALONG SELANGOR COASTAL

For all regions, the CVI solution range is between 3.65 and 11.31, while the percentage outcome range is between 6.25 and 81.25, as shown in Table 4. The total region of the coast of Selangor faced moderate levels of coastal vulnerability. MU 1 Bagan Nakhoda Omar, MU 5 Sungai Burong and MU 8 Pelabuhan Klang are the areas with Level 3 CVI. Looking at it, only one or two parameters show a high level of vulnerability and a low level of vulnerability is shown by the other parameters. There are also areas with a low to very low level of risk at a decent level. For areas with low vulnerability levels, MU 3 Kampung Haji Dorani and MU 4 Sungai Nibong and MU 6 Bagan Pasir are areas of very low vulnerability levels.

The area at MU 7 Pantai Jeram & Bagan Sungai Janggut shows a high level of coastal vulnerability with the score is 10.33. In this region, reference to the erosion and accretion parameter is higher compared to others. Then the region with the highest level of coastal vulnerability is at MU 2 with a CVI score of Bagan Sungai Pulau 11.31. This is because there are 3 parameters with high vulnerability levels in this area, which are geomorphology, coastal slope and mean tidal range.

Although geomorphology and coastal slope parameters are highly vulnerable in some areas, CVI values are not necessarily at high levels. This is because the beach's vulnerability relies on the location 's overall CVI parameters. As in Bagan Sungai Pulau (MU 2), there are

several triggers that cause a location to be at a very high level of coastal vulnerability based on CVI parameters that have been used in this study. According to Gill et al. (2014) revealed that the wave of builders triggered the development of the long coastline. Destructive waves cause erosion along the coast and destroy the coastal strip that the building waves have built.

Using ArcMap software, the mapping of CVI was performed. This map showing all parameters involved in determine CVI level for each MU. For local authorities and public awareness, this map is significant. Several measures should be taken to prevent or control the erosion of the coastline. The CVI map of coastal Selangor is shown in Figure 4.

Table 4. CVI results in Selangor

MU	Location	Geomorphology (a)	Coastal Slope (b)	Erosion & Accretion Rate (c)	Mean Tidal Range (d)	Mean Wave Height (d)	Rate of Sea Level Rise (f)	CVI	Percentile (%)	Coastal Vulnerability Level
MU 1	Bagan Nakhoda Omar	5	5	1	4	2	2	8.16	50	3
MU 2	Bagan Sungai Pulai	4	4	3	4	2	2	11.31	81.25	5
MU 3	Kampung Haji Dorani	4	5	1	4	2	2	7.30	31.25	2
MU 4	Sungai Nibong	5	3	3	4	2	2	6.32	18.75	1
MU 5	Sungai Burong	5	5	1	4	2	2	8.16	50	3
MU 6	Bagan Pasir	5	2	1	4	1	2	3.65	6.25	1
MU 7	Pantai Jeram & Bagan Sungai Janggut	4	2	5	4	2	2	10.33	68.75	4
MU 8	Pelabuhan Klang	4	3	3	4	2	2	9.8	56.25	3

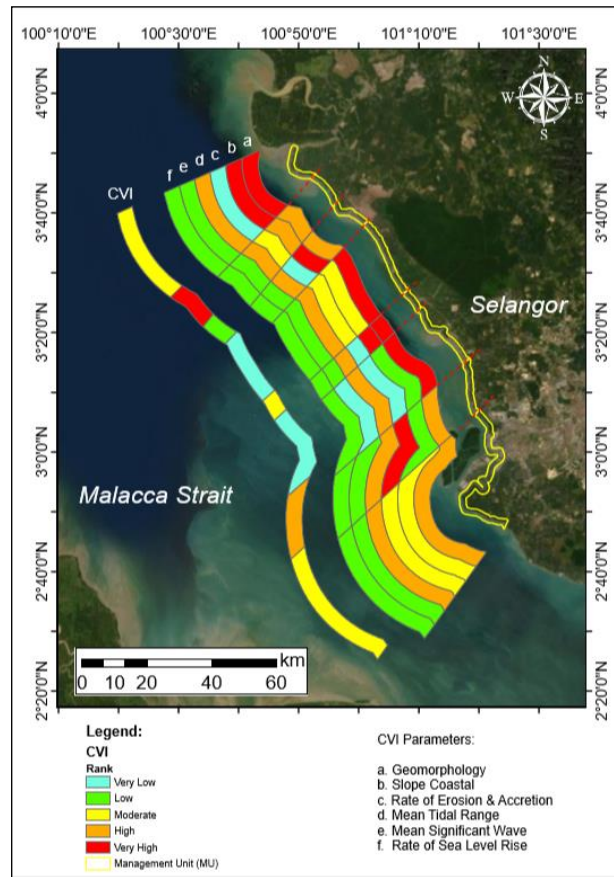


Figure 4. Map of CVI at Selangor Coastal

CONCLUSION

To conclude, all the goals in this analysis have been accomplished successfully. It is possible to evaluate the coastal vulnerability index parameter along the coast of Selangor according to the first objective of defining it. For this analysis, six parameters were calculated, namely geomorphology, coastal slope, erosion and accretion rate, mean tidal range, mean significant wave height, and sea level rise rate. The result shows that the level of vulnerability of MU 7 Pantai Jeram & Bagan Sungai Janggut is very high because the rate of erosion in the area is higher compared to other areas. There are 3 areas with a high level of vulnerability, and the remaining four areas have a very low level of vulnerability. The coastal areas in Selangor indicate that the level of coastal vulnerability is at a normal level, based on the CVI study conducted as a whole, since the amount of very high and high levels of coastal vulnerability in the class is low compared to the level of moderate and below vulnerability. Finally, the outcome of this study provides a framework which can be used by researchers, decision makers, and relevant authorities to formulate and implement mitigation and adaptation measures in the effort to deal with the impacts of climate change on coastal regions.

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LEAF AREA INDEX ESTIMATION OF RUBBER TREE USING DRONE BASED MULTISPECTRAL IMAGES

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Abstract

Unmanned Aerial Vehicle (UAV) has opened the door to new sources of data to effectively characterize vegetation metrics at very high spatial resolution and at flexible revisit frequencies. Cultivating rubber trees is necessary in order to ensure that carbon dioxide is efficiently absorbed and that the country is able to be provided with good economic income. The objective of this study is to determine the healthiness of rubber tree based on leaf area index map by using drone based multispectral images at Research Station RRIM, Malaysian Rubber Board (MRB) Kota Tinggi, Johor. By using the vegetation index method, leaf area index (LAI) can be identified by the red, blue, green band and little at the near infrared band with using raster calculator. Based on the finding of this project, there are 15 samples of rubber trees that were identified where seven samples are healthy rubber trees and eight samples are unhealthy rubber trees. The blue colour represents the unhealthy of rubber tree meanwhile the red colour represents healthy of rubber tree. The sample of rubber tree namely PL48 is represented as the highest value with 3.81 meanwhile PL103 as the samples of rubber tree is represented the lowest value of leaf area index with 0.06. This study is important in order to suggest the implementation of rubber tree monitoring at the Malaysian Rubber Board (MRB) research station as an experimental area by using new technology that involves the low-cost outcomes with good and better quality results to increase the production of rubber at the same time can help the players of the rubber industry including the research of rubber and development of rubber sector.

Keywords: *Leaf Area Index (LAI); Multispectral Image; Unmanned Aerial Vehicles; Rubber; Raster Calculator*

INTRODUCTION

One of the important commodity crops in Malaysia is rubber plantation. In order to manufacture natural rubber (NR) and latex wood, rubber was commercialized. To date, according to the Minister of Plantation Industries and Commodities, Malaysia was the world's fifth producer of NR in 2016, with a total output of 0.67 million ton. The Minister also notes that the government intends to increase the rubber plantation area from around 670,000 hectares now to 1 million hectares by 2020. In addition, he also said that NR productivity was projected to grow from 1.2 ton/ha to 2 ton/ha (Putra et al. 2020). The Leaf Area Index (LAI) specifically quantifies the structure of the plant canopy and is closely correlated with many canopy processes such as evapotranspiration, light detection, photosynthesis, respiration, and leaf litter dropping (Comba et al. 2020; Lu et al. 2020; Prananda, et al. 2020). In the cost-effective implementation of the Leaf Area Index as an input for photosynthesis, crop simulation models, nutrient uptake, net primary productivity estimation and large-scale vegetation / biosphere models, the Leaf Area Index will be of great benefit.

Remote sensing image sensors on both spatial and airborne platforms provide an effective tool for calculating the Leaf Area Index for vegetation guidance (Comba et al. 2020; Lu et al. 2020; Prayudi et al. 2020; Putra et al. 2020; Utari, et al. 2020). In order to increase agricultural input production, track crop growth and health, and estimate yield, remote sensing technology is widely used for crop management. The unmanned aerial vehicle (UAV) is the latest mapping technology in remote sensing. In particular, achievements in several spatial image studies have been identified as the key data for characterizing the forest Leaf Area Index (Utari, Kamal, and Sidik 2020). The method of extracting vegetation from the Leaf Area Index is the vegetation index method. In order to estimate the LAI, early work on the vegetation index method compared several vegetation indices determined from the mean multi-spectral UAV image radiance (Prananda et al. 2020; Putra et al. 2020).

Finally, this technology can be used by rubber industry participants, including the research and development sector, smallholders and property managers, to track their rubber-grown areas (Ali et al. 2018). This study is significant for recommending the implementation of rubber tree monitoring at the research station of the Malaysian Rubber Board (MRB) as an experimental area using modern low-cost technology with a good quality outcome to increase rubber production (Ali et al. 2018; Comba et al. 2020). This objective of this study is to determine the healthiness of rubber tree based on leaf area index map by using drone based multispectral images at Research Station RRIM, Malaysian Rubber Board (MRB) Kota Tinggi, Johor. Therefore, the effective use of UAV in agricultural monitoring has been studied and analyzed, especially for smallholder farmers, who are low-cost and can replace the high-altitude photogrammetry completely remote sensing process.

STUDY AREA

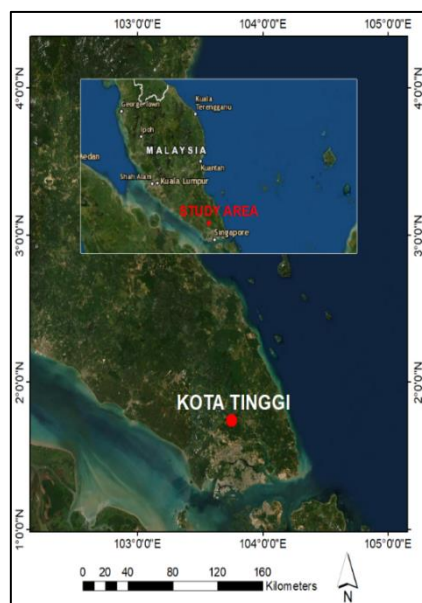


Figure 1. The study area located at Field 113, Pelepah Division, Research Station RRIM, Malaysian Rubber Board (MRB), Kota Tinggi, Johor

The research will be performed at Field 113, Division Pelepah, RRIM Research Station, Malaysian Rubber Board (MRB), Kota Tinggi, Johor as shown on Figure 1. The place is in Kota Tinggi, Johor, at 1 ° 47,778 'N and 103 ° 51,343' E. The temperature range is 25°C to 33°C. The age is 13 years for the rubber tree. The rainfall varies between 2,030 mm and 3,050 mm per year. Jeranggau series, Class 1 soil series and suitable for rubber planting are the entire area of this area of 9.4 ha with part of 25 clones with soil type (Lu et al. 2020; Utari, Kamal, and Sidik 2020). The planting date was in August 2006 and the planting distance was 3.6 m x 6.0 m.

METHODOLOGY

As shown on Figure 2, the methodology of this study consists of four stages. The four steps are the detection of preliminary research and research issues, data acquisition, data processing, and outcome and analysis. The first phases concentrate on the issues and problem of the field of study, Field 113, Pelepah Division, RRIM Research Station, Malaysian Rubber Board (MRB), Kota Tinggi, JOHOR. The aerial photograph, GCP coordinate, and rubber tree sample are the data needed for this purpose of analysis. These data to vegetation indices are used to generate the Leaf Area Index.

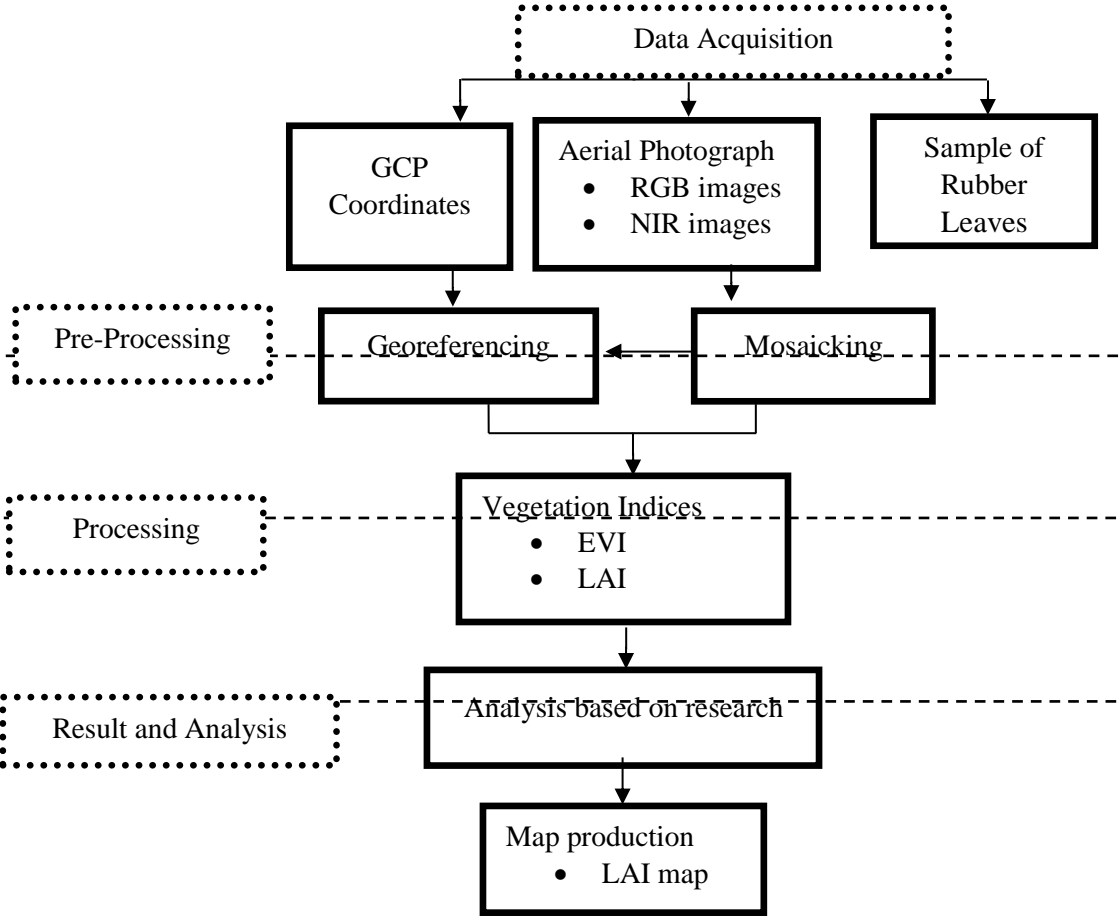


Figure 2. The methodology of this project

Data Collection

Three components are involved in this stage with regard to GCP coordinates, aerial photography and field measurement. Using UAV data collection, GCP coordinates derived from GPS data observation and aerial photography are created. GPS observation and UAV observation were conducted simultaneously on the same day.

UAV Data Collection

The UAV is used in this research to capture aerial images of data. The digital number obtained from the data collector was then produced. In UAV flight planning, few parameters need to be considered when setting camera orientation, altitude, angle and survey velocity. Using Phantom 4 attached to the camera MAPIR where the camera top should be facing forward, the aerial photos were taken. The UAV can fly twice where the altitude and angle have been set identically. The first fly of UAV captured an RGB image, and the IR image will be captured by the second fly trip. To revise the error between two images using the correction, it is important to set the same setting for each flight as shown on Figure 3.

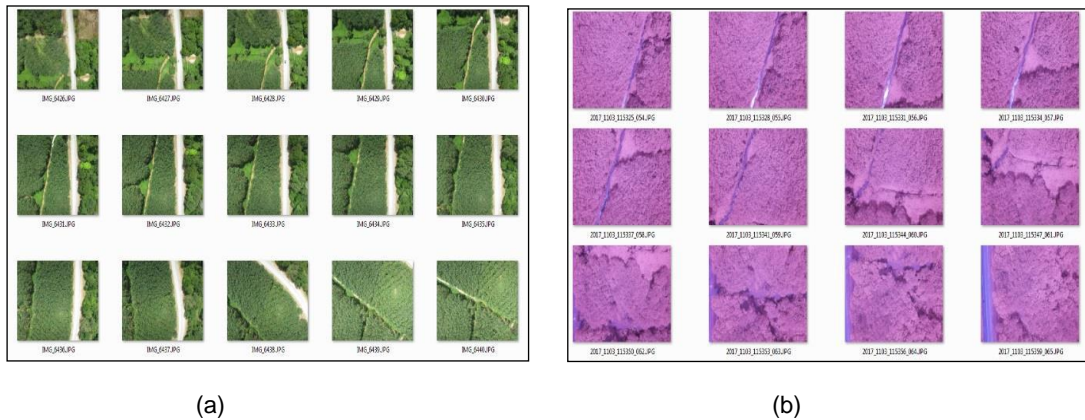


Figure 3. Unmanned Aerial Vehicle Images (a) RGB images and (b) Near Infrared Images

GPS Observation

Topcon GR-5 was used for GPS observation to assess the ground control point with coordinate reference. The control points were used to perform corrections in the process of mosaicking and layer stacking. Static observation is the methodology used for GPS observation. In order to establish a ground control point, a Malaysian Real Time Kinematic Network (MyRTKnet) survey was carried out. The distribution of the GCPs in the sample region is shown on Table 1.

Table 1. The coordinate of Ground Control Points (GCPs)

GCPs	Latitude	Longitude	Altitude
GCP 1	1.799033°N	103.853039°E	25.347
GCP 2	1.795276°N	103.856650°E	33.356
GCP 3	1.797430°N	103.856813°E	27.313
GCP 4	1.797211°N	103.857426°E	22.707
GCP 5	1.798457°N	103.855512°E	35.662
GCP 6	1.800450°N	103.855459°E	32.776

Computation of Vegetation Spectral Indices

Two indices of vegetation, EVI and LAI, were used. All the vegetation indices were processed in ARCGIS using the Raster Calculator tool. First, to establish EVI values, EVI must be finished. In the Raster Calculator, Formula EVI has been added. It is important to do EVI because it was appropriate to use the value obtained from EVI in the processing of LAI. By using a Raster calculator with the formula, LAI is also processed.

Equation 3.1: Enhanced Vegetation Index

$$EVI = 2.5 \frac{(NIR - RED)}{(NIR + 6 * RED - 7.5 * BLUE + 1)}$$

Equation 3.2: Leaf Area Index

$$LAI = (3.168 * EVI - 0.118) > 0$$

RESULTS AND ANALYSIS

Leaf Area Index

In this research, two vegetation indices, EVI and LAI, were used. The Enhance Vegetation Index must be determined to generate the leaf area index. Figure 4 displays a map of the rubber tree leaf area index using the formula for vegetation indices. The photos were taken with multispectral images using the Unmanned Aerial Vehicle where Red was used. Color, Blue, and Near-Infrared Images. This map was created to evaluate the rubber tree planting leaf area index and to evaluate the greenness of rubber leaves.

The range value of the leaf area index is 0-4. Where the soil and rock are marked by 0-0.5. This map shows the point at which the rubber tree sample was seen. They are 15 rubber tree samples where 7 are good rubber tree from that and others are unhealthy rubber tree from that. While the blue colour reflects the unhealthy rubber tree, the red colour reflects the healthy rubber tree.

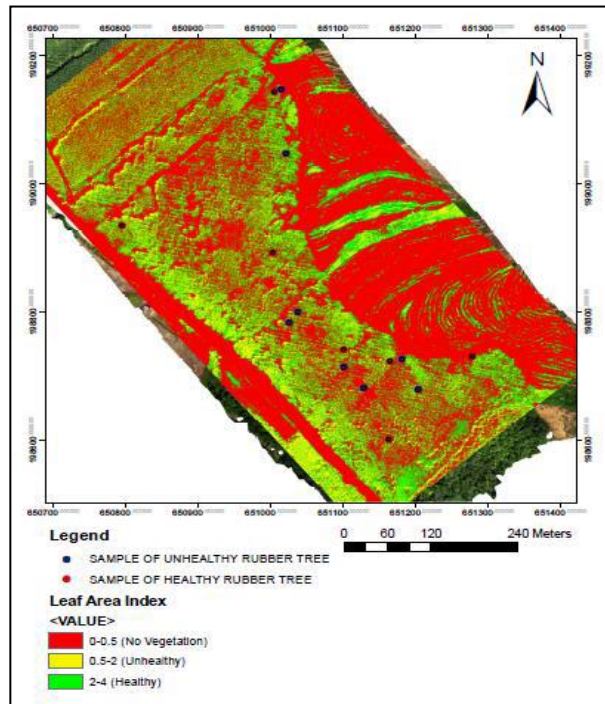


Figure 4. Map of leaf area index for rubber tree

Based on the leaf area index, the healthiness of the rubber tree can be calculated. PL196, PL238, PL115, PL5, PL48, PL127, PL38, PL103, PL52, PL43, PL39, PL233, PL126, PL88 and PL213 rubber tree specimens are accessible. This plot lies between the leaf area index and the rubber tree study. For each sample rubber tree, they provide the value of the leaf area index. Based on Figure 5, the range value of 0-4 where 0-2 of the rubber trees is unhealthy and 2-4 of the rubber trees is healthy. The highest value of the PL48 rubber tree sample is 3.81, while the lowest value of the leaf area index is 0.06 for the PL103 rubber tree sample. The 2.08 value is the low rubber tree value for healthiness. For an unhealthy rubber tree area of 0.06, the minimum value and the maximum value are 1.99.

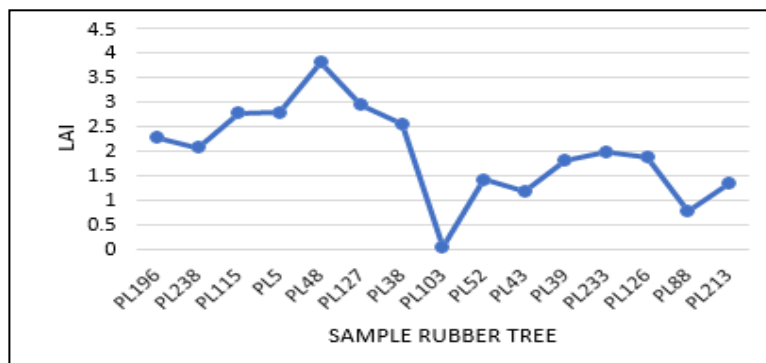


Figure 5. Plot of Leaf Area Index for sample rubber tree

The leaf area index of PL196, PL238, PL115, PL5, PL48, PL127 and PL38 are healthy for the sample rubber tree and the unhealthy for the sample rubber tree are PL103, PL43, PL52, PL39, PL233, PL126, PL88 and PL213. The highest leaf area index value for the sample rubber tree is PL48, based on Figure 6. The images (a) show the health point of the sample rubber tree with the highest leaf area index value, where the colour of the point was green. It shows that the point is in the healthy rubber tree area. Meanwhile, the images (b) reveal, the unhealthy point of the sample rubber tree is the point's location in the colour of yellow. The dot is the lowest leaf area index value.

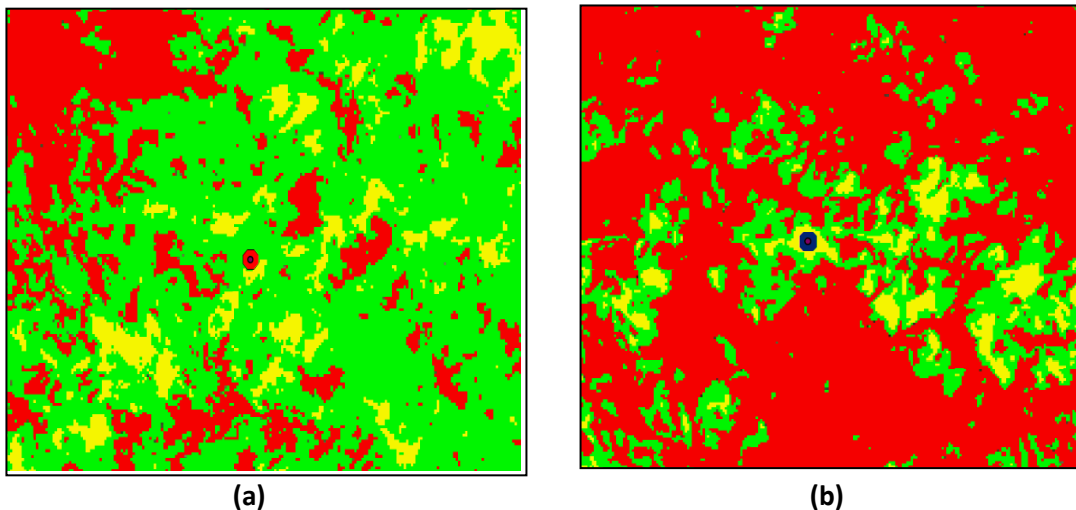


Figure 6. The samples of the rubber tree (a) The healthy rubber tree and (b) the unhealthy rubber tree.

CONCLUSION

This study has managed to accomplish the objectives which particularly to measure the Leaf Area Index (LAI) by using vehicle which is unmanned aerial on the rubber leaves at the RRIM Research Station, Malaysian Rubber Board (MRB) in Kota Tinggi, Johor. The area that was not occupied by the rubber tree can be determine by using the Leaf Area Index (LAI). Furthermore, the Leaf Area Index (LAI) is also used to measure the greenness in the plantation of rubber tree. The Leaf Area Index (LAI) map created by using the drone-based multispectral images. The value of the leaf area index is important as it able to determine the level of healthiness of the rubber tree. The high value of the Leaf Area Index (LAI) indicates a healthy rubber tree which it also based on the rubber leaf. In opposite, the low value indicates an unhealthy rubber tree which it also may have not much leaves on the tree. To conclude, all of the objectives of this study has been accomplished successfully.

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INTERNET OF THINGS APPLICATION FOR PROPERTY MANAGEMENT AT AXIATA ARENA, KUALA LUMPUR

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Abstract

Internet of Things (IoT) applications were introduced by Kevin Ashton in the early '90s. However, the acceptance from the public took a long period; a decade. This disruptive technology has been growing towards the fifth revolutionary of industry while slowly entering the market globally. It focuses more on the interaction between machine-to-machine (M2M) rather than machine-to-human (M2H). Issues are arising in managing the property and the major issues include improper aiding of services offered towards the building occupants. Thus, the applications of IoT towards property management practice will be discussed in depth where the convenience of building occupants is considered. The objectives of this paper involve the components, impact, future possibilities and opportunities of IoT in property management practices. Accordingly, semi-structured method is used that involves an interview session with the respective personnel and referral from previous research. The level of efficiencies in managing the property of the building will aid countless people or any relative authority in enhancing proper knowledge on the new experience and system applied. This resulted in the breaking down of the wall of the traditional method of managing the property by replacing it with the new system that will be further explicated in this paper.

Keywords: *Industry 4.0, Internet of Things (IoT), Property Management*

INTRODUCTION

Internet of Things (IoT) can be defined as collecting an ample amount of various data transmitted into simple or complicated codes. The connection between devices create a virtual communication in sharing all the collected data information and the data information will be consistently analyse by using suitable IoT platform. For instance, ThingSpeak, FavorIoT and Ubidots as the options on the suitability of the devices on the data that will be generated. The work being done by the property manager will be much easier and bearable while allowing correct standards and proper degree of excellence to be maintained. However, Malaysian Institute of Property and Facility Manager (MIPPM) stated an opinion that Malaysia is still ill-equipped for the installation or any of the property technology as can be seen from the unsold units and vacant possession from the properties that serve as big issues in managing the property. Hence, the need of the property manager to improve over time on the use of the latest technology trend patterns in handling the property so as in the reinforcement of the implementation of the applications into the building.

The purpose for the IoT applications devices that are needed to be installed offers considerable benefits to the building occupants. In the real estate industry, security plays a big role in the for the building occupant such as the tenant and people who work in the building. Hence, IoT proposed great outcomes that could solve many problems especially on wanting the feeling of secure. The aim of this paper is to identify the application of IoT towards property management practices specifically in Axiata Arena, Bukit Jalil, Kuala Lumpur. It will include numerous findings in the application of IoT in property management practices;

- i. To determine the components of the Internet of Things (IoT) application and its impact in property management practices.
- ii. To examine the future possibilities and opportunities when the Internet of Things (IoT) devices is being installed in property management practices.

Internet of Things (IoT)

Kevin Ashton introduced the term Internet of Things (IoT) in the year 1999 during the time where he works at the Procter and Gamble. Kevin Ashton majors in the supply chain optimization where it introduced the new ideas on technology which is the RFIDs. However, it took almost 10 years for the term to be used globally by the people around the world. The concept of IoT started to gain attention in the early summer of 2010. It is described as the Google Street View has not only produce 360-degree pictures but also collecting the information from the people Wi-Fi networks around the world. In the year 2011, Gartner Research Company states the most famous saying on the internet which is ‘hype-cycle for emerging technologies’, which stresses on IoT. Europe has organized the biggest technology conference in 2012 called the Web Summit or Le Web where the term IoT is being used. Simultaneously, the property technology company that is well-known such as the Forbes, Fast Company and Wired has been using the IoT as one of the phenomena for the vocabulary. In the year 2013, the International Data Corporation (IDC), the Global Intelligence Firm, has made and analyzation in one of the reports stated that IoT will reach 8.9 trillion dollars in the coming 2020. Google company has bought the Nest with a total of 3.2 billion dollars and the Consumer of Electronic Show (CES) in Las Vegas following the theme IoT in 2014. However, people would recognize the extends of IoT with the term Internet of Everything (IoE).

More than half the population in this world use the Internet to browse information, getting new updates and news, interacts with people on the virtual world, sending and replying e-mails and many other tasks or simply killing the time by using the Internet. Furthermore, IoT possess many positive attributes that will make human lives much easier in the future (Jaureguy, 2016). Various platform that is compatible with the applications uses simple or complicated coding in order to read the data and send it to the main structure. For instance, *Python* software which is a common software that is less complicated and readable for the machine to acquire any missing data (Kalaithasan, 2018). The applications also hold essential computing functions such as the passive Radio Frequency Identification (RFIDs) and for many complicated performances on services and handling the management of networking for property control practices.

There are many challenges that will be needed for IoT applications to be stable in the industry (Banafa, 2016). Firstly, the heterogeneity of the devices used which includes the diversity of approach on the way the system operates until all the data has been submitted and generated precise end result. Ad Hoc Networks states that a ‘thin waist’ method for the fundamental of the networking would ease the operable state of the devices. This protocol is quite common in the industrial sector where the design of the architectural structure follows the specifications where it will give ideas on tackling the building flaw.

Issues and challenges

Numerous studies have been carried out on the future challenges of IoT application on property management, but few studies have examined the applications of IoT towards property management practices. The acceptance of IoT applications may vary. Davis (1989) illustrates the technology acceptance model where it could measure the level of acceptance by using the theory of reasoning action. It is considered as one of the advanced technologies because it helps in enlightening the information for the new technology which includes the Internet of Things and the model is seen as successful (Gao, 2014).

New knowledge will be introduced by the management of the property that will encourage more people to be exposed with the technology advancement on the approach used in managing the property. The occupier of the building gets to enjoy the benefits that the Property Manager had to offer (Alonso, 2006). There are not any proper guidelines on the way the property needs to be treated and maintained because each property possesses different design, structure, functions and operations. Besides, the exchanged data should enable the smart devices to work properly by following the available spectrum to achieve different goals on the cognitive or dynamic part (Hanns, 2018). In addition, the energy used includes a huge amount of electricity used for the devices to be functional.

Next, the method includes the ability to detect the smart devices within a small range and have the capabilities to tracked and localized it. These features are vital for the life-cycle of the product management and logistics which previously had espoused the technologies of passive RFIDs. The distribution of system intelligence will increase the feedback as well as reducing the human involvement in creating full data coverage coordination (Hanns, 2018). Because there will be a massive amount of data awaits to be restored in a secure free-way which elevates the collection of the semantic data where it used a simple but readable description of the said data information.

On the other hand, security issues on the applications leads to certain threats for the user. Research shows that the applications are riskier where sometimes the cost is high in the initial stage. It is important to have a wall barrier as in the visible part but as in the virtual world, the correct malware to protect all the information. Then, IoT firmware needs to be updated in ensuring full potential. Normally, the sensor is made from strong elements with high compatibility on the devices including the convenient size of the sensor which is small (Dunbar, 2012). Besides, there is quite a lot of challenges faced by IoT sensors which includes high consumption of power energy, security and level of safety for the data to be transferred and the semantic interoperability of IoT application to be included and understood into the system.

THE COMPONENTS OF IOT IN PROPERTY MANAGEMENT PRACTICES

The first components of IoT application involves the sensor devices. These sensor devices will assist in the operation of the building where it could serve its functions properly. For instance, the most common sensors used for an indoor stadium include temperature sensors, humidity sensors and accelerometer. Axiata Arena uses the Programmable Logic Controller (PLC) in order to control all of the automated sensors that have been connected where it will

generate new data and processes it immediately which resulted an adequate amount of outputs. However, this will cover only based on the specific setup parameter.

Next, the components of IoT application involves the networking coverage. It is a medium for transport in order for the applications to function properly. The respondent elaborates on the Low-Power Wide Area Network (LPWAN) which explains the networking that could be used to power IoT. It is a wireless network in a wide area that connects between low-bandwidth connections where it emits slow speed and devices that is being powered by a battery which has lower bit-rates due to robust modulation scheme over long radius of networking coverage. The components of IoT involves the technology and regulations standard. As for Axiata Arena, the standard that must be followed is from the effective LPWAN protocol which is elaborated on the LoRaWAN standard. The functions involve providing connections between devices or sensors for the purpose of rapid deployment of high-speed services towards powering IoT. Smart analysis is one of the IoT component which divided into three different types. As for Axiata Arena, these smart analyses will be shown in the computer vision and language processor. However, it is still in the process in implementing the smart analysis through recognition of human voices. In the control system room of Axiata Arena, the respondent shows the smart analysis that has been depicted in a form of computer vision where all the sensors incorporated into one complete system which is called the Building Management System (BMS). All the data information will be interpreted into simple coding called Phyton where Axiata Arena management uses in handling the building as interfacing it into M2M and human intervention is needed as the output will be defined in the end of the entire process of analyses.

The last components that will complete the smart analysis involves the smart action of the application to be in an operable state. User interface (UI) from using these systems will result in greater user experience (UX). Axiata Arena management team will be incorporated with an application that will notify any changes from any unexpected circumstances. Moreover, the head of the team will also have the right to act on checking the system used from time to time without having to be in the area. However, it depends on the networking coverage where the software only limits certain range of networking. Earlier, the respondent explained on the machine to human (M2H) where it uses one software that could not be disclosed because of private and confidential data. As for the machine to machine (M2M) interfaces some of the actions that may be performed with the automation system initially from the machine.

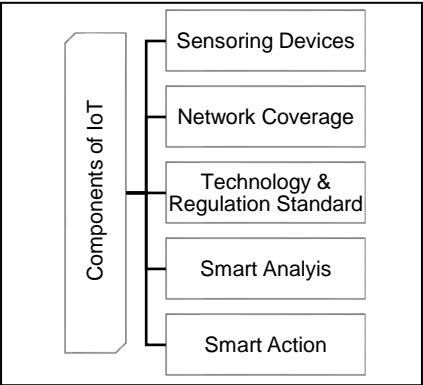


Figure 1. Components of IoT in Property Management

IOT APPLICATION IN PROPERTY MANAGEMENT PRACTICES

Previous Practice

The former name of Axiata Arena is Putra Indoor Stadium where the installations of new systems in assisting the management of the stadium basically focuses on the traditional method. Every scope of work needs to have a human intervention to keep the building in its operable state. Computerization on keeping the building function is only for certain important documents because mostly the management team will have to complete the task needed manually that might took much longer time than expected. At one time, some of the tasks need to be delayed which could create unexpected result because of failure in prioritizing the urgency of work or task.

Current Practice

Axiata Arena uses the fifth generation of wireless internet networking coverage which is known as 5G. It allows more than 20 GB per second for the speed and the optimization of the router for the internet to be working is being considered. Many devices have been connected with the devices that have been implemented throughout the indoor stadium where the interpretation and sharing of the data information can be done within the coverage area. The use of the Programmable Logic Controller (PLC) in one of the systems will enable any failure that might occur and reduces the time-span for the matter to be solved. It is the substitute of the panel of relays but without displays. It consists of CPU modules, input and output devices (I/O). The diagnosis being made created smoother work to be completed in a specified time-frame. The connection where the team communicates by utilizing the Ethernet. The coding used by processing the data information is needed where employing a new set of skilled people for the betterment of the team.

Moreover, the building management system (BMS) or known as building automation system (BAS) is being implemented in the stadium where it is a cloud-based computer controls with various systems that have been installed in the indoor stadium. The monitoring and controlling any mechanical equipment will be done for the lighting, fire system and security system of the building. The data information could be collected in a proper manner and reduces the duration between the point of initiation of processing the significant data and when the downtime or performing the maintenance needed. It is very important for Axiata Arena in integrating an ample amount of information into a single system without human intervention. In addition, it will create a good working environment for the employees where the monitoring can be done easily because it is being recorded in a real-time view of the management wholly. The system could be upgraded in the future where it could merge with much more advanced controlling system which can be computed into various different software in the management of the building such as Jira, Trello, VersionOne, Axosoft, Planbox, Spiriteam and more.

Future Practice

The problems that arise while operating the system in Axiata Arena will be reassessed and revised for future growth of expanding the system in exposing into new market specifically in Malaysia. The future technological advancement will be making a reference from the projects from the Tottenham Hotspur Stadium where the innovation of retractable pitch. The function comprises of the wide area of network connectivity with the utilization of Wi-Fi 6 that could deliver the vital information faster in line with the management system. These experiences will increase the bandwidth capacity compared to the current Wi-Fi standard. This will create more new features that could assist the management team including the user. The improvement of the existing system will be done in a secured cloud storage as the information that is needed to be processed is large as it needs to abide by the protocols that have been produced.

FUTURE POSSIBILITIES AND OPPORTUNITIES OF IOT IN PROPERTY MANAGEMENT PRACTICES

Future possibilities are the things that the people have control over whereby the opportunities are that several chances in making choices to attain certain goals in a stipulated time. These two terms are interchangeably used in a similar way, however, the control features over two scenarios is quite different. Proper forecasting over the system used where the upgraded version from the recent system could happen. People are looking for new alterations from the system that could captivate the current trend in accelerating much further into entering a new market. In this case, the installations of IoT devices which controls the whole operation of Axiata Arena create higher possibilities in the operational attainment and for a certain system that needs to be completed by human intervention, will decrease the expectations of the overall performances.

Furthermore, there will be several challenges faced by Axiata Arena which includes the initial investments costs, security system, existing infrastructure and the availability of the hardware. The investment costs involve the addition of new hardware into the system or by modifying the existing ones. These could cost a lot of monetary value. Then, the specialized personnel are needed in carrying out the system where the specialization in a certain area of work is vital for the system to be working in a proper manner. The opportunity to increase and broaden the knowledge towards a new form of *modus operandi* in entering the future of this industry. Next, the security system of the shared information data whereby it will be sent wirelessly through the IoT platform and send back into the cloud storage or the in-house storage. The worrying part involves the existence of crackers in hacking into the computerization system or into the devices itself. With this, the opportunities being created with implementing well-built security system for the property to be in an operable state with the execution of various high intelligence approaches from the collaboration in the future.

Moreover, the challenges on the existing building infrastructure that is needed for replacement of certain parts in implementing new devices or hardware that will be incorporated into the system of Axiata Arena. The availability of the hardware creates more forecast research on installing or upgrading the system. Some attributes of the system encompass of adaptability, flexibility and ready to evolve by unexpected circumstances. The

challenges faced will create new opportunities for the management in engaging towards much more promising stage not only in Malaysia but globally.

CONCLUSION

The sensor devices are within the Axiata Arena which includes the lighting system, heating, ventilation, air-conditioner system, and the scoreboard. Axiata Arena has been adopted fully these components of IoT whereby the operation of the property management is interconnected with different devices within similar networking coverage in accordance to the technological and regulation standard.

Future possibilities with opportunities towards the property management practices stress on entering a new market in the country as it will attract the potential investor which shows interest in the advantages or benefit from using the system. Different approaches of managing the building will create new experiences and eventually unlock new potential within the industries. Moreover, having a distinct way of thinking that would increase the expectations on the overall building performance. In addition, some attributes on the challenges faced by the management team involves adaptability, initial costs, security, evolvement from the old system into newer disruptive technology. As a result, the future will be more open to new challenges while modifying the existing ones. Challenges faced by the management team involves low availability of hardware for certain sensor devices and needed to be imported from outside the country. This can be seen from the current trend in the market which resulted into penetrating in a different new market per se. It is recommended that the applications of IoT could be used widely in managing property as it requires low maintenance with a guaranteed efficiency. In addition, as well as changing the perception from the public, upgrading the property management software and the installations of new smart devices into existing buildings.

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A STUDY ON THE SIGNIFICANT EFFECTS OF CREDIT REPORT IN PROPERTY FINANCING IN MALAYSIA

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Abstract

In property financing, a credit report is very important. Nowadays, to determine either an individual afford to repay the loan given plus the interest rate, the financial institution will go through into the report of individual scoring. Therefore, it is important to have a good credit report to increase the capability of obtaining the loan. This study aims to determine the significant effects of credit reports on property finance in Malaysia whilst the objectives are to determine the elements of credit reports on property financing in Malaysia, identify the factors that influence the credit report and suggest the improvement solutions in enhancing the credit report. The method of acquiring data for this study is by using qualitative method. Two expertise from the conventional bank which is HSBC bank and RHB bank are being interviewed to gain the relevant data and information. A result shows that the probability of receiving the approved loan may differ depending on which bank borrower wishes to apply to because each financial institution has a different principle on the evaluation of borrower. To evaluate it, there are three systems of the credit report used in Malaysia which is CCRIS, CTOS and RAMCI. According to observations, there are various factors effects on the credit report towards property financing which are forming of account for 12 months in CCRIS, Debt Servicing Ratio (DSR) and foreclosure. All these factors may cause a bad reputation on individual credit status. Lastly, Credit Counselling and Debt Management Agency (AKPK), is one of agency developed by Bank Negara Malaysia (BNM) to guide a borrower to overcome their credit status. Thus, this study will create awareness among Malaysian on the importance of credit report in property financing helping them from loan rejection.

Keywords: *Credit Report, Property Financing, Credit Report Element*

INTRODUCTION

Introduction

In this era of the globalization, demand and supply of the properties keep increasing year by years. Residential and commercial property are build as high-class properties and become a competition among developers. Owning more than one property is one of the ways to gain profit through investment. Although investment has high risk but it is one of the most popular ways on earning income. The factor for the banks when approving the loan, and deciding on the amount of interest rate is based on the 3 C's. (Chandrasekaran, 2016). Capital is the second factor which the bank will assess in the event of arrears. Capital shows the amount of valuable assets that can be used as loans in the event that borrower fails to repay the loan, such as property, savings or investment (Shamasundari, 2015).

Problem Statement

Credit score can be destroyed just in a blink of eyes even it takes years to form a good credit score. One of the main reasons for rejection in the loan application is that being late on a loan payment and also overdue of the amount. Probability can happen when owned a bank loan, a credit card or even a mobile post-paid plan and you received a call from the

representative of the centre reminding you that you were a bad paymaster (Nair, 2013). Blacklisted will be charged to anyone who fails to pay the outstanding or unpaid amount of debts within the time allotted. A person may not be able to make or apply any applications or even unable to go to overseas until all the debts have been settled up, therefore blacklist is the most crucial issues.

Next is foreclosure. For entire borrowers, foreclosure is a frightening term. Applicants may be able to lose their home if they failed to pay their mortgage loan. Foreclosure would also have an impact on the credit score, which can harm potential borrower opportunities to apply for a new loan (Shamasundari, 2015). The record can affect the borrower's credit score. The credit record will be remained until a full settlement is made.

Do not have any credit history is also a problem. In order to accept a loan, banks must consider whether the borrower must repay all debts according to the time period, full payment or monthly instalment, characteristic of applicants and monthly profits. Banks could not evaluate how they pay debts if they did not have any record. This category of borrowers is labelled as a high-risk borrower and less probability of approving the loan. Although applicants can manage their money well, the credit rating agencies could in fact view a lack of credit history as a negative attribute. And the older the credit report, the more points it gets.

Therefore, there is a need to study the significant effects of credit reports on property financing in Malaysia. This study will give awareness and make Malaysian realize the things that affect their credit report as well as obtain a solution to overcome and handling a good credit report.

Research Questions

Research question for this research are as follows:-

- a) What are the elements of credit reports on property financing in Malaysia?
- b) What are the factors that influence a credit report?

Research Objectives

The objectives of this research are as follows:-

- a) To study the elements of credit reports on property financing in Malaysia.
- b) To identify the factors influencing a credit report.
- c) To suggest the improvement solutions in enhancing the a credit report.

Scope and Limitations

The focus of this research is on the conventional bank that such as Hong Kong and Shanghai Bank (HSBC) and RHB Bank as participants to help effectively realize this analysis. These banks are selected as they offered real estate loans such as residential loans and industrial loans. This study covers on housing loan only. These two banks are chosen to gain more information regarding the major impact credit reports have on property financing. It has a different practice in their system therefore these two banks are the most favourite bank chosen by Malaysian for property financing.

Research Significance

A credit score is essential to ensure that the borrower can obtain a loan easily. The right way before making advance payments to buy a home is to print the records of CCRIS first (Isa & Hamdan, 2017). This meant that borrower would ensure that their credit report is clear from arrears before applying for a loan so that the loan can continue smoothly. This study would offer borrower benefits to make them more alert and aware of their credit scores. As they participate in the study of this credit scoring, it will help financial institution staff, CTOS and the Credit Bureau to increase the level of achievement in the world's eyes to strengthen their strategies for producing credit scoring quality and efficiency that can have the highest effect for each person who undergoes them. Besides this study will help on the loan applicants to determine the best way to ensure that their loan on property finance can be approved.

LITERATURE REVIEW

Definitions

Credit

Credit can be described as an arrangement where a shop or other business enables a customer to pay for the products or services provided at a later date based on Oxford University Press (2013). Credit is a debt where the money will be paid after goods have been obtained. In additions, credit has a bad effect if a person keeps it and it may reflect whole life if we never settle it.

Report

Previous declaration or data is keeping as a report. According to Oxford University Press (2013), report is a statement or announcement. Report is essential for revising the data as recommendations or for solving a problem. Report is usually used as a guideline and information for overviewing past cases.

Effects

Effect is change which is a result of an action or other cause (Oxford University Press, 2013). In any situations, causes of something to be happen is an effect. Effect will impact the case study either negatively or positively. Effect is crucial to know the outcomes and problem involved in any cases.

Property

Something to which a person or business has a legal title can be defined as Property (Merriam-Webster, 2016). Generally, property is either landed property or strata property asset to an individual. Land can be categorized as residential, commercial, agricultural, farming, and recreational. Different properties composed of different characteristics and functions.

Financing

Act of providing funds for business activities, making purchases or investing is known as financing (Investopedia, 2005). In consequences to reach the objectives, financing is involved by financial institutions as they supply or provide the resources for a company, customers an investor. For every economic structure, the use of funding is important, because it enables businesses to purchase goods from their immediate scope

Credit Report

There are three system of credit report used in Malaysia which is CCRIS, CTOS and RAMCI. Credit reports are essential to obtain a loan for a person. Record of the borrower's credit history from several of sources, including banks, collection agencies, companies, credit card and governments is a credit report is a (Mark, 2017).

The System of Credit Report

Central Credit Information System (CCRIS)

“Bank Negara Malaysia” (BNM) is organized and set up the Central Credit Reference Information System (CCRIS). It is an online credit information website containing the data identified by the Credit Bureau and presently over nine million debtors are reported on this webpage. (Property, 2015. CCRIS reports contain data on any outstanding loans, special attention account, repayment behaviours and any loan applications has made by borrowers. All documents are usually held for 12 months. Essentially, any financial institution, entity, registered credit reporting agencies or a company can request the CCRIS report. The purpose is to evaluate the overall borrowing record on their actions and balance level. Bank will then request the report to perform an evaluation on the applicant eligibility.

▪ *CTOS Data System Sdn Bhd (CTOS)*

CTOS is Malaysia’s leading Credit Reporting Agency (CRA) under the Credit Reporting Agencies Act 2010 and been established in 1990. CTOS is a privately-owned information system company that is commonly used by most financial companies, law firms, businesses and other companies (Azhar, 2014). The information is structured into an online database that allows for a rapid, convenient and reliable process of reviewing loan applications, business credits and lender decision making. CTOS consists all information associated to many public sources such as National Registration Department, Companies Commission Malaysia (CCM), Malaysia Insolvency Department, Publications of legal proceedings and notices in newspapers and government gazettes (Fara, 2016).

Score	What It Means to Lenders
744 - 850	Excellent! You're viewed very favourably by lenders.
718 - 743	Very Good! You're viewed as a prime customer.
697 - 717	Good! You're above average and viable for new credit.
651 - 696	Fair. You're below average and less viable for credit.
529 - 650	Low. You may face difficulties when applying for credit.
300 - 528	Poor. Your credit applications will likely be affected.
No Score	Your score couldn't be generated due to insufficient information.

Figure 1. FICO score

Source: CTOS Data System

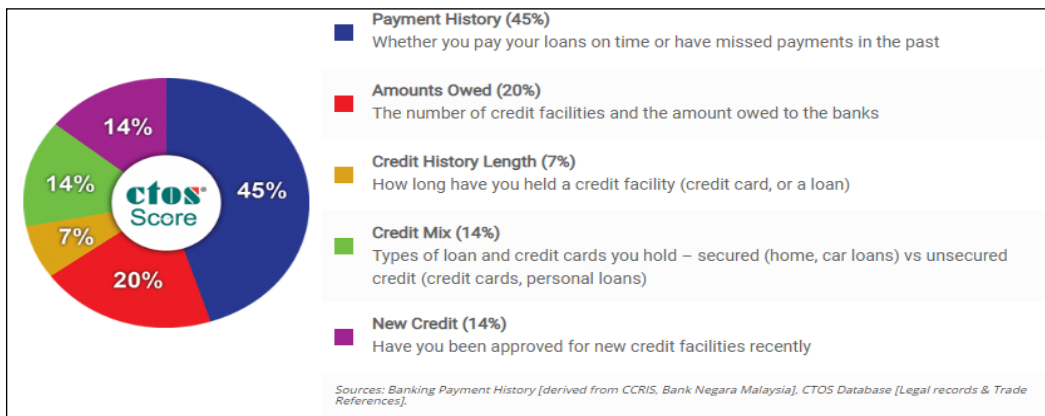


Figure 2. Percentage of CTOS score

Source: CTOS Data Website

Ram Credit Info (RAMCI)

Since they have many similarities, major competitors to RAMCI is CTOS. In addition, RAMCI is a leading Credit Reporting Agency licensed under the purview of the Ministry of Finance Malaysia, is relied upon for credit reports and scores by some of the most renowned global and local brands as well as financial institutions, Government Agencies and SMEs where they are more focusing on business (RAM, 2014). The purpose of the formation of RAMCI is to improve the reliability to the public of critical information about Malaysian individuals as well as the companies and their business affairs.

Property Financing

Asset is a building and the land on which it belongs (Oxford University Press, 2013) therefore it may be described as provided fund to an individual or organization (Oxford University Press, 2013). Consequently, they must apply loans through financial institutions or other sources. It's not easily to apply a loan if we have a bad credit score history. The major factor determining whether a borrower repays their loan, declares bankruptcy, or remain in long-term default is how aggressively their creditors pursue repayment through garnishment, property liens or other collection method (Amanda, 2014).

Financial Institution

Owning a house reflects a huge financial contribution. Housing financial institution all over the world are undergoing tremendous changes and have acquired great significance in the present day in the context of globalization, liberalization and modernization of the society. There are many things to consider, including down payment, tenure, financing margin, rates, instalments, and etc. This is particularly when we find out that the biggest concern, they have with most homebuyers is not just the instalments, but their initial deposit (Eugene, 2016).

Table 2. Base Rate in 2020

Base Rates, Base Lending/Financing Rates and Indicative Effective Lending Rates				
No.	Financial Institution	Base Rate (%)	Base Lending Rate (%)	Indicative Effective Lending Rate* (%)
1	Affin Bank Berhad	2.95	5.81	3.50
2	Alliance Bank Malaysia Berhad	2.82	5.67	3.36
3	AmBank (M) Berhad	2.85	5.70	3.50
4	Bangkok Bank Berhad	3.47	6.12	4.67
5	Bank of China (Malaysia) Berhad	2.80	5.60	3.80
6	CIMB Bank Berhad	3.00	5.85	3.75
7	Citibank Berhad	2.65	5.80	3.45
8	Hong Leong Bank Malaysia Berhad	2.88	5.89	3.75
9	HSBC Bank Malaysia Berhad	2.64	5.74	3.75
10	Industrial and Commercial Bank of China (Malaysia) Berhad	2.77	5.70	3.72
11	Malayan Banking Berhad	2.00	5.65	3.50
12	OCBC Bank (Malaysia) Berhad	2.83	5.76	3.95
13	Public Bank Berhad	2.52	5.72	3.35
14	RHB Bank Berhad	2.75	5.70	3.75

(Source: Bank Negara Malaysia (BNM))

Effects of Credit Reports to the Borrowers

Credit reporting is important in knowing the level of entitlement of an individual. Banks or lending institutions will review an individual's credit reports to assess a borrower's ability and behaviour. Credit reports have various effects on individual and lending institutions. There are two main effects of the credit report which are: -

- a) Effects towards an individual
- b) Effects towards lending institutions

RESEARCH METHODOLOGY

This research involved three (3) research questions which are (1) to study the elements of credit reports on property financing in Malaysia, (2) to identify the factors that influence the credit report and (3) to suggest the improvement solutions in enhancing the credit report.

Therefore, only one (1) tool is used to collect the data which is by interviewing. The interview sessions are held between the researcher and the expertise. The respondents are bankers from two different bank which is from RHB Bank and HSBC Bank. Each bank has its own specifications and requirement in determining and handling the credit report. The qualitative research is used in this study to ensure that the objectives are being solved and achieved.

Data Collection

Primary Data

Primary data is a set of data which is obtained by the researcher herself. It may be obtained by surveys, interviews, questionnaires and direct comments. All the collected data are called

primary data since the data is original and there are no copies. In this study, an interview is conducted between two different banks to gain information and solve the current problem. An interview is a two-way dialogue exchange, a discussion in which all parties try to accomplish their goals. The first interview is carried out by interviewing bankers to deeply understand about Central Credit Reference Information System (CCRIS) and CTOS report. There is two selected conventional bank which is HSBC bank and RHB bank to identify the standards of good credit report before applying for any loan.

DATA ANALYSIS

Introduction

Describes information on the data collection analysis of the various approaches for completing this research. It includes analyzing the collected data and summarizing the data collected. The data collection process involves an interview, primary data, secondary data and the study of documentation. It focuses on the data obtained in handling the credit report through interview sessions with the banker in determining whether the objectives through this research study, these results are essentials. The aims of this research were supported by the data obtained as a reference.

Data Analysis

Data analysis is the information or data obtained through the interviewed session. Findings are made based on the analyzation of the data obtained and it is also to ensure that the research objectives are in line with the findings.

Content of CCRIS Report

Bank Negara Malaysia (BNM) collects borrower's credit information from lending institutions and record it in Central Credit Reference Information System (CCRIS) (Gobear, 2017). There are nine particulars that need to concern in CCRIS before a loan is given by the bank. The report is recorded in the coding system, but for an individual report, the details on the particular are clearly stated (Respondent 1, 2020). The particulars that need to be evaluated before approving a loan are status, capacity, lender type, facility, total outstanding balance, limit, instalment in arrears for least 12 months, any special of the account and the borrower's history of the application for credit (Respondent 1, 2020).

For status that stated 'Outstanding' refer to the un-full payment and remaining balance of the loan. When full payment has been made the report will become "Finished" and the record will clear from any outstanding. Besides, a loan taken directly or indirectly is explained on capacity (BNM, 2002). If an applicant applies for a loan by themselves, their code on capacity will appear "Own". But if there is any joint venture or combination of loan, for example, husband and wife, the code on the capacity will show "Joint". Next, to identify the type of financial institution that been applied by borrower it is stated at lender column. Types of loan borrowed also been stated in the CCRIS report under facility item.

Total outstanding balance is the most important column or sections in this CCRIS report as it stated on the outstanding amount of the borrower (Respondent 2, 2020). The ability of a payment for an individual is based on the monthly salary that not exceeding 50% for the total

amount earned. Bank will reject loan application if the monthly loan payments exceed 50% from the monthly salary.

An instalment in arrears in the major part in CCRIS report to be analyzed. The number stated is '0' and '1'. '0' means the borrower is a good paymaster as they managed to settle the payment within a month. But if the number stated '1' means there is an arrear during that one month. The results that show the arrears will remain in the report if there is no settlement of payment made and this will affect the borrower credit report at the same time reduce the chances of the loan be approved as the bank will reject the property loan application.

Content of CTOS Report

Table 2. Summarization Content of CTOS report

Section	Descriptions
Section A	Identity Identification
Section B	Internal list and group exposure
Section C	Directorship and business interests
Section D	Legal actions
Section E	Trade referees and subject comments

Source: Bank Manager

Table 2 concludes the content of CTOS report which are constructed in five sections which are section A, section B, section C, section D and Section E (Respondent 2, 2020). Each section consists of different particulars. The score shown on the report helps lending institutions to determine qualified borrowers. Section A illustrated on an identity verification such as name, MyKad, address, company, business registration number and others. While Section B refers to the internal list or group exposure which linked to their own business experience with their customer. This detail is only relevant for the person who subscribes.

Next, Section C displays on the directorship and business interests. To justify the company, profit especially for shareholders and partnership, the bank used and concerned on this section. So basically, these section state on all information and the capacity of the company. While, the important part for the lending institution is section D which concerning legal action against (Respondent 2, 2020). Even one legal action such as summon, bankruptcy, legal proceeding and others may increase the potential risk of the effect on the credit report. Under CTOS report, this section is focused by the lending institution as through this section can borrower's status in any crime issues, bankruptcy and amount of any outstanding can be recognized and identified.

Factors Effectuated the Credit Report

Credit score and credit report is a simple digit number that represents financial health. It is a snapshot number that credit lenders (License Financial Institution) will look into before they decide to approve customer loan. To prevent from been a victim of identity theft borrowers should track their report regularly (Latoya 2017).

Forming of 12 Months Account in CCRIS report

This account stands a big portion in the credit score and before approving a property loan lending institution consider overall decision. In order to maintain good credit score, make sure there is no arrears, loan repayment before due date each month without fail. There are numbers as a code that represents the repayment flows. If stated number 0, it means they are good pay master without any outstanding, however if stated 3, 5 and more, it will show that they are not a discipline pay master as they cause an outstanding Bank usually will reject their loan application (Respondent 1, 2020). In the other hand, for the amount that customer owed outstanding, bank will look into the number for facilities that applicants have and how much current outstanding amount.

Debt Servicing Ratio

How much an individual's income is used to assign monthly instalment is DSR and each bank has its own DSR rate (Farish, 2017). DSR is to recognize individual affordability based on the percentage obtain therefore DSR is another component used by the financial institution will review besides credit report. A percentage is being used as a benchmark in approving or rejecting the loan, and it is used for example the higher the percentage the higher the opportunity to apply for the loan or else the lower the percentage the lower the chances to apply for the loan. There are maximum percentage need to be reached to prevent the application from being rejected. The higher and lower percentage also represents a borrower's credit report. Borrowers with high DSR percentage rate must have good trade records (Respondent 1, 2020). To own a property finance applicant must achieve the assigned percentage.

Table 3. Percentage of a DSR rate.

Net Salary	DSR Rate (%)
Below RM3000	60%
RM 3000- RM10000	85%
Above RM10000	90%

Formula of Debt Servicing Ratio:

$$\frac{\text{Net Salary /per month} \times 100\%}{\text{Total Commitment / per month}}$$

Figure 3. Formula of Debt Servicing Ratio

Source: Bank Negara Malaysia (BNM)

Foreclosure

Bad repayment or involvement in any legal proceeding cases will cause foreclosure. It is happened when borrowers are being blacklisted by the legal institution or any registered agencies after being reported to CTOS Manager Sdn. Bhd. There are procedures before bank auction process being taken. Banker will go through on the credit report of the borrower and after 3 months of given duration to make payment still being obeyed, bank will call the

borrower to remind on the late payment (Respondent 1, 2020). This is to prevent the credit report to turn into a bad report due to late of payment. Next, second reminder or notice will be given after 6 months if there is still no payment make but at this time their property are already being listed in property foreclosure and the document already being make. But, there is situations that the borrower did not received the notice (Respondent 2, 2020).

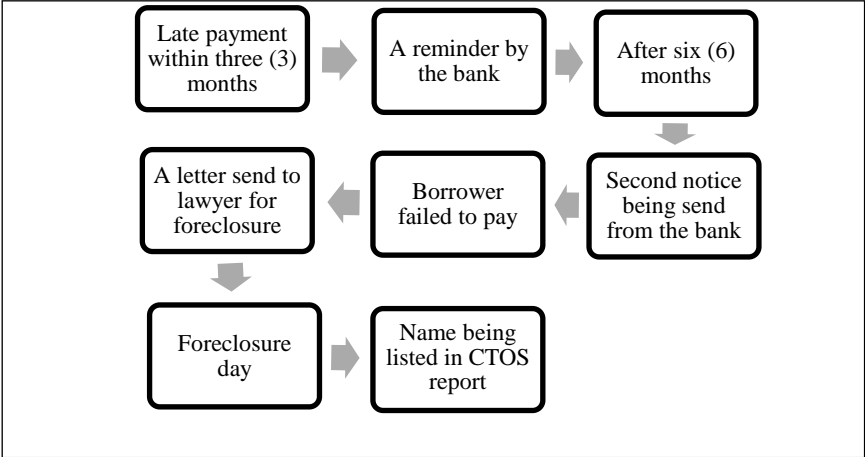


Figure 4. Property Foreclosure Procedures
Source: RHB Bank

CONCLUSION AND RECOMMENDATION

Introduction

This research is important in identifying the significant effects of credit report towards property financing in Malaysia. Financial institution will evaluate borrower credit report according to credit history of borrower. There are many factors affecting on individual credit report. In this chapter, a conclusion has been made on the whole research study on this topic and also some recommendations been stated to give awareness on the effect of credit report for property financing. From this study, readers will improve their credit report and can determine the solution and cause of their rejected property loan.

Review of Research Objectives

This research intended to meet the three (3) objectives that have been set at the beginning of the study. The suggestions and conclusions described are based on each of the objectives of this study.

To Study the Elements of Credit Reports on Property Financing in Malaysia

In Malaysia, CCRIS and CTOS report are usually used in credit report system. These two

reports are normally being referred by lending institutions. Bank Negara Malaysia (BNM) is the one that form and determine the CCRIS report thus CCRIS report can be obtain from Bank Negara Malaysia (BNM). According to CCRIS report, there are nine (9) particulars in the report. In CCRIS report there are specified code that been used in analyzing the report, each code represents different meaning.

Lending institution will use all the particulars to identify the borrower payment cycle and debt servicing ration (DSR). An arrear should be avoided for at least twelve (12) months before applying a property loan. A good paymaster will be simplifying the process of applying property loan compare to bad paymaster which have bad credit report status as their chances of loan to be rejected are higher.

Section D in CTOS report is the most part seen by legal institutions, all information will be analyse based on the details at section D of CTOS report. If borrower being convicted in any legal proceedings like bankrupt, foreclosure, blacklisted or summon the application loan property financing will be automatically being rejected by the bank except it has already been settle down. The worst scenario of CTOS report is that all the information that has been updated in the report will remain and cannot be remove or delete. Therefore, borrower should concern of their credit report before being listed in CTOS report.

To Identify the Factors Influencing the Credit Report

There are several consequences factors that affect the credit report on property financing either in a positive way or in a poor way. The factors are including the forming of account for 12 months in CCRIS report, Debt Servicing Ratio (DSR) and Foreclosure. In the first instance, the behavior of an account in the CCRIS study is the main influence on the acquisition of property finance. If the record is zero, banks will review the loan application, but if there are excessive amount of arrears, the bank will totally refuse or lift the application. Next factor is Debt Servicing Ratio is to calculate the willingness of the creditor to make a monthly payment. If the borrower is unable to meet the full amount, the banks may absolutely reject it. This is to reduce pressures in the life of the creditor because there are a lot of things to pay for.

Besides that, if borrower is listed in the foreclosure cases, the chance to get the loan will be lower. Somehow, the bank has absolutely denied the offer because the borrower has a poor experience with it. Section D of the CTOS must include a concise description of the mortgage cases so that the lender can examine the cases and decide whether to accept or deny the application.

Recommendations for Future Study

Based on the results and data obtained, there are some recommendations for further or future study on these matters which are:

- Review and compare on the element of credit report of conventional banks that follow “Syariah law” which all the rules and regulations to apply the property loan comply with Syariah guidelines.
- Identify which facilities of loan that effected the approval of property loan the most in CCRIS report.
- Identify on identity thief that happened in credit report especially in applying property financing and how to overcome it.

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BUYERS' PURCHASING PREFERENCES ON THE AFFORDABLE HOUSING OF RUMAH SELANGORKU IN SETIA ALAM, SELANGOR

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Abstract

Housing is the basic necessity of human beings along with water and food. Everyone needs a home to have proper rest in his own feasible way and feel comfortable to live a convenient life. Affordable housing is one of the government's initiatives of better housing for lower income group to help middle and low-income groups own their houses. Hence, this study is focused on affordable housing in Malaysia known as Rumah Selangorku which is under the initiative of the Selangor State Government. The aim for this study is to investigate the buyers' perspective on the development of Rumah Selangorku whilst the objectives of the study are to identify the factors contributing to the development of Rumah Selangorku and to investigate buyers' purchasing preferences. In conducting the study, Rumah Selangorku in Setia Alam, Selangor was selected as a study area. A quantitative research design was chosen, and a questionnaire survey was distributed to 174 targeted respondents which consists of buyers and occupants in that development. The descriptive analysis and relative important index (RII) have been chosen in analyzing the data collected. A result shows that, the development factors of Rumah Selangorku are contributed by price, housing population, construction cost, price, speculation, and inflation rate whilst the buyers' purchasing preferences consist of price, design, location, quality and construction technology, developer's reputation, facilities, safety and security, financing, government incentives, accessibility, public transport and distance. Hence this study will help the authority bodies to strengthen their policy and to improve the implementation of affordable housing in Malaysia to cater the buyers' needs and necessity.

Keywords: *Affordable Housing, Rumah Selangorku, Buyers' Preferences.*

INTRODUCTION

This study will discuss buyers' purchasing preferences on the affordable housing of Rumah Selangorku in Setia Alam, Selangor. Nowadays, the affordability to own a house has become a major concern issue in our country of Malaysia especially people that living in an urban area such as Kuala Lumpur and Selangor. Undeniably a good house that is filled with warmth and happiness could fulfill our life accomplishments and becoming everyone's dream. However, looking for a house that can fulfill our different considerations could give an impact on the housing market that is could be influenced by different factors (Assaf, Bubshaitr, & Al-Muwasheer, 2010). The impact of this condition could cause an increase in housing prices to converge by the new cost of housing construction. This shows that purchaser has the complete power to choose better housing where they prefer.

Therefore, due to this issue, the study is to identify the factors that influence the development of affordable housing based on buyers' preferences. It would determine the accessibility of affordable housing based on its awareness of Malaysia's affordable housing scheme (Susilawati, 2009). In assessing housing needs, it is important to clarify the demand for housing as a combination of what citizens want and what they are willing to pay for,

either individually or collectively (Yap & Ng, 2018). Besides, to provide affordable and high-quality housing, government and private developers need to know what are the main factors that attract people to buy houses and to avoid project abandonment and to guarantee that the projects are carried out effectively and in the long term, meet the expectations of homeowners.

Thus, the study will be conducted to identify the development factors of affordable housing and focusing to identify the housing buyers' preferences. It is important to make decisions in buying a house especially for the first home. Housing preference involves several factors. These factors will influence decision making to buy a house. In the housing market, the preferences of home buyers are important as they act as the basis for predicting housing demand, thereby indirectly helping the government to regulate housing policies and further promote homeownership. Knowing housing preferences is also important for homebuyers to make decisions, particularly as first-time buyers have noticed that several factors influence housing preferences (Olanrewaju & Tan, 2018). Therefore, this study is conducted due to the above issue and problems.

The aim of this study is to investigate the buyers' purchasing preferences on the affordable housing of Rumah Selangorku in Setia Alam, Selangor mainly focuses on the purchasing preferences of the buyers. The researcher has been outlined several research questions and objectives. Two research questions have been formulated as follows: -

- a. What are the factors that contribute to the development of Rumah Selangorku in Setia Alam?
- b. What are the buyers' preferences in purchasing of Rumah Selangorku in Setia Alam?

Thus, the study suggests several objectives to be attained as follows: -

- a. To identify the factors that contribute to the development of Rumah Selangorku in Setia Alam.
- b. To investigate the buyers' preferences in purchasing of Rumah Selangorku in Setia Alam.

The scope of this study is mainly focused on the Rumah Selangorku which is in Setia Alam, Selangor. There are three (3) Rumah Selangorku that have been chosen known as De Bayu, De Kiara and De Palma. The respondents of this study will involve the buyers to get their feedback on the purchasing preferences of the housing. In order to achieve the objective, convenience and random sampling techniques have been chosen and the data collections are subject to the time constrain, respondents' cooperation and other several limitations. A questionnaire survey will be conducted during the study.

LITERATURE REVIEW

Housing prices have increased dramatically over the last few years, particularly in urban areas. It is a question faced by homebuyers, where home buyers with low and middle income are unable to own a house. There is a huge gap between household income and the price of housing. Besides that, the home buyers are not only focusing on the housing price but also place a higher priority on the housing attributes. Housing affordability is related to the willingness to spend a certain amount of money on home purchases and relies on household income (Andrew, 2012). The measurement of housing affordability included three important elements which are housing price index, monthly income and household capacity

to pay for a housing loan. The household incomes are classified into low-income households, middle-income households and high-income households to identify their level of housing affordability.

While the housing preference is one of the elements that the purchaser would consider before making a purchase decision. According to KoKlic and Vida (2009), buyers tend to make complex purchase decisions when buying expensive goods such as cars and houses. The house buyers may want to purchase a better house than their present ones based on the change in their preferences. Therefore, it is important to understand the home buyers’ preferences by producing higher levels of customization in housing design to keep the housing price at an acceptable level (Wolters, 2002). It is vital to understand the housing preferences by identifying their housing attributes and housing affordability. The gap between homebuyers’ preference and housing attributes offered by the developers must be aligned. When discussing on the affordable housing in Malaysia, there are several affordable housing launches by government and private developers to solve housing affordability issue. For examples, 1Malaysia People’s Housing Programme (PR1MA), 1Malaysia Civil Servant Housing Programme (PPA1M), Rumah Mesra Rakyat 1Malaysia (RMR1M), People’s Housing Project (PPR), MyHome, Federal Territory Affordable Housing Policy (RUMAWIP) and Rumah Selangorku.

Affordable housing is provided for families that can be afforded by a range of very low to middle income-earner groups. Housing is considered affordable if it can afford to occupy without spending more than 30% of their income (Osman et al., 2017). Nowadays, the housing price in Malaysia is unaffordable for most middle to lower-income groups. Khazanah Research Institute (2015) found that Malaysia has a “seriously unaffordable” housing market. Affordability is rated on a scale of 0 to 5, as shown in Table 1. The 3.0x median multiple signs that the market delivers a distribution of housing that are subjected to minimal distortions which are housing supply is responsive and able to match effective demand (Suraya, 2015). Houses in Malaysia were unaffordable (5.4) in Kuala Lumpur, while Selangor was moderately unaffordable (refer Table 2). One of the reasons behind this unaffordability problem is the disparity between high demand and the availability of housing (Khazanah Research Institute, 2015).

Table 1. Housing Affordability Categories

Rating	Median Multiple
Severely Unaffordable	5.1 and Above
Seriously Unaffordable	4.1 to 5.0
Moderately Unaffordable	3.1 to 4.0
Affordable	3.0 and Below

Table 2. Housing Affordability in Kuala Lumpur and Selangor

Location	Median Multiple Affordability	
	2012	2014
Kuala Lumpur	4.9	5.4
Selangor	3.6	4.0
Malaysia	4.0	4.4

RESEARCH METHODOLOGY

The research methodology of this study is divided into two parts which are Phase 1 and Phase 2. Phase 1 will be proceeded by a literature review on identifying the factors that contribute to the development of Rumah Selangorku and investigate the buyers’ preferences in purchasing Rumah Selangorku. While phase 2 is employed a quantitative method by

using the questionnaire to collect the primary data. The questionnaire will be prepared to examine the actual buyer's preference for Rumah Selangorku to achieve second objectives.

Comfort sampling has been used due cheaper and convenient. A self-governing survey was conducted to gather the required data from the middle-income group in Setia Alam. A structured questionnaire designed by four main sections, which are Section A (Respondent profile), Section B (Current housing details), Section C (Buyers' preference), and Section D (Comments and recommendation). A total of 174 sets of questionnaires were distributed to the targeted population in different affordable housing in the Setia Alam (sampling area of Rumah Selangorku i.e De Bayu, De Kiara and De Palma). As a result, this makes the response rate of 58%.

The target population and respondents in this study is the buyers of three case study of the Rumah Selangorku in Setia Alam comprising De Bayu, De Kiara, and De Palma apartments. This apartment consists of 3 blocks which are A, B, and C. The development of affordable housing on the case study comprises 723 units, the total population for these 3 apartments are 2,169 units. However, the population for this study only involves 100 units for every apartment by using the convenience method for sampling purpose.

The structure of this questionnaire is using five point of scale questionnaire one (1) to five (5). The researcher will analyze the ranking of the preference criteria in purchasing affordable housing that being choose by respondents. The questionnaire was distributed for pilot study which is consist of thirty questionnaires distributing to the actual target population. This is to ensure that the questionnaire is well designed and could be used to gather useful information from respondents. The reliability test has been conducted and the result shows by the value of Cronbach Alpha. The result for objective 2 is 0.855 which is under 'Good' category.

The IBM Statistic Package, SPSS Version 26 has been used to analyse the data. The descriptive as and frequency analysis to achieve the research objectives. Beside the Relative Importance Index (RII) is also used to calculate the range of indicators according to each priority or value so that the researcher would be able to identify which elements of the data obtained from qualitative or quantitative research is more significant to use in determining the buyers' preferences. By using the RII formula, the ranking for each factor in the questionnaire would be able to identify accordingly so that the researcher will have more understanding on the importance of preference criteria from the selected respondents.

DATA ANALYSIS AND FINDINGS

Analysis of the Respondents Profile

The analysis of the respondent profile will include gender, marital status, age, ethnicity, household income, household size, and employment status. Table 3 show the result of the respondents prolife. Table 3 above shows most of the respondents were male with a total percentage of 61.5%. Meanwhile, female respondents with a total percentage of 38.5%. Most of the respondents based on the percentage contributed shown that 59.2% of respondents were married.

Table 3. Respondents Profile

Sub-Attribute	Percentage	Sub-Attribute	Percentage
1. Gender	Male - 61.5%	5. Household Income	RM 2,001-RM 3,999 - 30.5%
	Female - 38.5%		Less than RM 2,000 - 24.1%
2. Marital Status	Married - 59.2%		RM 6,000 - RM 7,999 - 22.4%
	Single - 40.8%		RM 4,000 - RM 5,999 - 20.1%
3. Age	30-39 years old - 49.5%		RM 8,000 - RM 9,999 - 2.3%
	20-29 years old - 34.5%	6. Household Size	More than RM 10,000 - 0.6%
	40-49 years old - 14.9%		4-6 person - 48.3%
	50-59 years old - 1.1%		Less than 3 person - 47.7%
4. Ethnicity	Malay - 56.3%	7. Employment Status	7-9 person - 4%
	Indian - 29.9%		Employed - 79.3%
	Chinese - 12.1%		Self-employed - 14.4%
	Others - 1.7%		Unemployed - 2.9%
			Retired - 2.3%
			Others status - 1.1%

Thus, the balance of 40.8% of respondents is still single. Most of the respondents aged were from 30-39 years old with a total percentage of 49.5%. Followed by respondents aged between 20-29 years old, with a total percentage of 34.5%. Meanwhile, for respondents aged between 40-49 years old, and 50-59 years old, both with 14.9% and 1.1% respondents, respectively. Most respondents were Malay with a total percentage of 56.3%. Followed by Indian, with a total percentage of 29.9%. Meanwhile, for Chinese and Others with total percentage both represent 12.1% and 1.7% respectively.

Besides, table 3 above also shows that most of the respondent's household income between RM 2,001-RM 3,999 with a percentage of 30.5% respondents, income less than RM 2,000, with a percentage of 24.1% respondents, income between RM 6,000-RM7,999 with a percentage of 22.4% respondents. Meanwhile, for respondent's household income between RM 4,000-RM 5,999, RM 8,000-RM 9,999, and more than RM 10,000 contributed 20.1%, 2.3% and 0.6% respondents respectively.

The highest respondent's household size is between 4-6 person with a percentage of 48.3% respondents. Followed by household size less than 3 persons, with a percentage of 47.7% respondents. Meanwhile, the balance from the total percentage of 4% of respondents is household size from 7-9 person. Based on the analysis above, majority respondent's employment status is employed with a percentage of 79.3% respondents. It is followed by self-employed with a percentage of 14.4% respondents, unemployed with a percentage of 2.9% respondents. Meanwhile, for retired and others status, both with a percentage of 2.3% and 1.1% respondents respectively.

Analysis on the Buyers' Preferences in Purchasing Rumah Selangorku

The preferences that influencing the buyers in purchasing Rumah Selangorku such as price, location, design, quality and construction technology, developer's reputation, facilities, and security and safety and others. Respondents were asked about their opinion regarding on the important level of each attribute and sub-attribute on the housing preferences for Rumah Selangorku in Setia Alam, Selangor. Below is the analysis of those preferences.

Table 4. Buyers' Preferences Attribute and Sub-Attribute

Attribute and Sub-Attribute	RII	Attribute and Sub-Attribute	RII
1. Price		7. Security & Safety	
• Less than RM 150,000	0.8241	• Minimal crime rates area	0.9092
• RM 150,001 - RM 250,000	0.7345	• Gated & guarded area	0.9011
• RM 250,001 - RM 350,000	0.6046	• 24 hours security control	0.8644
• More than RM 350,000	0.4979	• Access card provided	0.8322
2. Design		8. Financing	
• Numbers of bedroom / bathroom	0.8241	• Flexible loan / Fast approval loan	0.9023
• Size of house (living, dining and kitchen)	0.8149	• Low interest rate	0.8908
• House design	0.8115	• Loan facilities (My First Home Scheme)	0.8598
• Interior / Exterior design	0.7897	• Conventional and Islamic loan facilities	0.8460
3. Location		9. Government Incentives	
• Urban area	0.8333	• Stamp duty exemption on purchase	0.8816
• City centre	0.7828	• 10% discount on properties offered	0.8575
• Rural area	0.6448	• Stamp duty waiver for loan agreements	0.8563
• Others area	0.6402	• Cash rebate offered	0.8471
4. Quality & Construction Technology		10. Accessibility	
• Building workmanship	0.8552	• Access to workplace	0.8736
• Minimal building defects	0.8402	• Access to child day care centre, school etc	0.8448
• Building materials	0.8310	• Access to health centre	0.8299
• IBS System	0.7425	• Access to shopping mall or market	0.7989
5. Developer's Reputation		11. Public Transport	
• Developer's success on previous project	0.8483	• Trains (KTM Commuter, LRT & MRT etc)	0.8575
• Numbers of project done by developer	0.7977	• Buses (RapidKL bus & MRT feeder bus, BRT)	0.8195
• Popularity of developer	0.7736	• Taxis	0.7908
6. Facilities		• E-hailing services (Uber / Grab)	0.7713
• Supermarkets / Convenience stores / Shop	0.8943	12. Distance	
• Parking	0.8655	• Near to workplace	0.8345
• Community Hall / Places of worship / Open area	0.8322	• Near to other facilities	0.8299
• Children's play area & Kindergarten	0.8172	• Near to public transportation	0.8149
		• Near to school / colleges	0.7943

Table 4 above shows that the RII value of buyers' preferences based on their sub-attributes for Rumah Selangorku in Setia Alam, Selangor. Based on the RII value show that the most preferences, choosing by the buyers based on their sub-attributes are minimal crime rates area of security and safety are the highest RII with 0.9092 being ranked first compared

to other sub-attributes. Inflexible loan or fast approval loan on financing also important in buyers' preference based on RII 0.9023 that only slightly lower than security and safety attribute in the first rank. However, for gated and guarded area on security and safety being the third rank of the preferences with RII 0.9011.

Meanwhile, in near to public transportation on distance attribute are considered as a moderate preference for buyers' according to the rank middle with RII 0.8149. It is both being ranked with the size of house i.e. living, dining, and kitchen at the same place with RII 0.8149. However, for access to the shopping mall or market and numbers of the project done by the developer, both the number of RII also slightly differ 0.0012 with RII 0.7989 on accessibility and developer reputation attributes respectively.

In addition, in others area on location attribute being rank as third last sub-attribute with RII 0.6402. However, for price attribute in price between RM 250,001-RM 350,000 and more than RM 350,000, both being ranked as last preference chooses by the buyers' with RII 0.6046 and 0.4979 due to price is already being decided based on government guidelines.

Therefore, second objective of the study has been achieved, where the results can be based on the RII which the ranking for each preference sub-attributes in the questionnaire would be able to identify accordingly so that the researcher will have more understanding on the importance of preference for sub-attributes in purchasing Rumah Selangorku from the selected respondents.

CONCLUSION AND RECOMMENDATION

Achievement of Objectives

There are two (2) main findings of this study conducted, the first one is the factors that contribute to the development, followed by the buyers' preferences in purchasing of Rumah Selangorku in Setia Alam. The discussion of achievement is divided into two, according to the objective of the study.

The Factors That Contributed to the Development of Rumah Selangorku in Setia Alam, Selangor

Based on the literature review that has been made by the researcher in chapter two, there are a lot of development factors that might occurs during the development of housing. The development factors are consisting of housing price, population, demand and supply, government regulation, project financing and others. However, several factors that contributed to the development of Rumah Selangorku in Setia Alam are recognized. The development factors that contributed to the development of Rumah Selangorku in Setia Alam, Selangor consist of the housing price, population, construction cost, housing speculation, and inflation rate. These are also among the main factors of the affordable housing in Malaysia. Therefore, it can be concluded that the first objective of the study was achieved through the literature review that has been reviewed by the researcher.

The Buyers' Preferences in Purchasing Rumah Selangorku in Setia Alam, Selangor

Subtopic 5.1.2 shows that the achievement of the second objective of the study. It is done after the literature review; data collection and some data analysis being made to investigate the buyers' preference in purchasing Rumah Selangorku. There are twelve (12) attributes preferences of buyers' in purchasing Rumah Selangorku in Setia Alam.

The researcher found that most buyers' preference in purchasing Rumah Selangorku in Setia Alam is identified as price, design, location, quality and construction technology, developer's reputation, facilities, security and safety, financing, government incentives, accessibility, public transport, and distance. The highest of RII values have been chosen to show the buyers' preferences in purchasing the house for each preference. For example, the price preference attribute shows that the house price less than RM 150,000 was chosen as their preference in purchasing the house with RII 0.8241. The all RII value has been shown in the table 4. Therefore, it can be concluded that most of the preferences asked by the researcher are influencing the buyers' decision in purchasing the property, but only certain preferences show the lowest value such as the house price more than RM 350,000 and others.

Contribution of the Study

According to the study, the researcher was able to know more about buyers' preference in purchasing housing especially for buyers of affordable housing in Rumah Selangorku. It is important for both developers and government to acknowledge as much as it can to buyers' preference in order to make improvement towards the development of affordable housing for a better future. In addition, this research study helped the researcher understand how important to recognize buyers' preference in purchasing Rumah Selangorku for the property education. It is because if the property education did not take it seriously, this condition would lead to weakness in the development of affordable housing and do not able to achieve the objective by the government to help the middle income to own their first house. This research hopefully would be able to increase the awareness of public, property sector and government in promoting affordable housing for better future of housing.

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THE END-USER'S SATISFACTION AND QUALITY OF PUBLIC SPACE IN DATARAN CENDEKIA UiTM SHAH ALAM

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Abstract

Public space are vital elements for communities in cities. They are appropriate spaces for public activities as well as to spend their leisure time. In general, successful public space should meet the needs of all people in different social classes, ages, genders, ethnicities and backgrounds. These substantially beneficial spaces provide physical, social and psychological comfort for public user. Dataran Cendekia UiTM Shah Alam shows lack of satisfactorily public open spaces that meet user needs. The main question raised in this research is 'what are the public user satisfaction and the quality of public space towards a better public space?' This research aims to investigate the quality and public's satisfaction towards a public space at Dataran Cendekia UiTM Shah Alam. The research employed a set of questionnaires that involves quantitative approach to achieve a precise data collection and information. The finding shows that the public facilities, activities, landscape and maintenance plays a huge and significant role in attracting people to the public open space. The research disclosed that the public users are only having passive activities in the public spaces such as sitting, eating, talking to their friends, and watching people, waiting area and others. The results showed that the lack of quality in facilities and also lack of interesting activities affect social experiences in public space. Furthermore, the lack of proper shades. In summary, the physical factors, social activities and events, inclusiveness and social interactions, and design features are the public space contributing factors to the creation of a successful public open space.

Keywords: *Public space facilities, quality elements of public space, public satisfaction.*

INTRODUCTION

Public space is an important space and asset which it provides people many opportunities to come together and engage with the community. Public spaces also form an integral part of the green space in urban areas that benefit the well-being of people in different forms, including physical, emotional and social health. A successful public space has its own elements and criteria that lead to the maximum satisfaction of the public user. However, there are some issues and few lacking elements at the public spaces where it may lead to an ineffective public space. As we can see, most of the public space in Malaysia's are seldom used by citizens due to a several reasons and problems. The chosen case study is Dataran Cendekia (DC) in UiTM Shah Alam. Dataran Cendekia (DC) is one of the public spaces which are mostly utilized by students in UiTM Shah Alam. Besides, the location is at the centre of UiTM Shah Alam which surrounded by student's colleges. It serves as one of the main public places in UiTM Shah Alam. However, there are a number of issues that lead to unsatisfactory which includes; the lack of sufficient protection against adverse weather consequences such as trees and rooftop walkway and seating area (Rajjan, 2016, Dyah, 2013);, lack of activities and attraction whereby end users are only able to do passive activity such as eating (Cheesbrough,et. al., 2019, Marek, 2015) and lack of maintenance and facilities especially on the landscaping and environments (Praliya & Garg 2019).

LITERATURE REVIEW

The significances of public space are through the perspective of individual, community and city. The main purpose study to explore and establish, through the satisfaction and perception of users, the attributes of successful public space. The main feature is beneficial to an integrated project to revitalize public space that can be used by public users in a meaningful manner. Hence, developing appropriate planning strategies to improve their performance and comparing public space performance in specific urban and different urban areas to encourage the competitiveness of cities to improve their public space quality.

According to Wojnarowska (2016), public space is an important element of urban structure, playing a variety of spatial, social and economic roles in cities and cities. Its quality affects the quality of life of its inhabitants and the attractiveness of the city as a whole. Public space located in the centre of the city is the most representative of its identity and image, and also serves multiple functions and activities. In the opinion of Wojnarowska (2017) and Gruszecka et. al. (2009), the definition of public space usually takes the form of land ownership and space form as a basis for its functions. According to Alfatih (2018) and Dyah (2013), the essential characteristic of a public space is its open space that is accessible to all users, its spatial form as urban space and its capacity for various types of activities or interactions. Public space is a designed organization for the purposes of physical, social, meaning and governance. Not only the spatial elements of space, but the social context need to be understood. Space development forced by different elements will generate continuous space transformation over time to satisfy human needs. The approach thus covers the experiences and interpretations of individuals and groups that bring about common social, cultural, physiological characteristics and needs and that should be reflected in the proper elements of the physical public space.

Rouhi et. al. (2017) stated that, parks create a substantial part of the urban green space. In addition to the beauty which creates from the perspective of urban development, the role of these parks is fully evident in reducing environmental problems they can be seen as one of the most appropriate places for people to spend leisure time and cultural activities, social activities, leisure and so on. The observation and perception of landscape by humans is of great importance in and determines the satisfaction and unhappiness of the perception and understanding of the environment. Grant (2012) stated that space planning is a key element in the cycle of architectural design. It starts with a thorough analysis of how to use public space. The designer then drafts a plan that defines the space zones and the activities to be carried out in those areas. The space plan will also describe the movement trends that show how people move across space. The plan is finalized by adding details of all the facilities and amenities, vegetation, landscaping including softscape and hardscape and others related equipment. Efficient public spaces are in the long run an outdoor environment which works beyond the users' typical space of recreation, ensures social sustainability, psychological care and unlimited outdoor opportunity, with a feeling of comfort, protection and social stability and invites users to visit frequently (McCay et. al., 2019).

The main function of open space was, as reported in Elham (2013), to enable people to engage in various activities. The nature and function of open spaces have constantly been altered by cultural, social, economic and political changes. Thus, a good public space must meet certain cognitive, economic, organizational and visual needs. Deep understanding of successful public spaces by designers will promote good quality and long-term popular use, leading to a successful development project. Furthermore, Hanan (2014) said public space is an attractive

and safe place to live, work and play with people. Community planning also includes architectural practices as important facilities that allow the public to choose and spend more of their free time. Efficient public spaces are in the long run an outdoor environment which works beyond the users' typical space of recreation, ensures social sustainability, psychological care and unlimited outdoor opportunity, with a feeling of comfort, protection and social stability and invites users to visit frequently (McCay et. al., 2019).

The essential factors that attract people to open spaces are sitting areas, dining areas, shopping, sports and activities and enough toilets. Social interactions, sharing ideas and learning from others, practicing religious thoughts, spending free time, enhancing quality of life and feelings are the hidden opportunities that contribute to physical, social and psychological comfort in public open spaces. In addition, Amir (2014) pointed out that social interaction between different groups is one of the main issues in the use of open spaces by the public. Physical and psychological confidentiality, group equal rights, security and safety, compliance, cleanliness, cleanliness, art, locations, access to visual and physical materials, the delivery of numerous sociocultural activities and events, excluding offensive groups. Furthermore, Praliya, S., & Garg, P. (2019) argues that the park should be designed specifically for children and contains a variety of swings and a large area for children to enjoy, run around and play in which it is also enjoyed by families and is a popular place for morning walkers of a public space. Hence, various activities and facilities like a small open theatre, a public library, new landscape features, fountains, new swings and public amenities in a public park with the carrying out of regular maintenance works will attracts visitors from the entire city as well as a large number of tourists.

METHODOLOGY

This research focuses on the quality and level of satisfaction of users to understand the success of public space. To achieve this, this study used a quantitative approach to the data collection process. The study consisted of a series of well-structured questionnaires on the quality elements of the public space, as well as on the satisfaction of the public space user, involving, in particular, people with experience and familiarity with Dataran Cendekia UiTM Shah Alam. The questionnaires shall consist of two sections,

- 1) Part A: Demographic Specifications
- 2) Part B: Public Space Quality

Components of questionnaires structured on the basis of previous literature review theories and secondary source data. Åkerblad (2020) pointed out, theories are essential in the development of questionnaires to guide data collection and analysis of findings in order to address the research objective. In fact, each section of the questionnaires has been structured and classified to respond to each study objective. Part A deals with demographic data. In addition, respondents were asked about what are the purpose and the reason for visit to Dataran Cendekia, as well as the length of time spent. Part B is structured to determine the quality of the public space in order to achieve the second objective The study setting involved in this study is not contrived. In other words, in field studies and experiments where data collection will be conducted in a natural setting at Dataran Cendekia UiTM Shah Alam. Thus, the undetermined setting is where the research parameters are studied in the natural environment where they normally occur:

- 1) In the field

- 2) Field studies: no or minimal inference on the part of the researcher, observation
- 3) Field experiments: certain manipulation of variables

The site study focuses at Dataran Cendekia UiTM Shah Alam, setting out the background against which the research case studies can be both understood and analyzed. This study will use both on-site and on-line surveys for the distribution of questionnaires. An online survey or an online survey is one of the most popular sources of data collection, where a set of survey questions are sent to the target sample and members of this sample are able to answer questions worldwide. Respondents receive online surveys through various media such as email, embedded websites, social media and other related social media platforms. The online survey will make it possible to create and manage survey tools online. As a result, this study used the Google Form survey as the main survey tools to collect data that helps to generate questions and any subscales so that they can be easily analyzed and answered by question research.

RESULTS AND DISCUSSION

The first section (Part A) of this questionnaire gives information about the demographic profiles of the participants. The second section which is (Part B) is about the quality of the public space. For each part and section of the questionnaires, the data collected by the distribution questionnaires in the online survey will be analyzed in further detail below.

The Objectives of the Study

The objectives of the study based on these research questions:

- i. Research question 1: What is the main deficiency of the public space at Dataran Cendekia?
- ii. Research Question 2: Why the level of public's satisfaction is important towardssuccessful Dataran Cendekia?
- iii. Research Question 3: How the public's satisfaction and effectiveness of public space is related?

The Deficiency and Efficiency of The Public Space at Dataran Cendekia.

The analyzation of the qualities of Dataran Cendekia aims to achieved the research objective one (1) which to find out the deficiency and efficiency of the public space at Dataran Cendekia and the research questions is "What is the deficiency and efficiency of the public space at Dataran Cendekia?". The questionnaire on quality of public space has been divided and classified to seven (7) elements which are space and design, landscape elements, maintenance, accessibility, facilities, recreation and play and also safety and security elements. Each of the quality elements has several more questionnaire has been listed. The analyzation of the study finds that there is a several elements that has a high reading of mean value among all of seven (7) quality elements. The rank of qualities has been showed in previous chapter which exposed the deficiency and efficiency of each elements accordingly. The quality elements in term of accessibility of the space are at first rank followed by space and design and also safety and security elements recorded at second and third rank respectively. While the other four elements are listed in lowest mean value. This conclude that the best elements quality of the space is the accessibility while the lowest is the recreation play elements. In my

own observation, the accessibility for the public space has no major issues because the space can be easily accessed by everyone including disabled person. The pathway such as ramps with proper railings for the disabled are well prepared. The space also can be easily accessed by any public transportation, vehicle and more. This may because the public space is strategically located at the centre of the UiTM and surrounded by various faculties, colleges, dorms and apartment which it can be considered as one of the important areas in UiTM. However, some improvement should be focused especially on the lowest elements especially the recreation and play aspects. In my own observation, the space seems to be lack of activities and some interaction and connection with the user. The only activities that can be actively seen is only for single purpose such eating, buying and purchasing foods and goods. The space should provide some interesting activities that can attracts and connect with the users such proposed a mini library, some outdoor gym, or maybe some traditional activities or games such as *congkak* area, outdoor chess, mini sports for takraw and more.

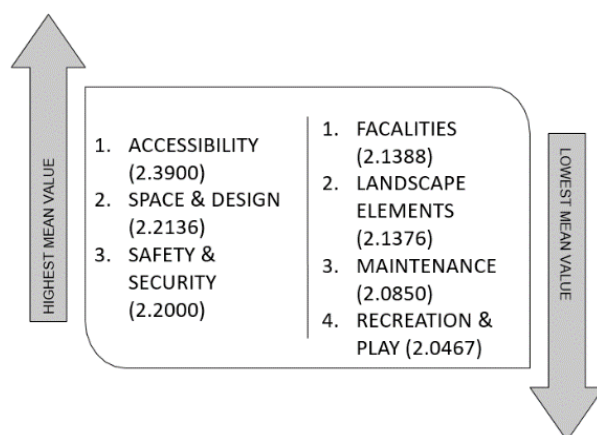


Figure 3. The Values of Mean in Qualities of Public Space.
(Source: Author, 2019)

CONCLUSION

This study summarized the significance of the immediate context aspects of quality and satisfaction. It aims to understand the quality and user satisfaction aspects that help designers create socially successful public areas where different groups of people use comfortably. It discusses how the results of the research contribute to the further development in the Dataran Cendekia or in similar circumstances of successful public spaces. Conclusion can be made based on each of the research question and also objective of this study. Successful green open areas are an outdoor environment that operates beyond a normal recreational area. This located in the area offers the user a sense of comfort, security and social cohesion that guarantees social durability, psychological treatment and unlimited outdoor experience and invites users to visit periodically in the future. Furthermore, public spaces are essential elements of every urban structure that shape the social life of the town fundamentally. However, due to the absence of these seven important public space aspects, including space, design, landscaping, infrastructure, safety and security, accessibility, recreation and play and activities, many parks and open spaces have been created, so long as it remain inadequately utilized, especially in the Malaysian context. Parks and open space are far from achieving permanent success without

understanding the criterion for the production of high public space. Furthermore, Public Park planning, design and management are one of the important elements because these parks are one of the most important areas of urban life, particularly for the rapid population growth of recent years. This public preferences for urban parks is to assess preferences in order to design and manage urban parks to meet appropriate standards. In urban planning the most important advice for management of parks is the use of park users' preferences in the development and design of parks. All decisions to design and build spaces in urban parks should be taken in compliance with end-user's requests, interests, experiences and values or else it would be unsafe and uninteresting. The overall study finds that the quality and satisfaction do have a strong relationship between them. To conclude, deep understanding of the new society needs is substantial in developing successful public spaces in future.

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CUSTOMERS' SATISFACTION TOWARDS FACILITIES OF CAPSULE HOTELS IN MALAYSIA

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Abstract

In Malaysia, capsule hotel is quite a foreign concept to the minds of the individuals of the nation. Unbeknownst to many people, this concept has been long-established in Japan but just recently introduced in Malaysia. With its eccentric concept, capsule hotel has made its name globally and has been a part of the Malaysian economy since 2014. In order to continue striving in Malaysia's tourism industry, it is trivial for hotel owners to understand the factors that could influence the satisfaction level of the customers in general. Hence, this research is to explore the adequateness of hotel facilities in relation to customers' satisfaction. To grasp the main objectives of the study, a questionnaire survey has been conducted to reach out to capsule hotel customers and analysed their opinions using SPSS to form findings. Aside from that, this study has successfully related customers satisfaction with the facilities provided, the customers also recommended their suggestions on how to make better of a capsule hotel to further satisfy the customers. This research has categorised customers' satisfaction into four main attributes, which are the general facilities, in-pod facilities, safety and inclusivity. The result shows that the attributes indeed affect the customers' satisfaction and their intention to stay. From the results, price and location are also important to the customers. Thus, by considering the objectives, the result and the recommendation of this research, capsule hotels can maximise their potential to further improve customers' satisfaction aside from being fierce competitors among other services the hospitality industry.

Keywords: *Capsule Hotel; Customer Satisfaction; Facilities*

INTRODUCTION

The hotel industry has been growing aggressively and to date, the industry is one of the most remarkable contributors to the development of the tourism industry. The fast-growing of the hotel industry in Malaysia indicates the successful economy and tourism industry in this country. Furthermore, it also provides evidence of the substantial competition that this industry had in order to have a place in a larger market share (Ahmad, 2014). Now that the importance of competition between hotel providers is established, they have to be outstanding by providing various types of unique products and services. In other words, the hotels can survive by delivering a high-level quality service to attract customers.

Essentially, the survival of hotels in this competitive environment lies within the delivery of superior quality to produce customer delight. More often than not, most small and medium-sized hotels (SMSH) have almost similar appearance services, facilities and room amenities (Chen and Chen, 2014). To be seen by the customers, it is crucial for the SMSHs to offer outstanding quality services, for them to be able to understand, meet or exceed visitor expectations (Wu and Ko, 2013). Balasubramanian and Ragavan (2019) have stated in their research that in order for hotels or any other hospitality sector in general can generate more customers as well as income, the main factor is the customers' satisfaction. This shows how customers' satisfaction will improve the hotel industry.

LITERATURE REVIEW

Capsule hotel has its own unique characteristic that differentiates it from other types of hotel. In general, a capsule hotel is a new concept of the hotel which was originally introduced in Japan. It provides minimum number rooms with the shape of capsules that fit a single guest for them to sleep with very minimal comfort facilities provided (Life Style, 2016). According to Lee et. al. (2018), capsule hotels can often be seen in airports as an initiative to increase the level of competitiveness among airline providers by responding dynamically to the declining in the numbers of transit passengers.

Also known as pod hotels, capsule hotels gain their name from its size, which is extremely small that bears similarities to pods or capsules' physical looks. Capsule hotels highlight a huge number of capsules that are cheap but equipped with basic necessities that are enough for an overnight stay, as compared to facilities of the regular hotels (Morrison, 2016). This fresh concept of the hotel has been widely adopted by innovative business owners in several countries, namely Britain, Russia, China, Hong Kong and the list does not discard Malaysia as well. However, the research on this type of hotel is seriously limited. With a better understanding of the opinions of tourists regarding capsule hotels, it can help in the evolution of the entrepreneurs in the tourism industry, mainly the hospitality sector.

Capsule Hotel in Malaysia

While the hotel market in Malaysia is gradually expanding due to the swelling number of tourists, the new trend of staying in inexpensive accommodation has become more popular since Malaysia is on the top of the list of destinations for young travellers and backpackers. These travellers are more inclined towards travelling in a long period of time, hence, controlling their budgets by choosing inexpensive accommodation instead of luxury hotels is a crucial choice (Amornpornwiwat and Kapasuwan, 2018). Since the attributes of capsule hotels fit their purposes well, it helps to improve the hotel market in Malaysia tremendously.

The first ever capsule hotel in Malaysia is CAPSULE by Container Hotel. The hotel was established in 2014 and conveniently located in the Kuala Lumpur International Airport 2 (KLIA2). With its minimalist concept, it has been attracting many transit passengers over the years. Capsule by Container offers not only the traditional single capsule that can be occupied by a single guest, but they also offer capsule for two and three guests. Capsule by Container also provides Private Capsule Suite that can accommodate up to 2 adults and 1 child with even bigger space than the capsule for three guests. Unlike any other capsule hotels in Malaysia, this capsule hotel rent out their room hourly rather than per day (CapsuleTransit, 2018). This is due to the fact that transit passengers normally only have a few hours before their next flight.

Over the years, capsule hotel has been multiplied across Malaysia with every capsule hotel has its own unique concept to attract customers. The most remarkable ones are mostly in the Klang Valley and west coast of Peninsular Malaysia. (Trip Advisor, 2020)

Facilities of Capsule Hotel

Generally, capsule hotel has very basic facilities but enough to make the customers feel comfortable in staying in the hotel (Life Style, 2016). Facilities in the capsule include things or services such as Wi-Fi, common lounge, in-room television and power sockets, communal bathroom, locker service, laundry service, breakfast service and 24 hours reception service (Lee et. al., 2018). Previous surveys have proved that the accessibility of the internet by the guests has been their top preference. (Hotels.com, 2013). Smooth internet access, preferably, free of charge, is crucial for travellers no matter what their purpose of travelling is, whether it is for business or for leisure. Heo and Hyun (2015) in their research found out that regardless of the type of the hotel, guests are more drawn to hotels with internet access regarded it as the most useful hotel amenity. Access card and closed-circuit television is also provided to ensure customers’ safety (Space Hotel, 2017).

Factors Affecting Customers’ Satisfaction

Regardless of any business, it is important to satisfy customers and have loyal customers and has been important for so long. Creating customer satisfaction and loyalty provides a prolonged competitive advantage and to be stand-out than rivals (Kursunluoglu, 2014). There are various ingredients that can create customer satisfaction and loyalty. Satisfaction can be defined as a degree of meeting the needs at the end of a purchase or service (Ahmad et. al., 2018). The satisfaction is an assessment on how much the hotel owner could meet or exceed customer expectations (Tseng, 2018). In order to satisfy the customers, hotel owners must know what attracts the customers into staying in their hotels in the first place. The following are the factors that influenced the customer’s satisfaction.

Hotel attributes

Based on a study conducted by Lee et al., (2018), customers are commonly inclined to choose hotels with several positive attributes. For instance, if the hotel offers good facilities or the hotel has a good customer service, the customer will definitely consider staying at the hotel. Some bonus points might help the customer in choosing which hotel they should stay, including low in prices and good accessibility to famous attractions in the area.

Table 1. Customers’ satisfaction according to hotel attributes.

Reference	Cherapanukorn and Charoenkwan (2017)	Berezina et al. (2016)	Kim et al. (2016)	Radojevic et al. (2015)	Zhou et al. (2014)
Staff members	√	√	√		√
Hotel facilities	√	√		√	√
Room facilities	√	√	√		√
Quality of room	√	√	√		
Food service			√		
Location		√	√		
Ambience			√		
Price				√	√
Hotel services				√	√

(Source: Alrawadieh and Law, 2019)

Service quality

Previous researches confirmed that service quality has positive results towards customers' satisfaction. When the customers are given the best quality service by the hotel's management, they will surely be satisfied and has the intention to revisit (Erjavec, 2016). Other researches also proved the mediating effect of exceptional service quality towards the customers' satisfaction (Lee, 2013)

Customers' expectation

Expectations of customers can greatly affect their satisfaction as well. Previous studies have shown that people with high living standards has high expectation towards hotels in general (Xu & Li, 2016), different types of travellers (Radojevic, et. al., 2015), travellers from different regions and different living standards (Banerjee & Chua, 2016). The origin of the tourists also affects their expectations and preference of a hotel (Matzler et al., 2016). Hotels favoured by the travellers from one region may not be liked by the travellers from other regions. Customers might have different expectations depending on the type of hotel they accommodate. Hence hotel managers should know which market segment they are aiming in order to meet their expectations more seamlessly.

Customers' Loyalty in Relation to Satisfaction

Loyalty is defined as a commitment which is formed profoundly about being a steady customer or purchasing the preferred product or service again in the future. Loyalty will provide a repetitive buying of the same product or service despite the marketing efforts or situational effects (Kursungluolu, 2014).

It is implied that customers who are satisfied are more likely to remain loyal to a brand or a service, make repeat visitations, and offer a positive word of mouth and consequently market the company. According to Joudeh & Dandis (2018), it is also suggested that customers who experience a good quality of service have the to share their good experiences with others leading to an expanded customer base and that such customers tend to become loyal customers, making the business or service more known to others. As a result, good hotel service can convince customers to book rooms again and again, and become loyal to their service. Hotel managers also found that service quality has a great influence on customers' satisfaction with service provided and loyalty is influenced both by satisfaction and service quality (Kursunluonglu, 2014).

METHODOLOGY

This research is to explore the adequateness of hotel facilities in relation to customers' satisfaction. To achieve the objective, this research used both primary and secondary data. Secondary data in this research involved books, journals, previous researches and official website. Meanwhile a questionnaire survey was conducted for the primary data. 103 responses were recorded from customers. All the data were then analysed using SPSS to generate Average Index (AI); where score 1 being most dissatisfied and score 5 being most satisfied and simplified in terms of figures, charts and pictures. Finally, the conclusion will be drawn based on the data collected.

FINDINGS

The questionnaire survey distributed to obtain data for this research has involved the opinion of 103 customers who mostly are female followed by male customers. The customers also majority came from the age group of 18 - 30 years. They mainly travel in moderate frequency. Generally, the customers did not have a preference for the type of hotel when staying in one and usually stay in a hotel for 4 - 3 days.

Customers' Satisfaction Towards Capsule Hotels in General

Table 2. Customers' Satisfaction Towards Capsule Hotels in General

Attributes	Average Index (AI)
Overall Experience	3.39
Comfort Level	3.24
Facilities	3.32
Service Quality	3.31
Price	3.34

From Table 2 that discusses customers' satisfaction towards capsule hotels in general, customers gave the highest rating to the overall experience of staying in a capsule hotel. This is probably due to the capsule hotel is still a new concept of a hotel that has just begin to bloom in Malaysia (Dinh, 2014), drawing people in with their unique concept. From this table, however, customers have reported being least pleased with the comfort level of the hotel. According to Forbes (2016), the room was compact-sized, and most of the facilities that are normally are provided in the room itself were discarded and made communal for the guests to share among others. This surely will make the guests a tad uncomfortable overall.

Customers' Satisfaction According to Capsule Hotel Facilities

Table 3. Customers' Satisfaction According to Capsule Hotel Facilities

Facilities	Average Index (AI)
Hotel Facilities	3.58
Sleeping Pod	3.30
Safety	3.55
Inclusivity	3.48

Referring to Table 3 on customers' satisfaction towards capsule hotels according to the attributes, customers look forward the most to stay in a hotel with good hotel criteria, From all the hotel criteria that were listed in the questionnaire, the customers seek hotels with good locations the most with decent accessibility. The least AI score for this table is the sleeping pod itself. The size of a single pod is relatively small, generally 2 meters long and 1.2 meters wide and 1 meter high which only can fit single-sized mattresses, making them not preferable for people who are claustrophobic. Spaciousness is also one of the most considered attributes when selecting a hotel room (Tsai, Yeung, & Yim, 2011; Amornpornwiwat and Kapasuwan, 2018). Hence, these are the reasons why customers rated the sleeping pod section the least among others.

Customers' Recommendation to Improve Capsule Hotel Facilities

Table 4. Customers' Recommendation to Improve Capsule Hotel Facilities

Recommendations	Average Index (AI)
Comprehensive Facilities	3.80
Lower Price	3.71
Bigger Pod	3.80
Improve Ambience	3.82
Improve Safety	3.93
Improve Inclusivity	3.89

Table 4 illustrates customers' recommendations to improve capsule hotel facilities. In this table, most customers agreed that in order to further improve the facilities of capsule hotels to accommodate the customers better, the safety of the guests and their belongings should be improved. It is understandable if the guests feel paranoid about their safety as they are staying with a bunch of strangers in one room. To lessen their worries, capsule hotels do provide access cards for room and individual pod entry and also locker access (Space Hotel, 2017). This way, other guests will not be able to access other guests' pods and lockers. The least recommended attribute is the price reduction of capsule hotels. Although it received the least vote, this attribute still falls on the 'Agree' classification. The price range of capsule hotels varies depending on the hotels' criteria (Chung, 2020). Capsule hotels are relatively cheap but it has limited facilities compared to other types of hotels (Morrison, 2016). The price range of capsule hotel in Malaysia is ranging from RM50 to RM 80 per night.

CONCLUSION

From the findings, it can be concluded that the factors that facilities, comfort level, service quality and price have an influence on customers' level of satisfaction. The customers also were most satisfied with hotels that have attractive criteria the most, such as good location and accessibility, decent price and offers adequate facilities for the customers. Aside from that, although the customers were mostly satisfied with the facilities of a capsule hotel in general, there is still room for improvement to make the experience of staying in a capsule hotel even better. Generally, the customers were most concerned about the safety of themselves and their belongings. The customers also suggested that capsule hotels should provide prayer rooms for Muslim guests.

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MYFASAD: AN EVALUATION TOOL FOR ARCHITECTURAL STYLES OF HERITAGE SHOPHOUSE FAÇADE

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Abstract

The development growth in Ipoh in the 1880s until the 1970s witnessed dwelling called shophouse built along the streets in the urban area. It has embarked on the revolution of the architectural movement, which creates a variety styles of heritage shophouse façade that need to be preserved regarding its original design. However, the originality of some materials and design elements of the façade has changed due to several factors. Thus few of them are not easily recognised in terms of its styles. Until now, there is still no standard method for classifying and grading the integrity of the heritage shophouse façade. Therefore, MyFasad is proposed as a tool to identify the features that characterised the architectural styles of heritage shophouse façade focusing in Ipoh, Malaysia. Through literature search and field survey, the list of the features is prepared based on the local government reports, books, articles, and research undertaken by nine scholars in architecture and building conservation areas of knowledge. A survey has then conducted within the heritage areas of Ipoh, involving 36 units of sampling. There are dozens of characters that portray the identity of the architectural styles that are classified according to its elements in the typology matrix. The typology matrix is a template to classify the characters of various styles of façade that can be applied in the documentation or inventories process by the local authorities.

Keywords: *Typology, architectural styles, heritage shophouse, façade.*

INTRODUCTION

The conservation of heritage buildings demands desire and dedication to ensure that the cultural heritage which has historical and architectural significance is preserved. It involves minimal intervention approaches (Tan et al., 2016) for providing maintenance, preservation or protection to prevent deterioration and manage change dynamically. Conservation embracing all acts that extend the life and basic functions (Arazi et al., 2010; Fielden, 2003) from being destroyed or changed in an appropriate manner (A. Ghafar, 1997) and to retain its authentic character as evidence to a site's history. However, the development of contemporary shophouse within the heritage areas does not concern on preservation and cultural significance (Elnokaly & Wong, 2014) of the existing shophouse and cause its vestiges to disappear gradually (Ju & Saari, 2010) such as new buildings and façades sandwiched in between old buildings (Shahrul et al., 2013). Besides, the demolition of heritage building for urban renewal projects (Karam et al., 2017) and unequivocal process of gentrification and regeneration is rapidly happening (Lim et al., 2014). The surrounding development causes pressure to heritage shop owners to maintain aesthetical and economic balance (Zalina & Rodzyah, 2012). Some of them were left neglected, abandon, dilapidated (Tan et al., 2016), decay (Robiah & A. Ghafar, 2011), and most of these buildings were not well conserved (Noorzalifah & Kartina, 2016) due to poor maintenance management (Arazi et al., 2010).

There are a few reasons that cause improper change to happen on the façade. Previous research highlighted that, no proper guideline regarding the façade's design (Wan Hashimah & Shuhana, 2005) and lack of technical information (Tan et al., 2016). As a result, due to lack of knowledge in building conservation, it might cause the failure of following the correct rules during renovation (Omar & Muna Hanim, 2016; Karam et al., 2017; Toong & Utaberta, 2015). According to Wan Hashimah (2012), the heritage buildings will remain intact only with proper management. However, issues such as lack of legislation and control within the local governments (Wan Hashimah & Shuhana, 2005), lack of inventory (Omar & Muna Hanim, 2016), the recorded data not been understood and kept comprehensively (Tan & Fujita, 2014) are still exist. Consequently, failure of preserving these cultural heritages can be seen whereby there was an increasing number of interventions on the elements of façade (Toong & Utaberta, 2015) that ignore the architectural characteristic (Noorfadhilah & Shamzani, 2012; Tan et al., 2016; Nur Farhana et al., 2017). The phenomenon of inconsistency elements of building façade has caused visual problems and this gives a negative impact and conflict on the historical images and identity (Omar & Muna Hanim, 2016; Toong & Utaberta, 2015; Zalina & Rodzyah, 2012; Elnokaly & Wong, 2014).

To fill the gap of which improper guideline information of façade's design as stated by Wan Hashimah and Shuhana (2005), and also Tan et al. (2016), thus the objective of this research is; to develop an evaluation tool for classifying and grading the architectural styles of heritage shophouse facades for inventory, and documentation purposes. This research context is the heritage area of Ipoh which consists of Transitional, Eclectic, Neo-Classical, Art Deco, Early Modern, and Modern styles. The selection of Ipoh is because the problems aforesaid currently occur here. It is hoped that the typology matrix can give value added to the existing guideline and technical information required by the stakeholders. Besides, until now, there is no standard indicator for classifying and grading the heritage shophouse facade. The inventory is conducted conventionally, using form or checklist and the information is filled-in manually based on experience and knowledge of the evaluators. Therefore, MyFasad is seen as the appropriate tool in facilitating the task and documenting the façade's condition, either they are still preserved or not for future references towards recognition of Ipoh as a world heritage site.

LITERATURE REVIEW

Heritage Shophouse

Shophouse is an urban house that has characterised the historical architecture of most towns and cities in the South East Asia with a dwelling above and a ground floor shop facing the road. A shophouse's component is façade, commercial area, air well, dining, kitchen, and bedrooms. It is usually built in a row of building blocks, mostly two or more storeys high with their upper floor overhanging the first storey to form a pedestrian covered walkway (Fee, 1998), known as five-foot walkway or 'kaki lima'. The stylistic of early traditional shophouse has hybrid characteristics incorporating rich architectural vocabularies from the West, Chinese that mainly came from Southern China, Indian, and the Malay Archipelago. Later, mass-developed shophouses after the 1960s are perceived as non-cultural importance and categorised as contemporary shophouses with the advent of International Modernism. The design features were moved away from excessive ornamentation and were no longer embellished in revivalist styles (Elnokaly & Wong, 2014).

Facade

Façade means the front exterior elevation or face of a building (Tyler, 2000), especially the principal front (Curl, 2006), as seen from the street or other public places (Comerma, 2008). As shown in Figure 1, the elements of the façade are divided into groups relating to the wall surface, structure, fenestration, and ornamentation (Burden, 1996) and opening (Burden, 2003). It is the most important architectural element and capable of conveying a building's function and significance and defines an interior space that it shelters (Comerma, 2008). According to Fee (1998), four main influences have contributed to the building traditions of Malaysia. These are; Malay, Southern Chinese, Sino-European, and Anglo-Indian. However, after World War II, according to Nor Hayati (2017), the architectural diversity established during the colonial periods had to be ended to unite the people through architecture. Buildings were constructed to serve public needs, totally utilitarian, and express a national vision for the future. The mix of cultural influences can be seen at the heritage shophouse façade on the tangible elements that clearly can be referred to distinguish the architectural pattern. The series of evolution or transitional changes are part of the process in the adaptation of climates, local cultural, economic demands, fashion influence, and introduction of new technologies (Wooi, 2015).

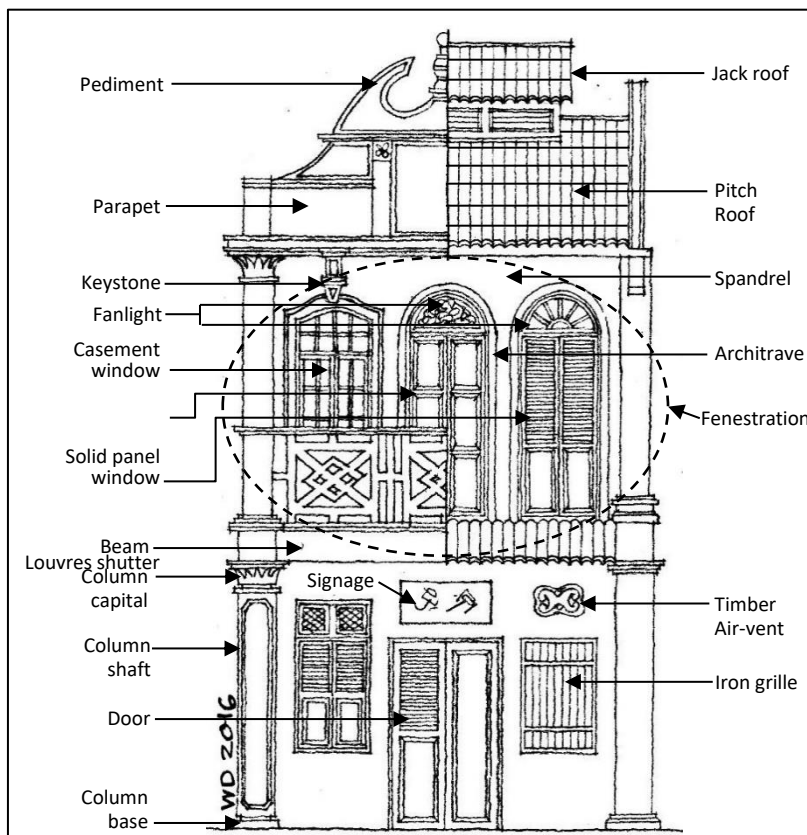


Figure 1. The terminology of typical heritage shophouse façade, Ipoh.
(Source: Wan Nordiana et al., 2016)

Heritage Building Inventory

According to the Ipoh City Council, the Special Area Plan of Ipoh City (2014) documentation was prepared to create an urban design that combines the urban development and conservation of heritage buildings. One of the important tasks that need to be made continuously in the process of preservation of the cultural heritage is to prepare an inventory of heritage buildings to be the primary reference in; i) Planning and building control, ii) Preserving significant heritage buildings, iii) Mapping the history of the building and the area, and iv) Preserving cultural heritage and urban activities.

METHODOLOGY

This research begins with collecting articles, relevant documents, reports, reference books, and others. The required data covers the conservation of heritage buildings, Malaysia's architectural history, and an in-depth description of heritage shophouses specifically on the architectural styles of the façade which involved nine sources (see Table 1). At this stage, the data of the elements that formed and diversified the architectural style are extracted, and the list of the key elements of the heritage shophouse façade was obtained by setting the theme codes, which are structural, building enclosure, opening, fenestration, and ornamentation. Three key elements are broken down into sub-elements, namely: structural - beam and column; building enclosure – roof and external wall; Opening - door, window, and air vents. By indicating these elements, then the attributes that are forming the heritage shophouse façade were obtained. A list was drafted, and general characteristics of the architectural styles were extracted from the literature study by using content analysis and are summarized to fill in Table 2. To finalize Table 2, a fieldwork at the Ipoh's heritage area has been carried out by observation and snap photos. 36 units of heritage shophouse facade in Ipoh were selected and reviewed through purposive sampling with each style of façade presenting six samples, which include; Transitional, Eclectic, Neo-Classical, Art Deco, Early Modern, and Modern. The selection criteria of the facade are; visually, it is still in good condition without major intervention or modification and displays its original characteristics of which are presented. All the data is gathered according to its category of styles. The similarities patterns and differences of the characters are recorded as primary data of the research. The analysis results are used to establish the final Typology Matrix in the form of MyFasad specifically for the heritage shophouse in Ipoh. Lastly, the report of the research is prepared.

FINDINGS

Architectural styles and period

From the analysis of previous research, nine researchers have been conducting research and published data concerning the architectural style of heritage shophouse facade in Malaysia. Their content of researchs are grouped according to the scope of the area that includes architectural styles that generally cover Malaysia, UNESCO World Heritage Site of Melaka and George Town, Heritage Area of Taiping and Kuala Lumpur. The architectural styles of heritage shophouse facade at the historic areas are different based on the historical background, the construction era and the town development. Table 1 lists the construction

period and the architectural styles of heritage shophouse facade according to historic areas in Malaysia.

Table 1. Comparison of selected texts by Malaysian authors on the architectural heritage shophouse facades.

Code	Authors. Title. Year	Scope	Outcome
A1	Chen Voon Fee. <i>Architecture. The Encyclopedia of Malaysia</i> , Vol 5. (1998).	Malaysia (i)	Transitional (c. 1890s), Neoclassical (c. 1920s), Dutch Patrician (c.1930s), Art Deco (1930s) and Modern (1990s)
A2	Amira Elnokaly and Jun Fui. <i>Demystifying Vernacular Shop Houses and Contemporary Shop Houses in Malaysia; A Green-Shop Framework.</i> (2014)	Malaysia (i)	Dutch (c. 1600s-1700s), Southern China (c. 1700-1800s), Early (c. 1800-1850s), Early Transitional (c. 1860s), Early Straits Eclectic (c. 1890s), Late Straits Eclectic (c. 1900s), Neo-Classical (c. 1920s), Dutch Patrician (c. 1930s), Art Deco (c. 1930s) and Modern (c. 1960s)
B1	Teuling, M. D. <i>Rebirth of the Malacca Shophouse, A Typological Research. Traditional Values in a Contemporary World.</i> (2009)	Melaka (ii)	Early Straits Eclectic (1890-1920), Late Straits Eclectic (1920-1940s), Neo-Classical (1900 – early 20 th century), Art Deco (1930-1950) and Early Modern (1950 – onwards)
B2	Noorfadhilah Mohd Baroldin et al. <i>Documentation and Conservation Guidelines of Melaka Heritage Shophouses.</i> (2012)	Melaka (ii)	Dutch (1600-1700), Southern China (1700-1800), Early (1800-1900), Early Transitional (1840-1900), Early Strait Eclectic (1890-1920), Late Straits Eclectic (1920-1940), Art Deco (1930-1950) and Early Modern (1950-1990)
C1	Rozliani Mansor et al. <i>Classification of Inheritance Shop Houses in George Town, Penang – UNESCO WHS.</i> (2012).	George Town (Pulau Pinang) (iii)	Early, Early Transitional, Early Straits Eclectic, Late Straits Eclectic, Neo-Classical (1800-1900s), Art Deco (1930-1950s) and Early Modern (1920-1930s)
C2	Tan Yeow Wooi. <i>Penang Shophouses; A Handbook of Features and Materials.</i> (2015).	George Town (Pulau Pinang)(iii)	Early Penang (1790-1850s), Southern Chinese Eclectic (1840-1900s), Early Straits Eclectic (1890-1910s), Late Straits Eclectic (1910-1940s), Art Deco (1930-1960s) and Early Modern (1950-1970s)
C3	Omar Adil Sabah & Muna Hanim Abdul Samad. <i>Penang / George Town's Shophouse Façade and Visual Problems, Analytic Study.</i> (2016).	George Town (Pulau Pinang) (iii)	Early Penang (1970s-1850s), Southern Chinese Eclectic (1840s-1900s), Early Straits Eclectic (1890s-1910s), Late Strait Eclectic (1910s-1930s), Art Deco (1930s-1960s) and Early Modern (1950s-1970s)
D	Penny Gurstein, <i>Malaysian Architectural Heritage Survey: A Handbook.</i> (1990).	Kuala Lumpur (iv)	Utilitarian (1880-1900s), Neo-Classical (1910-1930s), Art Deco (1930-1940s) and Modern (1950-1980s)
E	Nur Farhana Azmi, et al. <i>Character-Defining Elements of Shophouses Buildings in Taiping, Perak.</i> (2017).	Taiping (v)	Utilitarian (1880-1900s), Palladian (1890-1920s), Straits Eclectic (1901-1910s), Neo-Classical (1910-1930s), Art Deco (1930-1940s) and Modern (1980s)

Architectural Styles of Heritage Shophouse Façade at Ipoh

Heritage Area of Ipoh has been gazetted on 18th December 2014 due to the provision of the Town and Country Planning Act (Act 172), as stated in the Special Area Plan of Ipoh 2020 (Ipoh City Council, 2014). The report recorded 1,022 heritage shophouses with six major architectural styles that include Transitional, Eclectic, Neo-Classical, Art Deco, Early Modern and Modern. The architectural revolution from the 1880s until the 1970s. The architectural styles' typology is illustrated in Figure 2, and each style is coded P1 until P6 for analysis purposes.

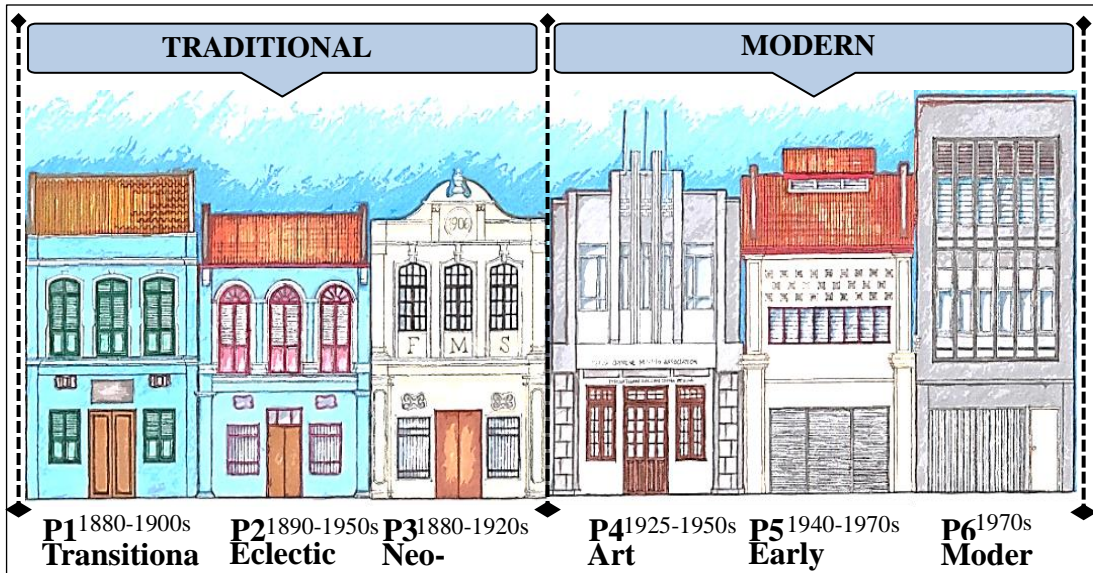


Figure 2. Typology of traditional and modern architectural styles from 1880s to 1970s for heritage shophouse facades at Ipoh.

(Source: Ipoh City Council, 2014; and Wan Nordiana et al., 2016)

Characters of Architectural Styles

There are 17 styles represent the shophouse facades as listed by the authors. An analysis of the construction era and similarity pattern of architectural characters shows varieties of them that were outlined in Table 2. Then, a fieldwork had been conducted to validate the content listed. New data collected were added in the table before a typology matrix of architectural styles is developed.

Table 2. Characters of architectural styles outlined by authors and site survey.

Tangible Elements		Characters	P1	P2	P3	P4	P5	P6
Structural	Beam	Timber beam	•	•	×			
		Reinforce concrete				•	•	•
	Column	Clay brick	×	×	×		×	×
		Reinforce concrete				×	×	×
		Free Standing column	•	•	•	×	•	
		Five-foot walkway without column					•	×
		Curvatures building corners without column					•	
Enclosure	Roof	Engage column at the upper level	×	×	×	×	×	
		Roman and Greek Orders	•		•			
		Pitch roof	•	×	•	×	•	×
		Flat roof					•	×
		Greek-style pediment			•			
		High pediment				•		
	Wall	Parapet wall			•	•	•	×
		Terracotta roof tiles	×	•	×	•	×	
		Paint in pastel or white colour	•	×	•	×	×	×
		Paint in vibrant colour		×				×
Opening	Door	Paint in shade colour				×	×	×
		Shanghai plaster				•		
		Wall tiles		×				×
		Timber door (solid panel or louvred)	•	×	×			
		Timber door frame with glass infilled				×		

Tangible Elements	Characters	P1	P2	P3	P4	P5	P6
	Removable or folding timber panelling	•	•	×	•		
	Removable or folding metal panelling				•	•	×
Window	Louvred / solid timber shutter	•	×	×			
	Casement window				•	•	×
	Glass louvres window					×	
	Flat arched transom	•	×	×	×	×	×
	Arched transom	•	•	×			
	Semi-circular transom	•	×	×			
Air-vent	Timber carved / ceramic slot at the ground floor	•	×	×	×		
	Squares, diamond or bat shape between windows at the upper floor		•				
	Concrete slot				×	•	
	Timber/metal lattice above door height at the ground floor	•	•	×	×	×	×
	Timber carved transom light	×	•	×			
	Timber carved fanlight	×	×	×			
	Radiating bars fanlight with glass infilled	•	•	×			
	Louvres above window	×	×	×		×	×
	Casement above window					×	×
Fenestration	2-3 bays full height traditional windows	•	•	×			
	2-3 bays or repetitive modern windows				•	•	
	Large size window bay						×
Ornamentation	Architrave surround window frame	•	•	•			
	Pilaster column in between the window		•				
	Keystone on top of the window frame	•		×			
	Natural or floral motifs plasterwork	•	•	×			
	Geometrical motifs				•	×	×
	Cornices or horizontal mouldings along the beam	•	•	×			
	Plain pilaster	•					
	Minimal decorations	•			•		
	Possess more decorations and ornamentation		•	•			
	Devoid any decoration or craftsmanship					•	•
	Flagpoles				•		
	Embedded building dates				•		
	Vertical or horizontal concrete shading fin around the window				•	•	•

Note: Symbol • for characters outlined by the authors. Symbol × for characters from site survey analysis.

Fifty-five characters of Transitional, Eclectic, Neo-Classical, Art Deco, Early Modern, and Modern architectural styles had been listed from the analysis and drafted in a checklist to develop a typology matrix. The matrix is a reference to formulate an inventory form to classify and grade the architectural styles of heritage shophouse facades.

MyFasad: Typology Matrix of Evaluation

MyFasad is an inventory form with a specific calculation method. It is purposely to classify and grading the architectural styles of the heritage shophouse façade based on the characters and physical condition seen on the façade. Figure 3 shows an example of the inventory form template with a list of characters whereby the observer will select the relevant characters of the façade for each tangible element. For each façade, the evaluator needs to select “1” in the box for relevant characters that portray the façade.


EVALUATION MATRIX FOR ARCHITECTURAL STYLES OF HERITAGE SHOPHOUSE FAÇADE															MyFasad	
Main Tangible Elements	Sub-elements	<div> <div>Select value 1 for relevant</div> <div>MATRIX FOR ARCHITECTURAL STYLES OF HERITAGE SHOPHOUSE FAÇADE</div> <div>If the answer is YES, please select '1'. If NO or NOT APPLICABLE, please leave blank.</div> <div>Significant characters of the architectural styles</div> </div>													 <div>Example</div>	
Structural	a) Beam															
	b) Column	<div>TC1</div> <div>Engaged column at the upper facade and free-standing column below.</div>	<div>1</div> <div>TC2</div> <div>Used of Greek and Roman order.</div>	<div>TC3</div> <div>Five-foot way sometimes without columns.</div>	<div>TC4</div> <div>Curvatures building corners without column.</div>	<div>TC5</div> <div>Others</div>										
Building Enclosure	a) Roof	<div>B1</div> <div>Pitch roof.</div>	<div>1</div> <div>B2</div> <div>Terracotta clay roof tiles.</div>	<div>B3</div> <div>Geek style pediment.</div>	<div>B4</div> <div>Parapet wall.</div>	<div>B5</div> <div>High pediment.</div>	<div>B6</div> <div>Others</div>									
	b) External wall	<div>D1</div> <div>Painted in pastel or white colour.</div>	<div>D2</div> <div>Painted in vibrant colour.</div>	<div>D3</div> <div>Painted in shade colour.</div>	<div>D4</div> <div>Granulated render known as Shanghai plaster.</div>	<div>D5</div> <div>Wall tiles finishing.</div>	<div>D6</div> <div>Others</div>									
Opening	a) Door	<div>P1</div> <div>Two solid timber shutters with louvres.</div>	<div>P2</div> <div>Two solid timber shutters.</div>	<div>P3</div> <div>Removable or folding vertical timber panelling.</div>	<div>P4</div> <div>Two casement shutters with louvres.</div>	<div>P5</div> <div>Metal folding panelling or roller shutter.</div>	<div>P6</div> <div>Others</div>									
	b) Window (Upper floor)	<div>T1</div> <div>Full height traditional window.</div>	<div>T2</div> <div>Traditional window above parapet wall.</div>	<div>T3</div> <div>Solid timber window shutters.</div>	<div>T4</div> <div>Solid timber window shutters with louvres.</div>	<div>T5</div> <div>Timber louvres shutters.</div>	<div>T6</div> <div>Full height or large size modern window.</div>	<div>T7</div> <div>Modern window above parapet wall.</div>	<div>T8</div> <div>Casement window.</div>	<div>T9</div> <div>Glass louvres window.</div>	<div>T10</div> <div>Concrete shading devices.</div>	<div>T11</div> <div>Others</div>				
	c) Air vent	<div>L1</div> <div>Carved timber or ceramic air vent on the ground floor facade.</div>	<div>L2</div> <div>Squares, diamond or bat shape between upper floor windows.</div>	<div>L3</div> <div>Timber lattice or metal grille above door height along the wall at the ground floor.</div>	<div>L4</div> <div>Anched transom light infilled with glass are often combined timber carved.</div>	<div>L5</div> <div>Flat arched transom infilled with glass are often combined timber carved.</div>	<div>L6</div> <div>Sem circular fanlight infilled with glass are often combined timber carved.</div>	<div>L7</div> <div>Timber louvres above window frame.</div>	<div>L8</div> <div>Porthole air vent or concrete air vent slots.</div>	<div>L9</div> <div>Transom light infilled with glass.</div>	<div>L10</div> <div>Glass or steel louvres above window frame.</div>	<div>L11</div> <div>Others</div>				
Fenestration		<div>F1</div> <div>2-3 bay of traditional windows.</div>	<div>F2</div> <div>4-6 bay of windows.</div>	<div>F3</div> <div>2-3 bay of repetitive modern windows.</div>	<div>F4</div> <div>Large size of windows and arranged in group.</div>	<div>F5</div> <div>Others</div>										
Ornamentation		<div>O1</div> <div>Classical style elements such as pilaster, pediment above the window frame, or dentil below the beam cornice.</div>	<div>O2</div> <div>Posses more decorative plasterworks of flora motifs with various ethnic tradition influence.</div>	<div>O3</div> <div>Minimal decorations.</div>	<div>O4</div> <div>Architrave framed the window openings.</div>	<div>O5</div> <div>Architrave framed the window openings with a keystone at the top.</div>	<div>O6</div> <div>Plasters and architrave framed the window openings.</div>	<div>O7</div> <div>Geometric design highlighting straight lines arranged either vertically or horizontally in conjunction with other forms.</div>	<div>O8</div> <div>Flagpoles and relief writing date of construction on the facade.</div>	<div>O9</div> <div>Devoted any decoration or craftsmanship.</div>	<div>O10</div> <div>Others</div>					

Figure 3. Example of the evaluation matrix for architectural styles of heritage shophouse façade.

The total score marks will appear at the score box (see Figure 4). The highest score marks is the recommended type of style that portrays the façade. However, if the score or result is contradict with the facade's physical appearance, there is a possibility that the façade's element had been replaced, redesigned or refurbished. The owner should restore and conserve the façade to improve the grade to upper level.

		Traditional			Modern			Others
		Transitional	Eclectic	Neo-Classical	Art Deco	Early Modern	Modern	
		1880-1900s	1890-1930s	1880-1920s	1925-1950s	1910-1970s	1970s	
TOTAL		9	7	8	8	7	5	0
STYLE(%)		64	47	53	50	50	42	0
Note:		1) Select an architectural style of facade based on the highest percentage value and fill in the score. 2) Others represents the architectural elements of the facade other than listed.						Fill in the value of the highest percentage score of the architectural style.
ARCHITECTURAL STYLE		Transitional					%	64
Score								
Architectural styles								
Grading scale								
<div>Note: Select the scoring grade according to the highest percentage value of the architectural style.</div>								
								<div>B</div> <div>Grade rating</div>

Figure 4. Example of the evaluation score and grading for heritage shophouse façade.

The physical and design condition of the heritage shophouse façade is graded according to its preservation level to measure its integrity in retaining the facade's architectural design. There are three grades; A, B and C. A - Very Good (Score 70-100); B - Good (Score 40-69); and C - Poor (Score 1-39).

CONCLUSION

MyFasad is registered with MyIPO with notification number CRLY00023980. This work also had joined an International Invention, Innovation and Design Competition (3IDC 2020) at Kedah, Malaysia and had been awarded a bronze medal. The matrix typology of architectural styles of heritage shophouse for Ipoh as the main content of MyFasad has added valuable information and knowledge that can be used in the inventory or re-inventory of heritage buildings, especially the shophouse for documentation purposes. Local authorities can apply MyFasad in other heritage areas in Malaysia by replicating the procedure and customizing the information of architectural styles at that particular heritage site. The inventory process will be much easier because the façade's evaluation is made online and paperless. The data can be stored and updated in the local authority's server system using various software that appropriate. Most importantly, this reference can be used as a guide and indicator by the stakeholders to retain the authenticity or preserve the integrity of the heritage shophouse façade. Furthermore, the grading recognition may encourage the shareholders to increase effort in conserving the heritage assets as the continuity of the legacy for future generations.

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SUSTAINABLE

INTRODUCING *XANTHOSTEMON* AND *METROSIDEROS* IN MOSQUES LANDSCAPE AND NATURAL CHEMICAL RESEARCH

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Abstract

An encounter with Pohutukawa or *Metrosideros excelsa* (*M. excelsa*) at Auckland Botanical Park, New Zealand, led to a literature search on a look-alike tree. The golden penda, or *Xanthostemon chrysanthus*, is examined after a local, flowering specimen was identified at Shah Alam, Selangor Darul Ehsan. Earlier, *Xanthostemon chrysanthus* was firstly described as *Metrosideros chrysantha*. It is also a member of the same plant (Myrtaceae), which receives similar attention as the decorative and ornamental plant. For that reason, it is getting popular in the scenery architecture field, including at mosques, varsity campuses, public parks and residential areas. Both *Metrosideros* and *Xanthostemon* are endemic to north eastern Queensland, Australia. The objectives of this study would include the introduction to both plants and their biological functions. Their colourful pictorial views, which were digitally captured during the field trips, are displayed. Publications on the chemical investigations of these natural products are also analysed. In the methodology, the technical reports and articles on both *Metrosideros* and *Xanthostemon* species were reviewed. The search was performed electronically (via Science Finder, Medline, Scopus and Google Scholar). The English journals (till January 2020) were studied. As one of the conclusions, the research findings stated that the compound extracted from *Xanthostemon chrysanthus* showed moderate cytotoxic activity. On a side note, the migration of Pohutukawa, also known as the Christmas tree, to Peninsular Malaysia could be recommended, via research collaborations between Malaysian and New Zealand government agencies involving international relations, agriculture, and tourism. Potted seedlings of the golden penda and Pohutukawa could possess the market potential. As a summary, it is anticipated that more explorations could be conducted on the scientific aspects of these crown, woody trees and their contribution to landscape design.

Keywords: architecture, chemistry, *Metrosideros*, *Xanthostemon*

INTRODUCTION

This presentation focuses on Pohutukawa, which is originated from New Zealand and Australia (Tarran *et al.* 2016). It is scientifically named as *Metrosideros excels* (*M. excels*). This plant species is very unique, due to its red flowering clusters that could withheld. The encounter with a similar local plant like pohutukawa, led to the identification of the golden penda, or *Xanthostemon chrysanthus* (*X. chrysanthus*). Nevertheless, it displays bright yellow masses of flowers. Data on the golden penda is available, owing to the research publications from national scientists (Francis, 2010; Ahmad Nazarudin *et al.* 2013) and their recommendations of this natural resource as a candidate for ornamental plant and landscape at government institutions, varsity campuses and public spots such as mosques and shopping complexes. The articles in international journals regarding this plant, have emphasized on the results and observations on the growth pattern, flowering, fruiting and seed dispersals. Similarly, high percentage of germination of fertile Pohutukawa seeds was recorded (Schmidt-Adam *et al.* 1999, 2000, 2002) and this plant is regarded as a coastal tree that could provide biological protection (De Costa *et al.* 2018).

METHODOLOGY

A review was conducted on *Xanthostemon* and *Metrosideros* species. The aim is to present a brief information on both plants, and their potentials in agricultural and chemistry research. The literature search was performed electronically (via Science Finder, Medline, Scopus and Google Scholar). The articles (till early 2021) were collected and studied.

RESULT AND DISCUSSION

Pohutukawa can be seen as a *Syzygium* species. It is grown in pots, nearby the fish market at Auckland, New Zealand. It gives a beautiful scenery, attributed by the red flowering of the stamens. Another specimen could be found at the Blue Spring, Waikato, New Zealand. Auckland Botanical Garden is also decorated by the blooming Pohutukawa (Figure 1). A Pohutukawa is planted outside the park and labeled as *Metrosideros excelsa*, a species from the Myrtaceae family. The floral source for manuka honey of New Zealand, could be assigned to the Pohutukawa (Schmidt *et al.* 2021).

In a field trip, a plant sample was discovered at Section 23, Shah Alam. It resembles a flowering Pohutukawa. In contrast, it displayed bright yellow flowers (Figure 2). Following a comparative analysis, this species could be recognized as the golden penda (Othman *et al.* 2016). This result is obtained, after the anatomical investigations were performed. These include the structural and botanical characteristics, in addition to the flowering color. The cultivated plant could reach a height of more than eight meters. This species could be identified as *Xanthostemon chrysanthus*, which is also categorized as a member of Myrtaceae. It is endemic at Queensland, Australia, specifically in the subtropical area. It can also be assumed as a type of Pohutukawa, *Metrosideros chrysantha*. Another *Xanthostemon* species, called *X. verdugonianus*, would also provide red flowering bunches (Chen *et al.* 2015).

Samples of the golden penda *Xanthostemon chrysanthus*, could also be witnessed at a number of locations, including the campus of International Islamic University of Malaysia (IIUM) (Othman *et al.* 2016). The same view can be observed at Universiti Teknologi MARA Selangor branch, particularly at Puncak Alam. Selangor city councils utilized this plant to decorate residential areas, such as Setia Alam, Bukit Bandaraya, Shah Alam and Aman Perdana, Klang. Other sites include the roadsides (Hasan *et al.* 2018) nearby the fire station at Sungai Pinang, Kapar, Klang, and alongside the road in front of Central Park Bandar Utama, Petaling Jaya, Selangor. Birds feeding on golden penda flower nectar could be observed (Lim, 2014; Bird Ecology Study Group, 2020). According to Ahmad Nazarudin *et al.* (2018), the flowering could last for about 40 days, which end at the drying stage of the stamens.

It is anticipated that more efforts on the writings and publications for both Pohutukawa and golden penda could be made by the local researchers (Ahmad Nazarudin *et al.* 2012; 2014), and foreign botanical experts, including the international scientists (Liu *et al.* 2018). The reviews could cover the methodology of the plant identification, in addition to the chemistry and analysis of the natural constituents and pharmacologically active biomolecules in these extracts. The separated compound (Figure 3) from golden penda showed moderate cytotoxic activity. In fact, the golden penda received the recognition to grace the front cover of *Chemistry & Biodiversity* (John Wiley & Sons, 2020). The isolation of natural products from air-dried leaves samples were provided in details (Liu *et al.* 2020). The major outcome of the golden penda and Pohutukawa studies could support large scale of their cultivation and

their contribution as a woody, crown trees for landscape (Ibrahim *et al.* 2012). This research could contribute to the urban and architectural studies, enhancing the aesthetical values, plus the plant biodiversity in modern cities (Ahmad Nazarudin *et al.* 2016). Furthermore, Pohutukawa trees would function as an alternative for playground equipment, in a green infrastructure study, concerning the pandemic urbanism (Herman *et al.* 2021).

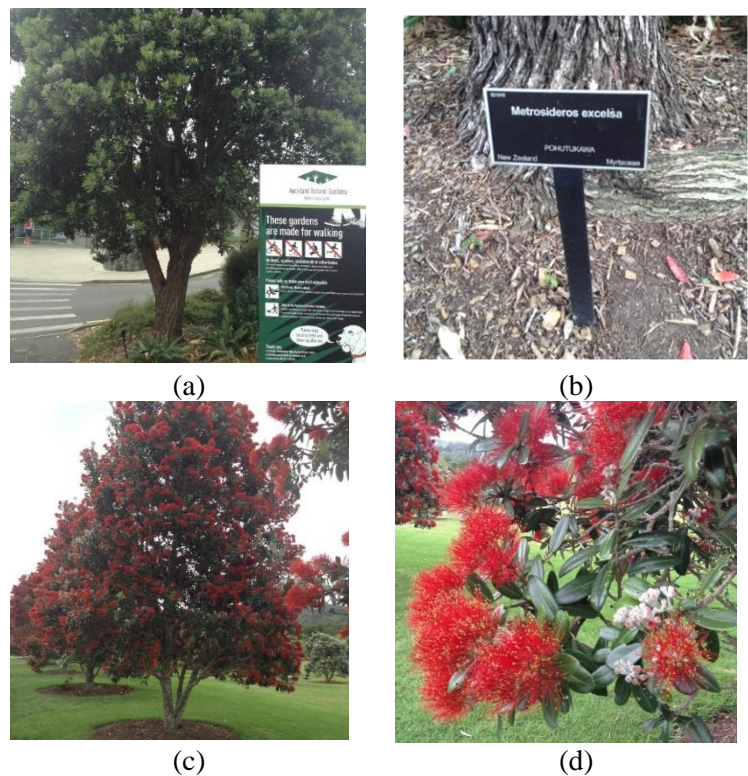


Figure 1. (a) Auckland Botanical Park welcomes the visitors with Pohutukawa, (b) a plant nearby the park entrance, is clearly written as *Metrosideros excelsa*, (c) Inside the park, the guests is greeted with flowering views of red Pohutukawa and (d) pohutukawa flowers that were photographed on the 3rd of November 2016.



Figure 2. The golden penda could be seen at Section 23, Shah Alam, Selangor which displays the (a) fruit capsule and (b) clusters of yellow, fluffy and feathery stamens.

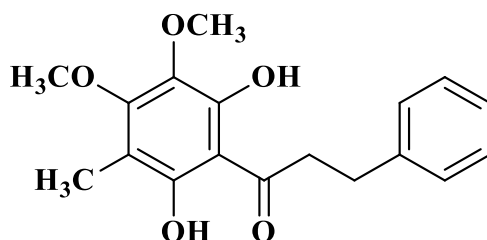


Figure 3. Xanchryone C, a natural chemical extracted from *X. chrysanthus*, showed a moderate cytotoxic activity (Liu *et al.* 2018).

CONCLUSION

The interest on these plants is increasing, and more studies could be conducted on these natural resources, focusing on the members of the Myrtaceae species. It is aimed that the public could be introduced to these plants and their biological function. Potted seedlings of the golden penda and Pohutukawa could possess the market potential. The migration of Pohutukawa to the Peninsular Malaysia could be recommended, via research collaborations between government agencies involving international relations, agriculture and tourism.

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A NOVEL PHARYNGEAL SAMPLING PLATFORM FOR COVID-19 TESTING DURING PANDEMIC IN MALAYSIA

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Abstract

The COVID-19 pandemic highlights a massive gap between the need to ramp up testing of potential positives and the capability of medical industries to quickly develop and deploy platforms that can meet that need. Using proper Innovation Value Chain (IVC) management methods highlighted in the OECD's Oslo Manual of 2018, the Coronavirus Mobile Test (COMBAT) unit was developed. This modified standard 20-feet ISO Cargo Container with positive and negative pressure rooms keeps patients and healthcare workers physically separated, thus reducing exposure to biological hazards and providing a comfortable environment. COMBAT is the only platform with integrated advanced technologies produced in this nation. This novel innovation reduces personal protection equipment (PPE) and manpower requirements whilst increasing testing capacity to meet mass screening needs.

Keywords : Covid-19, SARS-CoV-2, innovation value chain, personal protective equipment, pandemic

INTRODUCTION

The globe is battling a common enemy – the SARS-CoV-2 or better known as the COVID-19 virus. It was first detected in Wuhan, China in December 2019 and has now become a pandemic. Within a few months of its discovery, 2,719,897 infected cases and 187,705 deaths had been reported (WHO, 2020). As of 25th April 2020, Malaysia confirmed 5,742 cases and 98 deaths, yielding a mortality rate of 1.7% (Malaysia, 2020a). Every country is currently exercising as many strategies to stop the rapid spread of this contagious virus.

The human coronavirus, a zoonotic medium-sized RNA virus capable of inter-specie transmission, was first identified by Tyrrell and Bynoe in 1965 following cultivation from nasal washings (Tyrrell & Bynoe, 1966). In 2002-2003, severe acute respiratory syndrome or SARS, was first recognized in Guangdong Province, China where viral isolates were identified in live wild animals such as the Himalayan palm civet and raccoon dog; as well as in humans working in the live animal market (Guan et al., 2003). 10 years later in 2012, the Middle East Respiratory Syndrome coronavirus (MERS-CoV) emerged in Saudi Arabia (Zaki, van Boheemen, Bestebroer, Osterhaus, & Fouchier, 2012) where camels were found to be reservoirs and a source of non-human to human transmission (WHO, 2019). To date, no vaccine nor specific treatment is available in managing human coronavirus infections. Until herd immunity or definitive therapy is developed, the world could only battle reemerging outbreaks with well-preparedness and swift containment.

The COVID-19 RT-PCR test is a real-time reverse transcription polymerase chain reaction (RT-PCR) test used to qualitatively detect nucleic acids of the SARS-CoV-2. It best identifies the RNA of SARS-CoV-2 in respiratory specimens during the acute phase of

infection. The Malaysian Ministry of Health (MOH) recommends nasopharyngeal swabs in symptomatic and asymptomatic patients taken at times tailored to patient history, epidemiological information and clinical correlation. Collected samples are stored at 2-8°C and transported to a referral lab within 72 hours (Malaysia, 2020b). Due to the virus' contagious nature, personal protective equipment (PPE) consisting of nonsterile gloves, gown, N95 mask, head cover and face shield/goggles are essential when in contact with patients under investigation (PUI).

In Malaysia, PUIs are swabbed either at primary health clinics or dedicated areas in designated hospitals. Tents are set up to house testing booths, manned by medical personnel. The sampling process is tedious, requiring staff to don and doff PPE for every individual or group of patients. Discomfort, perspiration and suffocation from being in full PPE for long hours, with most performing samplings in the open space of Malaysia's tropical weather, are often a feat. The World Health Organization (WHO) recommends a combination of rapid diagnosis and immediate isolation of cases, rigorous tracking and precautionary self-isolation of close contacts. In South Korea, an efficient and well organized testing program has succeeded in flattening their epidemic curve (Cohen & Kupferschmidt, 2020). However, due to limited resources such as manpower, infrastructure and PPE, mass screening in Malaysia is a distant sight. Therefore, a walk-in mobile sampling unit for mass sampling of contagious diseases called COMBAT (Coronavirus Mobile Test Unit) was conjured to tackle these issues.

To the authors' knowledge, no innovation on walk-in screening booths for mass sampling has been reported. The main aim of this article is to present a single-centered experience in developing the COMBAT during the COVID-19 pandemic. The aim is to solve problems such as hazards toward healthcare workers, PPE shortage, long patient waiting time and laborious post-sampling disinfection processes. The secondary aim is to reduce workload and increase capacity for high quality work.

MATERIALS AND METHODS

Model description

COMBAT is a 20-feet container turned into a self-contained facility with five negative-pressure booths. Each booth is equipped with one set of intercom and integrated gloves to minimize contact with PUI. The positive-pressure medical personnel entrance area is placed in the middle, equipped with air conditioners to ensure comfort and a conducive working environment. The negative-pressure test booths complied with the ventilation requirements highlighted by the Malaysian Ministry of Health's guidelines on isolation rooms (Health, 2017).

Parameters specification

The container measures 2,370mm (height) x 6,000mm (length) x 2,430mm (width) and overall weighs at 2.3 tonnes (Figure 1). In a COMBAT container, there are 5 cubicles of which 3 are for adults and 2 for children accompanied by parents, claustrophobic individuals or those on wheelchairs (Figure 2). Rooms for walk-in persons, wheelchair persons and health care workers measure 90 ft³, 132 ft³ and 490 ft³ respectively. The 5 electromechanically-controlled booth swing-doors are controlled by the healthcare worker. The external structure is made of steel and the interior is coated with Polyurethane Panel Fire Retardant Grade "O" with a

thickness of 50mm. The container is designed as such that it can be transported on a 10-tonne lorry with crane (Figure 3) or the Airbus A400M Atlas aircraft (Figure 4).

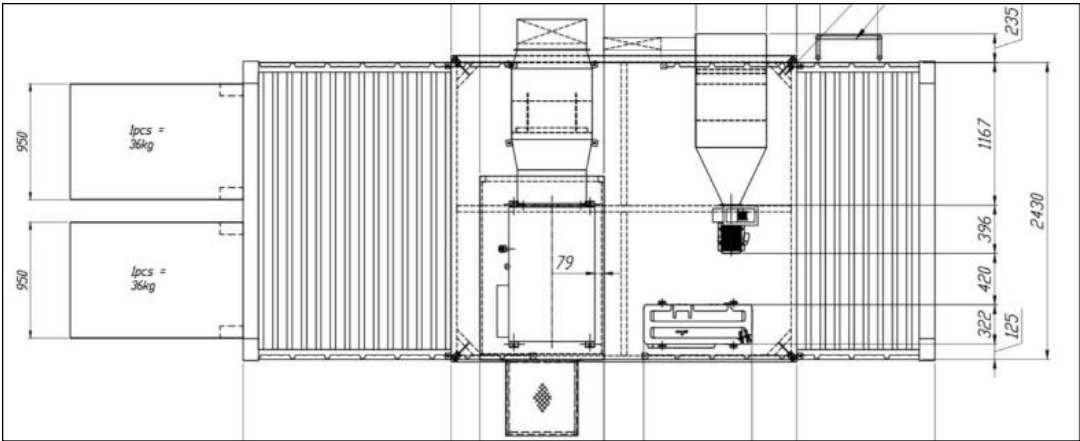


Figure 1. Diagrammatic top view of the COMBAT

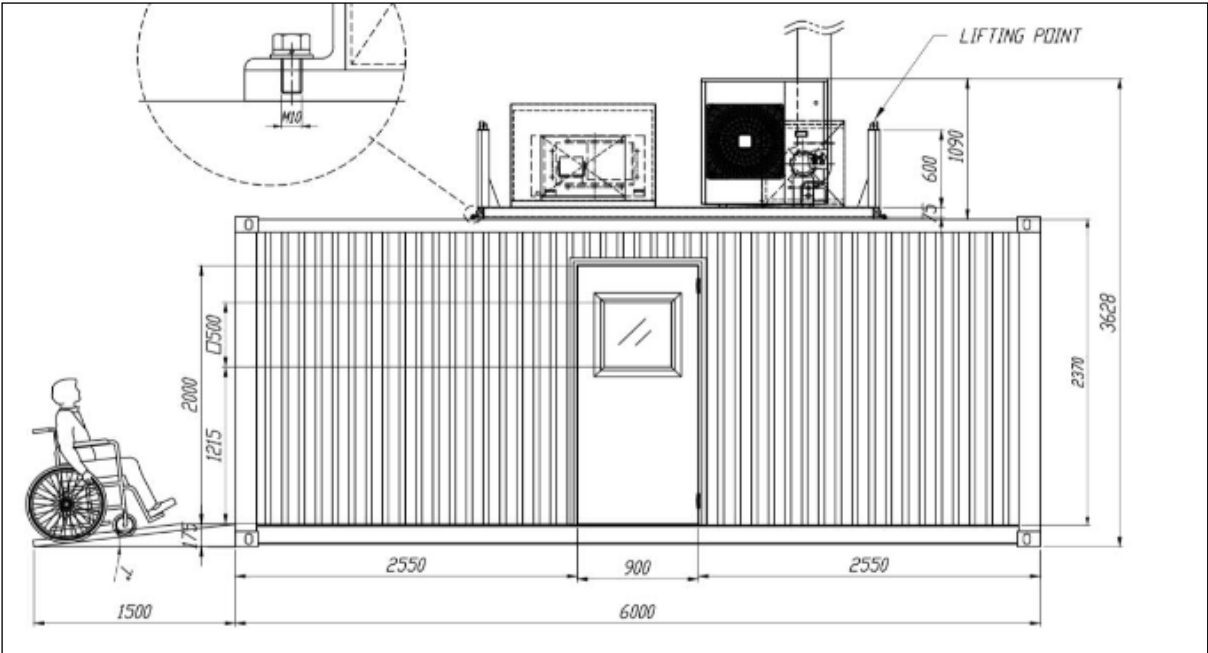


Figure 2. Diagrammatic side view of the COMBAT



Figure 3. 10 tonne lorry with crane for transport and repositioning

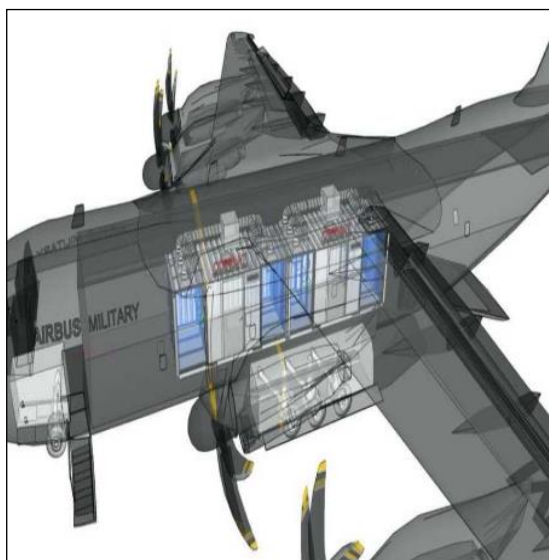


Figure 4. Designed to fit in an RMAF A400M military airlifter

Achieving isolation of infectious aerosol

For diseases that are spread by airborne or aerosol vectors, a certain level of airflow control has to be achieved to ensure total separation between the health care workers and test subjects. COMBAT adopts the concept of positive-negative pressure rooms as stated in the

Malaysian Ministry of Health's guidelines on designing isolation rooms. Such a design ensures that any infectious aerosol is pushed away from health care workers and sucked into a High-efficiency Particulate Air (HEPA) filtered channel.

In the COMBAT, this is achieved through the use of a HVAC system that provides the minimum-required .03" w.g. pressure difference between the negative pressure booths and the surrounding air. The airflow is 444 CFM @ S.P. 1.2" W.G and the cooling capacity is 47800 BTU/HR. COMBAT's electrical system requires a single phase 12kW, 240V AC and minimum 50 Amp supply. The central room where the healthcare workers are located is maintained at about 0.02" w.g. pressure above the surrounding.

Sampling step process

Every individual goes through an established workflow to ensure a systematic and effective way of sampling. The estimated time for a person to undergo a nasopharyngeal swab test is 6 minutes from the point that a patient enters a booth door. Once the swing-door is closed, negative pressure is held for 30 seconds before the health care worker validates the patient information in 1 minute. Subsequently, nasopharyngeal swabs are taken and placed in a transfer box within 2 minutes. Then, the door opens and patient exits the booth. Finally, the booth is disinfected with silver hydrogen peroxide 5% (1 litre diluted in 5 litre water) spray for about 1 minute.

RESULTS

The concept-to-prototype time was 21 days. Fresh air intake, chimney, air conditioner and HEPA filter systems are located on the roof of the unit (Figure 3). The entrance door to the healthcare worker cubicle is located in the front and centre of the container. On the right and left sides of the unit are entrance doors for test subjects, with ramps available for wheelchair users and lights to indicate room operation (Figures 5 & 7). Electrical connection and pump system for disinfection solution are located behind the unit (Figure 6).



Figure 5. Ramp for wheelchair users on the right of picture



Figure 6. View of the electrical connection for the mains (visible at the centre of the container) and the three booths designed for able-bodied test subjects



Figure 7. Another view of the COMBAT showing the access to the disabled-booths

Interiorly, each test booth is equipped with a negative pressure gauge, intercom, automatic door control and auto disinfection switch. The electrical control panel is back-to-back to the electrical supply. At the upper-left corner is the negative pressure system gauge and beside it is the pressure release damper (Figure 8). This positive-negative pressure room coupling makes the COMBAT far safer than other testing systems currently available.

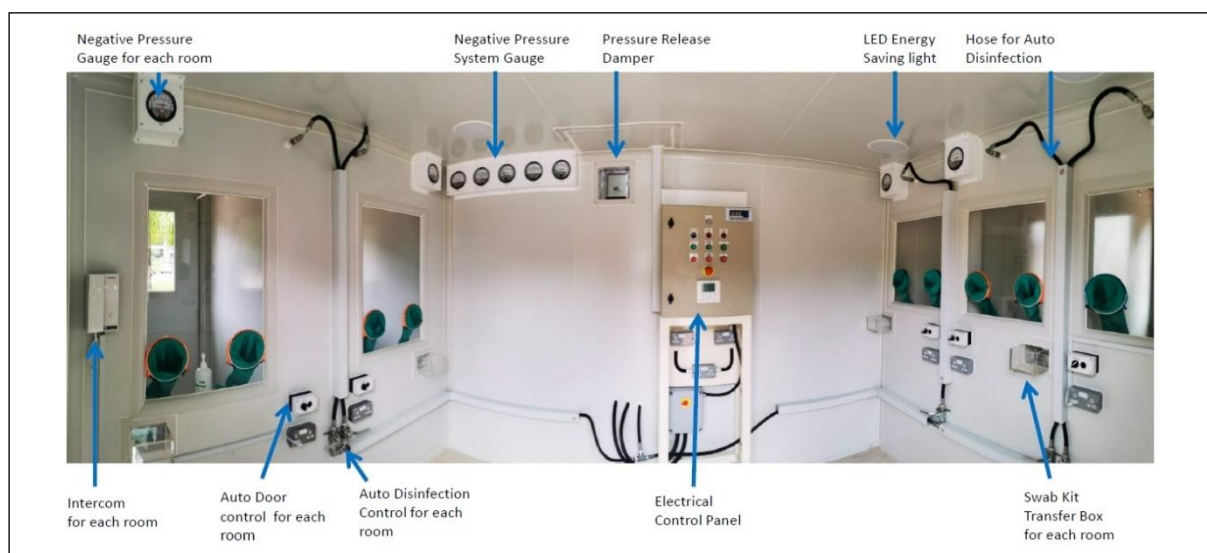


Figure 8. Interior view of the COMBAT's central working section housing the healthcare workers

For the past 10 months, more than 5,000 samplings for COVID-19 testing have been performed utilising the COMBAT. As donning and doffing of full PPE is not required, best sampling time has been shortened from 20 minutes to 6 minutes when performed in the COMBAT. Conventionally, an average of 10 HCWs are required to perform samplings in a day with an estimated cost of RM50.00 per set of full PPE. The COMBAT platform reduces the number of required manpower to 5 HCWs a day with an estimated cost of only RM1.00 per set of disposable gloves and hand sanitizer. This puts the minimum daily cost of PPE alone at RM5000.00/100 samples with conventional sampling method and RM100.00/100 samples with COMBAT (Table 1).

Table 1. Cost for PPE and manpower by conventional method compared to COMBAT

Method	Samples per day	Number of HCWs required per day	Cost for every 100 samples
Conventional sampling	300-400	10	RM 5000
COMBAT	500-600	5	RM 100

To illustrate the safety of COMBAT, no cases of COVID-19 transmission amongst HCWs stationed in COMBAT since its operation have been reported. With strict compliance to the standard operating procedure of the platform, no carry-over infections between successive patients have been identified.

DISCUSSION

The COMBAT is a novel platform to provide a safe, conducive and effective pharyngeal sampling during and after a pandemic. It is a result of doctors and engineers working together effortlessly in addressing the current COVID-19 situation. The exchanging of progressive ideas and managing any friction according to the innovation value chain methods (Eurostat, 2019) have produced innovations beneficial to mankind.

Malaysia is a tropical country where the weather is usually hot and humid especially in the major cities. The annual mean temperature is 26.4°C with an average daily maximum temperature of 34°C (Fadzil, 2011). Currently, subject sampling is performed in an open area under a tent with no ventilation. Being in full PPE throughout sampling for a usual work shift of 8 hours is uncomfortable and may interfere with the occupational duties of healthcare workers (Shenal, Radonovich, Cheng, Hodgson, & Bender, 2012). Apart from providing comfort, the COMBAT also saves time as the need for repeated donning and doffing of PPE is abolished. The conducive environment it provides to healthcare personnel and patients also translates into faster and higher number of sampling.

HCWs are at a higher risk of experiencing anxiety, depression, stress and post-traumatic stress disorder especially in facilities where stringent infection control measures are lacking (Tan et al., 2020). A safe working environment that limits exposure of HCWs to biological hazards are therefore imminent in providing assurance and reducing psychological stressors. Like COMBAT, SAFETY (Safe Assessment and Fast Evaluation Technical Booth of Yangji Hospital) in Seoul, South Korea has also demonstrated that sampling done in booths is safe for HCWs (Review, 2020).

Current practice sees gloves, aprons, masks, face shields and other PPEs being disposed after each activity to prevent cross-contamination of micro-organisms, causing a global shortage of PPEs. Having separate sampling rooms with the COMBAT reduces the need for PPE as no direct contact with PUIs is made. Reduced PPE demand consequently reduces manufacturing needs thus directly saving on resources and production costs. Carbon footprint as a result of PPE production and disposal is also reduced.

South Korea and Singapore have succeeded in containing disease spread by mass sampling (Davidson, 2020). This shows that detecting asymptomatic cases in a single group and in a confined geographical area help slow the rate of infection. COMBAT was designed to cater to mass screening especially in red zone areas identified by MOH. Its setup for mass screening only requires an open space for social distancing and a tent to serve as a waiting area. Estimated time for equipment setup is 1 hour. Swab results, when done using rapid kits, may be available within 30-60 minutes, giving a total on-site time of under 70 minutes per patient (Eeva Broberg, 2020).

The COVID-19 pandemic has taught Malaysians to be prepared for possible outbreaks at all times. A major part of that preparation is the Regeneration mindset. With sustainability in mind, the 20-feet COMBAT may continue to serve as a testing unit during outbreaks or modified into a mini-lab or isolation cubicle for contagious airborne diseases. The novelty of COVID-19 virus and ongoing inconclusive clinical research limit the use of evidence-based medicine in managing COVID-19. Due to limited resources during the movement control order (MCO), time taken to develop this platform from conceptualization to materialization took 3-4 weeks.

CONCLUSION

COMBAT potentiates effective sampling, reduces costs and saves time while ensuring safety to healthcare personnel and patients. Clinical and outcome studies utilizing COMBAT are recommended to prove its effectiveness in a practical setting.

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ASSESSING BUILDING CONDITION AND POTENTIAL FOR REFURBISHMENT; A CASE OF TADIKA DAN TAMAN ASUHAN KANAK-KANAK UiTM, SHAH ALAM

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Abstract

Tadika and Taman Asuhan Kanak-Kanak Universiti Teknologi MARA (TTAUiTM) is one of the essential facilities in UiTM. Constructed in 1995, the building design was inspired by a castle, with external cladding made by concrete in a concrete structure. Nevertheless, there are specific issues that arose after 25 years being built, such as issues on space, maintenance and facilities in the building. This study aims to carry out the site analysis, assess the building condition, and to update the measured drawing of TTAUiTM, Shah Alam. The collected data can be used for revealing the potential of the building for a design refurbishment project in order to enhance the aesthetic and significance value as a part of the essential buildings in UiTM. Building Condition Assessment (using BARIS), site investigation, interview, measuring work, literature review on related acts and guidelines, and design critique sessions are used from the site issues identification level until refurbishment proposal is carried out. The SWOT analysis showed the building strengths on its design, natural lighting and ventilation, and the spatial layout. However, its weaknesses identified are poor physical condition due to significant defects, abandoned playground, lack on drop off and pick up space, and lack of parking space. Nevertheless, this building also has potential to be upgraded by providing more efficient spatial usage, improving overall energy efficiency usage, applying environmental initiatives and sustainable design principle, and extending the life of the building by reducing defects.

Keywords: *Building Condition Analysis; Refurbishment; Kindergarten; Tadika dan Taman Asuhan Kanak-kanak UiTM*

INTRODUCTION

Malaysia has implemented its early childhood education system in developing its young generations for the future. The Department of Social Welfare has carried out an act called the Child Care Centre Act 1984 (Act 308), which is an act to provide for the registration, control and inspection of childcare centres and for purposes connected to ensure the well-being, safety and overall development of children is safeguarded (Official Portal of Department of Social Welfare, 2020). Since 1996, pre-school education was officially regarded as part of the national education system whereby consideration for this matter was made possible through the implementation of Act 550 in the National Education Act 1996 (Education Act 1996, 2006).

Most of the childcare centre in Malaysia serves both infant and toddlers, some even considered 'transit' children, primary school children that will stay in the centre between morning and evening sessions in their school (Azhari et al., 2014). Therefore, the condition of the childcare centre should be deliberated seriously to ensure that each group of children has its own separated space for their activities. Proper planning is needed to avoid overcrowding centres, which may influence the quality of the physical environment. Weaknesses

in the building space, design, safety and security, physical features, technology devices, and accessibility are among the crucial issues at childcare centres in Malaysia.

Previous research also shows that existing guidelines do not provide adequate strategies for developing physical environment reflective of child-centred pedagogy advocated in the National Preschool Curriculum Standard (NPCS) (Li & Bahauddin, 2019). Instead, the overall physical environment of pre-schools is reflective of the learning culture of pre-schools and vastly differs from one another. Li & Bahauddin (2019) suggests that physical environment of pre-schools need more attention, and enhancement will not only involve 'cosmetic' changes through painting on the walls with colourful characters but rather the transformation of the physical environment as a whole into inspiring places where young children are spirited to learn and explore.

Malaysia's strategy to improve the quality of childcare centre is highlighted in a few regulated acts and development plans; however, most of them are focusing on social environments and minimal allocated on the physical environment (Shaari & Ahmad, 2018). Resources will be wasted to modify, maintain or reconstruct the childcare centres with an adequately designed physical environment to cater the children needs.

According to the Early Childhood Care and Education Policy Implementation Review (2007), there are some concerning physical problems among Malaysian childcare centre, namely space allocation for the kitchen, dining and storage areas, furniture or facility allocation including cupboards, shoe racks and electrical fittings, lighting, ventilation, and water quality. Despite this, it was reported that teachers in the childcare centre are satisfied with the provision in their classrooms, which shows a lack of awareness of the need for better physical design.

Tadika and Taman Asuhan Kanak-Kanak Universiti Teknologi MARA (TTAUiTM) has been established in 1978 and relocated to its current site in 1995, where the new building was constructed with a concept of castle design. Today, TTAUiTM is one of the essential facilities in UiTM where it provides a childcare centre for the whole academic and administration staffs of UiTM in Shah Alam, Selangor. This study aims to carry out the site analysis, to assess the building condition, and to update the measured drawing of TTAUiTM, Shah Alam. The collected data can be used for revealing the potential of the building for a design refurbishment project in order to enhance the aesthetic and significance value as a part of the essential buildings in UiTM.

LITERATURE REVIEW

TADIKA and TASKA

In safeguard the survival, protection, and development of children, the Malaysian government has taken the lead in planning the essential legislation such as the Child Protection Act, the Child Care Centre Act 1984 and the Education Act 1996 (Azhari et al., 2014). Parallel with the initiative by the government in the Ninth Malaysia Plan to encourage women to be in the labour force, demand for alternative care for young children has increased ever since (Pheng, 2007).

TADIKA is defined in the Education Act 1966 (Act 550) as 'any place where pre-school educations (4 to 6 years old) is available to 10 or more students'. Meanwhile, in the Child

Care Centre Act 1984 (Act 308), TASKA means any premises that accept four or more entries of children under four years old from more than one household to pay for.

Based on education Act 1966, no kindergarten shall be established, operated or managed unless it is registered under this Act. The Minister shall prescribe a curriculum, to be known as the National Pre-school Curriculum, that shall be used by all kindergartens in the National Education System. In term of facilities and services, the Minister may render assistance whether financial or otherwise in respect of pupils or any class of pupils in government-aided educational institutions and such assistance may include the granting of bursaries, scholarships, loans or such other assistance, and the provisions of accommodation, transport, books, and medical and dental services. The Registrar General shall, from time to time, inspect for the cause to be inspected an educational institution registered under this Act to ascertain that this Act and the regulations made under this Act have been and are being complied with.

According to the Child Care Centre Act 1984 (Act 308), the minimum requirements for establishing a TADIKA or TASKA are as follows:

- The caretaker is a Malaysian citizen and is 18 years or older
- Entrepreneurs and caretakers must attend and pass the Basic Childcare Course (KAAK)
- The ratio of children to floor space should be 2.5 metres per child (TASKA at Home)
- 3.5 metres per child (TASKA Institution, Community and at Work)
- Prepare a balanced food menu for children
- Schedule age-appropriate daily activities for children
- Use safe and kid-friendly equipment to meet the needs of children
- Prepare and maintain records of childcare centre.
- Maintain cleanliness and security of the premise

Moreover, each TADIKA or TASKA in Malaysia should be established under the terms of registration as follows:

- Registered with the Companies Commission of Malaysia (SSM) or the Register of Societies (ROS)
- Meet the minimum standards of the Department of Social Welfare
- TASKA meets the requirements set by the technical agencies as Local Authority, Fire and Rescue Department, Health Department, and Department of Land and Survey (Sarawak)

Building Design of TADIKA and TASKA

The objectives of a childcare centre are achievable when there is a successful interaction between social and physical environments (Abbas, Othman & Rahman, 2010). Teaching programs must be designed to work with the built infrastructure and vice-versa. Teaching and learning activities should not prevent access but utilize the designed facility. Well-designed pre-schools, equipped with good spatial and aesthetic qualities, useful safety features, and appropriate use of materials, finishes and furniture, contributes to conducive environments for teaching and learning. Emphasis on both aspects of the learning environment will, therefore, maximize a child's development and learning.

Design elements are typically overlooked in discussions regarding a childcare centre's physical learning environment (Joshi, 2008). Childcare centre's education should not only concentrate on lesson planning, but also on spatial arrangements, which is equally important

(Morrow, 2007). Children are significantly influenced by their physical as much as social settings (Maxwell & Chmielewski, 2008).

Pre-school children are rapidly developing physically, cognitively, socially, and emotionally; therefore, their experience with the physical environment can have long-lasting effects on their development (Martin, 2004). Inadequate facilities and spatial quality also affect teachers' motivation and indirectly affect children's education (Salleh, Kamaruzzaman & Mahyuddin, 2013). Teachers will feel valued and motivated when they have access to good infrastructure, significantly improving their operating performance (Uline & Moran 2008), directly affecting children academic outcome.

Design of a childcare centre can be linked with the children school readiness (Shaari & Ahmad, 2018). An adequately designed childcare centre will boost the development and education of children in Malaysia, contributing to improved school readiness among children and a better education system. Ensuring that pre-school children are more school-ready is critical when designing a childcare centre. Children must be developed to their fullest potential while in pre-school, and they must be school ready. The application of crucial design aspects should be tailored to support children's developmental needs.

Besides the space of a childcare centre, another feature in ensuring a better quality of the physical environment is the centre's building design (Azhari et al., 2015). Most critical is to upgrade the safety and security measure, as this seems to be lacking in most centres. Accessibility to the centre's compound and the building is fundamental to control in preventing intruders from entering. Besides the use of physical features and technology devices, accessibility could be controlled even from the planning stage. Allocating entrances within the view of the centre's office area may incur more safety and security to the centres. Circulation is also crucial, whereby determining circulation path within the centre could avoid interruption of children activities.

Meanwhile, Azmin & Mahmood (2014) have implemented an experiential approach towards kindergarten design scheme. The experiential design components include experimentation, exploration and exposition of different activity spaces within the compound of the freestanding kindergarten building complex. From this approach, Azmin & Mahmood have established seven aspects of design considerations for designing Education+Care Model: spatial, scale and proportion, lighting, noise, material, colour, and indoor and outdoor. This research provides some insights to pre-school and kindergarten design, creates awareness for the community on the possibilities of pre-school and kindergarten experiential architectural in developing the learning ability, and leads to the better quality of pre-school and kindergarten design for the future development.

Refurbishment of TADIKA and TASKA

The refurbishment of educational buildings usually involves a variety of measures aiming at reducing energy demands and improving building functionality to achieve higher living comfort (Suman et al., 2019). In Europe, the renovation of the existing educational buildings is one of the most current issues concerning public buildings. Educational buildings not only present an enormous potential for energy saving, but they also need modernization in terms of functionality, aesthetics and economic efficiency. Although the tools and methods

to evaluate those advantages are already well-known, the renovations are not dealt with systematically and separately according to individual measures.

Shahli and Akasah (2019) have compiled a few factors that should be considered in order to ensure children's comfort in a right designed childcare centre: air and thermal comfort, space comfort, lightweight comfort, visual and aesthetic comfort, and acoustic comfort. In the context of a school, the green application can involve in various aspects such as improvements is additional daylight, improved indoor air quality, enhanced classroom acoustics, and comfortable and consistent indoor temperatures (Gordon, 2010). Thus, the diverse solution through green design can change the formal physical kindergarten building in Malaysia toward more sustainable buildings in the future.

METHODOLOGY

Building Condition Assessment (BCA: using BARIS), site investigation, interview, measuring work, literature review on related acts and guidelines, and design critique sessions are used from the site issues identification level until refurbishment proposal is carried out. BCA is reliable to obtain the knowledge on the physical state of the building, which enables the owners to develop the appropriate strategies and action for maintenance, repair, primary replacement, refurbishment and investments (Dejaco, Re Cecconi, & Maltese, 2017). In overall, BCA evaluates the building asset to gain knowledge on the current state of the asset to identify the appropriate maintenance strategy. Proper tools were used in the inspection to attain accurate data for the findings in the condition survey. The tools used in the inspection are measuring tape (100 meters), camera, laser distance, and a moisture meter. The condition survey work consists of preliminary work, confirmation of building, external inspection, internal inspection, and on-site assessment (RISM, 2010).

There are some limitations during the condition survey due to permission, restricted area, for safety purpose and others. Based on the factor of limitation, a few areas to be listed that cannot be inspected, which there is no further inspection or any test conducted towards the area where the defects occurred. Limitations of inspection are sickbay, baby's room, and rooftop.

FINDINGS AND DISCUSSION

Management and Operation of TTAUiTM

TTAUiTM (also known as Tadika Mutiara Bistari and Taska Impian Cemerlang) was established in 1978, where the original building was located at Seksyen 2, Shah Alam, Selangor. It was then relocated in 1995 to the current building, which is located in the middle of UiTM Shah Alam, Selangor. The new building design was inspired by a castle, with external cladding made by concrete in a concrete structure (Figure 1).

Here, children aged two months to 12 years old are given a special place where they will be allowed to grow and bloom at their own space (TTAUiTM Official Portal, 2020). The school aims to provide the community with an environment that responds to the intellectual and physical needs of developing children, as well as their emotional and social needs. Today,

this school is populated by 221 children and 29 staff, where the children are separated into 13 classes: 1 baby class (2 to 11 months old); 11 kid classes (1 to 6 years old); and one transit class (7 to 12 years old).

Activities in the class schedule for each of this class are different and handled at separated rooms, except for dining and free activity, that are carried out in the dining hall and the opened lobby area accordingly. Table 1 shows an example of class activities provided for children aged four years old. The building consists of two stories, where all classrooms, dining hall and playing room are located on the ground floor, and administration office, meeting room and staff's room are located on the first floor (Figure 2).

TTAUiTM is also facilitated with a few spaces needed as a childcare centre such as parent's pick up and drop off point, two playgrounds, limited parking spaces for the staff, enter and exit signage, receipt box, and a swimming pool. However, one of the playgrounds and the swimming pool are abandoned due to maintenance issues. A few CCTV cameras are also provided for the children's safety and security.



Figure 1. External View of TTAUiTM
(Source: author, 2019)

Table 1. Class schedule for four years' old

Time	Activity
7.30 am	Writing class
8.15 am	Breakfast
9.00 am	Free games, storytelling, practical prayers
9.30 am	Reading
10.30 am	Malay / English / Mathematics / Islamic studies, external activity
11.00 am	Reflection
11.15 am	Lunch
12.00pm	Day nap
2.00pm	Shower and drink
3.00pm	Iqra class
3.30 pm	Tea break
4.00 pm	Free activity, revision
5.00pm	Waiting for parents' picking up

(Source: Buku Info TTAUiTM, 2018)

The ranged age of children in this school is from 2 months to 12 years old. The building provides plenty of rooms such as two nursery rooms, seven classrooms, two activity rooms,

three sleeping rooms, 11 shower rooms/toilets, one dining hall, four storage rooms, two kitchens, one guest room, one administration room and one meeting room. It provides a place to care for and educate the children of UiTM staff at a minimal cost. This building is being maintained by the Office of Facility Management, UiTM.

Measured Drawings of TTAUiTM

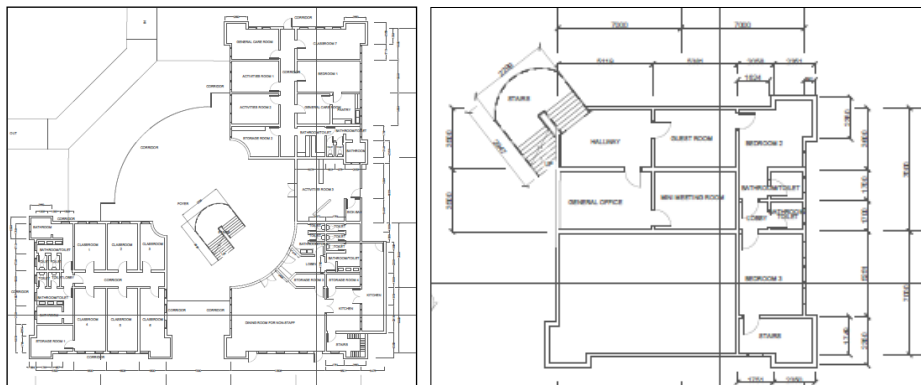


Figure 2. First-floor and second-floor plan of TTAUiTM

(Source: author, 2019)

SWOT Analysis of TTAUiTM

SWOT Analysis is a strategic planning framework used in the evaluation of an organization, plan, project or business activity (Gurel and Tat, 2017). It is a powerful tool for situation analysis that can help to identify organizational and environmental factors. It has two dimensions: Internal and External, where internal dimension includes organizational factors (strengths and weaknesses), and external dimension includes environmental factors (opportunities and threats).

The SWOT analysis showed that the building's strengths are on its design, natural lighting and ventilation, and the spatial layout (Figure 3). The architectural style of the building resembles a castle, which suits the theme of a childcare centre and attracts the children's interest as a theme park or a playground. Meanwhile, the opened lobby located in the middle of the building provides natural lighting and ventilation to the building, suits to its function as space where children assemble in the morning and play during their free activity session in the noon. The spatial layout of the building is also significant where it consists of partition walls that can help to create a variety of spaces and giving a sufficient number of functions to be used. Besides, TTAUiTM also practices good management and policies, which developed by the teachers to ensure the children is always in good condition.

However, some weaknesses are also identified, which are poor physical condition due to significant defects, abandoned facilities, insufficient space for traffic flow, and lack of parking space for visitors and staffs. According to the BCA, the analysis defect is 'dilapidated' which needs serious attention from the maintenance team. There are also some facilities abandoned

due to maintenance, safety and financial issues such as outdoor playground and swimming pool located at the back of the building. Meanwhile, traffic congestion is also occurred during drop off and pick-up time caused by inadequate flow of traffic and limited space provided in front of the building. Due to safety reason, each child is only to be picked up by parents and teachers in front of the waiting area located at the building's lobby. Parking space for staffs and visitors are also limited, causing illegal parking along the main road on the building's surrounding.

Nevertheless, this building has a lot of opportunities and potential to be refurbished in order to increase its significant value of one of the essential buildings in UiTM. Among the opportunity detected are location, surrounding facilities, the potential for a new landscape and potential for a sustainable design refurbishment. TTAUiTM is located in the middle of UiTM and can be easily accessed by all staffs. It is also surrounded by several facilities and amenities such as UiTM sports centre and swimming pool, which can also be used for children's activities, and the police headquarters that can ensure the children's safety. Moreover, there is also potential to create a new and better landscape in the territory since there is a large green area provided surrounding the building. This new landscape may also contribute to the new sustainable refurbishment concept to the building in addition to the existing natural ventilation and lighting system at the lobby area.

In addition to the weaknesses, threats to the building must also be considered. TTAUiTM is exposed to wild animals from bushes and trees at the back of the building site, which can harm the children during their activity spent at the external playground. Besides that, the steep road in front of the building's site and uncontrolled car speed on the road may also contribute to the building's threats.

STRENGTH	WEAKNESS	OPPORTUNITY	THREAT
<ul style="list-style-type: none"> •Attractive building design •Natural lighting and ventilation system •Spatial layout 	<ul style="list-style-type: none"> •Poor physical condition •Abandoned facilities •Insufficient space for traffic flow •Lack of parking space 	<ul style="list-style-type: none"> •Strategic location •Surrounding facilities •Potential for new landscape •Potential for sustainable refurbishment 	<ul style="list-style-type: none"> •Wild animals •Steep road and car speeding

Figure 3. SWOT Analysis of TTAUiTM
(Source: author, 2019)

Building Condition Assessment (BCA) of TTAUiTM

Overall building rating of the analysis defect is ‘dilapidated’ which needs serious attention from the maintenance team. The total mark for the matrix gained from the BCA is 803. By having 63 number of defects, the total score of the BCA is 12. BCA requires skill in identifying defect and familiarity with reporting procedures. It primarily involves on-site work and preparation of a report. Method statement for each defect is created and presented on schedule on building condition, defect analysis by types of defect, defect analysis by building elements, defect analysis by category of defects, and defect sheets (Figure 5 to Figure 8).

Based on Figure 5, it can be concluded that there are 13 types of defect found in the building, which are rusty, gap, crack, mould growth, damage, wear and tear, sedimentation, paint peeling off, uneven surface, stain mark, leaking and plaster has blown out. However, the major type of defect found in the stained mark, which consists of 21%. In the BCA, it can be analyzed that stain marks are caused by several possible causes which are leakage from roof, rain splashing and excessive moisture in the building. The defect may lead to a fatal effect on health in the future if it is not rectified immediately. This is due to the consideration of children as the primary occupants in the building.

As shown in Figure 6, wall and ceiling are the elements where most defects occurred, which are stain mark, crack, paint peeling off, damage, uneven surface and gap. For the element of doors, the primary defect sighted on it is damaged and rusty, which is due to the improper maintenance of the building, as for the element of the gate, fence, apron, perimeter drain, playground floor and equipment, roof, beam, staircase, window, shower, M&E fitting, plumbing trap, water closet and washbasin, only minor defects occurred. The focus on the rectification work needs to be done on the ceiling, wall and external wall. Another main concern is the condition of Playground 1 and Playground 2, which need serious attention to design and maintenance.

The category of fabric has the highest defect found, which are rusty, damage, stain mark, crack, paint peeling off and uneven surface (Figure 7). The category of external part is ranked second where the defects found are rusty, crack, mould growth, vegetation, damage, wear and tear, sedimentation, paint peeling off, plaster blown out and stain mark. The main concern on the external part of the building is the condition of the Playground 1 and Playground 2, which need serious attention to the design and maintenance. Meanwhile, the defect found on the services is minor, which are damaged, rusty, leaking and wear and tear. Overall, it can be concluded that the workmanship and maintenance work was lacking in the building based on the result recorded during the BCA.

From the overall inspection, it is recommended that the maintenance management for TTAUiTM to carry out the repairing works on the major defect which are rusty on the gate, mould growth on the fence, damage on perimeter drain, damage on playground floor, wear and tear on the playground, damage on playground equipment, wear and tear on playground equipment, sedimentation on playground floor, plaster blow out on the external wall, crack on the external wall, damage on door, rusty on the door, damage on the window, and crack on ceiling.

Other defects found are stain mark on ceiling, damage on the ceiling, crack on the wall, paint peeling off on ceiling, stain mark on the wall, paint peeling off on the wall, damage on the shower, rusty on M&E fitting, rusty on plumbing trap, wear and tear on M&E fitting, and leaking on the washbasin. As shown in the defect sheet, all of the defects need serious attention to the rectification work (Figure 8).

NO	ELEMENT	DEFECT	BARIS			CODDING INDICATION PLAN
			CONDITION	PRIORITY	MATRIX	
1	Gate	Rusty	5	3	15	E01
2	Gate	Crack	3	3	9	E02
3	Fence	Mould Growth	5	3	15	E03
4	Apron	Crack	3	3	9	E04
5	Apron	Vegetation	3	3	9	E05
6	Perimeter Drain	Damage	5	3	15	E06
7	Playground Floor	Damage	5	3	15	E07
8	Playground Floor	Wear and Tear	5	3	15	E08
9	Playground Equipment	Damage	5	4	20	E09
10	Playground Equipment	Wear and Tear	5	3	15	E10
11	Playground Floor	Sedimentation	5	4	20	E11
12	External Wall	Paint Peeling Off	3	3	9	E12
13	Roof	Rusty	3	3	9	E13
14	External Wall	Mould Growth	3	3	9	E14
15	External Wall	Plaster Blown Out	5	3	15	E15
16	External Wall	Plaster Blown Out	5	3	15	E16
17	Door	Crack	5	3	15	E17
18	External Wall	Damage	5	3	15	E18
19	External Wall	Stain Mark	3	2	6	E19
20	External Wall	Plaster Blown Out	5	3	15	E20
21	External Wall	Paint Peeling Off	3	3	9	E21
22	Beam	Stain Mark	3	3	9	E22
23	Staircase	Crack	3	3	9	E23
24	Door	Rusty	5	3	15	F01
25	Window	Damage	5	4	20	F02
26	Ceiling	Stain Mark	3	3	9	F03
27	Ceiling	Crack	5	3	15	F04
28	Wall	Paint Peeling Off	3	2	6	F05
29	Wall	Paint Peeling Off	3	3	9	F06
30	Ceiling	Crack	5	3	15	F07
31	Ceiling	Stain Mark	3	2	6	F08
32	Ceiling	Stain Mark	5	3	15	F09
33	Ceiling	Damage	5	3	15	F10
34	Ceiling	Stain Mark	3	2	6	F11
35	Wall	Crack	5	3	15	F12
36	Wall	Crack	5	3	15	F13
37	Ceiling	Paint Peeling Off	5	3	15	F14
38	Floor	Uneven Surface	3	3	9	F15
39	Door	Rusty	5	3	15	F16
40	Ceiling	Stain Mark	3	3	9	F17
41	Ceiling	Stain Mark	3	3	9	F18
42	Ceiling	Crack	5	3	15	F19
43	Ceiling	Stain Mark	3	3	9	F20
44	Ceiling	Gap	3	3	9	F21
45	Door	Damage	5	3	15	F22
46	Wall	Damage	3	2	6	F23
47	Ceiling	Stain Mark	3	3	9	F24
48	Ceiling	Stain Mark	5	3	15	F25
49	Wall	Stain Mark	5	3	15	F26
50	Wall	Stain Mark	5	4	20	F27
51	Wall	Uneven Surface	2	2	4	F28
52	Wall	Paint Peeling Off	5	3	15	F29
53	Wall	Paint Peeling Off	5	3	15	F30
54	Wall	Crack	3	3	9	F31
55	Shower	Damage	5	4	20	S01
56	M&E Fitting	Rusty	5	3	15	S02
57	Plumbing Trap	Rusty	5	4	20	S03
58	Shower	Damage	5	4	20	S04
59	M&E Fitting	Wear and Tear	5	4	20	S05
60	Water Closet	Leaking	3	3	9	S06
61	Wash Basin	Leaking	5	3	15	S07
62	Wash Basin	Leaking	3	3	9	S08
63	Water Closet	Leaking	3	3	9	S09
TOTAL MARKS			803			
NO. OF DEFECT SHEET			63			
TOTAL SCORE			13			
RATING OF OVERALL BUILDING			DILAPIDATED			
NO	BUILDING RATING		MATRIX			SCORE
1			PLAN MAINTENANCE			1 to 4
2			CONDITION MONITORING			5 to 12
3			SERIOUS ATTENTION			13 to 20

Figure 4. Schedule of Building Condition at TTAUiTM

(Source: author, 2019)

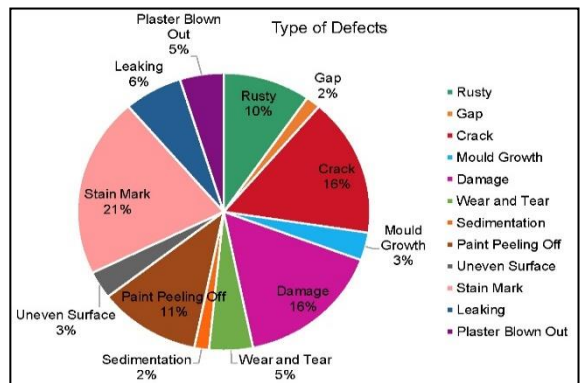


Figure 5. Defect Analysis by Types of Defect at TTAUiTM
(Source: author, 2019)

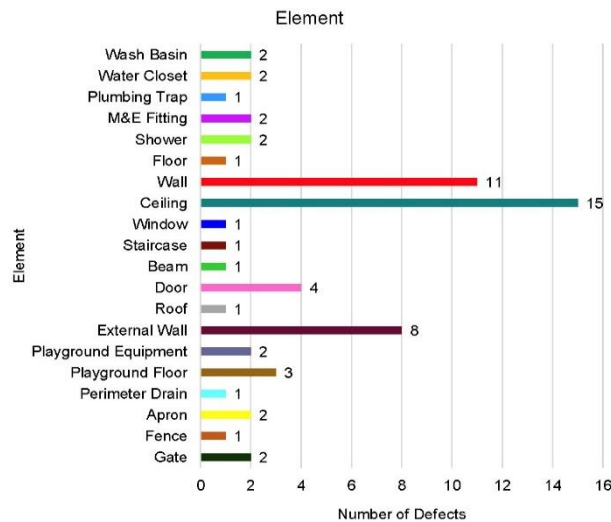


Figure 6. Defect Analysis by Building Elements at TTAUiTM
(Source: author, 2019)

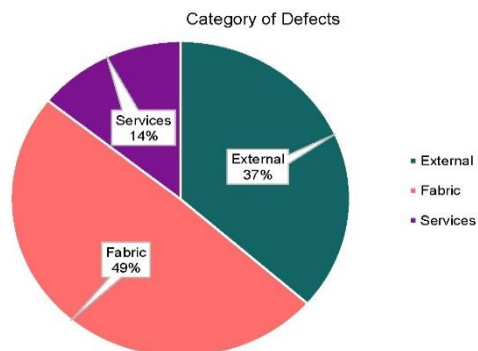


Figure 7. Defect Analysis by Category of Defects at TTAUiTM
(Source: author, 2019)



Defect Sheet No.	E15	Location	Rear Elevation	
Photo/Sketches:  Foresight View  Close View	Element	External wall		
	Component	Wall Finishes		
	Finding			
	Condition	Priority	Matrix	Colour
	5	3	15	
	Diagnosis:			
	<ul style="list-style-type: none"> Plaster on external wall found to blown out 			
	Prognosis:			
	<ul style="list-style-type: none"> Spalling of concrete on external wall 			
	Possible Causes:			
<ul style="list-style-type: none"> Improper installation of air-conditioning pipe Exposure to water and weather 				
Category	/	Remedies: 1. Remove the any materials from the external wall. 2. Mix the concrete patching compound. 3. Trowel the compound into the crack. Stab the trowel into the compound to remove air pockets and help work the patching material deep into the crack. Fill the crack up to the surrounding concrete surface. 4. Paint or seal the surface of the patch and surrounding area.		
Design				
Maintenance				
Construction material				
Workmanship	/			
Environment				
Human-usage				
Insect				
Disaster				

Figure 8. An example of a defect sheet for Building Condition Assessment at TTAUiTM
(Source: author, 2019)

Potential for Refurbishment of TTAUiTM

Nevertheless, this building also has potential to be upgraded by providing more efficient spatial usage, improving overall energy efficiency usage, applying environmental initiatives and sustainable design principle, and extending the life of the building by reducing defects. A refurbishment on TTAUiTM may preserve the value and make the best use of the building, address non-compliant code issues, making suitable accommodation for the building occupant especially children, provide more efficient use of space especially on the external playground area, increasing the revenue and return on investment on the asset, improve overall energy efficiency usage, through the various environmental initiatives and sustainable design principles, provide a building that meets its functional requirements more efficiently by improving fire safety non-compliance issues that can only be rectified by major refurbishment; and extend the life of the building by at least reducing the defects on the building.

The proposed refurbishment that can be considered of the building includes the scope of works as follows:

- new public and staff parking arrangement
- new building entry to the proposed parking area
- refurbishment of the external playground area
- a new canopy and rubber floor coverings for the external playground area
- new pond with a covered walkway
- external façade painting and murals decoration
- refurbishment of existing perimeter fencing
- upgrade on the fire safety system on the building
- refurbishment on the light fittings to improve energy efficiency usage
- refurbishment on ceiling finishes on the entire internal areas of the building
- new radiant air cooling to be installed chased in ceiling
- refurbishment on male and female toilets
- refurbishment of existing floor tiles at sickbay, mini-meeting room, baby's room and classroom areas
- new quality rubber flooring at baby's room and classroom areas
- new quality carpet at the office and mini-meeting
- new quality floor tiles at sickbay room

This study also suggests a sustainable refurbishment for TTAUiTM, which consists of green and nature (a new addition of nature-based corner, safe corner and happiness corner), and energy efficiency (installation of radiant air-cooling system, replacement of lighting fixtures to LED ceiling panel, and addition of air bricks on the wall).

CONCLUSION

In conclusion, TTAUiTM has met the minimum requirement by the regulations in terms of facilities provided in a childcare centre. Nevertheless, the overall building's rating of the analysis of defect is 'dilapidated', requiring serious attention. The total mark for the matrix gained from the BCA is 803. By having 63 number of defects, the total score of the BCA is 12. The SWOT analysis showed the building strengths on its design, natural lighting and ventilation, and the spatial layout. However, its weaknesses identified are poor physical condition due to major defects, abandoned playground, lack on drop off and pick up space, and lack of parking space.

Nevertheless, this building also can be upgraded by providing more efficient spatial usage, improving overall energy efficiency usage, applying environmental initiatives and sustainable design principles, and extending the life of the building by reducing defects. This research is expected to guide future refurbishment of TTAUiTM and another childcare centre in terms of the building condition, SWOT analysis and design, even though there are some limitations on the access of the space the baby's room, sickbay and rooftop. Future research on these limited spaces and another type of childcare centre is also recommended to complete this study and compare the findings.

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GREEN ROOFS AS ACCESSIBLE PUBLIC REALM IN MALAYSIAN CITIES

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Abstract

The green roof has gained a global reputation as a potent sustainable approach in green buildings, for its energy-efficient performance. However, in Malaysian cities, the green roofs are rarely made accessible for public use. Public accessibility is largely affected by the architecture of the building, the degree of safety and crime watch and vibrant activities that encourage public engagement indicated by crowd density. Very few articles have been published on accessibility of green roofs as public spaces, and the topic demands further investigation. Hence, this study aims to evaluate the best criteria for highly accessible public spaces to be adapted in green roof design guidelines, in response to the Malaysian urban context. It reviews current green roof issues which restrict public accessibility and compares the suitability of successful implementation in the public realm to suit green roof functionality. Building accessibility parameters that were studied include architecture, safety and surveillance, and various activities. The results indicate the positive contribution of these qualities on crowd engagement in the public realm. The study highlights the key elements which could be developed into future green roof design guidelines for high public accessibility.

Keywords: *green roof, architecture, accessibility, public realm*

INTRODUCTION

In current Malaysian urban setting, green roofs are treated as exclusive building features for green building strategies rather than being celebrated as part of a potential public realm. The public are not welcomed on to green roofs; the roofs are inaccessible, deserted and not fully utilised as public space. With growing health consciousness and young people's lifestyles, demand for recreational areas within the cityscape has increased significantly, with insufficient acreage to cope with the growing needs. Thus, this paper is motivated by concern for the availability of green roofs in urban areas, currently not fully appreciated as social spaces and with low public accessibility. This scenario demands a solution: what is the essence of a highly accessible public realm that can be injected into the design of green roofs? This research aims to identify the factors surrounding the issue of green roof disengagement with the public and how the strategies can be implemented in designing more accessible green roofs. Combining the need for urban green space with improving social connections through public green roofs could meet the demand for functioning green roofs as public spaces in urban areas.

Aim and Objectives

This research aims to provide a conceptual framework that incorporates the criteria of high levels of public accessibility to green roofs. It can be achieved by meeting the following objectives: identifying existing green roofs in Malaysia through identifying the issues that

hinder public accessibility; and evaluating the best criteria for making green roofs available as a public realm.

LITERATURE REVIEW

Issues of Green Roof Accessibility in Malaysia

Architecture

The tropical climate requires typical roofs in Malaysia to adhere to a specified degree of inclination in order to solve rainwater drainage issues (Asinas et al., 2019). However, a steep gradient affects public accessibility to green roofs, especially for the physically impaired, such as wheelchair-bound persons and senior citizen (Pouya, 2019). This barrier limits the green roof facilities to the physically fit, whereas buildings intended for public use should cater for most of the building's users, regardless of their ability. This problem is also prevalent among children, whose comparatively large heads give them a higher centre of gravity, making them prone to leaning forward while running, with greater risk of stumbling (Senda, 2015) on steep inclines. Furthermore, poorly designed means of entrance, such as doors, gates and elevators, limit the functionality if the width of the access route is insufficient for the volume of traffic or too narrow to negotiate, especially for wheelchair users (Das, 2020). Confusing signage may also hinder public access to the green roof, as terms such as sky lounge and podium roof do not represent the green roof identity. Poor signage design and placement also result in poor public navigation towards the green roof, thus fewer people are aware of the green roof facility.

Safety and Surveillance

People are less likely to visit public places which are deemed to be unsafe through the absence of active frontage (Jansson, 2019). Uncontrolled accessibility on to the green roof can also become a security issue, as the space could easily be misused by reckless users, leading to vandalism and threatening the safety of the building's occupants (Rahman et al., 2013). This results in never-ending needs for repair and maintenance, and eventually exposing the facilities to the risk of being abandoned when the public loses interest in an area with bad condition. In the case of the IbuPejabat PKNS green roof, deliberate surveillance is a protective measure against vandalism, but it limits public access by reducing numbers, instead of functioning as a potential public realm for everyone.

Function

Some green roofs stagnate, with no clear intended purpose and poor landscaping resulting in a boring environment (Nagase & Koyama, 2020), ignoring their function as potential public spaces. If energy efficiency is the only reason for a green roof, without considering better use of the space, the decision to have a green roof is not feasible for long-term return on the investment (Rahman et al., 2013). A healing garden for therapeutic purposes has found its niche in hospital design and has become an integral element in providing welcoming space among building blocks (Pouya, 2019). Despite its massive five acres of green roof covering the top of the building, Hospital Serdang in Seri Kembangan, Selangor, the hospital

management has limited its green roof potential and restricted public access, although carefully planned landscaping was incorporated in the building design.

Public Realm

Activities

The public realm comes to life with the injection of diverse activities and programmes, some introduced by local residents, evolving to become a tradition and identity of the place, and others planned beforehand or proposed by authorities to suit local demographic patterns. In the case of Jonker Street, Melaka, the local culture is most apparent at night, with night markets and stalls lining the streets. It attracts visitors with on-stage participation, such as live singing watched by both the local community and visitors, crowding this lively stretch of Jonker Street. This is an example of successful placemaking (Sanders, 2019), gaining reputation as a must-visit place in Melaka that promises a memorable experience among local and foreign tourists.

Surveillance

Places with a high level of pedestrian traffic give the perception of security (Nilsson, 2019), as help is all around whenever a crime takes place, as opposed to places less visited by the public where surveillance is needed. However, deliberate placement of security teams can give the public a perception of an unsafe environment, thus creating a sense of discomfort of being watched over. Such a move would not only deter criminals, but also suggest vulnerability and lack of privacy, thus discouraging public engagement. The alternative to deliberate surveillance is natural surveillance, such as streetlights, clear view and positioning of strategic entrance points, creating the perception of safe environment (Mohit and Elsayahli, 2017). For example, public presence within a residential area eliminates the need for security teams when the residents stand together as a strong community. Similarly, this is being translated well in Bulatan Aman Jaya, Ipoh, where the passing public are the “eyes”, without the need for police officers stationed within the public area. The location of a public space at the centre of a busy roundabout also creates an inward view where vibrant activities are staged at night, eliminating the typical perception of dangers lurking in the dark.

RESEARCH METHODOLOGY

The research approach is qualitative and data are collected through case studies of selected green roof buildings in Malaysia, with on-site observation which reflects the actual issues. The case studies include the elements discussed in the literature review as the basis of the appraisal of strategies to determine how successful these buildings have integrated green roofs and their use by the buildings' occupants and as public spaces. The selected case studies are: i) Ibu pejabat PKNS, Shah Alam; ii) Hospital Serdang, Seri Kembangan, Selangor; and iii) Heriot-Watt University, Putrajaya, chosen for their implementation of green roofs and to reflect the focus of the study, which is buildings located within urban settings. In addition, observation of selected local public realm was carried out: i) Jonker Street, Melaka; ii) KLCC Park, Kuala Lumpur, and iii) Bulatan Amanjaya, Ipoh; these areas were selected for their high

traffic engagement with distinctive strategies as reported in the literature review, and to provide an insight into successful public realm criteria.

FINDINGS AND DISCUSSION

Green Roofs as Public Realms

Architecture

In order to cater for a wide spectrum of the population, barrier-free design should be considered as it will accommodate not only the general public, but also disabled persons, the elderly and toddlers (Das, 2020). This includes smooth gradients on the green roof, with less risk of slipping or tripping. Wheelchair users would require less assistance to navigate to the top of the green roof if the slope is made disabled-friendly and designed according to barrier-free design guidelines (Yusoff et al., 2019). Effective wayfinding should go hand in hand with clear signage to direct the public to the location of the green roof. Strategic placement of clear signage should consider routes with high traffic, intersections and means of display. These strategic points are known as nodes, where the concentration of traffic is high and landmarks are usually located (Refaat, 2019). Wayfinding can be improved to guide visitors if one node is visible from the next at a walkable distance. The same strategy can be applied on the green roof, which can be glimpsed by the public at a walkable distance to attract curiosity, hence increasing public engagement with the green roof. According to studies of human behaviour and psychology, people are less likely to ascend to upper floors and less likely to travel further distance, thus reducing accessibility (Zhao, 2019). This could be a disadvantage for the use of green roofs, typically located many floors above ground level and with limited means of access far from the building's main entry points. However, this can be overcome by having green roofs located closer to pedestrian traffic, along with close proximity to main entry points and prime building space. This would enhance public connectivity with the green roof, encouraging public engagement and enlivening its functionality.

Safety and Surveillance

Public spaces that are perceived by people as safe are most likely to have more traffic and to be preferred by families with children, where safety is the main priority (Permanasari & Purisari, 2019). An accessible green roof means allowing large volumes of pedestrian traffic with adequate access and space for movement. This is where sufficient clearance of entrances is crucial; doors, gates and elevators must be able to handle public movement without crushing to accommodate the maximum number of people. Sliding doors offer a higher degree of safety than hinged doors, which have a greater chance of collision when opened expectedly (Senda, 2015). Another way to establish a safe environment is natural surveillance. In the context of green roofs, natural surveillance could take the form of having high traffic engagement in a clear environment visible to the surrounding public (Park and Garcia, 2019). Public visiting the green roof would feel more secure with a lower probability of crime when the area is visibly exposed; with lighting placed strategically, green roofs would also be safe functional recreation areas at night (Svechkina et al., 2020).

Active Functions

Having green roofs as public space means being able to host many types of public and community-based activities. By having vibrant activities, the green roof could develop its own sense of belonging and inclusiveness among the public, attracting active participation especially where the green roof is part of shared facilities such as in residential buildings. Green roofs could benefit from high public accessibility when visible to the public and connected to an active frontage directly with means of access such as ramps or lifts (Yusoff et al., 2019). Contrary to the current view having green roofs merely for therapeutic purpose, bringing public into natural setting with visual delight helps to improve their state of physical and mental health, besides improving the function of green roofs as public spaces. Table 1 summarises the relationship between green roof accessibility and green roofs as public realms with high public accessibility strategies.

Table 1. Summary of High Accessibility Strategy in Green Roofs as Public Realm

Public Realm	Green Roof Accessibility Aspect	Green Roof as Public Realm
Surveillance	Wayfinding	Effective Wayfinding
		Clear Signage
		Barrier-free pathway
		Alternative Escape Route
		Clear Demarcation of Steps
	Architecture	Near to Main Access
		Safety Barrier
		Smooth Gradient
		Natural Surveillance
		Sufficient Clearance Measurement of Entrance
Activities	Function	Sufficient Width for Traffic Volume
		Disabled-friendly doors
		Well-Constructed and Well-Maintained Steps
		Active Frontage
		Vibrant Activities
		Landmark
		Visual Delight

RECOMMENDATIONS

This study has established the close relationship between green roof and public realm with high levels of accessibility as the bridging catalyst. Figure 1 illustrates the framework of this study. Each aspect that contributes to high accessibility; namely architecture, safety and surveillance, function and activities, could be extended into more in-depth specific study. The culmination of these studies would become the foundation in developing highly accessible green roofs in the Malaysian urban context. Additional research could be carried out to investigate further the impact of high traffic density on green roof functions. Other than that, the study could be extended to the criteria for a safe green roof environment so that the public could be assured of the safety measures.

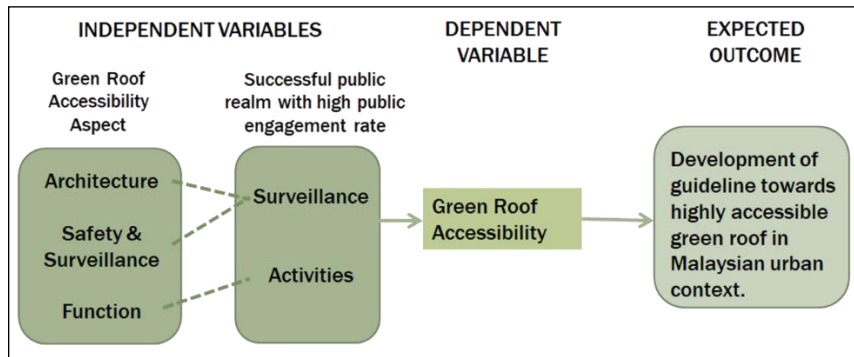


Figure 1. Conceptual Framework

CONCLUSION

In the context of Malaysian cities, green roofs are rarely made accessible to the public because of dysfunctional architecture, safety hazards, crime risk and lack of reasons to engage with a green roof facility. By reviewing current green roof issues and evaluating the best measures for accessible public spaces, suitable criteria have been identified as green roof design guidelines for the Malaysian urban context. They include determining accessibility parameters such as architecture that responds to people's needs, safety and surveillance and active functions. The parameters are interconnected, for example a smooth green roof gradient allowing wider public access to include wheelchair-bound persons, elderly and children. Thus, means of entry would be made suitable for universal use and able to serve large volumes of traffic. A high level of public engagement creates the feeling of a safe environment when entry points are located strategically and directly connected to active frontage with vibrant activities. The study outcome indicates the presence of a strong relationship between strategies for high levels of public traffic and widely accessible green roofs. These elements for successful public spaces could be developed into green roof design guidelines with greater public accessibility, in line with growing concern over the need for green roofs as future recreational space.

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IMPLEMENTATION OF TRANSIT-ORIENTED DEVELOPMENT (TOD) TOWARDS A SUSTAINABLE COMMUNITY: ISSUES AND CHALLENGES

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Abstract

Transit-Oriented Development (TOD) is gaining popularity as a tool to achieve sustainable development as it consists of a mixed-use development, which can cater the problem of urban sprawl, road traffic congestion and increase in carbon gas emission. However, there are effort and incentives by the Malaysia policies related to TOD constructed under Eleventh Malaysian Plan (RMK-11) to encourage the use of public transportation, walking and cycling as an alternative to the main modes. However, the efforts seem in vain as the public are not concerned regarding this issue. The dependency of public on private vehicles still at significant concern. The public need to take part in this approach, together with the government to ensure that this concept finds its way to success. This study aims to identify the implementation of TOD towards sustainable community with the following objectives; to identify the criteria and concept of TOD, to investigate the issues and challenges in implementing TOD towards sustainable development, and to recommend the suggestion for improvement of TOD towards a sustainable community. To achieve these objectives, Subang Jaya Station is chosen as a study area as it is seen to be potential in implementing this concept. A mixed method of qualitative and quantitative research used in the form of a semi-structured interview and questionnaire distribution. The study found that the implementation around the Subang Jaya station is still immature and in developing phase. A few aspects or issues that need to tackle to achieve sustainable community such as a problem with a limited number of park-and-ride facilities, housing price around transit station and quality service of the public transportation served by related agencies. With the recommendation from both methods, this concept can further improve in achieving sustainable community.

Keywords: *Transit Oriented Development (TOD) Implementation, Sustainable development, Issues and Challenges.*

INTRODUCTION

Sustainable development seeks to create an urban environment, which maximizes economic growth and social equity while minimizing negative externalities upon the natural environment (Renne, 2003). Transit-Oriented Development (TOD) has become a popular tool to achieve sustainable development as it involves the mixed-use of residential and commercial development, which add vibrancy to city spaces, reduce pollution and energy consumption and increase the use of public transport. According to Yap & Goh (2017), TOD promotes the usage of the public transit system to reduce the volume of private motor vehicles on Malaysian roads. Indirectly, it can improve the economy and quality of life (Rahmat et al., 2016) and at the same time as a solution to the increase in road congestion, increase in greenhouse emission and other environmental impacts. Although there are effort and incentives by the Malaysia policies related to TOD constructed under Eleventh Malaysian Plan RMK-11 to encourage the use of public transportation, walking, and cycling as an alternative to the main modes.

However, the efforts seem in vain as the public are not concerned regarding this issue (Rahmat et al., 2016). The dependency of the people on private vehicles stills a significant concern. The public need to take part together with the government, to ensure that this concept

finds its way to success. City authorities will adopt TOD as part of the city's competitiveness master plan to add vibrancy to city spaces, reduce environmental effect and energy consumption by increasing the use of public transport or walking and also revitalize brownfield areas within the city (Economic Planning Unit, 2016). TOD is supposed to bring about new compact development in urban areas to address the worsening situation of urban sprawl in cities throughout the world (Abdullah & Mazlan, 2016). The main objectives of this research are to identify the criteria and concept of TOD while investigating the issue and challenges in implementing this concept and recommend the suggestion for improvement. This research aims to identify the implementation of TOD around Subang Jaya station towards sustainable development.

LITERATURE REVIEW

Increase in population especially in the central of the nation led to increase in demand for dwelling, job seeking and motorized vehicles on the road which also brings effect in the increase of congestion, greenhouse gas emission and other environmental, social and economic impacts (Sohoni, Thomas, & Rao, 2017). The demand for residential development and its surrounding in the city centre increase as the population increase. This medium led to pressure to an actual event, which then created an urban sprawl and created a more suburban area (Zainuddin Rahman, 2013). To cater to the problems and demand, transit-oriented development (TOD) seems to be the answer to the issues mentioned above.

Transit Oriented Development (TOD) and sustainable development

Three pillars of sustainable development; social, environmental, and economical by which people, habitats, and economic systems are inter-related. TOD is said to be a favourite tool to achieve sustainable development as it can tackle three elements of sustainable itself. Peter Calthorpe first defines TOD in the late 1980s as a mixed-use community within an average one-fourth mile walking distance of a transit stop and core commercial. As mentioned in chapter 8 of Eleventh Plan (2016-2020) Handbook, TOD refers to the mixed-use of residential and commercial development, which promotes an urban development that designed to be pedestrian-friendly, and full access of public transport (Economic Planning Unit, 2016). TOD is an urban planning concept that has been implementing widely to many cities around the world, especially Europe, North America, and Southeast Asia during the last few decades (Alwehab & Al Ani, 2015).

Thus, the benefits of TOD said can reduce the problem of urban sprawl, reduce dependency on private vehicles, reduce environmental issues, provide housing and mobility choices, and reduce traffic congestion. According to Abdullah and Mazlan (2016), the main elements of TOD are diversity, density, and design. The difference is in the form of mixed-use development, frequency in the way of more residence and jobs during the procedure in the form of functional street connectivity for the pedestrian. The concept of TOD is a mixed-use community with an average of 2,000-foot walking distance (10 minutes of comfortable walking distance for most people), typically within a radius of 600-800m (Sohoni et al., 2017). The principles of TOD are listed as below:

- Walk - Develop neighbourhoods that promote walking
- Cycle - Prioritize non-motorized transport networks

- Connect - Create dense networks of streets and paths
 - Transit - Locate development near high-quality public transport
 - Mix - Plan for mixed use
 - Densify - Optimize density and transit capacity
 - Compact - Create regions with short commutes
 - Shift - Increase mobility by regulating parking and road use
- (Source: USDOT, 2012)

In addition to the concept and definition of TOD, this paper also investigates the issues and challenges in implementing this concept around Subang Jaya station. This medium because of a few problems and challenges faced in achieving the full idea.

Issues and Challenges in TOD

Despite the numerous benefits of TOD, it cannot avoid any issue and problems arise. There are often barriers that need to overcome for TOD principles to include in planning processes successfully. A few of issues and challenges have identified such as require a higher amount of cost, requires regular maintenance, causes environmental and health problems, increase in the price of the land around Klang Valley and inconvenience of park-and-ride facilities. Generally, the development of a city's transportation system will influence the environmental aspects of its residents. There are two significant ecological problems relevant to the growth of the rail transit system.

Indoor air quality

These are the indoor air quality of the vehicles, and the noise levels in the surrounding areas. These issues directly affect the environmental sustainability of the TODs for community residents. According to (Brandon et al., 2013), the standards for the indoor air quality (IAQ) of public transportation establish in Hong Kong. Based on these standards, the air quality in the passenger cabins of railway vehicles may improve through the ventilation system using outside air. Also, it is reasonable to use the carbon dioxide (CO₂) levels as the index improvement (Kwon, 2008). The IAQ of MTR in Hong Kong is a significant factor to estimate the achievements and limitations of public transportation, and its effect on riders. Adverse environmental effects on riders can cause health issues and discourage ridership. The quality beyond the limits of the MRT station has a large role in the environmental sustainability of each TOD. According to Borrego (2006), through air quality simulations that urban structures have a large effect on the air quality within the city. Through a mixed fluid-dynamic and chemical diffusion model, each different type of town exposes to similar conditions. The towns that contained compact mixed-use buildings, airflow corridors, and centralized design were able to distribute pollutants more efficiently.

Create noise disturbance

Public transportation is convenient for the residents; however, it also creates noise. Excess noise affects people's health and mood subtly and decreases the quality of life for residents. According to Lam (2009), the results of his study show that annoyance is largely caused by noise disturbance and perceived noisiness. When road traffic noise dominates, annoyance is primarily determined by noise peaks of train events can induce a direct annoyance response. Noise is a criterion to assess the quality of living in TODs. By reducing the noise made by

commuter rail, the mental states of residents will improve. Environmental sustainability encompasses the green area of each TOD as well quantitatively measurable parameters such as air quality and noise pollution. Social sustainability includes the walkability of the built environment, and the resident perception of their environment. Economic sustainability includes the expected housing prices within the area. A meaningful study will evaluate all the sustainability indicators, and well as combine and compare the individual data sets (Brandon et al., 2013).

Zoning and land-use issues

There are several important reasons why sustainable TOD is challenging to achieve. Transit and land-use decisions made separately-too often, and policy decisions favors transit locations that fail to optimize transit-oriented development opportunities, privileging short-term expediency over long-term value. Zoning and land-use restrictions can also prevent communities and developers from being able to capture the opportunities to create more compact, workable, and affordable organizations that take advantage of transit locations. This medium will be resulting in the built environment continues the favors of automobile dependence. At the same time, many areas near transit fail to produce the types of development needed to support equitable TOD. Land-use decisions are made at the project level and neighborhood scale and fail to consider corridor or regional level issues. Land use policy and public and private investment decisions are often based on individual project and neighborhood considerations, yet creating sustainable TOD also require planning and coordination at the level of the transit corridor and region. The result of this action is the critical connections between where people live, work, shop and play are often not factored into important decisions about where transit investments are made where housing and jobs are currently located, or where they should be created.

Value of land

Assembling land is expensive because transit line locations are often announced well before they are built, and speculation can occur years before construction. Land prices thus make the provision of affordable housing and other community amenities more challenging to provide. Besides, new transit corridors are most often auto-oriented places that require significant public and private investment to transition into more compact, walkable and transit-cantered communities. The reality is that the benefits of TOD take time and coordination to develop. The experience in many places where the transit line has yet to be built is that property owners and developers create auto-oriented development of key parcels along these future transit corridors because the community has not yet experienced the catalytic potential of the transit line. This medium makes it much more challenging to create the more compact, walkable, mixed-use environments along these corridors that truly optimize the transit investment. This resulting to land speculation and short time horizons can reduce TOD to the high end of the market, at the expense of the border societal benefits that should be created at these sites (Wood and Brooks, 2009). Nevertheless, according to Brandon et al. (2009), major sustainability factors such as green area, walkability, mixed-use buildings, pollution, resident satisfaction, and station design.

Study area

Subang Jaya has initially been a township of Petaling Jaya. However, due to the high population and rapid developments, it has earned its municipality, which governed by the Subang Jaya Municipal Council (MPSJ). Subang Jaya is well-connected to the cities of Kuala Lumpur, Shah Alam and the townships of Petaling making their public transport system highly developed with two (2) LRT lines, one (1) KTM commuter line, one (1) BRT line, bus and taxi services. With the highly developed public transportation, making Subang Jaya as one of the cities in implementing this TOD concept. Among many stations built in Subang Jaya, Subang Jaya station which hosted the LRT station and KTM Commuter station chosen as study area due to the rapid development and potential in developing TOD concept. The station situated at the city centre of Subang Jaya behind Subang Parade and Aeon Big Subang. Ever since the station remodelled and upgraded to accommodate the LRT service, it is a famous train and bus hub. College students commonly used it for travel to and from colleges and universities like SEGi University College, Taylor's University, Monash University, Inti College, University of Wollongong, and Sunway University.

METHODOLOGY

This research adopted a mixed method of qualitative and quantitative research in the form of a semi-structured interview, questionnaire distribution, observation, and document analysis. The research methodology chosen is undertaken to answer the research objectives. All the goals employed the same research instrument, which is the perception of the public as an end-user and point of view from the local authority (MPSJ) whom in charge preparing the guideline of TOD. Targeted respondent is public whom using the public transport from the Subang Jaya Station and resident around the study area and interview with the two resources person from the Town Planning Department of Subang Jaya Municipal Council (MPSJ). Fifty (50) sets of questionnaires distributed which cover various aspects such as demographic background, the level of agreement for the criteria and concept of TOD and issues and challenges TOD around the study area. A total of 50 sets of the questionnaire returned, and the data gathered is analysed by using software called Statistical Packages for Social Sciences (SPSS). The data analysed will then be calculated and ranked according to the calculated mean to identify which criteria and issues that are most agreed by the public. The data from the interview will then be analysed and compare with the data from the questionnaire.

RESULT AND DISCUSSION

In all, fifty (50) sets questionnaires were sent out by hand, and all the results obtained. The results are analysed and divided by the research objectives as discussed below:

Criteria of TOD

Based on the survey done to public, top three (3) criteria and thought that most of the respondent agree for the implementation of TOD concept around Subang Jaya station is shown in Table 1 which is connected to other spaces, reduce pollution and carbon emission and reduce the use of private vehicle and road traffic congestion.

Table 1. Criteria of TOD

	N	Min	Max	Mean	Classification
Accessibility to public transport	50	1.00	5.00	3.8200	Agree
Mixed of housing and commercial close to transit station	50	1.00	5.00	3.7400	Agree
Offer pedestrian-friendly space	50	2.00	5.00	3.8200	Agree
Walkable distance to transit station	50	1.00	5.00	3.7000	Agree
Reduce the use of private vehicle and road traffic congestion	50	2.00	5.00	3.9600	Agree
Reduce pollution and carbon emission	50	2.00	5.00	4.0000	Agree
Create more livable community	50	1.00	5.00	3.9600	Agree
Connectivity to other spaces or area	50	1.00	5.00	4.0600	Agree
Valid N	50				

From the interview with the local authority, they mentioned that the connectivity to other spaces could be the result of the mixed development, which consists of commercial and residential around the station in the radius of 400m. Thus, this concept can be related to social sustainability (Refer Figure 1).

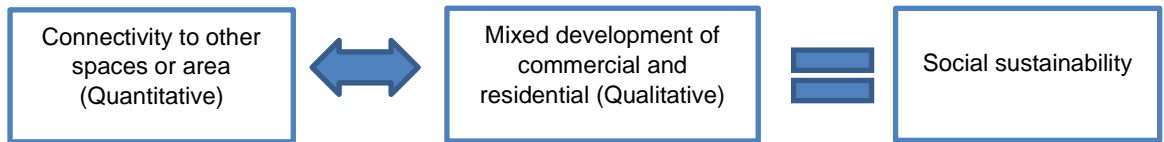


Figure 1. Criteria of TOD in relation to social aspect

The other two criteria, which are to reduce the use of private vehicle and reduce carbon emission, are correlated. This medium is because when the use of individual vehicle decrease, it will contribute to the lowering of pollution and carbon emission. This medium might be the result from the implementation by MPSJ which any development in TOD area must comply with the guideline that mentioned any residential are limiting to one (1) parking/unit and one (1) parking / 1000 sq. Ft for commercial. This approach can reduce half of the number of private vehicles on the road and as a result, can help in reducing the carbon emission. Thus, these two concepts can tackle in term of environmental sustainability (Refer Figure 2).

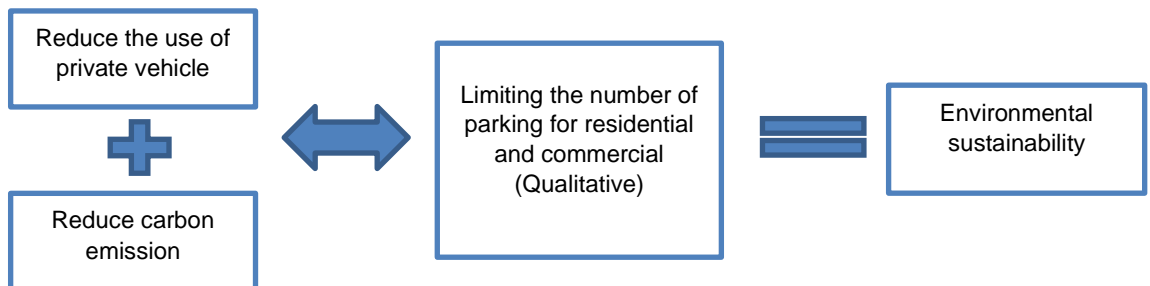


Figure 2. Issues and challenges in relation to environment aspect

Issues and challenges in implementing TOD

Based on the bar chart shown in Figure 3, limited for park-and-ride facilities and higher in housing price around transit station is the major issue concerning for respondent. From the interview with the local authority, it is undeniable that minimal parking area is provided due to the approach to reduce the use of private vehicles as they want the public to utilize feeder bus that was equipped fully. Local authority provide feeder bus such as Rapid KL and Bus Smart Selangor to the station depending on the scheduled routes. This issue might relate to social sustainability, as it shows how people react to the physical environment (Refer Figure 4).

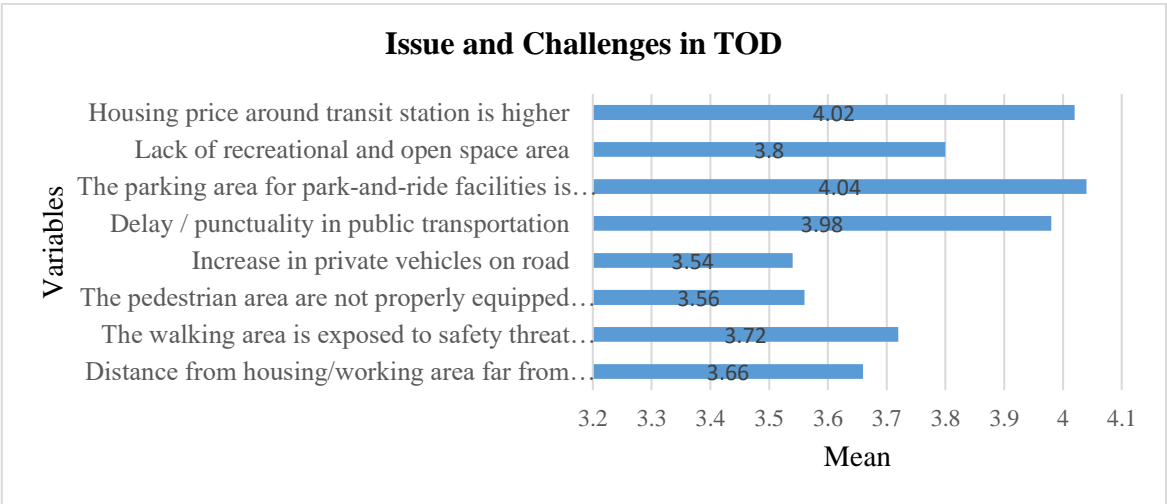


Figure 3. Issues and challenges in implementing TOD

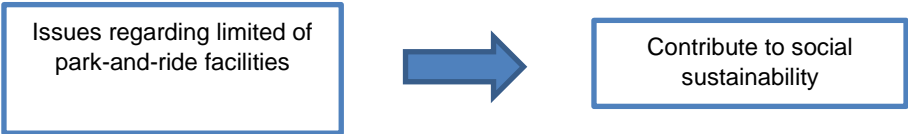


Figure 4. Relation of limited parking with social sustainable aspect

Regarding the issues of higher housing prices around a transit station shown in Figure 5, the local authority has no right to control the selling price for any residential property by the developer. It is undeniable that rail transit influence residential property value because of the amenities offered. Moreover, the developer has their target buyer, and they will not merely increase the price as it may affect their selling record. This medium will affect the economic sustainability as it about financial.

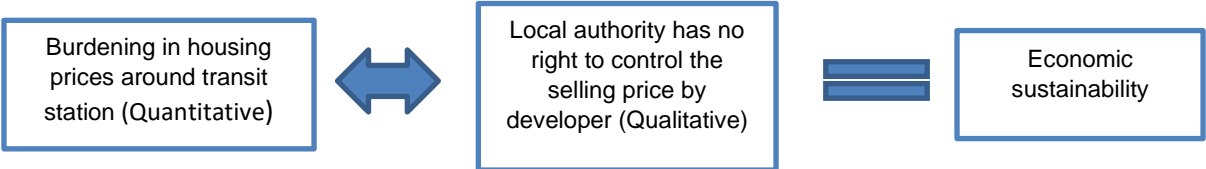


Figure 5. Housing prices in relation with economic sustainability

Recommendation for improvement of TOD

Based on Table 2, the most recommendation agree by the respondent is to improve the quality of public transportation, provide more park-and-ride facilities, and pedestrian walkways must be covered.

Table 2. Recommendation for improvement of TOD

	N	Min	Max	Mean	Classification
The distance from one area to another can be reachable by walking or cycling.	50	1.00	5.00	3.9400	Agree
Pedestrian walkways must be covered and equipped with lighting especially at night.	50	3.00	5.00	4.5800	Agree
Encourage public to use public transport	50	3.00	5.00	4.4200	Agree
Improve the frequency of public transportation especially during peak hours.	50	3.00	5.00	4.6200	Agree
Provide more park-and-ride facilities	50	3.00	5.00	4.4800	Agree
Build more park and other recreational area.	50	2.00	5.00	4.2600	Agree
Provide more affordable housing price	50	3.00	5.00	4.4600	Agree

The local authority also agrees with the recommendation suggested which transportation agencies such as KTMB and Prasarana must improve their services as many complaints received due to the incidents and misconduct by transport operator which cause frustration to the passenger. Another recommendation from the local authority is they need to have a clear and comprehensive guideline. Since the development of the TOD concept is still new and immature, so they need to prepare clear and detailed guidance starting from plot setting until all the provided facilities. The local authority (MPSJ) need to make a new guideline or checklist that suit with the development around Subang Jaya. The direction will be further enhanced to work the current event so it can provide better facilities to the public.

In the view of the public, the majority of the respondent agree to recommend for the improvement of the transit service quality, pedestrian walkways must be covered and provide more park and -ride facilities. Based on the interview conducted, there are two (2) recommendation made by the local authority for the improvement of the TOD concept. The first recommendation by the public as the end-user is to improve the transit service quality. This medium is due to the lousy service such as delay/punctuality of public transport, which restrict the public from using public transportation. With the improvement of the quality service, it might attract more public to trust and rely on public transport for daily use. Another recommendation is to provide covered pedestrian walkways and equipped with lighting, especially at night. The local authority might at least place a traffic light for pedestrian crossing. Another recommendation from the point of view local authority is they need to have a clear and comprehensive guideline.

Since the development of the TOD concept is still new and immature, so they need to prepare a clear and comprehensive guideline starting from the plot setting until providing all the facilities by the developer. The policy from State in general, which contain nine principles that must be referred for any development within the TOD area. So, the local authority (MPSJ) need to prepare a new guideline or checklist that suit the action around Subang Jaya. The policy will be further enhanced to suit the current development so it can provide better facilities to the public. Furthermore, the enforcement of the law by any related parties must be strictly enforced so that people will eventually follow the rules. Another recommendation suggested by the local authority is the developer need to develop a successful TOD so they can prove that this concept indeed can reduce the use of the private vehicle. Suppose this concept can bring success and advantages. In that case, the government can further enhance any initiatives and effort to improve this concept so that many urban cities will implement this concept to reduce the use of private vehicle and cater all the urbanized issues.

CONCLUSION

This paper has evaluated and identified the implementation of TOD around Subang Jaya station. Overall, it can say that the application of TOD concept by Subang Jaya Municipal Council (MPSJ) is still in developing and planning phase due to the time constraint in preparing guideline and checklist to suit with development around Subang Jaya. Majority of the respondent agree that all the criteria and concept of TOD implemented in the study area. However, the public is concerning the issues of limited park-and-ride facilities, burdening in housing price, and punctuality of public transportation. To improve the TOD concept towards a sustainable community, a few recommendations offered. The first is to improve the quality of public so the public will attract to use public transport, which can increase the number of ridership. Another recommendation is to provide a covered walkway to the adjacent building. This medium would allow more people the convenience of going to the station, especially during rainy periods. The third proposal is by providing additional parking space. Hopefully, with these improvements, this concept would improve considerably and helping TOD achieves its main objectives.

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GREEN ECONOMY IMPLEMENTATION IN MALAYSIA CONSTRUCTION INDUSTRY

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Abstract

Green economy is a set of activities that produced goods and services for measuring, controlling, reducing or improving environmental destruction. In construction industry, green building is also part of the green economy concept due to its efficiently uses energy, water and material resources, through improvement of the setting, planning and development activity. Even though green building has become highly demanded and vital nowadays in Malaysia construction industry, the concept of green economy has not yet become the interest of all groups within construction players. This paper aims to examine the implementation of green economy in Malaysia construction industry. Three objectives were outlined; to identify the concept of green economy, to investigate the awareness of green economy concept among construction players and to determine the issues in implementing green economy in Malaysia construction industry. Data were collected from literature reviews to acquire information on green economy at large and questionnaire surveys were distributed to 60 respondents enrolled with the Construction Industry Development Board (CIDB). The data were analysed by using SPSS software based on 50 number of responded. Findings revealed that there were four main concepts of green economy; environment, services, technology and goods or material. However, developing a new method or technology requires significant paper and development before reaching a reasonable degree of reliability to allow green economy adoption in Malaysia's construction industry.

Keywords: *Green; Economy; Building; Construction.*

INTRODUCTION

The green economy (GE) is defined as economy that aimed at addressing environmental risk reduction, environmental scarcity issue and aimed at ecological development without corrupting the environment. It is also diligently related to the practical political focus (Kahle & Gurel-Atay, 2014). The UNEP (2011) highlighted that apart from the economy itself be productive, it must also take into consideration the evolution to a low-carbon, resource-efficient, and publicly comprehensive economy. According to Bullard and Muller (2012), the focus in greening the economy is in the reaction to the increasing reality, the production and consumption mechanism, the prospect of exponential growth fuelled by fossil fuels, which has rapidly exceeded its limits. One of the foremost principles of the GE concept is having low-carbon energy technologies that have significant probable in achieving socioeconomic and ecological goals. The GE standard usually promises a new complete model of social well-being.

In Malaysia context, there have been a moderately move towards supportability in the business expansion due to the awareness and information on GE (Abidin, 2009). Every party involves in construction industry, for example, temporary workers, designers, experts and clients are aware of the GE significance in accomplishing maintainable development. The concept of GE can be seen in the construction of green buildings (GB). GB has a structure which has less environmental impact compared to conventional buildings, and it's efficiently uses energy, water and material resources through improved setting, plan, development,

activity, support, and expulsion (Saidin, Mohammad, Yop Zain & Lop, 2020). These factors are essential in GE concept.

FUNDEMENTAL OF GREEN ECONOMY

Green economy concept

Green environment

According to Yilmaz and Bakis, (2015), environmental problems leads to an expansion of ozone-depleting element emanation, a dangerous atmospheric deviation, ozone layer fatigue, and abatement in biodiversity have reached at worldwide measurements because of an unbalance among creation and utilization brought about by the boundless creation strategy of modern transformation while their effect was feeling on a neighbourhood scale. Furthermore, the environmental issues are also influenced by the overconsumption of ordinary resources and demolishing life, social wealth and lifestyles to the most negligible degree ever. According to Zhang (2017), biological morals, being a significant and regular subject in human everyday life, mirrors the necessity by these days condition in which people propensity impacts. Therefore, green environment is one of the primary highlights of present-day society which requires the economical turn of events.

Green technology

Green technology influences the profit of the companies and consumers. It can also reduce overall opposing effects on the environment (Dangelico, Pujari & Pontrandolfo, 2017). It consist of the revolution procedure including in vitality sparing, contamination counteraction, squander reusing, structure for green items, ecological administration and others (Huang & Li, 2019). As an important part of green revolution, green technology has established constant consideration because of the increasing anxiety over the state of the environment (Abdullah, Bakar, Jali & Ibrahim, 2017). Concerning of the ecosystem decay and shattered resources, it is an all-encompassing agreement that implementation of green technology is a substantial way to change the recent unfavourable environmental development mode into an ecological, community and economic improvement (Vergragt Xia, Zhang, Yu, and Tu, 2019). According to Li, Liang and Han (2018), green technology in construction is driving things up to help manufacturing ability due to advancement driven assembling, mechanical extension, quality enhancements, and green turn of events. Feasible green innovation is significant for proficiently and financially monitoring contaminant emissions (UNCTAD, 2018).

Green goods and material

Huge volume utilization of industrial waste for construction materials creation can redirect enormous amounts of results from landfills for esteem included to improve the maintainability and to the financial matters (Almalkawi, Balchandra & Soroushian, 2019). For example is green roofs, which in constructions; it is partly or entirely covered with plants. The plantations act as a medium that provide various sustainability benefits. Green rooftops may incorporate root boundaries, waste, and water system frameworks (Mickovski, Buss,

Mckenzie & Sokmener, 2013). Green construction material has significant part in sustainable development (Retno, Hardjasaputra, Tudjono & Hapsari, 2014). It is realised that solid innovation advancements have been executed in the development of construction industry. Conversely, those developments are as yet to be achieved to meet the measures of green development material (Thakur, Pappu & Thakur, 2018).

Green services

According to Mohd Nordin, Halim and Yunus (2018), the construction industry is one of the main suppliers to Malaysian economic development. Workers who are unemployed or difficult to fulfil the productivity, the performance of economy offer a chance to add income. One of the distinctive qualities of the performance of economy is that people operational in this space are all around thought about self-employed entities, not representatives of the organization they present (Gleim, Johson & Lawson, 2019).

Issues and challenges in implementing green economy

Lack of resources

Unintentional urbanisation of industrialisation has initiated lessening in gradually green field, increase of energy per capita, unconsciously consumption of limited natural resources and intensive use of petroleum resources (Azmi, Musa, Abdullah, Othman & Fam, 2017). Industrialisation also leads to unplanned urbanisation which resulted in a steady reduction of the Greenfield, a growth in electricity per capita, the intake of scarce natural resources unintentionally and consumption of oil assets seriously. There is a more prominent need for making vitality freedom and confidence dependent on the resources (Mohanty, 2012). Mohanty (2012) added that lack of skilled mechanics, installers, inexperienced contractors, designers and construction expertise, and local suppliers are not warning about new products and procedures that contributed to the issues in implementing green economy.

Social sustainability

Consistency synergy of environmental and social component of sustainability is essential for strategic development. Ecological and social sustainability are compulsory to be embedded in economy sustainability in GE implementation (Yilmaz and Bakis, 2015). As for professionals in construction industry, they should confronted with such a significant number of specialized alternatives in the greening effort, for example, to consistently comprehend their properties precisely before settling on a sensible decision coordinating with green aspiration and related conditions in the business. The circumstance has effects the experts a great deal and causes a genuinely negative impact on related players in a green crusade (Xia et al., 2019).

METHODOLOGY

This paper aims to determine the green economy implementation for Malaysia construction industry. To obtain general information on the related green concepts and issues in the construction industry, an extensive literature review was done. The component of green

concepts in general and the issues in implementing green economy were outlined. Additionally, to support the information in the Malaysian construction industry context, a questionnaire survey was done. A total of 60 questionnaires were distributed amongst G7 construction organisations in Klang Valley. The list was obtained from Construction Industry Development Board (CIDB) under the Building Works category. The sampling was done based on simple random sampling. However, 50 cumulative respondents obtained for this paper.

The questionnaire was divided into two (2) main sections; the concepts of green economy and the level of awareness among construction players and the issues and challenges in implementing green economy in Malaysia construction industry. For the first objective, there were three main concepts outlined. A five-point Likert scale was used to measure the activities (1: strongly disagreed to 5: strongly agreed). For the second objective, there were ten issues outlined for this paper, and similarly five-point Likert-scales were used to measure the items. The data for both objectives were analysed using SPSS software. The Descriptive Statistic: Frequencies-Mean-score method was used to achieve the objectives.

FINDINGS AND DISCUSSION

Concept and awareness of green economy in Malaysia construction industry

Table 1. Concept and awareness of green economy in Malaysia construction industry

Concept	Percentage (%) level of awareness			Rank
	Neutral	Strongly Agreed	Agreed	
1. Green Environment				
a) Low Carbon				
-Improved climate change			100	1
-Reduced long-term greenhouse gas emission		2	98	2
-Precursor to the zero-carbon economy		4	96	3
-Improved efficiency of energy and reduced carbon emission		4	96	3
b) Ecology				
-Enhanced the competitiveness of high technology products		4	96	3
-Propagandised education of ecological culture		6	94	4
2. Green Technology				
a) Renewable Energy Technology				
-Help reduced cost and gain larger market		4	96	3
-Decarbonised sustainable energy system		8	92	5
-Renewable energy technology help increasing the level of green economy in country		4	96	3
b) Recycling Product				
-Aesthetic value for a building		8	92	5
-Give impact to environment biodiversity		4	96	3
-Reduced the need for materials extraction		8	92	5
-Recycled products are more expensive than virgin or original construction material		2	96	3
c) Waste Management				
-Poor waste management will lead to inefficient material handling		6	94	4
-Design changes was one of the factor to construction and demolition waste	2	4	94	4
-Help in reducing construction waste		6	94	4
3.Green Goods				
a) Organic				
Strengthen the construction	2	8	90	6
b) Material				

Concept	Percentage (%) level of awareness			Rank
	Neutral	Strongly Agreed	Agreed	
Organic polymer has already used as one of the construction material		4	96	3

Table 1 show the concept and awareness of construction players towards green economy concept. Green environment involved with two concepts; low carbon and ecology. For low carbon concept, all respondents were strongly agreed (100%) that GE can improve the climate change, followed by reduced the long-term green house gas emission (98%). Moreover, by implementing GE, Malaysia may have a zero-carbon economy, improved efficiency of energy and reduce carbon emission (a total of 96% stated strongly agreed). By imposing the GE in Malaysia, respondents strongly agreed (96%) that it enhanced the competitiveness of high technology products and 94% strongly agreed that it created high education of ecological culture. For green technology, 96% of the responded strongly agreed to renewable energy technology concept, under sub-heading of cost reduction and gain larger market, and increased the level of GE in a Malaysia; and for recycling product concept with sub-heading of environment biodiversity and recycle products. Respondents were also strongly agreed (94%) to the concept of waste management in GE.

In addition, respondents were also agreed strongly on the green goods concept that gives significant contribution to GE, such as recycled material, given example of polymer has been use in construction (96%), and by imposing organic based material as part of construction material, it will strengthen the construction output (90% stated strongly agreed). Thus, some concepts which were crucial in the implementation of green economy need to be identified. When seeking to accomplish the target, it was highlighted that most of the contractor did know about the green economy and were aware of it. However the construction in Malaysia's operation has not yet been invested worldwide. The government should play an important role in recognising this approach to the Malaysian construction industry in order to bring this to the building performer.

Issues in implementing green economy in Malaysia construction industry

Table 2. Issues in implementing green economy in Malaysia construction industry

ISSUES	MEAN	RANK
-Not many people are aware of green economy	5.00	1
-Stricter skill needed that make people lost interest in working	2.96	5
-Green construction cost is more expensive than common construction	2.62	6
-Lack of support from Government	2.96	5
-Client's lack of awareness on green construction	4.80	4
-Time overrun	4.90	3
-Cost overrun due to delay	4.90	3
-Huge amount of construction waste	4.98	2
-Deforestation	4.90	3
-Can lead to natural disaster if not control the intake of natural resources	4.90	3

As shown in Table 2, the highest mean score was 5.00 outlined the issue of not many construction players aware of the green economy concept. Moreover, respondents also indicated that another barrier in implementing whole-concept of green economy was construction industry still involved with huge amount of material waste (mean score of 4.98). Besides, with a mean score of 4.90, other issues were essential to be taken into consideration; time overrun, cost overrun due to delay, deforestation and may lead to natural disaster if the

intake of natural resources used in a project, cannot be controlled. Client's lack of awareness on green construction, government policy and high price of green construction also contributed to the issues in implementing green economy in Malaysia construction industry, with mean score of 4.80, 2.96 and 2.62 respectively

Moreover, the biggest concern in the challenges for GE implementation was knowledge constraint, because GE was still a new phenomenon. Even though the construction players knew most of the concepts however, not many players were aware of it as part of GE implementation. For examples, most respondents know about low carbon, greenhouse gas, renewable energy and waste management but they have never known specifically about green economy. They didn't realise how important it is for the future generation, Deep study and practice was recommended for solving these issues.

CONCLUSION

Developing a new method or technology requires significant research and development before reaching a reasonable degree of reliability to allow green economy adoption in Malaysia's construction industry. Growing awareness of green economy in construction industry would be an open eye to the government and peoples in Malaysia to look after the environment so that creatures who live in the ocean, in the forest and the desert would not be extinct. Moreover, all habitats and the green need to be balanced. Same goes to construction, if the industry did not reserve and recycle all construction waste, there will be no places for the Construction Industry, Government and private sectors to build up buildings. If the contractors keep on using virgin construction products, every forest in Malaysia will be gone after 10 years. Contractors should use recycled construction material if they have choice and enough money and also agreement from the client itself.

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CLIENT VALUES FOR THE INTERIOR DESIGN WORKS FROM THE PERSPECTIVE OF ISLAMIC SHARI'AH

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Abstract.

This paper discusses on client values for interior design work from the perspective of Islamic values. Client represents as a person or a well-define body that has different values, interests and perspectives. Understanding of their needs and requirements is a process that known as a very complex system. The complexity refers to the difficulties in understanding client's interest and to transform it into an intended space provided with the most basic structure and facilities. The design made shall obtain the best value that fits different interests for building owner, users, society and environment. Clients are the most important person to determine the value of an interior design works. The client values discussed herein concerned on the aspects of religious value of Islam that could be incorporated in improving client values in interior design works. Islam offers solution in every aspect of life that benefits human beings with all the needs that would fulfill their living expectations. That is the reason Allah provides guidelines written in the Holy Quran as the guidance, which provides the set of *Shari'ah*. Incorporating the Islamic principles into interior design work is an attempt to improve the way of capturing client values thus optimizes the satisfaction of client. A good interior design space, it's not just about aesthetic appearance but the practicality and philosophical discipline. Therefore, the interior designers should take this into consideration in giving the best design value in their design work. The aim of this paper is to obtain an understanding of the Islamic *Shari'ah values* and to present the identified values that support these religious values. The objectives of the paper are: 1. to describe client values from the perspective of Islamic *Shari'ah*; and 2. to seek for relevant Islamic Syariah values for the interior design works. The methodology adopted in preparing this paper is rigorous literature reviews. Findings from literature search conclude with a framework of *Islamic Shari'ah's* values that could be incorporated into interior design work.

Keywords: *Client values, Islamic Syari'ah values, clients, interior design works*

INTRODUCTION

In construction industry, which includes the interior design projects there is a need to improve the engagement of stakeholders in the design process to make their values explicit to the design and delivery team (Koskela, L. et al, 2002). If client values are not fully understood at the outset of an interior design works it is likely to result in either low fulfilment of client expectations or multiple design alterations during the process, which leads to additional costs and frustration among the project participants. However, when starting to analyse and articulate client values, there are at least two basic questions that must be tackled by the designers, what is the nature of value and who is the client.

Understanding client needs would be one of interior designer's scope of work, which requires them to capture every detail of client need. Researches in capturing client values for design work was unlikely to be found. Most of researches presented were more towards physical aspects and less concern on the psychological aspects, which it is to be seen as a

complex process. Dodsworth (2009) emphasized that value is seen as a holistic interpretation of an individual needs. Thus, client of the interior design work will also be having the rights of obtaining the best value for their project. They can be either a person or from body of government or private bodies who plan to initiate a project or who owns properties. In building projects, client / project owner is the one who are responsible in providing financial project with the intended of obtaining quality product thus achieving best value as per their expectations (Thomson et al, 2003; Best & De Valence, 1999). Therefore, as an investor of a project, they will surely hope for a good return in all aspects of the project outcome including design works from the project team. Besides client and stakeholders, there are other parties that have important influence in design making such as the end-users, society and environment. Every each of them has their own interests and gives different perspective of values that need to put into account during design process.

One of values that contributes to client decision making is the religious values and Islam is the religion that covers all aspect in this world, including values. Islam offers solution in every aspect of life that benefits human beings with all the needs that would fulfill their living expectations. That is the reason Allah provides guidelines written in the Holy Quran as the guidance which known as the *Shari'ah*. *Shari'ah* is the Islamic law that provides basic principles of law in the performance of a social conduct and it comprehends the practicality of everyday life. The basic principles of *Shari'ah* consist of three main pillars in Islam, which are the *akhlak*, *ibadah* and *muamalah*. These principles will be more valuable when the fundamental of value and ethics are understood and practice well.

LITERATURE REVIEW

The value of some state of the world is typically defined as the extent to which it is considered desirable or undesirable. Historically, the concept of value has been described by economists as the ratio of costs to benefits. However, the definition of value was seen to be too narrow, thus researches on value were widely explored especially by most phycologists, anthropologists and sociologists. As a result, value can be interpreted not only through costs benefits but also through socio-psychological impacts (Rokeach, 1979). Value concept is attached to a person who possesses values, not to an object which has a value. It is because values are naturally created within individual's culture and it creates system of values that leads them in determine their directions of life. As stated by Koivula, N. (2008:4) that values can be very subjective and "its importance are more important to be concerned rather than the desired outcomes of values". Understanding values is very complex (Oyserman, 2001), yet it is important to understand individual and society from all level of ages and cultures (Hofstede, 1980; Schwartz, 1993).

Capturing Client Values in Interior Design Works

Interior design (ID) works involves in a multitude of analytical, creativity and technical knowledge in creating a quality design that emphasizes more on the aesthetic and functional aspects. Creativity in problem solving as well as design skills are required to ensure design process and project performance work accordingly to the agreed timelines and cost during the initial stage. Previously, ID works only played a small role in building projects, which emphasized on the decorating aspects rather than creating spaces. However, the ID works has

become importantly needed as clients are aware of the important to have a quality interior space. A quality interior space is not just about aesthetic per se, but it is also about making the space functionable according to its needs. It is believed that this will be able to create soul for the space and portray client's identity. As stated by Hoon-ku, L. et al (2008), this specialization of creating value for interior spaces that makes it special and differentiates from other building works. However, to create value is not easy as it is too subjective and difficult to be interpreted into design. Nevertheless, this issue can be solved if designers would emphasize more in understanding of client values during the initial stage.

Client values can be determined from various perspectives based of client's preferences. Preference is the evaluation of judgements in the sense of liking or disliking of an object or system, which influences by their goals, constraints and experiences (Warren, C. et al, 2010). However, preference changes across context and the evaluation can still be modified by explicit decision-making processes of given choices which later it may divert the thinking and end up with different outcomes.

Client Value in the Perspective of *Shari'ah*

Shari'ah is typically defined as the Islamic religious law or in other words known as the Islamic faith. According to Al-Quran and Sunnah, there are five *Shari'ah* have been made known, which were from Noah, Ibrahim, Musa, Isa and the Prophet Muhammad. As for Muslim today, they live under the tradition of the holy Prophet who indicate the importance of ethical senses in daily life (Mohammad Tahir, 2003). *Shari'ah* is an Islamic law that provide basic principles of law in the performance of a social conduct and it comprehend the practicality of everyday life which involves Muslim's basic obligations including prayer, fasting, charity as well as other aspects in life that *wajib* to be applied in the society to act in a civilized manner at all times (Abdul Jalil and Muhammad Khalilur, 2010).

When discussing about client value in *Shari'ah*, it is actually describing the life principle that a Muslim holds on in dealing with their life as well as responsive to other creations of Allah such as humans, animals and nature. It is like doing business, which Islam sees it as a dignified ethical process of seeking *halal* way of life and wealth. *Shari'ah* is the ethics that have been emphasize by the Prophet Muhammad, where this fundamental need to be understood in order to execute the *Shari'ah* principles (Foster, 2006). The basic principles in *Shari'ah* are *Ibadah* (religious observance), *Akhlak* (moral), and *Muamalat* (transaction), which these principles are believe to be the basic of client value in *Shari'ah*.

These basic principles are the path in leading humans in making and performing good way of life as well as to show their obedient and love to the mighty Allah SWT. As a Muslim, *ibadah* is the essential aspect in Islam, which has been determined as the hold of believers to Allah. The foundation of *ibadah* consists of focusing on human direct relationship to their Creator by being obey and humble with the *shari'ah* of Allah (Ustaz Hasrizal, 2008). Obedient to Allah is based on the sincere love to Allah and awareness of all bestow given to human as mentioned in the chapter of Ali Imran verse 31 which explain 'If ye do love Allah, follow me: Allah will love you and forgive your sins: For Allah is Oft-Forgiving, Most Merciful.'. Expressing and performing *ibadah* does not limit to any specific places, as long as the *ibadah* is perform with good intention and covers all aspect of human activities.

Human activities are performed with good *Akhlak* (moral) that supports their way of thinking and actions. According to Imam Ghazali, *akhlak* defines as ways of direct aims to

achieve the Islamic *shari'ah* through their attitude, characters and knowledge, which is also called as ethics. Ethic is code of values, which give guidance to Muslim in making actions and choices to determine the purpose of living, either good or bad. Meanwhile, values reflect to ethical behaviour and actions, which a person holds on to his/her belief and principles. Ethics perform quality performance that may achieve through two ethical values, which are *amanah* (trustworthiness) and *accountability* (responsible). Both of these ethics do related to each other. *Amanah* is trustworthiness which something that a person left to someone to protect or to keep (Stacey, 2008). She added that being trustworthy implies being honest, fair in dealings and punctual with time as well as honouring trusts and keeping promises and commitments which covers all aspect of life including religious, politics, economy and social. Being *amanah* has to come along with a big responsible especially when protecting people rights called *haqq*. Mohammad Tahir (2003) explained *haqq* is used for rights as a correlative of duty, litigation and lawsuit. He explained further, the important usage of *haqq* is to “show the owner’s title to a property and his exclusive powers of dispensation and control over his property” (Muhammad Tahir, 2003:64). Right and duty can be determined by the conjunction, which follows the term of *haqq*. According to UN (1985) in Muhammad Akbar (2011), satisfying consumer’s rights is a close concept to human rights which everyone has the rights to a standard of living adequate for health and well-being of themselves and their close ones. This kind of responsible use to deal within two or more parties, which require having a legal contract, called as *aqad*. Islam heavily stresses on the protection of consumers’ rights. The importances of protecting rights as mentioned by Muhammad Akbar (2011:2) are to “protect them from fraud, misrepresentation, negligence, unfair contracts, exorbitant profiteering and other malpractices in trade”. This shows that Islam is very emphasizes on human rights and justice.

Contract in Islam is formed to protect client’s right and the contracts are based upon various types of commercial transactions and it is the measure of transaction validity, which is call as *muamalah* (Muhammad Akbar, 2011). It is the main factor in determining the lawfulness of transaction, whether it is *halal* or *haram*. Transaction in Islam is defined, as dealing businesses that comprises of both selling and buying process between two or more parties that aim to gain profit with mutual understanding. As per mentioned in the chapter of Baqarah Meccans, ‘sale is like *riba*’ and Allah SWT replied ‘Allah has made sale permissible and forbidden usury’. It later explained in chapter Al Nisa verse 29 saying, ‘O ye who believe! devour not your property among yourselves by unlawful means, except that *you earn* by trade with mutual consent. And kill not yourselves. Surely, Allah is Merciful to you (Al-Nisa 4:29). The business process shall fulfil the condition of *ijab* and *kabul*, in order to ensure the transaction is agreeable by both parties and acceptable in Islam (Muhammad Akbar, 2011). This way, the *muamalah* system can ensure that every aspect of politic, social and economic are protected from all the negative possibilities.

METHODOLOGY AND RESULTS

This research attempts to capture the values that has been underlined by the perspective of *Shari'ah*, which is in related to design decision making. To achieve the objective of this paper, data collection was based on literature review and was conducted using textbooks, journals, conference, seminar proceedings, dissertations and theses in related to design values that are closely related to *Shari'ah*. This literature search focuses on the Islamic principles

that may influence human values in decision making. From all the data obtained, the values were mostly being portrayed by the principal way of living of our Prophet Muhammad SAW. The results shown that Islamic principles comprise of space planning, protecting privacy, safety and security, comfort, adequate facilities and respecting environments.

DISCUSSION

Data from the exploratory survey is presented from the beginning of this paper as an analysis of the data collected. The survey was executed to audition the preliminary findings based on the observations from the literature study.

Islamic Principles as the Guidance to The Values in Built Environment

The Prophet (PBUH) has once said that Allah is beautiful and He loves beauty. This means that Allah blesses humans for the beauty that was brought with good efforts. He loves the inside beauty in human's heart and the courage towards knowledge, living, generosity and purity, because beauty is the purposes of Allah's Creation which determines the excellence of His duty that created beyond our imagination. Being excellence is one of the ethical behaviors that leads to value creation. This ethical value has been implemented by the Prophet (PBUH) in creating a value-built environment for the civilization of Madinah and this can be adopted in other practicably value system. The Islamic design should feed the value system by preferences, orientation, families and religion and principles that consist of space planning, privacy, safety and security, comfort, providing enough facilities and respecting environment.

i) Space planning

The Prophet (PBUH) has taught that a design should be created with soul and value, for instance having a home does not mean there is a house and if you have a house it does not mean that you have home (Spahic, 2010b; 2010c). This statement is actually trying to explain how creating value could make a place to be meaningful in sense that it gives the inner satisfaction for a person to live on. A house is a structural form which represent as value, while home define as the spiritual and comfort nice feeling. The nice feeling derives from a reaction of satisfaction, which also known as values. One of the factors that could create these values is through a proper and systematic planning. Planning and building should apply the concept of excellence because Islam is a religion of excellence. The important element in planning is to differentiate between private and public space. Public and private space shows how Islam really emphasizes on respecting everyone's rights. Public spaces are meant for social activities and a place for gathering which the space to be shared with others. Meanwhile, private space is meant for personal activities that require a very individual space that only meant specific people (Spahic, 2010c).

ii) Protecting privacy

Privacy is an important aspect in Islam because it protects the human rights. The Holy Quran does not like disrespecting one's privacy in the dramatic mode. The concept of privacy is defined as a claim of individuals or groups to determine of having the authority to control their own personal space (Hall, 1969). Nevertheless, Spahic (2010b) view privacy as *aurah* which means in every building design has its restricted and classified aspects that are specific

for certain people and time. Alireza (2011) stated that the concept of privacy is different between societies, where not everyone feels privacy is a significant issue. However, Islam do emphasize on this particular issue.

The need for privacy is one of the socio-cultural elements that have influenced building designs in almost every society. The main part of Islam society is its' respect to privacy and it can be defined in three main elements (Spahic, 2009; 2010b). The elements are privacy between the neighbors dwelling as well as between the individual dwelling and the street; privacy between sexes and privacy between individual family members of a building. These elements are basic needs in Islam that are required in building design. The purposes of these privacy elements are to protect occupant's privacy from outsiders. In Quran (Surah Nah, 80), Allah says, "It is God who made your habitations of rest and quiet for you." This verse means that a house should protect the house occupants (male and female) from being seen and listen by the outsiders. It indicates that a house should be design with a good visual and acoustics system that may help to protect the privacy of the occupants from outsiders and the spaces are to be design with rooms that separate both of male and female. This is a way to protect Muslim woman from the eyes of unrelated visitors. Besides separating male and female, the planning should considerate the privacy for individuals of all various ages and their different relationships. This is the beauty of Islam where it considers all aspects of living and workmanship on earth.

iii) Safety and security

Another aspect in design that should be considered is the safety of the building users. This aspect is important and a primary concern to be considered during design process. Before a design is being produced, an interior designer ought to think of how a building design can give the optimize security as well as comfort living for the building users. Majdah (2008) added that designer have to ensure their beliefs, lives, honor and property are well guided. Safety elements are to seen as a part of giving an additional of comfort level for users. It also secures the occupants in term of psychological and spiritual safety. On top of that, it is important that a designer to put consideration of safety and health in the design that they produced. This is the obligation required by *Shari'ah* that mentioned whatever a person does and practice, it is important to be responsible in safety and security aspects.

iv) Comfort

Comfort defines as happiness that fulfils human needs and desires. A building that adapts a proper way of life will gives a better performance and comfort living for the building users. Islamic principles have provided full guidance for humans to cater comfortable living environments to suit their culture and life style as Muslim. In order for human to adapt with a space, their needs and requirement have to comply with their culture and belief. For example, living requirements which require spaces for sleeping, eating, cooking, leisure, toilet, utilities and smooth circulation are designed to adapt with their living expectation culturally. These expectations are influenced by Islamic principles of life, traditional values, building form and heights, security needs, weather and the environment as well as the numbers of occupants living in it. Comfort can also be determined by having additional accessories that help to enhance the level of calm towards the space.

v) Providing enough facilities

Based on the lesson of the Prophet (PBUH), providing sufficient facilities for the Madinah society was the main objective for everything he did. These facilities are to enhance the needs of a specific space or building. A design of a space is determined by the needs of the space users and this has been addressed in Islam. Thus, a building is assumed to be properly designed if it will be built from inside out and not the other way around (Khaled, 2008). This way, a design of a building would be better in a way that the building will turn out to be better functional and most likely all the facilities are well equipped for the needs of the users. Understanding of cultural elements may also help in giving direct influence on design facilities (Stoecklin, 1999). Similar to mosque designed by the Prophet (PBUH) where it is designed as a center for Muslim activities that provides not only for religious activities but also design to facilitate for other several functions. Prophet's mosques were designed in simple form but it accommodates enough facilities to serve the function purposes. The facilities are such as hostel for *Al-Suffah* (people who does not have any house), benches called as *dakkah* used for sitting during public assemblies and *mimbar* as the media of communication between Prophet and people (Spahic, 2009a). Although it is simple, yet it serves the purpose very well and the design is not over doing.

vi) Respecting environment

In Islam, respecting environment is a way of showing the appreciation to Allah for the wealth and sources (*rezeki*) that He grants for humans. Dealing with environment means dealing with Allah's faithful servants that requires human highly responsibility (Spahic, 2009). Built environment is the process of natural environment that is being loan by Allah to His servants. According to Abd-al-Hamid in Spahic, O. (2009: 125) built environment must be safe from every misuse, mistreatment and any destruction. The statement supported by in Islamic *Shari'ah* where it emphasizes to preserve of wealth including natural wealth for the future generation. Therefore, it will consider as committed to sin when it is against the nature. This process is to avoid them from being too arrogant and wasting / over spending on unnecessary things. Being arrogant will only benefits in term of self-satisfaction and getting profits but on the other hand, this attitude may give bad impact in their future outcome. As Allah's curse on arrogance human, 'you got now, but then you'll get nothing in future'. Ignoring the consideration of the environment may lead to disaster and destruction such as imbalance of the ecosystem, global warming and the weather patterns. This shows the importance and benefits of the environments towards built environment.

CONCLUSION

As for the conclusion, there are gaps in interior design practice especially in project delivery practice definitely that needs to be explored in many ways. This study discloses for the crucial needs of guideline in managing interior design project. This paper may be used to gives opportunity to help in filling the gaps or issues, as to improvise the quality of project delivery process.

Briefly, it can be summarized that there was a huge gap of research area of interior design project delivery practice. Interior works are sometimes being wrongly interpreted by people for merely a decoration work. Although interior design has been practiced many years before, hence it is still considering as a new bud in the construction industry. In Malaysia, there were

two interior design organizations amalgamated into one (Malaysian Institute of Interior Design), emerged and regulated under the Architect Acts 1957 in 2016. This proves that the industry is structuring and enhancing for the establishment in the Malaysian construction industry players. Therefore, the inauguration of interior design project delivery practice is becoming essential tool and standard for the interior design practitioners.

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ACCEPTANCE OF CONSTRUCTION PLAYERS ON SUSTAINABLE CONSTRUCTION IN RURAL AREA

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Abstract

The Malaysian government has been encouraging the implementation of sustainable construction since 2004 through several initiatives in both public and private sectors. As highlighted in the 11th Malaysia Plan, the government aims to pursue a balance between regional developments and several objectives have been fixed to achieve this aim. Thus, this paper aims to determine the acceptance of construction players on sustainable construction in rural areas. The objectives of this research are to identify the construction team understanding on the concept of sustainable construction, to determine the level of acceptance from the construction team towards the implementation of sustainable construction in rural areas and to recommend ways to influence the construction team in implementing sustainable construction in rural areas. An extensive literature review was done to grasp the concept of sustainable construction. The questionnaire survey was distributed to the construction players working at the east coast of Malaysia. The gathered data were analysed by using the descriptive statistic in SPSS. The research showed that the concept of sustainable development referred to the development to sustain human needs without compromising the ability of future generations to fulfil their needs while sustainable construction is the way for the construction industry adopting the concept of sustainable development. Majority of the respondents were willing to implement sustainable construction in rural areas as most of them agreed to adopt sustainable practices, use green material products, and adopt the IBS method or modular construction in the project. The research also revealed that by enhancing awareness of the construction team, improving government incentives, increasing the supply of green construction products, and increasing the knowledge in sustainable construction are the ways needed in implementing sustainable construction. The research concluded that most construction teams are willing to implement sustainable construction in rural areas.

Keywords: *Sustainable development; Sustainable construction; Sustainable practices; Rural area*

INTRODUCTION

Construction industry is the main sector which will generate activities of other sector in every country. It is an important sector which contributes to a country's economy, one of the largest markets around the world and plays important role in nation's Growth Domestic Products (GDP) (Sfakianaki, 2015). As great as it seems, this industry however brings a lot of problems and destruction to fulfil human's desire. Construction industry was pinned as one of the most devastative industry that bring downfall towards the environment and ecological system (Ghafourian, Mohamed, Ismail, Abolghasemi, & Bavafa, 2017). In addition, this sector had been held guilty for being the biggest contributor for waste in every nation and represented as one of the most significant contributors to global waste production and accountable toward over 30% of waste at landfill (Crawford *et al.*, 2017). Due to these problems, it brings into the term of sustainable construction in order to resolve and bring a win-win situation that beneficial toward all these three component which is environment, society and economy (Ghafourian, Mohamed, Ismail, Malakute, & Abolghasemi, 2016). The

concept of sustainability in construction sector aims to meet present day needs for housing, working environments and infrastructure without compromise the ability for usage of future generation (Sfakianaki, 2015). According to Chen (2019) both rural and urban areas shares the same fate where the two of it serve different yet complementary functions for a country's socio-economic development which if any of these functions refrained, the country might fail to achieve its modernization. For past few years, the previous government had included in their manifesto and achieved their objectives of building world class infrastructure and transforming the rural area landscape (Parzi & Yunus, 2018). However, even though it was discussed in the 11th Malaysia Plan, rural area had been one of the focus which is to transform this areas in order to uplift wellbeing of rural communities but urban area such as Johor, Selangor and Wilayah Persekutuan Ramli *et al.*, (2018).

LITERATURE REVIEW

Generally, sustainability were defined as the ability to utilise or harness the resources to meet the present demands and needs but at the time manage to maintained it for the use of future generation (Ghafourian *et al.*, 2016). Wahi *et al.* (2018) then stated that sustainable development as the development that manage to fulfil the demands of present without compromised the needs for the next generation. According to Sharifi (2016), sustainable development is important to be implemented as a result of many problems occurred especially at macro-city scale by the reason of poor planning during micro-neighbour level. To accomplish sustainable development is a challenging job as it required a combination of great effort from government, purchaser and developer (Mahat, Saleh, Hashim, & Nayan, 2016). Table 1 shows the chronological overview of the meaning of sustainable development since 1987 to 2015.

Table 1. Chronological overview of sustainable development meaning

Authors	Definition of sustainable development
WCED, 1987	Development that meets the needs of present without compromise the ability of future generation to fulfil their demands.
Pearce <i>et al.</i> , 1990	A conceptual socio-economic system that ensures the sustainability goals in the form of real income achievement and improvement of educational standards, health care and overall quality of life.
Hardwood, 1990	Unlimited developing system which focused on achieving the greater benefits for humans more efficient resource use.
IUCN, UNDP & WWF, 1991	Process of improving quality of human life within framework of carrying capacity of sustainable ecosystem.
Meadows, 1998	Social construction derived from long term evolution of highly complex system
PAP/RAC, 1999	Development given by capacity of an ecosystem
Beck & Wilms, 2004	Powerful global contradiction to contemporary western culture and lifestyle
Vare & Scott, 2007	Process of changes where resources are raised, direction of investment is determined, development of technology is focused while the work of different institution is harmonized which at the same time ensuring the human needs and desire will be increased
Sterling, 2010	Reconciliation of economy and environment towards a new path of development which will allow a long-term sustainable development of humanity
Marin <i>et al.</i> , 2012	Give possibilities of time unlimited interaction within ecosystem, society and other living system without depriving the key resources
Duran <i>et al.</i> , 2015	Development that protects the environment

(Source: Klarin, 2018)

Kibert (2016) defined sustainable construction as construction of sustainable structure which environmentally responsible and resource efficient around the building lifecycle. Chamikara, Perera, and Rodrigo, (2020) expressed that sustainable construction is a reliable and practical solution in order to vanquish the issues aroused as a result of construction industry activities. Mohd-Rahim et al. (2016) also described sustainable construction should be practiced in construction projects as in line with sustainable development principles. Sustainable construction is a complete process that aims in restoring and at the same time maintaining the relationship between the natural and built environment, creating settlements by human needs and encourage equity as mentioned in Agenda 21 on Sustainable Construction for developing Countries (Aigbavboa et al., 2017). Construction industry and its product have been stressed in sustainability literature for their resource intensive nature negative impacts towards environment and society (Goel, 2019). Construction industry give a lot of impact especially towards the environment (Durdyev, Zavadskas, Thurnell, Banaitis, & Ihtiyar, 2018). While concerning on the environment, human needs also must be satisfied. Therefore, social well-being concerns on the matter regarding human desire with relate to the workers and users (Pham et al., 2020). Yılmaz and Bakış (2015) stated that this aspect is the most vital and concerning matter in sustainability as it related to basic rights and freedom which is the things that make us human.

Sustainable construction in Malaysia construction industry

According to Lim (2015), the government of Malaysia had been promoting sustainability initiatives ever since 2000 and committed to adopt an indicator of voluntary reduction up to 40% of emission intensity. Construction Industry Transformation Plan (CITP) is an agenda of Malaysia national plan which expected to commence from 2016 until 2020, aiming to transform construction industry through four strategic thrust as mentioned by Kong (2020) where the four thrust are quality, safety and professionalism, productivity, environmental sustainability and also internationalisation and competitiveness. The Sustainable Development Goals or known as SDGs also known as the Global Goals as a resolution to end poverty, protection towards the environment and ensuring that all people will enjoy peace and prosperity by 2030 where 17 sustainable goals had been highlighted (“Department of Statistics Malaysia Official Portal,” 2019). Aleksanin and Sborshikov (2018) highlighted on the 11th goal which is to ‘make cities and human settlements inclusive, safe, resilient and sustainable’ which in simple words means provide a safe and affordable housing, transport system and on top of that reduce the negative impact of cities towards the environment. In Malaysia, there were several initiatives taken by both government and local authority in order to promote sustainable construction such as promoting financing high impact research on green technologies through Ministry of Energy, Green Technology and Water (KeTTHA) (Aziz, Senik, Yau, San, & Attan, 2017), the launching of National Green Technology Policy and green tax initiative such as Green Investment Tax Allowance (GITA) and Green Income Tax Exemption (GITE) (Onuoha et al., 2017),

There were a lot of barriers that prevented the adoption of sustainable construction in project development in Malaysia. Pham et al. (2020) stated that the most challenging barrier to be overcome was lack of interest and support from the owner. Implementation of IBS in Malaysia was at a slow pace due to client unwillingness to adopt the IBS method as the client was unconvinced with the method (Khalil, Abd Aziz, Hassim, & Jaafar, 2016). Aghimien,

Aigbavboa, and Thwala, (2019) agreed client's demand and which often influenced by their lack of knowledge in this area is one of the major barriers from the implementation of sustainable construction. Findings from research conducted by Pham et al. (2020) and Mahat, Tah., and Vidalakis, (2016), said that increase in construction cost, professional capabilities, lack of effective policies and environment investment by government and poor collaboration between the construction team are the reasons that obstructed sustainable construction from being adopted. On the other hand, Agyekum et al., (2019) stressed that lack of proper regulatory, training and education, lack of interest from the developers, might become the reason on the incompetency of project team as they do not feel the need to improve their knowledge.

Ohueri et al. (2018) found that there are some ways to implement sustainable construction. By organising educative and awareness program are one of the solution that can be done. Lop, Che Ahmad, and Nik Zulkipli, (2019) stated that all parties need to possess awareness on sustainable construction through the green building certification programs towards enhancing quality of life and create a good environment surrounding. Awareness of end-user and developers is the main important factor that will influence the practices of green construction in every nation including Malaysia (Idris, Ismail, & Hashim, 2015). Professional knowledge that obtained from university or college influence in level of awareness of the construction team and create a positive perception towards sustainable construction (Sichali & Banda, 2017). The government played the most crucial part in the construction industry as they will guide the industry through law and regulations and balanced the interest of stakeholders (Pham et al., 2020). Clune and Zehnder (2018), stated that the government should give priority in providing education in regards to sustainable construction. Oke, Aigbavboa, and Musenga (2019) inferred that the government should develop a framework to adopt sustainable construction and collaborated with other professional bodies to ensure that such policy and framework were enforced such as collaboration with CIDB in introducing sustainability ratings tools Infrastar and MyCREST. In addition, a high level of expertise and cooperation among the construction participants was crucial while engaging in green construction.

RESEARCH METHODOLOGY

In this research, the data collection method that will be involved is through the questionnaires. A set of questions will be included in the questionnaires based on information gathered during the first phase of the study which is literature research from the secondary sources such journals and articles. The questionnaire will be in the form of closed questions where the respondent will choose the best choice among the set of alternative answers which given so that the information can be analysed easily for immediate action. The samples of questionnaire in the form of Google Form will be distributed through email to the construction team consist of developers, contractors, architects, engineers, quantity surveyors and other consultants such as safety and health officers and site supervisors within the state of Pahang, Terengganu and Kelantan. 56 out of 150 questionnaire that been targeted were returned which comprises of 37% from the targeted respondents. The data gathered were then analysed by using SPSS to grasp the information given by the respondent.

RESULT AND DISCUSSION

Table 2. Acceptance of respondents on sustainable construction practices (%)

Scale	Definition and the meaning of sustainable development	Definition and the meaning of sustainable construction	3 pillars of sustainability	Different between sustainable development and sustainable construction	Knowledge on sustainability approach (SDG, IR 4.0, RMK11, CITP)	Understanding and knowledge in green construction	Knowledge in GITE, GITA and IBS
Very poor	0	0	1.8	1.8	7.1	0	3.6
Poor	3.6	3.6	1.8	8.9	10.7	1.8	7.1
Average	25	23.2	26.8	23.2	26.8	19.6	23.2
Good	39.3	58.9	35.7	53.6	30.4	64.3	51.8
Excellent	32.1	14.3	33.9	12.5	25	14.3	14.3

Table 2 shows the respondent's level of understanding in sustainability concept. 39.3% of the respondents have good understanding in the meaning of sustainable development while none of them have very poor knowledge in it. 58.9% of the respondent have good knowledge in the meaning of sustainable construction while also none of the have very poor knowledge in that. Nearly 70% of the respondent have good knowledge for 3 pillars of sustainability. 53.6% of the respondent have good knowledge in differentiating between sustainable development and sustainable construction while only 1.8% of them is very poor. 30.4% have good knowledge in the sustainability approach such as SDG, IR 4.0, RMK 11 and CITP. 64.3% of the respondents have good knowledge in Green Construction while 51.8% have good knowledge in the initiatives taken by the government. This showed that even though the respondents do not have an excellent level of understanding, however, their level of understanding was quite high and better even though most of them have experience in sustainable construction within one to five years only.

Table 3. Acceptance of respondents on sustainable construction practices

Action taken	Level of Agreement						Mean	Classification
		1	2	3	4	5		
Sustainable practices such as 3R and waste management	Frequency	1	-	9	30	16	4.07	Agree
	(%)	1.8	-	16.1	53.6	28.6		
Use of green material products	Frequency	1	1	11	31	12	3.93	Agree
	(%)	1.8	1.8	19.6	55.4	21.4		
Adoption of innovative method such as IBS or BIM	Frequency	3	1	8	29	15	3.93	Agree
	(%)	5.4	1.8	14.3	51.8	26.8		
Construction of green building	Frequency	2	2	12	32	8	3.75	Agree
	(%)	3.6	3.6	21.4	57.2	14.3		
Use of sustainability rating tools such as MyCREST or GreenRE	Frequency	2	4	9	29	12	3.80	Agree
	(%)	3.6	7.1	16.1	51.8	21.4		

Table 3 shows that in the sustainable practices' column, the highest value with 53.6% shows that the respondents agree to enforce sustainable practices on-site if the construction project will be constructed in rural area. While 28.6% were highly agreed to implement sustainable practices. The mean value extracted from this action is 4.07 where most of the respondent agreed to apply sustainable practices in the project even if it will be constructed

in rural area. 55.4% out of the total number of respondents agreed to adopt the usage of green material products. 21.4% highly agreed to implement the use of green material products in the construction project, amidst the fact that it will be developed in rural areas. The mean value is 3.93 which classified that the respondents agreed to take implement the use of green material products in construction.

78.6% agreed to adopt innovative method such as IBS in the construction project while 5.4% disagreed to implements IBS. Overall, with the mean value of 3.93 shows the respondents agreed to adopt innovative method such as IBS which is also part of sustainable construction practices. 31 respondents which represent 55.4% of the total respondents agreed to used green material product in their development. In addition, 8 respondents highly agree should the construction of green building will be implemented in rural area. The mean value 3.75 shows that most of the respondents who represented the construction team agree to adopt such action amidst of several respondents disagree to do so. 21.4% agreed to use the sustainability rating tools in their projects even though it will be constructed in rural areas. Out of all, 3.80 is the mean value which means that out of all respondents, most of them agree to use the sustainability rating tools in the project such as 3R and waste management, use of green material products and adoption of the innovative construction method.

Table 4. Approaches to be taken in sustainable construction implementation

Approaches		Level of Agreement					Mean	Classification
		1	2	3	4	5		
Enhance awareness of construction players	Frequency	1	-	8	27	20	4.16	Agree
	(%)	1.8	-	14.3	48.2	35.7		
Increase knowledge on sustainable construction	Frequency	1	-	11	33	11	3.95	Agree
	(%)	1.8	-	19.6	58.9	19.6		
Improve in government incentives	Frequency	1	1	7	29	18	4.11	Agree
	(%)	1.8	1.8	12.5	51.8	32.1		
Increase supplies of green products	Frequency	1	1	9	32	13	3.98	Agree
	(%)	1.8	1.8	16.2	57.1	23.2		

Table 4 shows that several approaches that need to be taken to implement sustainable construction had been outlined. 83.9% of the respondents agreed that by enhancing awareness of construction players including the owner is one of the ways towards implementation of sustainable construction. The mean value of 4.16 which can be classified as the respondents agree with the statement. 19.6% of the total respondents highly agreed that by increasing knowledge on sustainable construction, this method can become one of the ways to implement sustainable construction whereas 58.9% of the overall respondent agreed that increase knowledge in sustainable construction can help its implementation. The mean value is 3.95 which classify that based on the respondents, increased knowledge in sustainable construction considered as one of the ways to implement sustainable construction. Another approach that should be taken to implement sustainable construction is to improve in government incentives as 32.1% highly agreed while 51.8% agreed to the statement. Nonetheless, the value of mean 4.11 shows that most of the respondents agree that sustainable construction can be implemented by improving government incentives. Finally, 80.3% where the mean value is 3.98 of the total respondents are agreed that sustainable construction can be implemented by increasing the supply of green products.

CONCLUSION

In conclusion, the first objective of these research had met the expected outcomes where almost all the respondents shared their level of understanding regarding the concept of sustainability especially in the definition of sustainable development and construction. In fact, most of them also familiar with the approach that had been highlighted to promote sustainable developments such as Sustainable Development Goals, Industrial Revolution 4.0 and Construction Industry Transformation Plan. In addition to that, most of them also have quite good knowledge of the sustainability rating tools that the government introduced to promote sustainable construction. The level of acceptance from the construction players on the implementation of sustainable construction in rural area was quite high as majority of them agreed to adopt sustainable practices, use of green material products, and use of modular construction or IBS method in the project even when the project should be constructed in the rural areas. Thus, the outcome of the second objective shows that construction players do accept this action positively. Furthermore, the construction team agreed that enhance awareness of construction team, improve in government incentives, increase the supplies of green products, and increase knowledge in sustainable construction is the approach that should be taken to implement sustainable construction in rural area.

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GLAM04: ENVIRONMENTALLY FRIENDLY SOIL STABILISER FOR INFRASTRUCTURE USE

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Abstract

Around the world, soil engineers have been reported the problems correlated with poor ground condition. The most serious problems in the field of foundation engineering are the changes of soil water content. These changes may cause undesirable movement of structures that are established on such ground, causing shear failure, excessive settlement, cracking and breaking up particularly for road pavements and building foundations. Thus, in order to produce an improved, the ground condition which has the desired engineering properties, it is essential for the soil to gone through alteration for one or more properties. Either by doing the alteration by mechanical or chemical, this process is called as soil stabilisation. The purpose of soil stabilisation not only limited to enhance the soil engineering capacity but also improve the permeability, enhance ground resistance to the weathering process. However, most of these methods are relatively expensive to be executed and the best way is to use locally available materials with relatively cheaper in costs. The conventional soil stabilisation using lime and/or cement is well established, but there is also a need of alternative cementitious technologies which are more sustainable, environmentally friendly and economical to the society. Moreover, there have been abundant research efforts to make soil stabilisation sustainable, either by evolving another soil stabilizer, or by way of partially replacing of the traditional stabilisers of lime and/or Portland Cement. The goals have mainly been to alleviate the environmental effects associated with the manufacture of the traditional stabilisers without severely compromising on performance. However, these efforts have been successful in both mitigating the environmental effects, as well as resulting in added benefits of economy and/or improved performance. Soil stabilisation using recycle and reused material besides to improve the engineering characteristics of a soil and preservation with the goal of eliminating all environmental concerns is a serious matter nowadays. Different investigators have reported on the formulation of new stabiliser materials by replacing lime with industrial by-products at varying percentages, with the benefits of swell suppression, strength improvement, durability enhancement, waste management, resource conservation and reduced carbon emission. The initiatives by the government and many others for more sustainable practices are encouraging and stimulate the innovations in sustainable road construction practices in Malaysia.

Keywords: *Soil, stabiliser, environmentally friendly, cementitious technology.*

INTRODUCTION

Soil stabilization may be defined as the alteration of the properties of an existing soil to meet the specified engineering requirements. The main properties that may require to be altered by stabilization are strength, to increase stability and bearing capacity; volume stability, to control the swell-shrink characteristics caused by moisture changes; durability, to increase the resistance to erosion, by weathering or traffic usage, and permeability, to reduce permeability and hence the passage of water through the stabilized soil. Soil stabilization is widely used in road construction to improve sub-bases and sub-grades, for railroad, and airport

construction, for embankments, as soil exchange in unstable slopes, as backfill for bridge abutments and retaining walls, as canal linings, for improvement of soil beneath foundation slabs and for lime piles.

LIME STABILIZATION

Lime stabilization is not an innovation. Lime was extensively used during the Second World War for roads and pavement construction. Today, stabilization of clay soil by the incorporation of lime is a technique widely used throughout the world to improve its use in construction. The addition of about 5% hydrated lime significantly reduced the plasticity of cohesive soils and increased the strength of both fine and coarse-grained soils. The effect of lime on soils was due to an exchange of calcium ions for adsorbed cations on the clay particle surfaces. They found that the reactivity of a soil towards hydrated lime increased as the plasticity index and the cation exchange capacity of the soil increased. Lime stabilization of soils has been used when; materials are unacceptably wet or plastic, workability and compaction properties are needed, greater soil strength and stability is required, off-site disposal needs to be avoided, materials up to sub-base quality are required from in-situ soils, there is a need to encapsulate difficult materials, sites are easily affected by adverse weather conditions and it is a necessary to reduce swelling and shrinkage.

Clay-lime Reactions

When lime is added to a clay soil, it has an immediate effect on the properties of the soil as cation exchange begins to take place between the metallic ions associated with the surfaces of the clay particles and the calcium ions of the lime. Clay particles are surrounded by a diffuse hydrous double layer which is modified by the ion exchange of calcium. This alters the density of the electrical charge around the clay particles which leads to them being attracted closer to each other to form flocs, the process being termed flocculation. This process is responsible for the modification of the engineering properties of clay soils when they are treated with lime (Nidzam and Kinuthia, 2010 quotes Sherwood, 1993). Several types of chemical reactions take place simultaneously when lime is added to a clay soil in the presence of water. They can be divided into two groups as:-Cation exchange, flocculation and agglomeration happen during the soil modification process and occur rapidly after addition of lime to clay. This occurs typically within 24 hours, although sometimes it takes several hours depending on the clay minerals involved and Pozzolanic reactions happen during the longer-term soil stabilization process and occur slowly, producing long-term strength gain by the progressive crystallization of gels that are created once lime has reacted with the clay minerals in the soil (Nidzam and Norsalisma, 2011 quotes Rogers *et al.*, 1997).

CEMENT (PC) STABILIZATION

Portland Cement is a product consisting mostly of calcium silicate, obtained by heating to partial fusion a pre-determined and homogeneous mixture of materials containing principally lime (CaO) and silica (SiO₂) with a small proportion of alumina (Al₂O₃) and iron oxide (Fe₂O₃). Calcareous materials, typically chalk or limestone, provide the CaO and

argillaceous materials, such as clay or shale, provide the SiO_2 , Al_2O_3 and Fe_2O_3 . Cement has been used effectively in the strengthening of granular materials such as soils. There are four compounds that are usually regarded as the major constituents of cement;

Tricalcium silicate (alite) $3\text{CaO}.\text{SiO}_2$ (C_3S); Dicalcium silicate (belite) $2\text{CaO}.\text{SiO}_2$ (C_2S); Tricalcium aluminate $3\text{CaO}.\text{Al}_2\text{O}_3$ (C_3A); Tetracalcium aluminoferrite $4\text{CaO}.\text{Al}_2\text{O}_3.\text{Fe}_2\text{O}_3$ (C_4AF). Portland Cement is a primary stabilizing agent, which can be used alone to bring about a stabilizing action (Nidzam and Kinuthia, 2011 quotes Sherwood, 1993). The C-S-H gel and C-A-H phases that form during the hydration process, produce a strong, hard matrix in which a granular material, like clay soil is embedded. As the hydration reaction proceeds from the surface of the cement grains, the reaction is slow and the centre of the cement grains will normally remain un-hydrated. There is a further reaction that takes place in most cement-stabilized soils. Lime that is liberated from Portland cement hydration, combines with clay minerals in the soils. Over time this reaction may form C-S-H, C-A-H and C-A-S-H strength promoting phases in a similar way to lime-stabilization. Cement-clay reaction can be divided into two parts: The primary reaction; where Portland cement hydrates and immediately produces cementitious gel subsequently producing a modification of the clay structure to a skeletal matrix-type system and the secondary reaction; where the lime originating from the cement reacts with clay minerals to form strength giving phases over time.

Clay-PC Reaction

The hydration of standard Portland cement is a chemical reaction between the phases present in the cement powder and water. During production, about 4%-7% gypsum ($\text{C}\bar{\text{S}}\text{H}_2$) is added. As water is introduced to the cement, it reacts with the aforementioned phases. Hydration then commences resulting in the formation of a number of hydration products. These hydration products contribute to the properties of the hardened cementitious material, a calcium silicate gel (C-S-H), the primary binding component of the hardened PC paste is formed. The reaction between C_3A and water is very rapid and the calcium sulphoaluminates are the first hydration products to form. It is these products that contribute to the early strength of cement. The C_4AF phase follows a similar hydration process to that of C_3A producing the iron equivalent of ettringite ($\text{C}_6\text{FS}_3\text{H}_{32}$), monosulphoferrite ($\text{C}_4\text{FSH}_{12}$) and calcium ferrite hydrate (C-F-H). (Nidzam and Kinuthia, 2010)

SOIL STABILISATION INCORPORATING GROUND GRANULATED BLASTFURNACE SLAG (GGBS)

Blastfurnace slag is produced from iron blast furnaces as a by-product of the iron making industry. It results from the fusion of a limestone flux with ash from coke and the siliceous and aluminous residue remaining after the reduction and separation of the iron from the ore. Iron blastfurnace slag, consists essentially of silicates and alumino-silicates of lime and other bases (Nidzam and Kinuthia, 2010, quotes Lee, 1974) with potential cementitious reactivity. Molten blastfurnace slag has a temperature of $1,300^\circ\text{C} - 1,600^\circ\text{C}$ and is chilled very rapidly to prevent crystallization. The granulated material produced is known as granulated blastfurnace slag. It is a latently hydraulic product that can be activated with lime, alkalis or Portland cement to give hydraulic properties (Nidzam and Kinuthia, 2010, quotes Gupta and

Seehra, 1989). The latent hydraulicity means that once activated, the slag reacts with water to give cementitious products. Ground granulated blastfurnace slag (GGBS), can be incorporated in cementitious materials to modify and improve certain properties in order to conserve non-renewable natural resources and to utilize industrial by-products. The possibility of recycling or processing materials to use as partial replacements for cement in concrete, or to stabilize soils, has great economic benefits in all areas of the construction industry (Nidzam and Kinuthia, 2010, quotes Wild and Tasong, 1999). Although GGBS is cementitious on its own, the process is very slow unless there is an activation. Higgins (1998) observed that GGBS on its own has only mild cementitious properties and in conventional concrete, it is used in combination with Portland cement whose alkalinity provides the catalyst to activate the cementitious properties of the GGBS. He also reported that lime (calcium hydroxide) could provide the necessary alkali for activation. The use of GGBS is well established in many cement applications where it provides enhanced durability, high resistance to chloride penetration, resistance to sulfate attack and protection against alkali silica reaction (ASR). Its use in soil stabilization is however still a novel process. The well-established sulfate-resisting properties imparted to cements by blending them with GGBS suggests that by blending lime with GGBS, the latter may impart similar sulfate-resisting properties to lime-stabilized clay. In both hydrated PC and mixtures of sulfate-containing clay mixes and PC, the phases present are similar – ettringite, C-S-H, C-A-H and C-A-S-H gels. As PC hydration products are practically the same as those of slag-Portland cement blends, then it is likely that those of lime-slag-clay are also similar or at least comparable with those of cement-slag blends. The utilization of GGBS in soil stabilization is a relatively new phenomenon in Malaysia. The introduction of GGBS into a clay-lime hydration system modifies the clay-lime reaction products. GGBS provides additional alumina, calcia, silica and magnesia to the system, depending on the type and amount of GGBS. Since the principle reactants introduced by GGBS are also present in the clay-lime system as well as in PC-GGBS blends, the strength of hydrated clay-lime GGBS mixtures is likely to be governed by the same factors observed in hydrated PC-GGBS blends. These factors include water content and curing environment, the properties of the C-S-H gel, such as its amount, porosity and permeability, the fineness and composition of all reactants involved, the efficiency of mixing, the temperature and the curing period. GGBS also introduces extra and more freely available alumina and silica, due to its high reactivity in the presence of lime, thus enhancing strength by contributing silicates and aluminates. The lime in the clay-lime mix will provide the required alkaline environment for GGBS activation and hydration, whilst also modifying the clay. (Nidzam and Kinuthia, 2010 quotes Smolczyk, 1980, Regourd, 1980, Kinuthia, 1997, Wild *et al.*, 1998).

Clay-Lime-GGBS Reactions

The introduction of GGBS into the lime-clay hydration will undoubtedly modify the lime-clay reaction products. The clay-lime-GGBS reaction is different from the clay-lime reaction in that there are two competing reactions rather than one. The first reaction is the hydration of GGBS activated by lime to produce C-A-S-H gel and hydrotalcite type phases containing magnesium (Meng *et al.*, 1998). This reaction is known to consume lime. The second reaction is the typical clay-lime reaction to produce C-A-S-H and calcium aluminates and aluminosilicates. In contrast to the pozzolanic reaction of clay with lime, which is slow, the slag hydration activated by lime is much quicker. The strength of clay-lime GGBS mixtures is

governed by the same factors observed in GGBS-PC blend hydration. These factors include properties of the C-S-H gel such as its amount, porosity, permeability and structure. The lime-clay mix provides the required alkaline environment for GGBS activation and hydration. Thus, the observed increases in strength in GGBS-Portland cement blends are also likely to take place in lime-clay-GGBS mixes since the GGBS will introduce extra and more freely available alumina and silica thereby enhancing the formation of the strength contributing silicate and aluminates hydrates, compared to the clay-lime system. The partial replacement of lime by GGBS enhances strength and using a GGBS-lime system instead of lime only leads to a reduction in total binder content.

EFFECTS OF GLAM04 STABILISER ON THE ENGINEERING BEHAVIOUR OF SOIL

Effects of GLAM04 Stabiliser on the Consistency (Atterberg) limit

Nidzam and Kinuthia (2010) studied the effect of adding GGBS on the consistency, compaction characteristics and strength of lateritic soil. The slag content varied from 0% to 15% by dry soil weight. He observed a decrease in both liquid and plastic limit and an increase in plasticity index with increasing GGBS addition. The blended stabilizers PC-GGBS and Lime-GGBS produced overall increases in both the liquid limit and plastic limit for clay soil, thus generally reducing their plasticity indices.

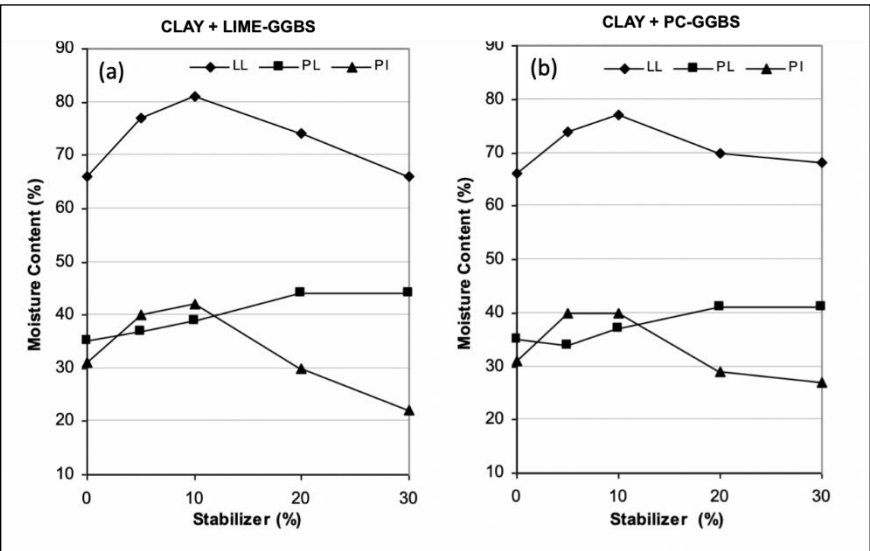


Figure 1. Consistency limits of clay soil stabilized with (a) Lime:GGBS at (50:50) ratio and (b) PC:GGBS at (50:50) ratio.

Nidzam and Kinuthia (2010) studied the effect of adding lime, and GGBS activated by lime on clay. They observed that the addition of small amounts of lime to clay soil produces a marked increase in the plastic limit. The liquid limit may increase or decrease but in such a way that there is a decrease in the plasticity index with increasing lime percentage. The addition of GGBS and lime to clay alters the Atterberg limits giving a small reduction in the

liquid limit and a marked decrease in plastic limit, thus producing an increase in plasticity index with a decrease in lime-GGBS ratio.

Effects of GLAM04 Stabiliser on the Compaction Characteristics of Soils.

Nidzam and Kinuthia (2010) found that the addition of lime-GGBS and PC-GGBS stabiliser to clay soil dramatically decreases the maximum dry density and increases the optimum moisture content. However, a decrease in lime-GGBS ratio produced a slight increase in maximum dry density and a slight and non-systematic variation in the optimum moisture content. The presence of gypsum gives a slight increase in maximum dry density and optimum moisture content. This could also be due to an increase of fine powder in the mixture leading to a decrease in the proportion of the coarse material thus making it difficult to attain good compaction.

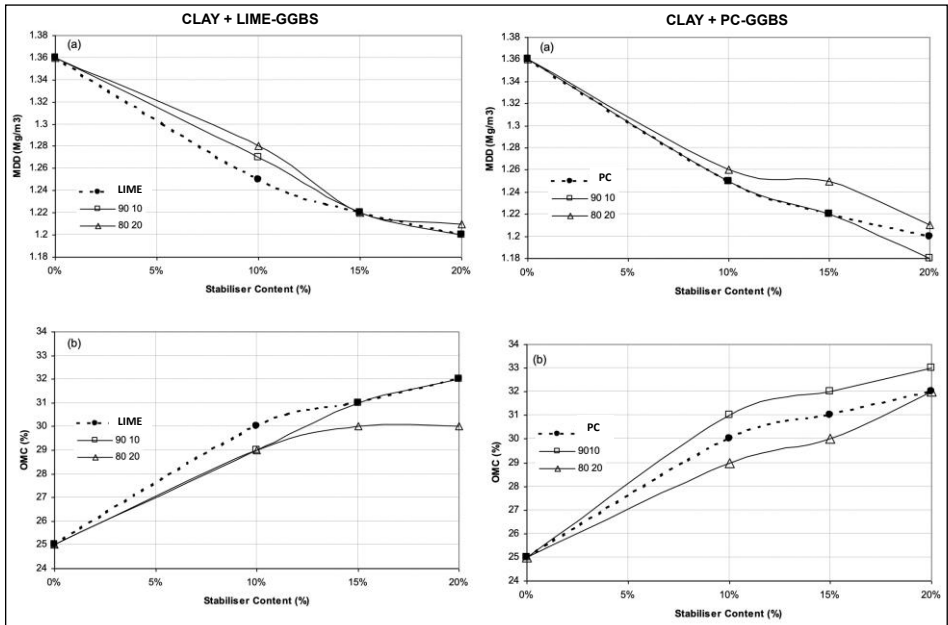


Figure 2. (a) Maximum Dry Density (MDD) vs. Stabilizer Content, and (b) Optimum Moisture Content (OMC) vs. Stabilizer Content of clay soil stabilized with lime-GGBS blends and PC:GGBS (at 90:10 and 80:20 blending ratios).

Effects of GLAM04 Stabiliser on the Strength of Soils

The strength gain using GGBS activated by lime has been investigated by many researchers. Gupta and Seehra (1989) in their studies, found that lime-GGBS soil stabilized mixes with and without the addition of gypsum, or containing partial replacement of GGBS by fly ash produced high unconfined compressive strength (UCS) and California Bearing Ratio (CBR) in comparison to plain soil. They concluded that partial replacement of GGBS with fly ash further increased the UCS. Akinmusuru (1991) studied the effect of adding GGBS on shear strength parameters. He stated that the CBR increased with an increase in GGBS percentage up to 10% GGBS content, and then started to decrease.

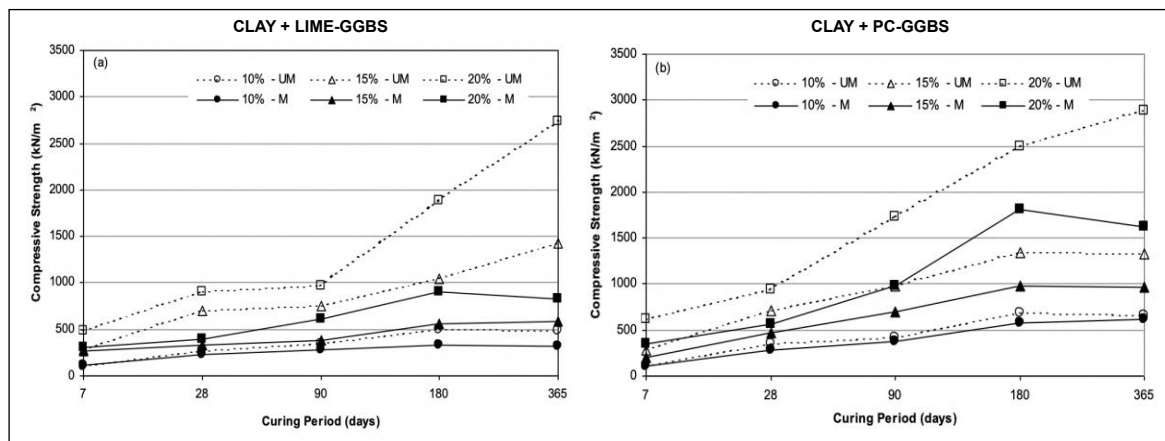


Figure 3. Compressive Strength of clay soil stabilized with (a) Lime-GGBS at (50:50) ratio (b) PC-GGBS at (50:50) ratio, for the mellowed and the unmellowed conditions.

Increased amounts of stabilizer contents generally resulted in increased unconfined compressive strength with increasing curing period for stabilized clay soil. Unmellowed stabilized clay specimens consistently exhibited higher strength values than their mellowed counterparts throughout the one-year curing period. The strength development was very similar for both lime-GGBS and PC-GGBS stabilized clay soil. A partial substitution of lime with GGBS produced improved strength for the clay soil. After 28 days of curing, the most significant strength enhancement was at higher dosage of lime-GGBS ratio, and was due to the contribution of gypsum to the longer-term clay-lime-gypsum reaction. In the absence of gypsum, the most significant strength enhancement was at low lime-GGBS ratio, due to lime-activated GGBS hydration. The greatest short-term strength enhancement was for low lime-GGBS mixture with gypsum, due to the accelerating effect of gypsum on the lime-activated GGBS hydration (Nidzam and Norsalisma, 2011).

DISCUSSION AND CONCLUSION

In the current research project, an effort was undertaken to investigate the overall performance of a clay soil stabilized with various novel blended stabilizers all incorporating GGBS – Lime-GGBS, and P-GGBS. The physical and chemical changes of the soil properties were analysed. A wide range of stabilizer combinations was employed, so as to permit a more complete assessment of the potential of the novel and sustainable (non-traditional) stabilizers for the modification and stabilization of clay soils.

This research is anticipated to contribute to knowledge on environmentally friendly sustainable soil stabiliser material development. This is an ambitious and novel sustainable cementitious technology utilising locally available industrial by-products (GGBS) that potentially contributes toward saving the environment in supporting sustainable development. The success of the development of this innovative stabiliser will provide basis for better understanding as strength enhancing agent in cementitious material. This will eventually upsurge the fundamental and substances to the pool of existing knowledge for future research. The achievement of such improvement to soil stabilisation would foster the growth of road

infrastructure development particularly for low-income economies community. This research will also enhance the attitude, tradition and appreciation of the conversion of waste into viable sustainable soil stabiliser. The development of the novel GLAM04 Stabiliser consists of environmentally safe recipe works on principal of sustainable cementitious technology. When added to soil in presence of water, it will penetrate the soil, create composites within the soil fabrics and modifies its micro-structure, increases the interconnection between soil particles producing homogenous and isotropic material through agglomeration process, thus increasing load bearing strength of the soil. GLAM04 is chemically engineered to withstand durability and swelling of low-load bearing capacity soil.

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LSP BRICKS: AN ECO-COMPLAISANT BUILDING COMPONENTS

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Abstract

The utilisation of waste from industry in the development of advanced materials has been exemplifying the researcher enthusiasm to create eco-accommodating building components. The main objective of this research was to investigate the potential of utilising local industrial waste, Solid Waste Fly Ash (SwFA) and Paint Sludge (PS) as target material in replacing non-renewable natural resources, laterite soil. Pilot industrial and commercial trials were carried out using full size unfired bricks of 225mm x 102mm x 65mm of LC with SWFA and PS (LSP) at 50:25:25 ratio as target material and Hydrated Lime (HL) and Ordinary Portland Cement (OPC) on its own and incorporating Ground Granulated Blast Furnace Slag (GGBS), (Lime:GGBS and OPC:GGBS) both at 50:50 ratio as stabiliser. These trials demonstrated that all key parameters of compressive strength, tensile strength, durability, water absorption, thermal and acoustic properties were within the acceptable engineering standards of masonry units for unfired clay bricks with the system of LSP with blended stabiliser HL-GGBS recorded the best engineering and environmental performances. The test results obtained from this investigation suggest that there is potential in the use of SWFA and Paint Sludge as substitute to clay for unfired bricks. This will certainly contribute to the recycling of SWFA and Industrial Sludge (Paint Sludge and possibly others) and hence to minimise the impact of these by-product landfills on the environment.

Keywords: *Industrial waste, eco-brick, durability, thermal, acoustic.*

INTRODUCTION

Producing a sustainable construction component could prevent and control the pollution and environmental degradation which also one of the key areas in Malaysia's Green Strategies (Department of Environment, 2010). The production of conventional building components for example, clay bricks involve high energy consumption through intensive firing and high carbon dioxide emission. This will also lead to higher material cost to the end user. For this reason, to achieve sustainable construction, there has been a growing interest in reducing energy consumption in the manufacture of building components and construction materials in general. The development of unfired clay building components for example, enables the reduction in manufacturing, energy costs as well as a reduction in carbon dioxide (CO₂) emission. Zhang (2013) reported that production of 1kg Ordinary Portland Cement (OPC) consumes approximately 1.5kWh of energy and discharges approximately 1kg of CO₂ to the air. On the other hand, using industrial waste and/or by-product materials as raw materials to replace the amount of clay used to make unfired bricks or to enhance the performance, is an effective way of recycling waste materials. It reduces the use of natural resources, reduces energy consumption and hence produces a new cost-effective product. Therefore, this research is programmed to use waste or by-product material and targeted to reduce cost in the production of building materials through unfired brick production. The use of waste materials, perhaps, is one of the ways of integrating sustainable approaches in the construction industry.

Sustainable Brick Production

Clay bricks are very sturdy, fire resistant, and require minimum maintenance. Greater clay bricks building depend on the clay brick strength, and fire resistance properties, durability, beauty and performance with mortar (Sadik, et al., 2013). Brick masonry has good thermal mass effect which makes useful components for fuel-saving, natural heating and cooling strategies during the solar heating and night-time cooling. Brick houses have moderate insulating properties, which make the brick houses cooler in summer and warmer in winter, compared to houses built with other construction materials (El Fgaier, et al., 2016). The manufacturing processes of fired bricks contribute to the emission of carbon dioxide (CO₂) which increasing the greenhouse gases to the atmosphere. This impact became critical and should be reduced, as it contributed to global warming and natural disasters. High-energy consumption during the production will also contribute to high cost building materials which led to increasing of total construction cost generally. New research should be carried out to find alternative strategies to integrate sustainable process and technology in the production of construction materials/components. Henceforth it has become a need in producing sustainable construction materials globally. Zhang, (2013) reviewed three (3) general categories of brick production method which are firing, cementing and geo-polymerization. Zhang pointed that firing consumed a significant energy of 2.0 kWh per brick emitted a large quantity of greenhouse gasses about 0.41kg of CO₂. Another issue in brick industry was a shortage of clay that non-renewable sources in many parts of the world. With that reason exploration for alternatives materials for clay in brick industry are essential.

Unfired brick mostly has lower embodied energy and is easier to recycle and dispose as compared to fired brick. This is due to the relatively soft nature of unfired clay bricks which all excess unfired bricks on site can be immerse in water on site, reverting to clay suitable for use in landscaping or with adding additives it can be clay mortar, in that way this will reduce waste on site (Mike, et al., 2008). Since unfired bricks does have the same moisture resistance as blockwork or fired brick it is necessary need to kept dry during and after construction. Materials that normally use as unfired brick has low plasticity with low sulphate and chloride levels and contain large variation of organic component (Ali, 2017). As the unfired brick considered as natural product, performance of it vary slightly with the fired brick.

Utilisation of waste material either from Industrial by-products or agriculture by-product in replacing the natural raw materials in the production of sustainable or green construction components is the new era of research nowadays. (Zhang, et al., 2018, Al-Fakih, et al., 2019). Further promoting sustainable development research, it is also in line with government green policy and supporting government campaign of reduce, reuse, and recycle to reduce carbon emission. The use of waste from other industries will also contribute for low cost building materials. Pappu, et al., (2007) classified 5 categories of solid waste have been explored as construction materials that are agro waste (organic nature), industrial waste (inorganic), mining/mineral waste, non-hazardous wastes and hazardous waste were used to produce bricks, blocks, wood substitute product as well as ceramic products. Brick production utilising recycle wastes is a breakthrough for sustainable green materials which the best solution to avoid all generated waste dumped into the landfill. The awareness of society today in the direction of sustainability in Malaysia encourage more researches on the sustainable and eco-friendly construction materials. The construction industry has the important roles to implement sustainability practices to ensure a better life for everyone now and for future

generations, by reduce dependency on non-renewable construction materials through the use of environmental friendly materials. The latest development of eco-friendly materials especially green bricks is excellent concepts to convert waste into innovated building materials. Zhang, Choy, Arulrajah & Horpibulsuk, (2018) reviewed from previous research which majority of reviewed publication papers on bricks using substitutions waste materials in form of glass, plastics, sludge, slag and ash. Figure 2.6 indicate amongst five types of waste materials explored incorporated as brick, block or cementitious development.

MATERIALS AND METHODS

Laterite Clay Soil

Laterite clay used in this experiment were collected from a construction site located in Shah Alam which frequently used as backfilling during earthwork. LC was air dried at room temperature before oven dried at 40°C for 24 hours and crushed for finer particles.

Solid waste Fly Ash (SwFA)

Municipal Solid Waste (MSW) typically can be managed in three methods such as thermal treatment, biological treatment or landfilling. Thermal MSW treatment minimised the volume of waste through heat energy and produces biofuels (i.e. syngas, char or bio-oil) (Tan et al., 2014). Solid waste Fly Ash (SwFA) is by-product from incineration process of solid waste burning. SwFA is classified as hazardous materials most of the countries, and it needs to be stabilised. The stabilisation that widely used such as solidification using cement-based or chemical stabilisation. The current capacity incinerator in Pulau Langkawi, Malaysia (100 tonnes/day), Cameron Highland (40 tonnes/day), Pulau Pangkor (20 tonnes/day) and Pulau Tioman (15 tonnes/day), Semenyih (100 tonnes/day) and more heat treatment for MSW will expand in future. Production of bottom ash about 250-300kg /1000 kg waste and fly ash about 25-30 kg /1000kg of waste. Previously SwFA were also used as aggregate, asphalt paving, water-permeable brick and flagstones, sand, cement and other construction materials. The recycling and reused of SwFA should help to extend the life of existing landfill (Lin, 2006). SWFA collected from Cameron Highland incinerator (Figure 1).

Paint Sludge

PS were collected from paint manufacturer located in Shah Alam. The PS are solvent-based waste. Figure 1 also simplifies the paint production process which produced paint sludge as waste from all equipment or machineries washing and production process. The largest volumes of solvent-based waste came from washing production equipment. This wastewater needs to be treated, and sludges were collected after the treatment process prior to discarded legally. PS cake were collected from the manufacturer which in moist condition and needed to oven dried in 24 hours before crush into small particle size. According to manufacturer about 11,000 tonnes of hazardous waste were generated equating to 1.5 percent of production volume. The major oxide composition is Aluminium Oxide and Calcium Oxide which able to contribute for better mechanical properties (Marotta, 2011).

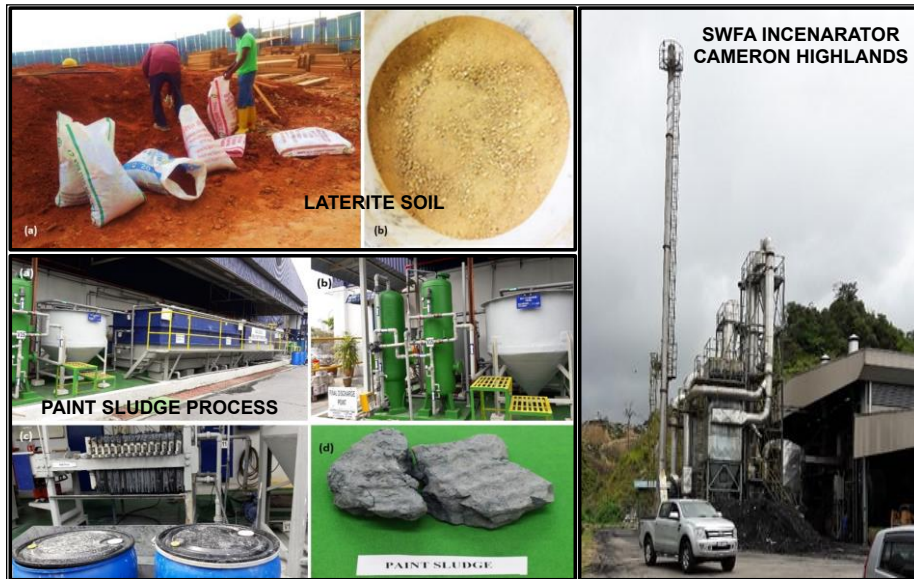


Figure 1. Target Material, Laterite Soil, Paint Sludge and Solid Waste Fly Ash

Ordinary Portland Cement (OPC)

The OPC is simple materials, yet its complexities have an impact on the properties and behaviour construction components from mixing right through to the end of its life. OPC is in fine grey or white colour powder, and the particles have a relative density of about 3.14. OPC is largely a mixture of calcium silicates (dicalcium silicate, C_2S , and tricalcium silicate, C_3S) with smaller proportions of tricalcium aluminate and tetracalcium aluminoferrite (Marotta, 2011).

Hydrated Lime (HL)

Traditionally lime has been used as a stabilising agent to carry out soil stabilisation experiment. Lime able to improve the engineering properties as it can modify the strength of soil. Lime is able to stop the swelling of soil and increase in yield stress for soil stabilisation.

Ground Granulated Blast-furnace Slag (GGBS)

GGBS is manufactured from blast-furnace slag, a by-product of the iron making process with steel industry. GGBS a glassy, off-white powder contained similar chemical composition to OPC which contain Silica, Alumina, Iron oxide and lime (Yi, Liska, & Al-Tabbaa, 2014). GGBS used in this research was supplied by YTL cement



Figure 2. Materials were thoroughly mixed and pressed. Fabrication of LSP Bricks

RESULTS AND DISCUSSION

Compressive Strength of LSP Bricks system (50:25:25)

Figure 3 indicates the pattern of compressive strength for HL stabiliser system (Fig 3(a)) and OPC stabiliser system (Fig 3(b)) for LSP bricks system. LSP with HL stabiliser systems showed that blended stabiliser HL-GGBS gave better performance in compressive strength compared to LSP bricks stabilised with HL only. LSP bricks with HL only at 7 days curing period did not reach $5,000 \text{ kN/m}^2$ the strength only attained at $4,043 \text{ kN/m}^2$, but the strength increased when reached 28 days curing period which logged at $6,479 \text{ kN/m}^2$. The compressive strength at 60 days curing period had slightly increased to $6,547 \text{ kN/m}^2$ and the strength marginally developed at 180 days and 365 days the compressive strength reached $10,674 \text{ kN/m}^2$ and the final monitored curing period the strength attained at $16,577 \text{ kN/m}^2$. LSP bricks with blended stabiliser HL-GGBS increased the compressive strength value which at 7 days curing period the value recorded at $8,661 \text{ kN/m}^2$ that was more than required strength at $5,000 \text{ kN/m}^2$. When reached 28 days curing period the compressive strength continuously increased to $13,638 \text{ kN/m}^2$ the values gradually improved when reached 60 days curing period to $15,202 \text{ kN/m}^2$. The compressive strength at 180 days achieved at $16,707 \text{ kN/m}^2$ and continuously increased at the 365 days final curing period observation recorded at $25,630 \text{ kN/m}^2$. Fig 3(b) indicates the comparative of compressive strength pattern for LSP bricks with OPC stabiliser system. LSP bricks with stabiliser of OPC and OPC-GGBS also exceed the minimum requirement in compressive strength. Compressive strength for LSP bricks stabilised with OPC only for at 7 days curing period the compressive strength logged at

11,163kN/m², 12,450 kN/m² were recorded at 28 days, the value continued to increase at 13,690 kN/m² when reached 60 days. Curing period at 180 days the compressive strength constantly rose to 15,947 kN/m² when reached the final curing period at 365 days the compressive strength reached 27,035 kN/m². LSP with blended stabiliser OPC-GGBS indicated steadily increased of compressive strength. At 7 days curing period the strength recorded at 7595 kN/m² slightly lower than LSP with OPC stabiliser. The strength progressively improved to 28 days to 60 days and 180 days which attained at 12,538 kN/m² to 13,736 kN/m² and 15,497 kN/m² respectively. The final observation of curing period the strength reached 21,507 kN/m².

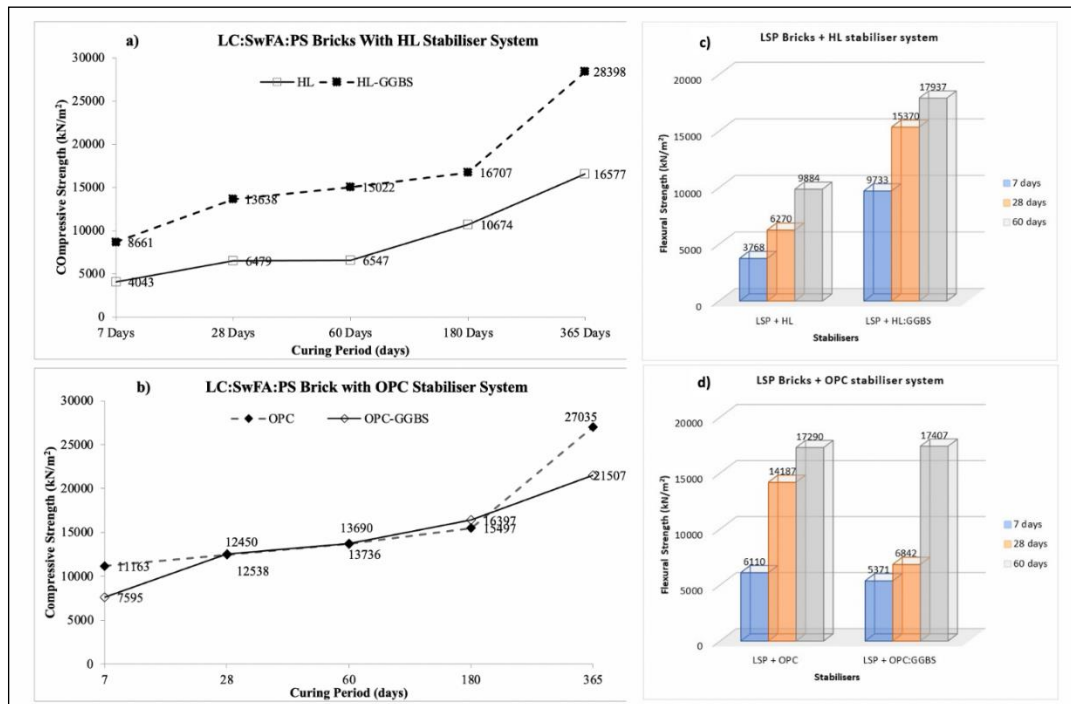


Figure 3. (a and b) Compressive strength vs Curing period and (c and d) Flexural strength vs stabilisers of LSP Bricks

Flexural Strength of LSP Brick System

Figure 3 (c) and (d) shows the flexural strength value for LSP (Laterite Clay: SWFA:Paint Sludge at 50:25:25 ratio) brick stabilised with HL and OPC stabiliser system. This LSP brick system recorded the highest flexural strength of all other brick system investigated. Both stabiliser system also showed incredibly increased of flexural strength value with the increased of curing period like all previous brick system discussed. When HL on its own to stabilised LSP bricks, flexural values gain 3,768kN/m² at an early stage of curing, 7 days before climbing to 6,270kN/m² and 9,884kN/m² at 28 and 60 days respectively. On the other hand when LSP bricks were stabilised with HL:GGBS stabiliser, the flexural strength were enhanced greatly. At 7 days curing the flexural strength was recorded at 9,733kN/m² and continue to increase to 15,370kN/m² at 28 days and the finally to 17,937kN/m² at 60 days.

Figure 3 (d) illustrates the flexural strength for LSP bricks using OPC stabiliser system. Very high strength value were recorded at prolonged curing period of 60 days which was $17,290\text{kN/m}^2$. This condition indicated that prolonged pozzolanic reaction occur in the brick system. When LSP bricks were stabilised with OPC:GGBS stabiliser, the flexural strength were low the early curing of 7 and 28 days which are $5,371\text{kN/m}^2$ and $6,842\text{kN/m}^2$ respectively. At 60 days of curing, the flexural strength value was greatly attained at $17,407\text{kN/m}^2$ which occurred from the never ending pozzolanic reaction as the OPC and GGBS contained higher cementitious materials of C-S-H and C-A-H that improved the brick's strength.

Thermal Conductivity of LSP Brick System

Figure 4 shows the thermal conductivity values of bricks made of the combination of Laterite Soil: SWFA: Paint Sludge at 50:25:25 ratio. The overall thermal values are below 0.45 W/m.K for all stabilizer used. In this system, when blended binders were used to stabilized bricks, recorded marginally higher thermal values than when hydrated lime and PC were used on its own as stabilizer. The highest thermal conductivity value marked by LSP+HL:GGBS brick which is 0.451 W/m.K ., and the lowest thermal values for the system is LSP+OPC which is 0.272 W/m.K .

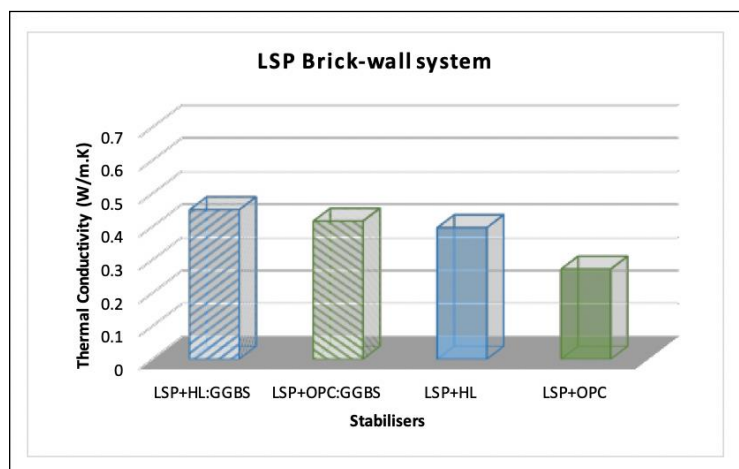


Figure 4. Thermal conductivity vs stabilisers of LSP Bricks

CONCLUSION AND RECOMMENDATION

LSP brick stabilised with HL:GGBS recorded higher sound absorption co-efficient compared to bricks that stabilised with OPC:GGBS but at minimal differences. The average of sound absorption co-efficient were 57% and 51%, meaning that 57% sound were absorbed and 43% of sound energy were reflected by LSP+HL:GGBS bricks and 51% sound were absorbed and 49% of sound energy were reflected by LSP+OPC:GGBS bricks respectively. The research outcome showed compliance with the thermal properties and sound absorption of masonry bricks. Using SWFA and Paint Sludge as raw materials to make unfired bricks is

an effective step towards enhanced of recycling industrial waste and by-product materials, reducing the use of natural resources, reduces energy consumption, and hence produces a new cost-effective and environmentally friendly product. This is also fulfilling the criteria set by most environmental assessment methods for the selection of the materials for use for “green” building. The success of pilot industrial commercial trials for unfired LC, SWFA, LS and LSP bricks was a good outcome as it showed that is possible to utilise HL:GGBS and OPC:GGBS blends without dosing solely to HL or OPC as viable binders for the manufacture of sustainable building materials. This new brick invention can therefore be used for low-medium cost construction and economical alternative to the fired building wall elements. The current research has demonstrated that there is an increasing number of potential alternative green bricks from waste as replacement to conventional masonry bricks. Utilisation of appropriate waste material in the production of unfired brick can be helpful in reducing the landfill and associated environmental problem. Moreover, the innovative bricks with improved properties can be manufactured on industrial scale leading towards sustainable and cleaner production, for possible future field trials by enthusiastic contractors, developers, building components manufacturers and designers.

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LIGNOCELLULOSE BRICKS FOR DOMESTIC INFRASTRUCTURE

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Abstract

The aims and objective of the research is to develop the technologies for sustainable building components for low impact housing from locally available agricultural waste/by-products. This study investigates the potential of utilising industrial agro-waste from paddy straws at Sekinchan, Selangor as a target material (partially added to soil) in development of eco-bricks. Rice straw is presently disposed of mostly by open burning. This results in the release of various pollutants affecting the environment, weather and local communities. Yet, there are several potential uses for rice straw which can still be explored and developed to benefit Malaysia's rural economy. The potential economic benefit of utilising straw into the development of building components are competitive while adopting more ecologically sustainable agricultural practices. Extensive laboratory experimental was carried out in the soil laboratory in Faculty of Architecture, Planning and Surveying, UiTM Shah Alam. Various design composition was investigated with laterite soil mixed with rice straw mash (RSM) at 50:50 ratio on target material. Target materials were stabilised with traditional binder Lime and PC with on its own, and with combination of GGBS and blended binder with is Lime:GGBS and PC:GGBS at 50:50 ratio at 20%, 30% and 40% of stabiliser dosage at 20% moisture content. Bricks were fabricated and left for air curing prior to engineering testing at 7 and 28 days. The results showed bricks with 20% PC and 30% Lime: GGBS stabiliser are suitable for construction materials. Generally, the compressive strength for rice straw bricks ranged between 3.8 MPa at 20% rice straw content and 30 MPa at 5% rice straw content. The results of the compressive strength and flexural strength indicated that rice straw cementitious mixture could be classified as carrying material for making bricks with straw content up to 10 %. showed bricks with 20% PC and 30% Lime: GGBS stabiliser are suitable for construction materials.

Keywords: *Sustainable, bricks, sludge, ash, durability*

INTRODUCTION

There are many various types of waste which is industrial waste, agricultural waste, construction waste and other waste. Most of the higher industries that produce material waste are the agricultural sector based on agriculture waste statistic. Agricultural waste shall be generated from waste harvesting, farm waste and other waste. Example of waste harvesting is producing rice straw. Rice straw is an agricultural by-product made up of cereal plant dry stalks after the cereals are extracted. In scientific terms, rice straw consists of three components, lignin, cellulose and micellulose as a lignocellulose biomass. It was also referred to as a straw bale. Rice straw is taken off in harvest with rice grains and eventually stacked or scattered over the field, depending on whether it is manually harvested or by machines. One of the waste harvests in the agricultural industry is rice straw. There are several uses of rice straw which is for animal feed, biofuels, biomass and others. The rice straw can also be as additives in materials such as brick in the construction sector. So, as a researcher the development of innovative brick with improved engineering properties utilising rice straw must be investigated. The properties of rice straw are light. By applying the rice straw to the

clay brick, it can create the clay brick a lightweight brick compared to others brick. The lightweight clay brick can absorb sounds to specific levels of decibels. It can also help to build efficiently and thereby reduce time and construction expense. Therefore, the aim of this research is to determine whether the rice straw can affect clay brick workability with the following objectives i) To identify the potential of using agriculture waste (rice straw) in the production of clay brick and ii) To find out the strength and water absorption of rice straw clay brick.

Uses and Potential of Rice Straw

Rice straw can be used in different industries as well. Rice straw can be used for animal feed. Straw can be fed to cattle or horses as part of the rough portion of the diet that are near energy requirement maintenance. It has a high digestibility capacity (instead of hay, which is much nutritious) and it is nutrient content. The heat generated by microorganisms can be useful in sustaining body temperature at cold climate levels in an herbivore's intestinal digest straw. It should always be limited to part of the diet due to the risk of impaction and it is low nutrient profile. The straw can be fed or cut into short lengths called chaff to be used as basketry. Basketry or basket weaving is the weaving or sewing process for folding into two- or three-dimensional artefacts such as mats or containers. Handicraftsmen and artists specializing in basket weaving are usually referred to as basket weavers. Bee skeps and linen baskets are made of coiled and packed continuous straw lengths. Rice straw is becoming a common practice in large-scale biomass power plants in the EU, with several installations online. The rice straw can be used either directly in bales or densified into pellets to carry the feed on longer distances. Pellet torrefied straws can be fired directly with coal and gas at very high rates and can use existing coal and gas plants processing infrastructures. Since the torrefied straw pellets have superior structural, chemical and combustible properties to coal, all coal can be substituted and the coal plant converted into a fully biomass power plant. Besides that, the rice straw also can used for construction material. Straw is used for binding clay and concrete. As building material can be used a mixture of clay and straw known as cob. It is possible to build straw bale houses alone or in a post-beam building. When rice straw is used for the construction of buildings or isolation, the straw is usually finished with plaster. The plastered walls provide a thermal weight, compression and ductility, an acceptable fire resistance and thermal. Straw is an abundant product of farm waste which requires minimum bale and transport energy for construction. The rice straw is usually used for mixing with clay brick.

The rice straw may potential as bioenergy resources. According to (Zafar, 2019) rice husk, the primary rice milling by-product, accounts for approximately 22% of paddy weight while rice straw to paddy is ratio about 1.0 to 4.3. Although the rice husk technology is well developed globally, rice straw is used sparingly as a renewable energy source. Rice straw can be used either alone or in direct combustion combined to produce electricity and thermal energy with other biomass products, combustion kilns and steam turbines. Rice straw energy content is approximately 14 MJ per kg at 10% moisture content. The by-product of fly-ash and bottom-ash are economically valuable and can be used in concrete or brick processing, road construction and embankments. Then, the rice straw also potential to mixed with concrete or brick processing. Today the increasing numbers of demand to clay brick as a wall material. By using agricultural waste in rice straw form, the pollution caused when

agricultural waste is expected to be decreased at the same time and also the weight of clay brick is reduced. According to (Ilham Bahari, 2019) straw material bricks are lighter than bricks without straw.

MATERIALS AND METHODS

Laterite Clay Soil

Laterite is an iron and aluminium rich soil and rock type and is commonly considered formed in tropical areas whether heat or wet. Almost every laterite is rusty-red due to the high content of iron oxide. If it is wet, it is possible to cut laterites quickly into blocks with a spade. The laterite is extracted under the water table and therefore is wet and fragile. So, it is easy with laterite clay soil to form a brick. Soil with very fine mineral particles and little biological material is classified as the soil of clay. The soil is quite sticky, as mineral particles do not have a lot of space and they are not well drained. The clay was collected from Shah Alam at project LRT 3, near UiTM station. The clay soil is containing a high percentage of fine particles and becomes sticky when wet. The clay was air dried ground and sieved beforehand.

Rice Straw

Rice straw is an agricultural by-product made up of cereal plant dry stalks after the cereals are extracted. During harvest, rice straw is removed with rice grains and ends up stacked or spread out in the field depending on whether it was harvested manually or using machines. In the event of a yearly harvest, the straw created is three times more than usual average. In scientific terms, rice straw consists of three components, lignin, cellulose and micellulose as a lignocellulose biomass. Rice straw in this research as a mixed material. The rice straw was collected from the agricultural waste at paddy field, Kuala Selangor. After be collected, the rice straw was be dry and cut into 10mm.

Portland Cement

A cement is a binder, a building product that adds certain materials to it, hardens them and ties them together. Cement is seldom used alone, but rather to tie together with sand and gravel. For building, cements are typically inorganic, often calcium or silicate-based. These can be classified as hydraulic or non-hydraulic in the presence of wate depending on how well the cement can be placed. In this research cement is used as others raw materials in clay bricks. The Portland Cement was provided by the lab Faculty of Architecture, Planning and Surveying (FSPU) in the UiTM Shah Alam, Selangor.

Hydraulic Lime

Hydraulic Lime (HL) is a generally used in the making of lime mortar that is hydrated by lime (calcium oxide) or slaked lime (calcium hydroxide). Hydraulic lime has a quicker starting range and a greater strength than air lime and highly hydraulic lime including under water is used in more extreme conditions. A hydraulic lime is made of a claystone which either natural contains some kind of amorphous silica or has been artificially added into the burning process. Lime also be used in the mixtures of clay bricks. Usually, the weight of lime from 2% to 5%. The Hydraulic Lime (HL) was provided by the lab Faculty of Architecture, Planning and Surveying (FSPU) in the UiTM Shah Alam, Selangor.

Ground granulated blast furnace slag (GGBS)

Ground granulated blast furnace slag (GGBS or GGBFS) is extracted from water or steel furnace by quenching molten iron slag to create a glassy granular material that is subsequently dried and ground into a fine powder. In combination with normal Portland cement or other pozzolanic material, GGBS is used to produce durable concrete structures. Not only for concrete, GGBS also can be as stabilizer material in production of bricks. The physical of GGBS is like a powder same as Portland cement. The brick that containing GGBS cement has higher strength than brick used Portland cement. This is because GGBS has a higher proportion of strength calcium silicate hydrates. The GGBS was supplied by YTL factory in Pulau Indah, Klang. Since being collected, the GGBS was taken to the lab for the next step.



Figure 1. Materials used for brick fabrication (a-b)Rice straw (c) Laterite Soil (d) Lime (e) Portland Cement (f) GGBS

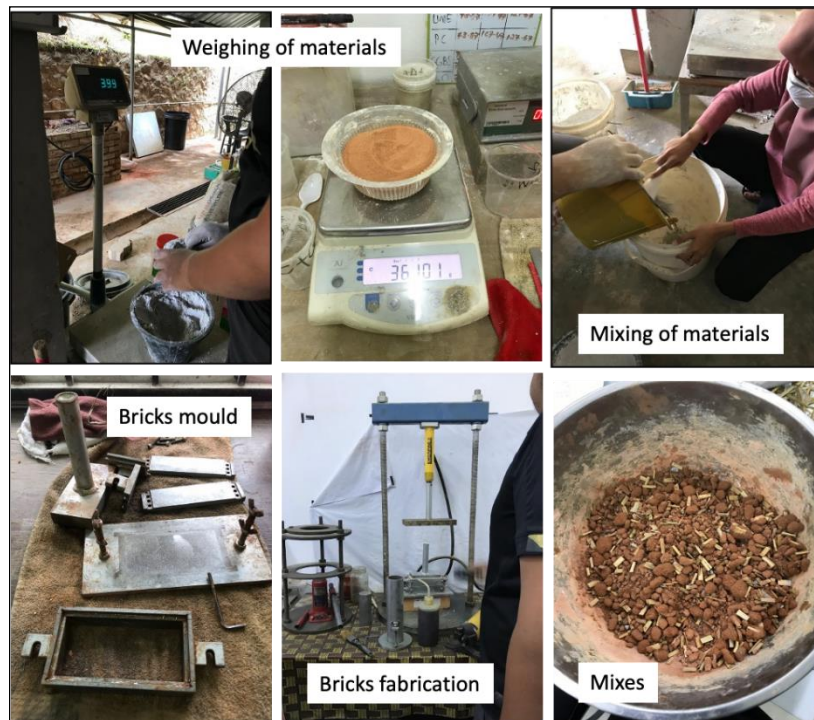


Figure 2. Methodology of brick fabrication

RESULTS AND DISCUSSION

Due to current Corona pandemic situation, although the test specimens were ready fabricated, unfortunately the access to the FSPU laboratory was not granted. Therefore, the results were solely based on the previous researcher that did similar investigation.

Compressive strength

The compressive strength of the composites with respect to the straw particle content and size at 28 days is presented in Figure 3. The results show that the increase of the straw content decreases the compressive strength of the composites. Also, compressive strength decreases with an increase of the straw particles size at the same level of straw content. The compressive strength of the composites ranges from 3.8 to 30 MPa. The compressive strength values fall within the range of values reported by Karade (2003) for cork cement composites with 10 – 30 % cork incorporation, i.e., 1.05 to 26.18 MPa. Compressive strength value decrease from 51 MPa, for neat cementitious paste, to 6.6, 5.14, 4.5 and 3.8 MPa, for 20-40 mesh, 10mm, 20mm and 30mm straw particles at 20 % straw content. A plausible explanation for this phenomenon was provided by Morsi (2011) quoted Li (1992), who describes the effect of the presence of various fibers on the compressive strength in cementitious materials. The strength properties of cement-based materials are influenced by porosity. At low levels (0.5–1.0% by volume) of inclusion, fibers enhance compressive strength by resisting the growth of cracks. However, higher fiber content increases porosity of the composite material and results in a

loss of compressive strength. Other possible reasons for an increase in porosity at higher levels of straw addition include the higher amount of water input and poor compaction Morsi (2011) quoted Karade (2003). Also, the decrease in the compressive strength is attributing to the physical properties of the straw particles, since they are less stiff than the cement matrix. Under loading, cracks are initiated around the particles, which accelerate the failure of the cement matrix.

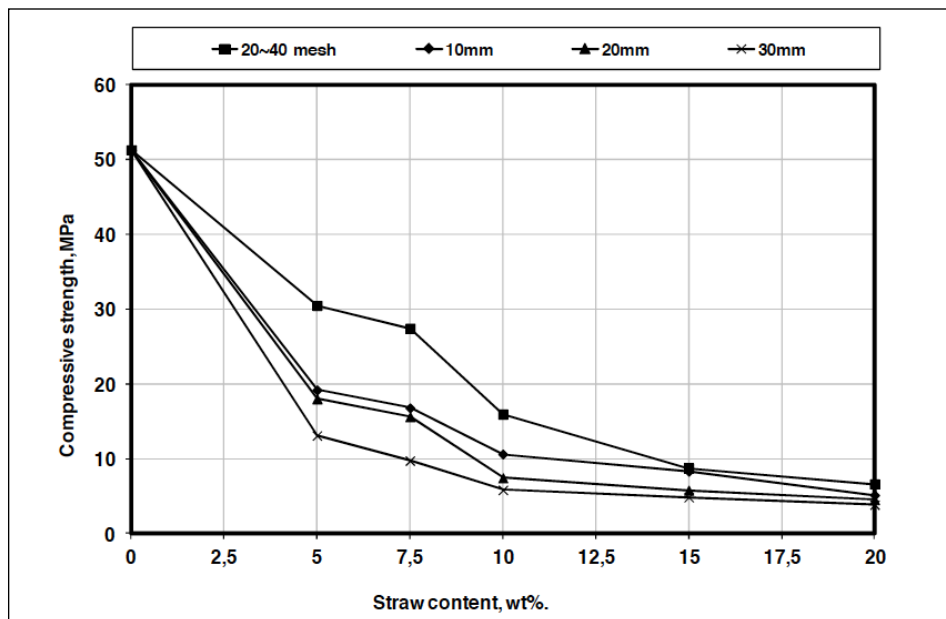


Figure 3. Effect on rice straw content on compressive strength (Source: Morsi, 2011)

Flexural strength

The variation in 28 day flexural strength as a function of the straw content and straw particle size is shown in Figure 4. The flexural strength of the composites increases with an increasing straw content up to 7.5 wt%. Value of flexural strength increases from 3.62 MPa, for neat cementitious mixture, to 4.46, 5.49, and 5.88 MPa for 10 mm, 20 mm, and 30 mm straw particles at 7.5 % straw content. While, for straw particles size (20 -40) mesh, flexural strength decrease with an increasing straw content. This behavior is caused by an increase of the critical length of the straw particles. The higher strength of the composites with longer fiber fractions can be attributed to the increase of the critical length of the straw particles. The straw critical fracture length is defined as twice the length of straw embedment, which will cause straw fiber failure during pullout. Therefore, when the embedment is shorter (20- 40 mesh Straw particles), fiber tends to be pulled out, and when it is longer, fiber tends to break. The longer straw fiber fraction had better strength property. The length contribution however was not that significant to the strength improvement. For example, at 7.5% fiber content, with straw length nearly tripled from 10mm to 30mm, the composites strength values increase from 4.46 MPa to 5.88 MPa.

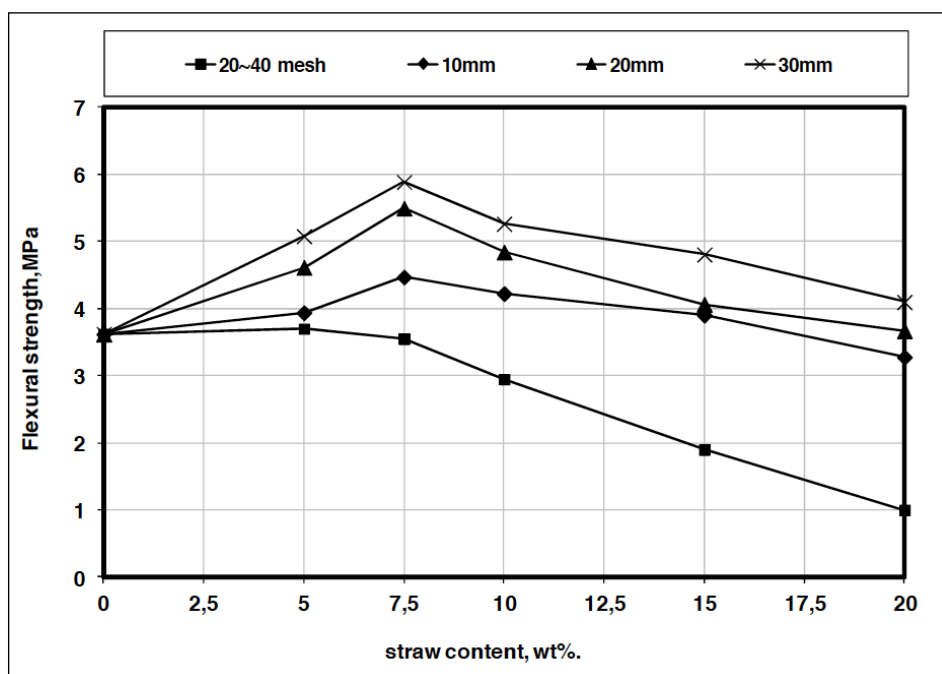


Figure 4. Effect on rice straw content on flexural strength for different straw particle sizes
(Source: Morsy, 2011)

Water absorption

The mean Water Absorption (WA) for each straw composite produced with different straw / cementitious mixing ratios and straw particle size combinations after 24 h immersion in cold water is shown in Figure 5. The results show that the increase of the straw content increases the WA of the composites. Also, WA increases with an increasing straw particles size at the same straw content. Table (11.10) shows that the straw content and the interaction of both, straw particle size and straw content have a significant effect on WA of the composites. As the straw content and particle size increase, the ability of the composite to absorb water increases significantly. This may be explained by the fact that straw, like other lignocellulosics, is hygroscopic, with a relatively high affinity for water. Also, the cementitious matrix apparently better encapsulate the smaller straw particles. Therefore; the smaller capsulated particles absorb less water than the bigger straw particles.

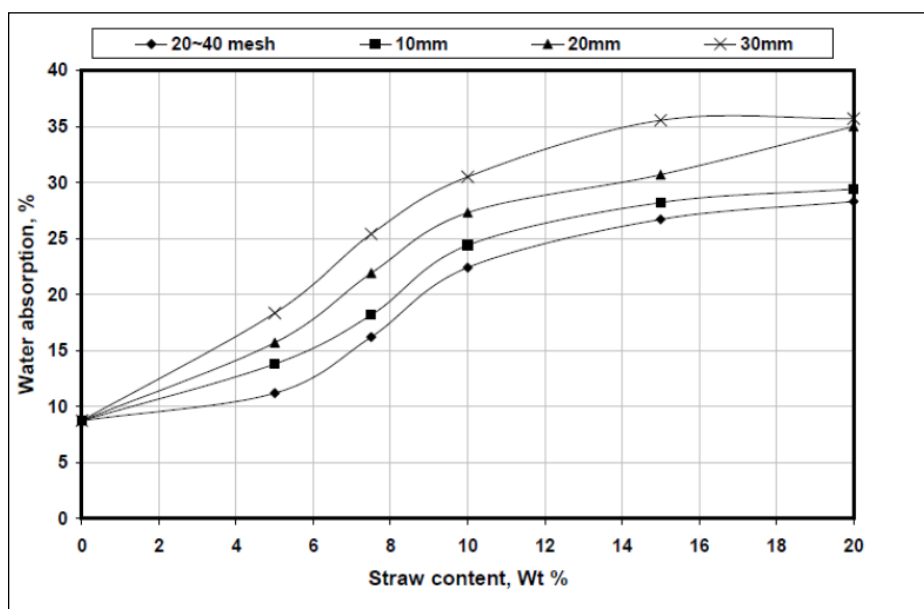


Figure 5. Effect on rice straw content on water absorption for different straw particle sizes (Source: Morsy, 2011)

CONCLUSION

A reduction in compressive strength of the rice straw composite was observed due to the increase of rice straw content. Also, compressive strength increased when straw particle size decreased at the same fiber content. Generally, the compressive strength for rice straw - fly ash cementitious mixture ranged between 3.8 MPa at 20% rice straw content and 30 MPa at 5% rice straw content. Rice straw cementitious composite flexural strength increased by increasing the straw content up to 7.5% for 10-, 20- and 30-mm rice straw particle. Also, flexural strength increased when flake length increased at the same fiber content. The flexural strength for rice straw cement mixture ranged from 1 MPa to 5.88 MPa. The results of the compressive strength and flexural strength indicated that rice straw cementitious mixture could be classified as carrying material for making bricks with straw content up to 10 %.

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SUSTAINABLE UTILISATION OF PAPER MILL SLUDGE ASH FOR THE MANUFACTURE OF BUILDING BRICKS

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Abstract:

The need for sustainability, reduction of material processing costs such as firing is well established within the construction industry. The recycling of wastes as admixtures nowadays is much more than an alternative for reducing costs. It is therefore, the most efficient way for the construction industry to approach sustainability is to reuse waste materials and by-products from other industrial activities. The objective of this study is to investigate the potential of using industrial waste from Malaysian Newsprint Industry (MNI), Mentakab Pahang as target material, partially replacing precious clay soil in the manufacture of building bricks. Extensive laboratory experimental was carried out in the soil laboratory, in the Faculty of Architecture, Planning and Surveying, UiTM Shah Alam. Various design composition was investigated. Laterite Soil (LS) and Paper Mill Sludge Ash (PMSA) were combined at 50:50 ratio as target material. The target material was stabilised with traditional binder Lime and PC on its own. The incorporation of GGBS as blended binders, Lime:GGBS and PC:GGBS at 50:50 ratio at 10%, 20%, 30% and 40% stabiliser dosages were also investigated. Optimum moisture content that used in the mix design was 7%. Bricks were fabricated and left for air curing for 7 and 28 days prior to durability testing. The results showed that in all system investigated, strength was continuously developed as curing period increased. Bricks specimen containing LS:PMSA+Portland cement system recorded higher compressive strength compare with when LS:PMSA+Lime system. Water absorption test showed system that used Lime as binder absorb large amount of water compared to when PC were used as binder. Overall results show that there is a potential of using waste paper sludge ash (PMSA), industrial waste from Malaysian Newsprint Industry (MNI), Mentakab Pahang industry in the development of sustainable building components in promoting national campaign of recycling to support sustainable development.

Keywords: *Sustainable, bricks, sludge, ash, durability*

INTRODUCTION

More than 450 million tons of papers are produced across the world every year. Every year there are a lot of waste paper will produce and the paper manufacturing become the main industrial that cause pollution to the environment. According to the Malaysia Paper Association (MaPA), (The Star, 15 October 2015) was reported that annually the discarded paper is recycles about 45%. Therefore, this means that about 55% or 48 million tons of paper ends up in landfill and the balance are incinerated. If waste paper sludge ash is added to the brick, it can have good sound absorption and thermal insulation since it is a lightweight and refractory material (Susman and Dawson, 2012). In the last decade due to increase in pollution which cause an issue to building, it may be problem among engineer to create something innovative towards waste material that exist. Arya and Kansal, (2015) investigated that one of the most recycled materials used waste paper sludge ash as a building material. The potential role of recycled paper in producing a low-cost and lightweight brick production for

construction not only offers the potential use of waste paper recycling, but also reduces the demand for global natural resources. This is because the construction industry consumes a lot of non-renewable resources. Nowadays, there is a renaissance of interest in traditional building materials, especially building materials made from renewable or recycled, which is one of the materials that can arouse public interest (Arya and Kansal, 2015). The aim of this research is to investigate the potential of utilizing the waste paper sludge ash in the production of brick and to study the engineering properties of the bricks, water absorption, compressive strength and efflorescence for each series of mixed. The waste paper sludge ash sources come from the Malaysian Newspaper Industry (MNI) in Mentakab Pahang. The sludge paper was brought to experiments and tests in the workshop and laboratory of the Faculty of Planning, Planning and Surveying, Shah Alam. The reason of utilize the waste paper sludge as in brick is because to investigate the mechanical properties. Therefore, this research is about the innovative method of waste paper sludge ash in construction material.

Application of waste paper sludge ash

With the ultimate goal of reducing the environmental impact of cement production and of continuously consuming the characteristic natural resources, it is necessary to use the waste paper sludge ash (WPSA). Therefore, there are potential to use WPSA in brick production. The applications today include waste neutralization, livestock farming and the spread of land. For these reasons, in order to reduce environmental impact and produce low-cost bricks, it is extremely important to develop profitable building materials from waste paper sludge ash (Goel and Kalamdhad, 2018). Sustainable industrial production in the 21st century faces two major challenges, first the reduction of carbon dioxide emissions and second the recycling of waste materials. To reduce costs and environmental impact, construction companies and brick manufacturers need an alternative source to meet the demand for sustainable building materials. Due to the growing population, the high demand for building construction has caused a persistent regional shortage of building materials.

Performance of waste paper sludge ash

Akinwumi et al., (2014) investigated that waste paper sludge ash has properties and performance by fixing cellulosic fibres, fillers such as calcium carbonate and china clay, and properties of chemicals that mix with water. Waste paper sludge ash has an energy content that makes it useful as a replacement for Portland cement production (Ruslan et.al., 2019). After drying and grinding, it may cause the waste paper sludge containing reactive silica as well as alumina and lime (CaO). It was investigated that in compression strength, about 5% of the cement replacement by waste paper sludge ash increased by 10% after 7 days and by 15% after 28 days. In addition, the percentage of water absorption increases with increasing waste paper sludge ash (WPSA) content. With increasing waste paper sludge ash content, the average weight for the 20% waste paper sludge ash content mixture drops by 4.58%, making waste paper sludge ash brick light weight. Then, the ability of the brick mixes decreases with increasing waste paper sludge ash content. Next, the splitting tensile strength decreases with increasing waste paper sludge ash content and is more than 5% when compared to the reference brick. In addition, the use of waste paper sludge ash in bricks can become more economical. This is because WPSA is not a useful waste and does not incur costs. In order to

protect the natural resources, waste paper sludge ash is the good idea and therefore a sustainable material for the partial replacement of cement. Also, the disposal problem of the paper industry for this waste material is completely solved.

Waste paper sludge as partial replacement of cement

A study to improve the performance of brick that can be more economical. The new innovation to improve the brick mix in the construction industry by using Waste Paper Sludge Ash (WPSA) as the rest of the paper burning in a waste paper recycling mill in the cone. However, other researchers have found that a class-C WPSA considered higher calcium carbonate or calcium fly ash content of free lime (CaO) approximately 62.39%. Class C of fly ash actually provides the good quality land agent. It is because of unstable nature strengthen themselves. The use of WPSA as a partial replacement for Portland cement may limit the use of Class- C WPSA. Waste paper sludge ash (WPSA) can replace up to 30% of the mass of Portland cement. It can increase the final strength of the bricks, increase its chemical resistance and durability, and reduce the "footprint" of the greenhouse gas of bricks. Due to the spherical shape of the WPSA particles, it can also improve the workability of bricks while reducing the need for water (Balwalk and Raut, 2011, Fauzi et al., 2016).

EXPERIMENTAL PROCEDURES

Brick mixtures is prepared and the brick mixtures are mix with mixer and specimens are cast using brick mould, the standard size of brick (215mm x 102.5mm x 65mm) moulds. The specimens were store under conditions that maintain the temperature immediately adjacent to the bricks in the range of 16°C to 17°C until the age of testing at 7 and 28 days. The preparation is according to the specification BS 3921:1985.

Method of Compressive Strength Testing

Compressive strength is measured by crushing the brick specimen in a compression strength testing machine at a pace rate of 48.00 N / mm. The compression test is performed on the sample after the samples have completed their curing process, after 7 and 28 days of curing. This test is performed to determine the compressive strength of bricks. As a rule, 3 pieces of bricks are brought to the laboratory for testing and tested one by one. In this test, a brick sample is placed on a crusher and pressurized until it breaks. The final pressure at which bricks are broken is taken into account. All 48 brick samples are tested individually and the average result is used as the brick compression / compression strength. The procedures are explained in Figure. The test is carried out according to specification BS 5628: Part 1: 1992

Method of Water Absorption Testing

The water absorption test is carried out according to ASTM C 1403 after 28 days. In this test, the bricks are weighed in a dry state and immersed in fresh water for 24 hours. After 24 hours of immersion, these are removed from the water and wiped with a cloth. Then the brick was weighed in the wet state. The difference between the weights is the water absorbed by the brick. The percentage of water absorption is then calculated. The less water is absorbed

by bricks, the higher the quality. High quality brick does not absorb more than 20% of its own weight. The process is shown in Photo.

Method of Efflorescence Testing

The presence of alkalis in bricks is detrimental if it forms a grey or white layer on the brick surface due to the absorption of moisture. To find out if alkalis are present in bricks, this test is performed. In this test, a brick is for 24 hours immersed in fresh water. Then it is taken out of the water and allowed to dry in the shade. If the whitish layer is not visible on the surface, the absence of alkalis in the brick is detected. If the whitish layer makes about 10% of the brick surface visible, the presence of alkalis is in the forbidden range. If this is about 50% of the surface, it is moderate. If the alkali is more than 50%, the brick is strongly affected by alkalis.

RESULTS AND DISCUSSION

Compressive Strength of LS:WPSA + PC stabilizer system

Based on the observation in Figure 1, the laterite soil combined with WPSA at 50:50 ratio stabilised with PC on its own has a great compressive strength compare to the laterite soil combined with WPSA at 50:50 ratio stabilised with PC and GGBS (50:50). In LS: WPSA + PC system, the quantity of Portland cement in the system is higher than in LS: WPSA + PC: GGBS. The present of Portland cement in the laterite soil and WPSA can trigger the compressive strength of the specimen. Based on the theory, WPSA can improve the durability and bearing capacity when mixed together. This might be because of the waste paper sludge ash (WPSA) possess cementations property. It bind well with the Portland cement and thus the strength was subsequently increase. But the quantity of Portland cement in the design mixed of LS: WPSA + PC: GGBS was insufficient as the Portland cement and ground granulated furnace-blast slag had been used as the stabilised. The little quantity of Portland cement in the mix cannot react effectively together with the ground granulated furnace-blast slag in forming a bond between each other. So, the strength of the specimen is too weak compare to the other stabiliser. Based on the result, the specimen need longer curing period for the Portland cement to fully react with the ground granulated furnace-blast slag. The compressive strength between these two stabilisers was good but stabilisers Portland cement and GGBS need a longer period to react with each other. This is because the Portland cement was not capable to activate the ground granulated furnace-blast slag by its own. This is due to the dawdling pozzolonic reaction between the target material laterite soil, WPSA and stabilisers used. Based on the result, with the present of GGBS in the Portland cement as stabilisers the compressive strength was decrease compare to the absent of GGBS in the Portland cement as in LS:WPSA + PC. Ground granulated furnace-blast slag was not too suitable in stabilised the laterite soil and WPSA. Therefore, the overall compressive strength of every specimen is good.

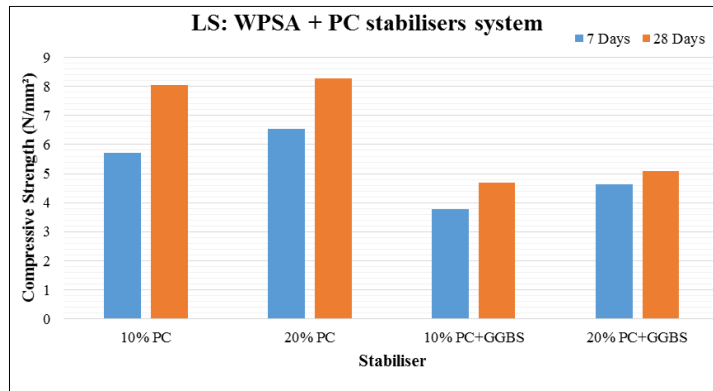


Figure 1. Compressive Strength of LS:WPSA stabilised with PC stabiliser system

Compressive Strength of LS: WPSA + Lime stabilizer system

Based on the observation (Figure 2), the laterite soil combined with WPSA at 50:50 ratio stabilised with Lime on its own has a weak compressive strength compare to the laterite soil combined with WPSA at 50:50 ratio stabilised with Lime and GGBS (50:50). In LS: WPSA + Lime design mix, the quantity of lime in the mixture is higher than in LS: WPSA + Lime: GGBS. The present of lime in the laterite soil and WPSA lower the compressive strength of the brick specimen. Based on the theory, lime can decrease the durability and bearing capacity of the soil. This might be because of the lime does not possess cementitious property. It is not bind well with the laterite soil and WPSA, thus the strength was subsequently decreased. But the quantity of lime in the design mixed of LS: WPSA + Lime: GGBS is less because as the ground granulated furnace-blast slag combined with lime had been used as the stabilised. The quantity of ground granulated furnace-blast slag reacts effectively together with the lime in forming a bond between each other. This might be because of the GGBS possess cementitious property. Because of good in performing bond between each other's, these two stabilizers can hold each other when pressure was applied on them. So, the strength of the specimen is too good compare to the absent of GGBS in the LS:WPSA + Lime.

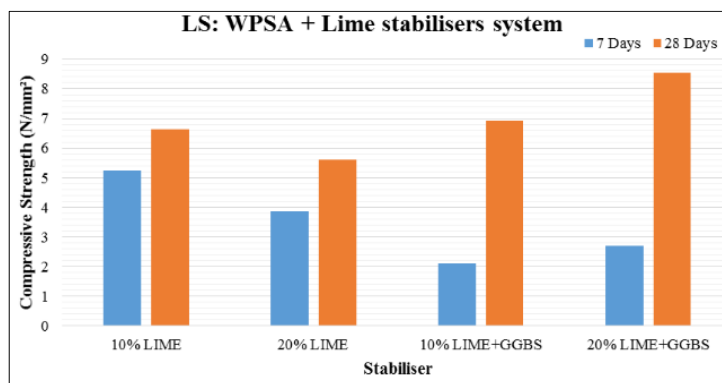


Figure 2. Compressive Strength of LS:WPSA stabilised with Lime stabiliser system

Water absorption of LS: WPSA + PC stabilizer system

Water absorption test (Figure 3) showed the performance of the specimen brick for LS: WPSA+PC and LS: WPSA+PC: GGBS at 10% and 20% mix design. As the ratio increase, the percentage of water absorption increase. The values range from 25% to 34%. All the specimen bricks showed poor performance since it absorbed more than 20% of water. Good quality of bricks shall not absorb more than 20% of water. This concludes that the presence of waste paper sludge ash, lime and GGBS in the bricks does not helps on the performance of the bricks in the term of water absorption. This might be because of the waste paper sludge ash, lime and GGBS possess water absorption property. It absorbed well with the laterite soil, lime, Portland cement and ground granulated furnace-blast slag and thus the water absorption was subsequently increase.

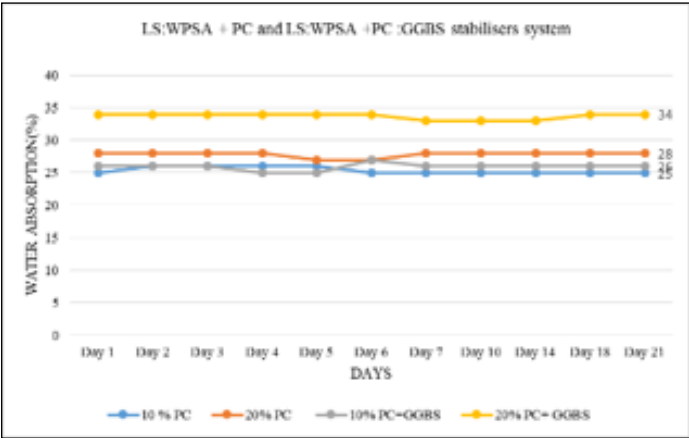


Figure 3. Water absorption of LS:WPSA stabilised PC stabiliser system

Water absorption of LS: WPSA + Lime stabilizer system

Water absorption test (Figure 4) showed the performance of the specimen brick for LS: WPSA+Lime and LS: WPSA+ Lime: GGBS at 10% and 20% mix design. As the ratio increase, the percentage of water absorption increase. The values range from 26% to 35%. All the specimen bricks showed poor performance since it absorbed more than 20% of water. This might be because of the waste paper sludge ash, lime and GGBS possess water absorption property.

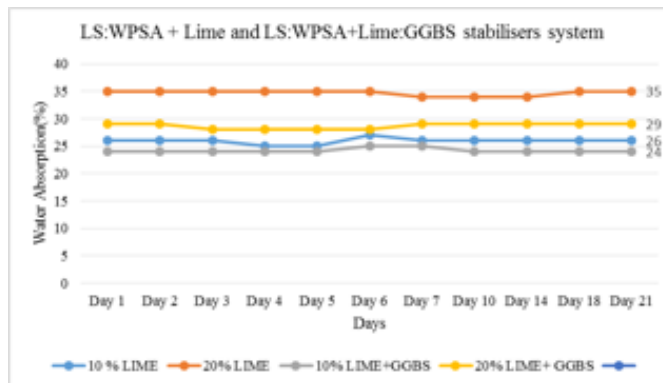


Figure 4. Water absorption of LS:WPSA stabilised Lime stabiliser system

Efflorescence

The efflorescence test also showed the excellence performance of the non-fired bricks. There is no absence of grey or a white deposit was shown on its non-fired bricks surfaces for design mixed with the percentage LS:WPSA +10% PC ; LS:WPSA + 10% Lime ; LS:WPSA + 10%Lime: GGBS and for design mixed with the percentage of LS:WPSA+20%PC:GGBS ; 20% LS:WPSA + Lime ; LS:WPSA + 20%Lime+GGBS. It was showed that the bricks specimen indicates no absence of soluble salts or alkali. But there is present of grey or a white deposit was shown on its bricks surfaces for design mixed with the percentage of LS: WPSA + PC: 10%GGBS and the percentage of LS: WPSA+20% PC. It was showed that the bricks specimen indicates present of soluble salts or alkali but the whitish layer visible about 10% of brick surface. Therefore, the presence of alkalis is unacceptable range. From this test, it can conclude that only slight alkalis were presence in this non-fired brick.

Table 1. Results of Efflorescence for various mix

SAMPLE	LS:WPSA + 10% PC	LS:WPSA + 10% LIME	LS:WPSA + 10% LIME:GGBS	LS:WPSA + 20% PC:GGBS	LS:WPSA + 20% LIME	LS:WPSA + 20% LIME:GGBS
NIL						
SLIGHT						
SAMPLE	LS:WPSA + 20% PC	LS:WPSA + 10% PC:GGBS				

CONCLUSION

The objectives of this research are to study the potential of utilizing waste paper sludge as (WPSA) in the production of non-fired brick. From the results obtained, thus it can be concluded that additive material which is laterite soil, waste paper sludge ash (WPSA), ground granulated blast-furnace slag (GGBS), Portland cement and lime in non-fired brick can be used in brick production in term of compressive strength and efflorescence. Based on the compressive strength result laterite soil combined with WPSA at 50:50 ratio stabilised with PC on its own and combined with GGBS (PC:GGBS) at 50:50 ratio at 10% and 20% stabiliser dosage increase as the ratio increase. The highest compressive strength was 8.27N/mm² for LS: WPSA + 20% PC at 28 days. Then, laterite soil combined with WPSA at 50:50 ratio stabilised with lime on its own and combined with GGBS (Lime:GGBS) at 50:50 ratio at 10% and 20% stabiliser dosage increase as the ratio increase. But the laterite soil combined with WPSA at 50:50 ratio stabilised with lime decrease from 10% to 20%. The highest compressive strength was 8.55N/mm² for LS:WPSA +20% Lime at 28 days.

The bonding between the waste particles and the cement paste is weak. However, the mixes of non-fired brick and laterite soil, waste paper sludge ash (WPSA), and ground granulated blast-furnace slag (GGBS), Portland cement and lime seems impossible because water absorption is more than 20% for all ratios. Furthermore, there are only slight salt/alkalis presence in the brick sample mixes with laterite soil, waste paper sludge ash (WPSA), ground granulated blast-furnace slag (GGBS), Portland cement and lime. The reduced compressive strength values of waste plastic bricks mixes show that it can be used only in situations that required low-degree workability. Such situations are numerous in civil engineering applications, namely, precast bricks, partition wall panels, canal linings, and so forth. By simplifying, the most problem in production of brick is easily to damage such as cracking, surface deformation and surface defects (mould exist), causing problems and affecting on building. So that, from this research, the entire problems have been solved. And then, improper brick production especially in Malaysia that can cause problem to building and make users become uncomfortable also can be solved. The successful use of that laterite soil, waste paper sludge ash (WPSA), ground granulated blast-furnace slag (GGBS), Portland cement and lime in non-fired brick production provides significant impacts on Malaysia's economic savings, waste and environment issues of the coal combustion product. This is because, the price of aggregates has been raised from RM18-RM19 per tonne to RM22 a tonne, which is very expensive. So, this research was proven can reduce the shortage of conventional construction materials especially aggregates. From this problem, material of laterite soil, waste paper sludge ash (WPSA), ground granulated blast-furnace slag (GGBS), Portland cement and lime in non-fired brick is the proving method to solve that problem in production of non-fired brick. As conclusion, this study has reached its objectives.

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ASSESSING THE THERMAL PERFORMANCE OF MALACCA TRADITIONAL MALAY HOUSE TOWARDS SUSTAINABLE PRACTICES

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Abstract

Various innovations in construction technology for modern residential architecture have been introduced recently in urban area due to rapid modern development. However, they have generated saturated settlement which causes the urban heat island (UHI) phenomenon. This has led to an uncomfortable living environment due to increased air temperature. To achieve a cosy condition, occupants use artificial ventilation system. Unfortunately, inefficient energy utilisation eventuates. Therefore, studies have started to seek natural sources as an option to fulfil the occupants' needs and comfort. Previous researchers have specified that modern architecture has poor passive thermal building designs compared to traditional architecture. They have highlighted that the construction of traditional Malay houses is intended for a good indoor thermal performance. Thus, this study assessed the thermal performance based on the spatial division of Malacca traditional Malay houses in a tropical environment towards sustainable practices. This study used qualitative and quantitative methods; both in observation of the houses' condition and thermal data collection. The result showed that the indoor air temperature and RH were slightly lower than the outdoor area, i.e., about 2.1°C and 3.8% respectively. Meanwhile, the indoor's wind speed was higher compared to outdoor area, i.e., about 0.67m/s. The findings of the study showed that courtyard influenced the thermal condition of the Malacca houses. It contributed to the indoor ventilation which created natural cross ventilation. Hence, this study highlights an idea and knowledge in improving the construction technology for modern residential architecture to produce an effective indoor thermal performance in a tropical environment. (250 words.)

Keywords: *Courtyard, Malay house, thermal performance, traditional architecture, tropical environment*

INTRODUCTION

Various innovations in construction technology such as for modern residential cluster and layout have been introduced recently due to the rapid modern development. The development has generated an urban heat island (UHI) phenomenon (Misni, Jamaluddin, and Kamaruddin, 2015). This has led to an uncomfortable living environment due to increased air temperature. (Misni et al., 2020; Misni et al., 2015; Buyadi, Mohd, and Misni, 2014; Sakka et al., 2012). Due to this UHI, energy utilisation for the cooling purpose has increased substantially in the residential sector. This indicates that the modern building construction is poor in passive thermal design. Occupants have decided to use artificial ventilation system, such as air conditioning to have an ideal thermal condition. Unfortunately, inefficient energy utilisation eventuates (Hassan and Ramli, 2010). In fact, the process of energy is becoming more expensive. As a result of these situations, people have started to look for natural sources as an option to fulfil their needs and comfort.

Previous researchers have specified that modern architecture has poor passive thermal building designs compared to traditional architecture. They have highlighted that the construction of traditional Malay houses is intended for a good indoor thermal performance. According to the previous studies, experimental study is carried out to evaluate or assess the thermal performance of the Malay houses. The data obtained are analysed to assess the indoor thermal performance in traditional Malay houses. The characteristics of the climatic design strategies will also contribute to a sufficient indoor thermal quality of Malay houses. Thus, this study assessed the thermal performance of traditional Malay houses in tropical environment towards sustainable practices.

LITERATURE REVIEW

Traditional Malay houses are believed to have the right harmony with the environments which is responsive to the surrounding physical environment (Hosseini, Mursib, and Shamninan, 2016). The climatic design of the Malay houses consists of two main components which are building setting and physical architectural aspects. As for the building setting, building orientation and outdoor environment are the elements that play an essential role in contributing to the effective thermal qualities of the house. The appropriate building orientation can help and control the solar radiation, which is to reduce the heat gain, as well as allow for the wind flow to ventilate the house (Misni, Baird, and Allan, 2013). Meanwhile, the houses arranged randomly, are being supported with suitable natural vegetation in the surroundings for shade and a cooler microclimate (Sahabuddin, 2012).

The physical architectural aspect that helps in performing the ideal thermal performance in Malay houses are the building envelope and design or form of the houses. Walls with openings (windows, doors, and ventilation lattice) and minimal partitions in interior (open plan layout) are to allow cross-air ventilation. In addition, the raised floor (built on stilt) catch winds of a higher velocity. Besides, the roof space (attic) allows the air to ventilate through space below which cools the house effectively while the broad roof eaves can control direct solar radiation. These composed building elements exhibit how Malay houses practice a passive thermal design, especially for natural air ventilation (Kubota and Toe, 2012).

Several studies have been conducted in Malaysian states to evaluate the thermal performance of traditional Malay houses. Based on these studies, the character of the houses selected can be concluded by the same type of roof design which are *bumbung panjang* and *limas*. Moreover, the design and layout of the houses are common that include a veranda, *rumah ibu* and kitchen. From these research analyses, it can be concluded that there is a lack of experimental studies on traditional Malay houses that have a courtyard, such as the Malacca houses. Malacca houses are the only traditional Malay houses that have a courtyard/*pelantar* addition (Yaaman and Ramli, 2013). Henceforth, this study also identified the influences of the courtyard/*pelantar* in the Malacca houses which provide maximum ventilation among the other spaces.

METHODOLOGY

The method used for this study was fieldwork. This involves qualitative and quantitative methods. There are two-stage process of fieldwork; observation method (on-site physical inventory process) and experimental study (thermal data collection).

Observation

The following information for the physical inventory process is the measurement of Malacca houses and compounds with the layout, respectively. The use of physical architectural elements and building materials were observed. In addition, outdoor compound, landscaping, and mechanical cooling system used in the house were record. All information was recorded into an inventory table, photographic images, and schematic drawing.

Experimental Study

There are four specific standards of the environmental parameters taken in this experimental study; air temperature (°C), relative humidity (RH) (%), wind speed (m/s), and solar radiation (MJ/m²) (ASHRAE, 2017). The climate data were obtained from the nearest meteorology station. Whereas, the thermal data (air temperature, RH and wind speed) was taken using Anemometer 4-in-1 thermal monitoring test. The various points indicate the indoor & outdoor measurement of the house (Figure 3b). The measurement was taken 1.2m from the wall in interior (CLEAR, 2019) and 1.1m above floor level (ASHRAE, 2017). As for outdoor measurement, the sensor was located to indirect solar radiation (Rice, 2018). Meanwhile, the measurement point is not less than 5m distance from the house’s walls and 1.5m above the ground (Tcollow, 2014). This is because the wind speed and direction may dramatically be affected by all physical obstructions near the ground level (Prodata, 2019; Misni et al., 2013).

The measurements were taken in 12 hours from 7.00 a.m. until 7.30 p.m. with 30 minutes’ intervals in three days, whereas, no measurement was conducted at night considering the owners’ privacy of night time. During the measurement, the houses were occupied and windows were always kept open. The data were only taken during the overcast sky (partly cloudy) condition, which is a typical type of sky conditions in Malaysia. In order to verify the thermal performance of the house, Olgyay’s (1963) bioclimatic chart to ASHRAE was used as climatic analysis tools. The aerofoil-shaped zone as shown in Figure 1 is the comfort zone. The range of comfort level based on the Olgyay’s Bioclimatic Chart is shown in the Table 1.

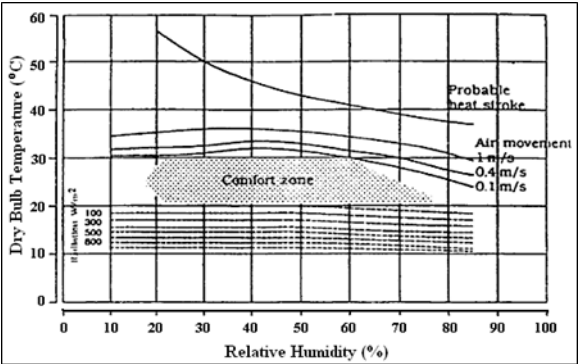


Figure 1. Metric version of the Olgyay’s Bioclimatic Chart. Source: Olgyay (1963), cited in Al-Rawahi et. al, (2013)

Table 3. Comfort levels based on The Olgyay’s Bioclimatic Chart

Parameter	Comfort level
Air temperature	20 to 30°
Relative humidity	20 to 80%
Wind flow	0.1 - 1.5m/s

(Source: Modified from Olgyay (1963), cited in Al-Rawahi et.al, 2013)

RESULTS AND DISCUSSIONS

Physical Data

A traditional Malay house in Jasin, Malacca was chosen as the case study. The house is located at Kampung Pondok Kempas in Selandar, Jasin, Malacca with 2.3593° N latitude and, 102.3711° E longitude, while elevation is around 38m, as shown in Figure 2. The owner of the house is Normala bin Ali. It was built around 1940 and already 80 years old with a total area of 143.7m² (1546.8sqft). It is a single-family house with ample outside spaces. It still possesses and maintains the distinctive characteristics of a traditional Malacca house. The house is oriented to face east-west direction, with the direction of qibla is 293°. The house is surrounded by an ample lawn compound area and part of it has to be tarred as a groundcover. The front yard of the house also has ample space with a few trees planted.

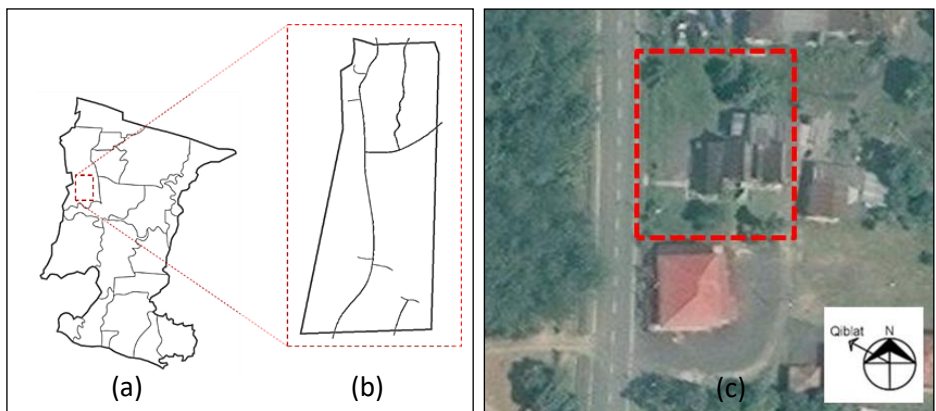


Figure 2. The key plan of Selandar, Jasin, Malacca (a), location plan at Kampung Pondok Kempas (b), and the site location of the Malacca House (c)

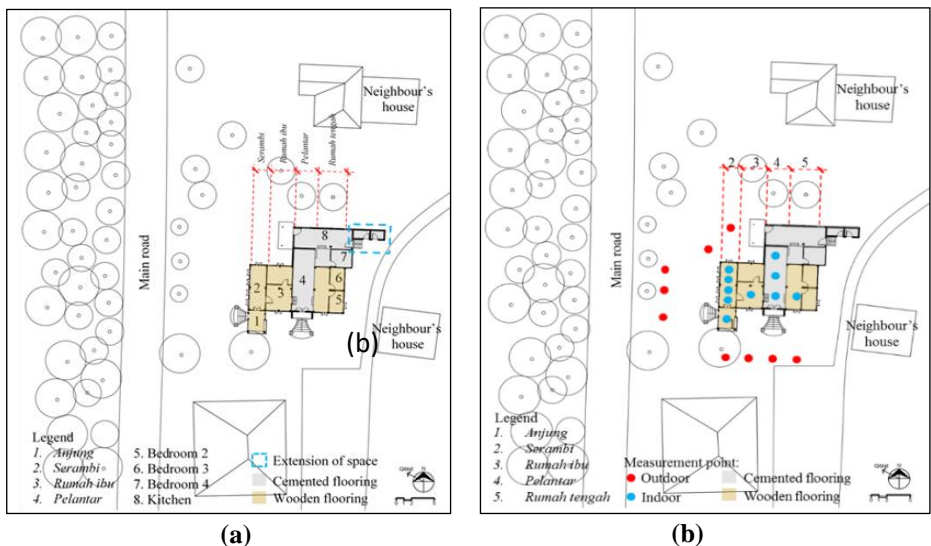


Figure 3. Site plan; the house's spatial division (a), and measurement points inside the house and outdoor area (b)

The typology of the house is *Berbandung Tiga* which consists of 16 main pillars. The house has six spatial division; *anjung* (6.8m²), *serambi* (14.3m²), *rumah ibu* (35.4m²), *pelantar* (courtyard) (24.1m²), *rumah tengah* (25.4m²), and *rumah dapur* (kitchen) (20.6m²). The house has undergone some modifications and extensions of space or area. As for this house, toilets are the extension spaces (Figure 3a). The kitchen has been renovated into brick and concrete materials. The original bedroom of this house is only the *rumah ibu*. However, as the number of family members has increased, Bedrooms 2, 3, and 4 have been added. Plywood has been used as walls to demarcate the space.

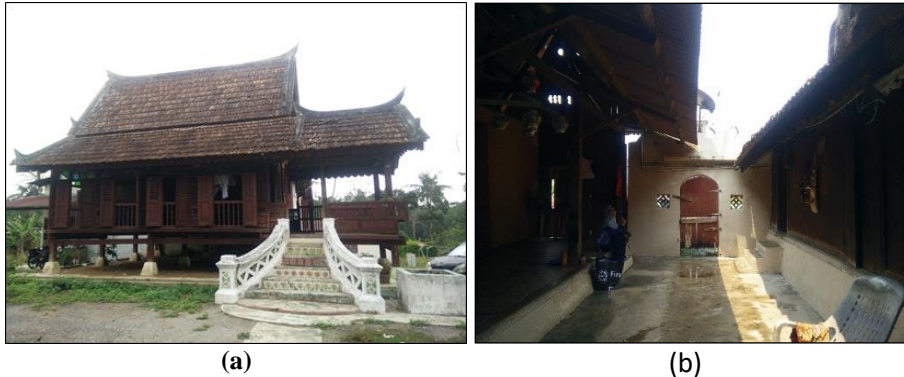


Figure 4. The house's main entrance is from the *anjung* (a), and the courtyard/*pelantar* in between the *rumah ibu* and *rumah tengah* (b)

The house form or type of the roof is *bumbung panjang* (long roof) (Figure 4a). The house was designed with a double-slope roof. This shows that the house has ample roof space with the highest roof pitch at *rumah ibu* (5.39m). In addition, the roof has gable end features with ventilation panels. The roofing material used at *anjung*, *serambi* and *rumah ibu* was clay roof tile. Furthermore, the floor and wall material used at these areas were wooden panelling and timber flooring. Meanwhile, roofing material at *rumah tengah* was ardec and at kitchen was zinc. The detail materials used for building envelopes in each spatial divisions of the house are stated in Tables 2.

Table 4. The material used on building envelope in every space of the house

Building Envelope	Spatial Division					
	<i>Anjung</i>	<i>Serambi</i>	<i>Rumah Ibu</i>	<i>Pelantar</i>	<i>Rumah Tengah</i>	Kitchen
Wall	Half-high perforated wooden aneling	Perforated wooden paneling wall	Wooden paneling	Brick wall	Wooden paneling	Brick and concrete wall
Floor	Timber flooring	Timber flooring	Timber flooring	Cemented flooring	Timber flooring with rubber mat finish	Cemented flooring
Roof	Clay roof tiles	Clay roof tiles	Clay roof tiles	-	Ardec roofing	Zink

The house was constructed on stilts and has a timber structure elevated above the ground at the front part of the house, i.e., *anjung* (1m), *serambi* (1.13m), and *rumah ibu* (1.38m). Meanwhile, the rear part of the house is of the brick-and-timber structures directly on the ground, i.e., kitchen and bathroom/toilet. As for the passive cooling system, the house was

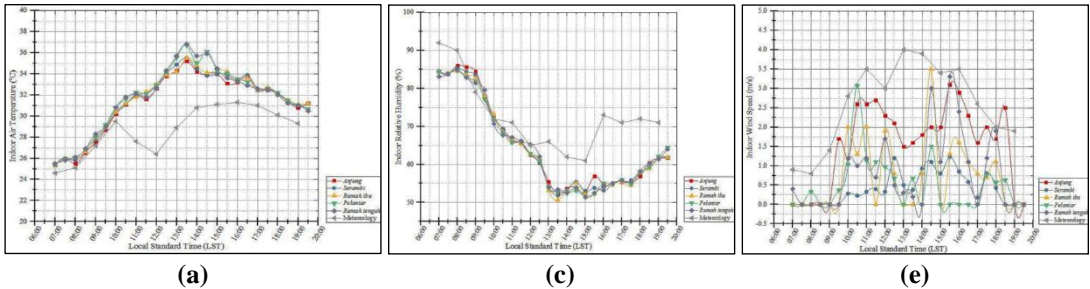
designed to have plenty of full-/half-height wooden panel operable windows. Moreover, the ventilation openings or lattices were fabricated in a variety of designs. In addition, the house has roof and floor joist gap to aid passive cooling. Besides, the courtyard which is *pelantar* is an open space which can count as part of the passive cooling system. However, a standing fan was used as a mechanical cooling system. Tables 3 shows the details of ventilation devices used in the house.

Table 5. Ventilation devices used in the house

Ventilation devices	Spatial division					
	Anjung	Serambi	Rumah Ibu	Pelantar	Rumah Tengah	Kitchen
Passive	<ul style="list-style-type: none"> • Half-high perforated wooden paneling • Floor & roof joist gap 	<ul style="list-style-type: none"> • Perforated wooden paneling wall • Full height operable window w/louvers • Roof & Floor joist gap 	<ul style="list-style-type: none"> • Half-height operable windows • Roof joist • Floor joist gap • gable end features with ventilation panels 	<ul style="list-style-type: none"> • Open roofing (courtyard) • Ventilation lattice 	<ul style="list-style-type: none"> • Half-height operable windows • Roof joist • gable end features with ventilation panels 	<ul style="list-style-type: none"> • Louvers window • Roof joist
Mechanical	-	-	Standing fan	-	Standing fan	-

Thermal Data

Thermal measurement was conducted from the 22nd to the 24th of August, 2019. In order to provide an analytical comparison of thermal measurement data, the average thermal (indoor and outdoor) and climate data were recorded. The thermal data were recorded according to the spatial division, whereas the hourly climate data were obtained from Felda Kemendor Station, Malacca. As for solar radiation, data were obtained from the Malacca Airport Station. The thermal data measurements (indoor and outdoor) of the house are presented in Figure 5.



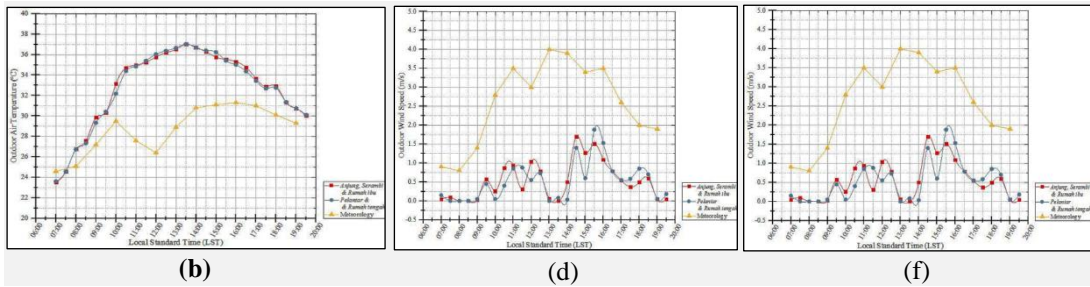


Figure 5. Measured air temperature, RH and wind speed (a-f), based on the spatial division with the corresponding outdoor thermal conditions

Based on the measurement, the relative humidity (RH) has versa data responding to the air temperature in both areas. When the air temperature was high, the RH was low. Most of the time, the air temperature ranged between 30.3 and 36.7°C and not under comfort level. The house was only under the comfort level between 7.00 and 8.30 hours. The temperature kept thriving from early morning until late noon. This situation was similar to the solar radiation pattern with recorded 2.23 MJ/m² in late noon (14.30 hours). After 15.00 hours, the levels of indoor air temperature and solar radiation uniformly decreased. They reached the lowest readings which were 30.20°C and 0.28 MJ/m² at 19.00 hours. The RH level was in the range of comfort level between 09.30 and 19.30 hours. As for the wind speed, the data recorded were in the range between 0.01 and 3.5m/s.

Anjung has recorded the lowest indoor temperatures most of the time than the other spatial divisions. The range of differences between spatial divisions were 0.6-0.9°C. In addition, it recorded the most wind speed reading. The reading was between 1.5 and 3.0m/s. It is because of the house's veranda which is enclosed with the half-high perforated wooden panelling. Thus, the wind can freely flow into space without any solid obstacles. In addition, there is a tree that was planted at the corner of the *anjung*. The function of the tree is as a sun-shade. Hence, it helps to minimise direct solar radiation. At 09.30-19.30 hours, the RH level was in the range of comfort level. The reading was between 78.4 and 53.2%. Meanwhile, the indoor air temperature at the *serambi* was slightly higher than *anjung*. The range of differences was 0.2-0.3°C. This happened because solar radiation had heated the tar in the front yard. Thus, the warm air permeated into the *serambi*. However, it was lower than in the other spaces most of the time. It was built with a perforated wooden panelling wall. Besides, it has full-height windows with louvers and a gap between the rafter and roofing. Thus, these elements aid to dispense warm air outdoor. Furthermore, the floor joist gap has also driven cool airflow into space. However, the wind speed rate was not as high as in the *anjung*. It has a light air movement within the range of 0.3-1.24m/s, whereas the RH level was at a comfort level.

Rumah tengah is the warmest indoor area compared to the other areas starting from 07.00 to 14.30 hours. The temperature ranged between 25.5 and 36.8°C. This situation eventuated because the space is adjoins the *pelantar*. As the *pelantar* is open roofing, the solar radiation indirectly permeates into the *rumah tengah*. In addition, this area uses a rubber flooring mat thus it blocks the airflow through the floor joist gap. However, the wind speed recorded was within comfort level ranging between 0.2 and 3.3m/s. The half-height operable windows and *pelantar* help to wind-driven cross ventilation. The indoor RH was slightly lower than other spaces with a 1.13-1.45% range of differences. Despite being exposed to direct solar radiation, the *pelantar* recorded the air temperature lower than the *rumah tengah*. The range of differences between both spaces started at 07.00-14.30 hours was 0.2-0.8°C. *Pelantar* is an

open space without roofing and interior partitions. It can allow an easy passage of warm air being discharged from the area. At noon, when the sun strikes the *pelantar*, the warm air raises the airflow from the adjacent space. Nevertheless, the wind speed rate is not as high as *rumah tengah*. However, in this study, the reading showed that it was windy most of the time, which was in the range of 0.35-1.5m/s. Meanwhile, the RH level was under the range of comfort level. The reading ranged from 53.02 to 79.1%.

Compared to the *rumah ibu*, even though it is adjacent to the *pelantar*, the indoor air temperature was cooler than the *rumah tengah*. It ranged from 34.2 to 36.2°C. It was lower because it has an attic space and it indirectly acts as a ceiling. Thus, it helps to lessen the heat penetration. Besides, the roofing material is clay roof tiles which give good insulation against heat. Gable end with ventilation panels and floor joist gap also help to execute hot air. The half-height operable window has allowed wind speed at the comfort level. It was between 0.1 and 3.5m/s and as for the RH level, it was slightly lower than the other spatial divisions. The range of differences was 0.1-0.7%. According to the reading, the front part of the house (*anjung*, *serambi*, and *rumah ibu*) had lower indoor air temperature compared to the rear part of the house (*pelantar* and *rumah tengah*) in the morning till late noon (08.00-14.30 hours). The differences ranged between 0.1 and 2.0°C. This is because the rear part is facing the east and exposed directly to solar radiation from the sunrise. Meanwhile, starting from 15.30 until 19.30 hours, the reading showed the opposite pattern with the range of differences between 0.02 and 1.0°C. Because the front part of the house is facing the west, it is directly exposed to solar radiation from the sunset. Thus, the air temperature can be influenced by sun orientation.

Based on the study, the finding on which design feature of this Malacca house influences its indoor thermal performance has been identified. According to the data analysis, it can be concluded that there are two main components of design features that control the thermal performance. They are a) building setting (building orientation and outdoor setting), and b) physical architectural elements (building envelop and building design or form).

Building Setting

Building setting is a crucial factor in achieving effective indoor thermal performance. This refers to the Malay house orientation which is corresponding to the sun path and wind direction. The house was oriented to face the east-west direction. The main entrance was designed to face the qibla which is 293°. The sidewall of the rear part of the house is exposed to the sunrise, whereas in the evening, the main entrance which is the front part of the house is exposed to the solar radiation from the sunset. Based on the air temperatures recorded in the sunrise period, they were under the range of comfort level. Hence, this approach has intentionally minimised the area of exposed walls to direct solar radiation during the day.

In addition, the house is a single-family house. The front yard of the house is ample space with a few trees planted. The intention is to not block the wind from flowing into the house. Besides, the trees were planted at a particular location. As an example, there is a tree being planted at the corner of the *anjung*. It functions as a sun-shade and indirectly minimises direct solar radiation. The result showed that the *anjung* has the lowest indoor temperatures most of the time than the other spatial divisions. Thus, the house has a strategic placement of plants. According to Misni (2018), as well as Misni et al., (2013), well-designed landscaping is comprehended by having an adequate number of plants with the appropriate sizes and species for the area, and situated in a strategic location.

Physical Architectural Elements

The construction method of the house also plays a role in allowing the wind to flow into the house. The house has received evenly wind speed for every spatial division because the floor level of the house was built at almost the same height which is around 1-1.38m. To maximise indoor ventilation, the house was designed with operable windows at the body level. Most of the windows come with wooden louvers panelling. In addition, the house has a ventilation lattice on the wall and floor joist gap. These design approaches allow easy passage of air and good cross ventilation. They function as a significant factor in producing an affective indoor thermal performance that can be proved by the wind flow movement based on the data recorded.

Courtyard/*pelantar* was designed to function as an air well in this house. It is an open space without roofing and interior partitions with operable doors and ventilation lattice on the wall. These designs can allow warm air to be discharged from the area easily. Other than that, the cool air from the outside can freely flow into the courtyard/*pelantar* and other adjacent spaces. Thus, the outdoor wind flows through the door has helped to jack up warm air from the adjacent space to be discharged through the open roof. According to this fact, it can be deduced that the courtyard/*pelantar* influences the thermal condition of Malacca houses. It contributes to indoor ventilation which creates natural cross ventilation.

The other element is the roof construction itself. The house form is *bumbung panjang*. It is a double-slope roof with a ventilation feature at gable ends. The house has an ample roof space with the highest roof pitch at *rumah ibu*. It has an attic space that indirectly functions as a ceiling. The measurement has shown that the ventilated roof space helps to cool the *rumah ibu*. In addition, the ventilation also flows through the roof joist. Besides, the roofing material is clay roof tiles which give good insulation against heat. The variation of indoor air temperature in this study has shown that spaces that use this material have recorded lower measurements than other spaces.

CONCLUSIONS

This study assists in producing ideas for a model of modern housing configuration with two primary functions: to enhance and acknowledge the modern generation's confidence with the local ideas and to lessen energy consumption, thus, reduce the hot temperature in a tropical environment. The research collected data on Malacca houses, the surrounding environment, and the thermal measurement. The variation of houses was classified by their type of roof and layout. This study only focused on one type of house form (*bumbung panjang*). This study used mixed methods which were qualitative and quantitative to observe the existing houses' condition while recording the thermal data collection. The significant finding showed that the indoor air temperature and relative humidity were slightly lower than the outdoor area, i.e., about 2.1°C and 3.8%, respectively. Whereas, the indoor area's natural air cross ventilation was higher compared to wind flow in the outdoor area, which was about 0.67m/s. The primary findings of the study also showed that the open courtyard located in the middle of the house has influenced the thermal condition of the Malacca houses. It has contributed to indoor ventilation effectively by providing natural cross ventilation around the interior spaces and reducing the temperature and relative humidity, as well as making the interior space cool and comfortable. Finally, this study found that the traditional ways of construction still respond

well to the current weather conditions of the surrounding. The study highlighted sustainable practices in traditional Malay houses which illustrate an idea and knowledge in improving the construction technology for modern residential architecture and producing an effective indoor thermal performance in a tropical environment.

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NEUROSCIENTIFIC EVIDENCE FOR THE IMPACT OF DIFFERENT VIEWS UPON, EMOTION, HUMAN BRAIN, AND GENES

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Abstract

Newberg and Waldman's concluded their well-known scientific experiment, "A single word has the power to influence the expression of genes that regulate physical and emotional stress". Likewise, could architectural space also speak? Alter the expression of genes? Recent studies by the World Federation for Mental Health estimated that by 2030, "depression" will be ranked top as the leading cause of the global burden of diseases. It is well known that our environment has a profound effect on our mental health, and statistics reveal that most of our time is spent indoors. Consequently, Architects are the designers of these environments. However, contemporary architecture has started to receive more accusations of emotional coldness, restrictive aesthetics, distanced from human and life. This research aimed to awaken the unserious consideration of architecture and health through a scientific methodology. A single-case experimental design (SCED) is used to investigate the relationship between neural underpinnings of the brain, for a single participant and various views. Data collected was based on the Electroencephalography tests, synthesised interactively with an existing well-known experiment. Findings showed a significant contrast between different water views and environmental settings, each with its unique effect on participant emotions and the electrical activity of the brain. Water view showed a high positive electrical activity, and emotional arousal compares to other views. This research concluded the establishment of the theory which hypothesis that: architectural space alters the expression of the gene that regulate physical and emotional stress.

Keywords: *Neuroarchitecture, Behavioural science, Emotional architecture, Cognitive architecture, Electroencephalography.*

INTRODUCTION

Despite the enormous scientific advancement, depression is increasing - numbers do not lie. The world most significant illness in 2030 is announced to be "depression" WHO (2012). Almost all scientist agrees that the environment has an inevitable influence on human happiness and emotions. (Hall & Helliwell, 2018) A single view of a single tree shortened the hospital stays of patients after surgery, smoothed the recovery, lowered the use of painkillers, and lowered post-surgical complications. (Ulrich, 2002) Countless studies prove the same point about the power of space upon psychological wellbeing (Adrian Bica, 2016; Pallasmaa, 2014; Zaino, 2020). Yet, this issue is not seen as equally important as physical wellbeing (Adrian Bica, 2016). Hence, studies that may provide direct/scientific/measurable/Medical evidence to awaken the unserious consideration of emotional architecture is needed.

Newberg and Waldman's (2009) well-known scientific experiment concludes that words have the power to change the brain in profound ways. By altering the neural resonance, which in turn results in enhanced cognitive health. Their research suggests that long-term compassionate communication and contemplative practices reinforce a specific neurological circuit which generates peacefulness and solitude followed by positive wellbeing.

Furthermore, Sharon Begley (2007) believes that the human brain can remake itself and be changed through positivity. Neuroplasticity is the mechanism that allows these changes to occur in the brain (scientifically). Compassionate experience is cognitively structured, where thoughts-beliefs play a central role. Because when we believe in a specific thing, we inform our brains, talk to ourselves, and silently say words to our brains. Neuroscience research suggests that compassionate experiences are associated with patterns of brain activity. However, no specific brain area mediates those experience (Jeeves & Brown, 2009; McNamara, 2014; Newberg & Waldman, 2010). Just looking at negative words for a few moments will increase your worry and depression. The more you ruminate, the more you damage key structures that regulate your memory, feelings, and emotions. You'll disrupt your sleep, your appetite, and your ability to experience long-term happiness and satisfaction.

Architecture speaks

Newberg and Waldman's (2010) concluded their research on how powerful speaking a single word can be. It alters emotions, followed by behaviour and the expression of genes. Long-term influence of words scientifically proven for its ability to restructure one's body and genes (Newberg and Waldman's, 2010), either positively or negatively. Everyone agrees with this conclusion. However, do architecture also speak? What is the definition of a word? According to the Oxford dictionary (2020), Word is a single distinct meaningful element, used to form a sentence to create communication. This research hypothesises that space is a single meaningful element, built to form a structure to communicate with human existence, emotionally, physiologically and finally genetically. However, if the communication was uncompassionate, it will influence humans through the three stages, emotionally, behaviourally, and ultimately altering genes' expression. Therefore, any form of turmoil, emotional experience, or rumination—for instance, worrying about your economic future, health, or achieving specific thing—will stimulate the release of destructive neurochemicals, the more negative thoughts/feelings they have, the more likely to experience emotional turmoil. But if you redesign things to be turned positively, you can turn your life around. Not philosophically speaking, but, scientifically (Newberg,2010).

A positive experience can fight your genes back—if someone was born with genes tells that he is a depressed person. Those genes create a neural pathway of depression in the brain. However, The positive experience, positive thoughts, or positive emotions recreate parallel neural pathway to the existing depressed ones. Those new neural pathways are created to tell a different story—a story which is designed by your beliefs and the environment around you (Newberg,2010).

The problem begins with the awareness of emotional architecture. Engineers and architects do not believe in the emotional aspect of space (Adrian Bica, 2016). Artificial environments are turning the world outside in, And that's not the way to save the planet (Simon Marvin,2017). Contemporary architecture has started to receive more accusations of emotional coldness, Restricted aesthetics, and distance from human and life (Pallasmaa, 2015). Recent studies by the World Federation for Mental Health (Dine, 2012) reveals the most significant illness in 2030 is going to be the mental disorder of "depression," according to statistics, 80-90% most of our time spent inside buildings (Dine, 2012).

Architectural spaces designs affect how we feel. Feelings influences behaviour. Behaviour influences genes. But the problem is people do not believe very strongly in the

things they can not see. However, many researchers are aware of emotional architecture. Still, not many are taking it such a severe problem because emotion can not be touched or seen. The study's objectives were first, To measure the variations of environments upon human's emotions and brain. And secondly to develop a theory of spaces influences genes.

LITERATURE REVIEW

Despite the enormous scientific advancement, depression is increasing - numbers do not lie. The world most global burden of disease in 2030 is "depression" WHO (2012).

EMOTIONS

Definition of Emotion

Emotion has many definitions. The simplest way to obtain a definition is from the dictionary. Oxford Dictionary (2019) defines emotion as a feeling which results from one's mood or circumstances. Taking a step further and looking at emotion from the medical point of view, According to Friedman (2010), it is a complex feeling that results in a physiological change that influences thoughts and behaviour. A more recent definition by Davidoff in (2018), describes emotion as a state of feeling expressed through the physiological functions such as facial expressions, quicker heartbeat, and behaviours such as aggression. By reviewing all the definitions, all scientist agree that emotions influence human behaviour, and it is complex. It is complicated because it is influenced by many aspects such as environment and genetics that are hard to scientifically outline how exactly it gets formed (Davidoff, 2018).

Beauty Is in The Eye of The Beholder. Beauty Is Subjective

An experiment conducted, supported by the "Evolutionary behavioural sciences" answered the argument that beauty is subjective and there is no common good for all. The experimental work presented in the Savannah principle brought kids from all around the world, and photos of different landscapes were showed to them. They were tasked to choose a view they liked the most. 80% of them singled out the picture of the savannah landscape (Kanazawa, 2019). The result of this seminal experiment established that regardless of the subjectivity of beauty, there is a common good thing for all humans (Behling, 2016).

The Bio-Psycho-Social Model of Emotional Construction

The bio-psycho-social model is one of the most recognised ways of understanding overall human wellness, including emotions and behaviour (Epstein et al., 2004). This interdisciplinary model associates the significance of three fundamental dimensions, (biology, psychology and socioenvironmental) which collectively, is responsible for the human wellbeing. Additionally, it provides an integrated basis and understanding wellbeing in various disciplines, ranging from social, emotional and behavioural difficulties (Cooper, 2014) to health and human development. This model was first introduced by George L. Engel in the 1970s, who argued the need for a new biomedical model (Engel, 1977). Since then, it has been critiqued for its limitations yet continues to guide interventionists, scientists and researchers in psychology, health, and human development (Epstein et al., 2004).

Overall human spiritual wellness is a combination of a complex process of these interconnected factors to shape one's welfare. As shown in the model Figure 1, the factors that may affect the emotional state could be either genetic or sociological; simultaneously the environmental aspect plays a significant role in impacting human emotions and reflecting on biological and social being. The environment shapes human behaviour and vice versa.

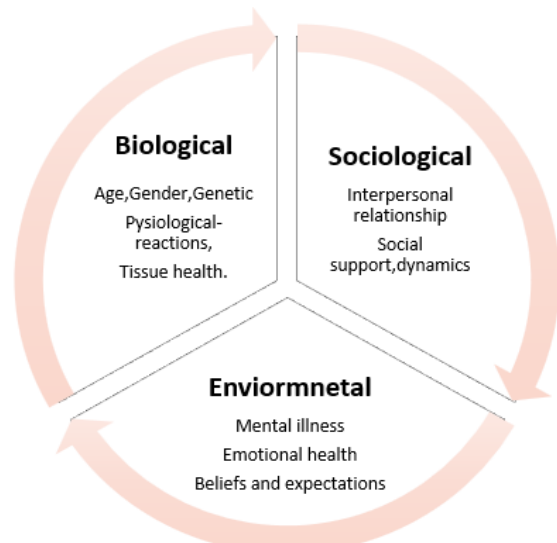


Figure 1. the bio-psycho-social model (Engel, 1977)

Human Between Good Design and Money

A survey was led by (World Business Council for Sustainable Development, 2018) showed a surprisingly common belief that around 17% of the overall cost of a building is attributed to the green characteristics of that building. However, a study done on the green cost of 146 green buildings has indicated an actual marginal cost of less than 2% and showed that green-certified buildings bring significantly higher rent than conventional buildings. A University of California–Berkeley study evaluated and compared 694 certified green buildings and 7,489 office buildings, each situated within a 400m radius of a green building. The results showed a remarkable outcome that on average green-certified buildings rented 2% higher than nearby conventional buildings after adjusting for occupancy level (Green research Institute, 2011).

Emotional Experience from Theory to Science

An experiment conducted, supported by the "Evolutionary behavioural sciences" answered the argument that beauty is subjective and there is no common good for all. The experimental work presented in the Savannah principle brought kids from all around the world, and photos of different landscapes were showed to them. They were tasked to choose a view they liked the most. 80% of them singled out the picture of the savannah landscape (Kanazawa, 2019) The result of this seminal experiment established that regardless of the subjectivity of beauty, there is a common good thing for all humans (Behling, 2016).

Designing Spaces of Positive Emotional Experiences

The diagram below is a collection of several studies from psychological, neuroscientific and medical backgrounds; It explains the central values of creating spaces that evoke positive emotional experiences. Positive environment designs can be understood by understanding

these nature and design elements, form and geometry, and its integration with the natural environments are the primary keys to build a positive emotional design.

In designing spaces to elicit positive emotions, the basic elements are:

(1) Water Element Integration. All those elements are healers of human emotions in the presence of sound, colour and the touch of water (Zaino, 2020). (2) Visual force of the form of construction; curvy, rigid, square or linear, each shape brings to the emotions of humans a particular experience. (3) Materiality: natural, such as timber and stone. (4) Natural lighting quality: to provide an optimised lux level or to determine the perfect level for a targeted room that brings about a big difference in the feeling of space. (5) Colour psychology: Each colour evokes different emotions; (6) Noise level: it has a major effect on the consumer's emotional comfort. (7) The Green Element; one of the fundamental elements to be thought of as building a space of positive emotions. (8) Creating alive spaces: the overall integration of birds singing, natural lighting, buffering of trees, all the natural features that make a space comes alive without the need for other things to bring the space alive like, televisions, music or people.



Figure 2. A collected study of psychological, neuroscientific and medical backgrounds, which explain the main principles of designing spaces to evoke positive emotions. Source (Zaino &Abbas, 2020)

BEHAVIOUR

Fear causes fleeing. Courage causes confronting. And motivation helps you to pursue your dreams. Behaviour is the key function of emotion. Emotion is the feedback system that influences behaviour (Roy. F,2007). Perhaps the idea of human behaviour shaped by environments is not an argument anymore. What is missing is a deep understanding of the neural underpinnings that drive human behaviour impacted by the environment. Thus, this study, with the help of neuroscience it explores the answer of the question-can space, shape human action and behaviour followed by alteration of genes.

GENES

Human is a genetic creature. Genes express itself by giving commands to the brain. On the long-term process, These genetic expressions influence human thinking patterns; it outlines behaviour, emotions and thinking paradigms. However, Genes develop neural

pathways in the brain. The neural pathways may carry a specific behaviour (or feature). It resists any attempt to change.

Nevertheless, according to many neuroscientists, it is not impossible to change it (Newberg, 2016), the director of (Research At The Myrna Brind Center For Integrative Medicine At Thomas Jefferson University Hospital). We can change. By creating new neural pathways by starting new living experiences, positive emotional experiences, or changing the stories that we tell ourselves. This fact called (Neuroplasticity)

Neuroplasticity: The brain's ability to restructure itself by forming new neural connections/pathways throughout life. It allows the neurons (nerve cells) in the brain to alter their behaviour in response to new situations or changes. It also may compensate for injury, disease.

Newberg's experiment (2010)

Andrew Newberg conducted this scientific experiment of incompassionate communication. Tested the influences of negative words, which brought negative emotions, tested a different brain experiencing negative words all-time and vice versa. Just listening to negative words for a few moments will increase human worry and depression. The more you ruminate, the more you damage key structures that regulate your memory, feelings, and emotions. You'll disrupt your sleep, your appetite, and your ability to experience long-term happiness and satisfaction. However, the experiment concludes that if you hear, experience, look and feel and negativity it will change your brain, therefore influencing the expression of human genes.

METHODOLOGY

This analysis was carried out in three phases. Firstly, is the literature review, explicitly on the nine principles as illustrated in Figure 3. Secondly, using the Electroencephalography (EEG) unit, the scientific experiments that measure certain components. Third, to compare the results of the experiments.

Strategy used.

The suitability of the method linked to the argument that people are not always accurate in describing their own emotions, that's why other methods like questionnaire or interview were not selected because it is not a stable ground of discussion.

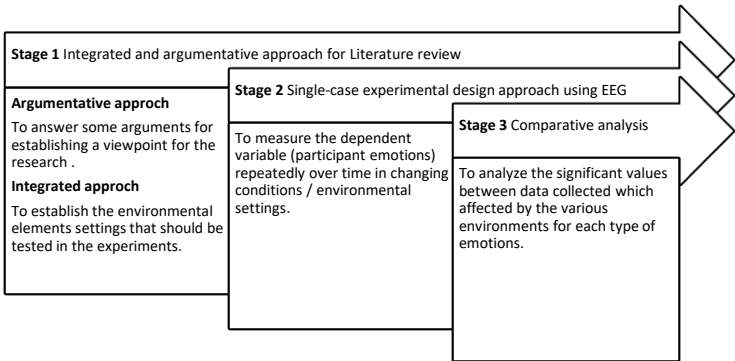


Figure 3. Methodology stages justification.

However, the strategy used is an attempt to take the emotional design controversial topic into a scientific-based ground due to the many arguments that happened between many people like

engineers versus architects about emotions and design. Emotions have always been theoretical knowledge to argue and discuss. Thus, the research strategy is decided to be with a scientific-measuring approach through Quantitative Electroencephalography signal.

Stage one; Integrated and argumentative approach for Literature review.

The literature review was established based on research questions which are:

- What are emotions?
- How are emotions constructed?
- Is beauty subjective by all means?
- Is there a good design for all?
- Can we measure emotions?
- How to design a space to evoke positive emotions?

Stage two: Electroencephalography experiment

The experiment's Dependent variable is environment settings. And the Independent variable: emotional response of participates. Controlling environmental factors might affect the findings; therefore, it is essential to control those factors by choosing the right day of similar environmental conditions like temperature or lighting. The experiments were done in a field, all the experiments done in similar environmental conditions in terms of lighting level, noise level, humidity, and temperature but in with a different view.

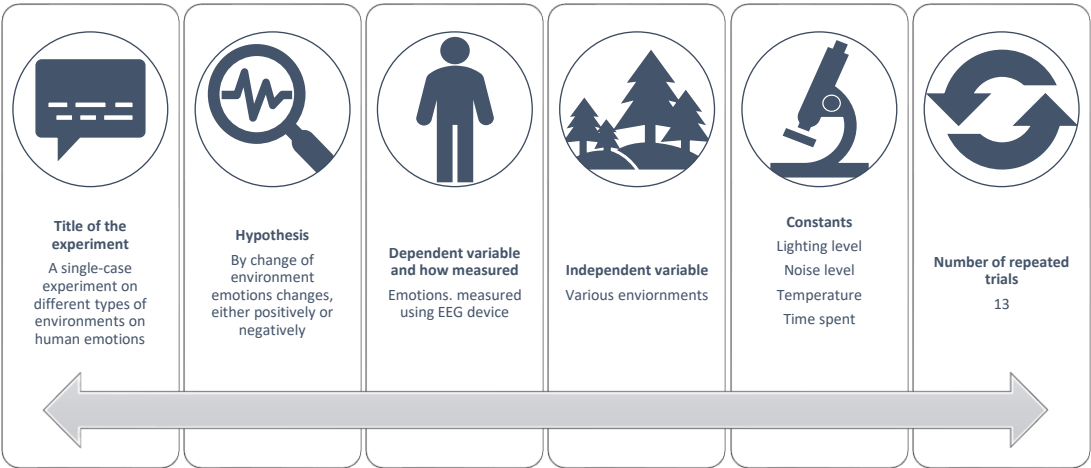


Figure 4. Design of experiment

Stage three: Comparative analysis

After getting the results of experiments, it was compared in the form of a chart to evaluate the differences between each experiment for every single emotion, in order to identify the significant values for each type of emotions such as relaxation. The Electroencephalography tests were synthesised interactively with an existing well-known experiment.

FINDINGS

Below charts presents the Findings of (Pilot experiments) measuring emotions and electrical activity of the brain impacted by different environments, it was conducted using the EEG device to identify the impact of the six elements on human emotions and electrical activity in which divided into six main findings, namely: water element, greenery, natural lighting, noise, smell. Figure 5 and Figure 6 presented numerically the emotional change and electrical activity by change of environments such as water views, greenery views, natural lighting levels, noise, and smell.

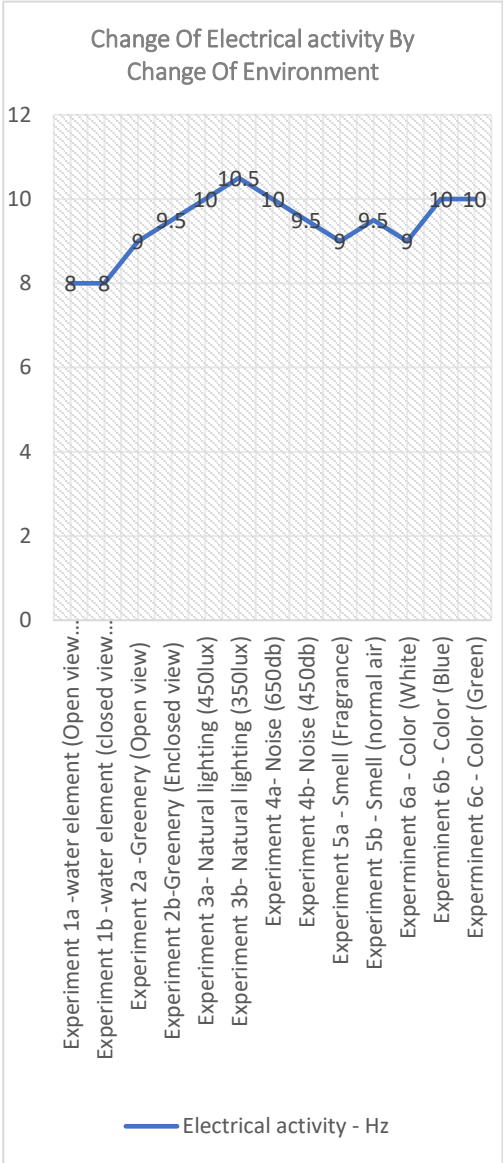


Figure 5. Electrical activity change (Source: EEG device).

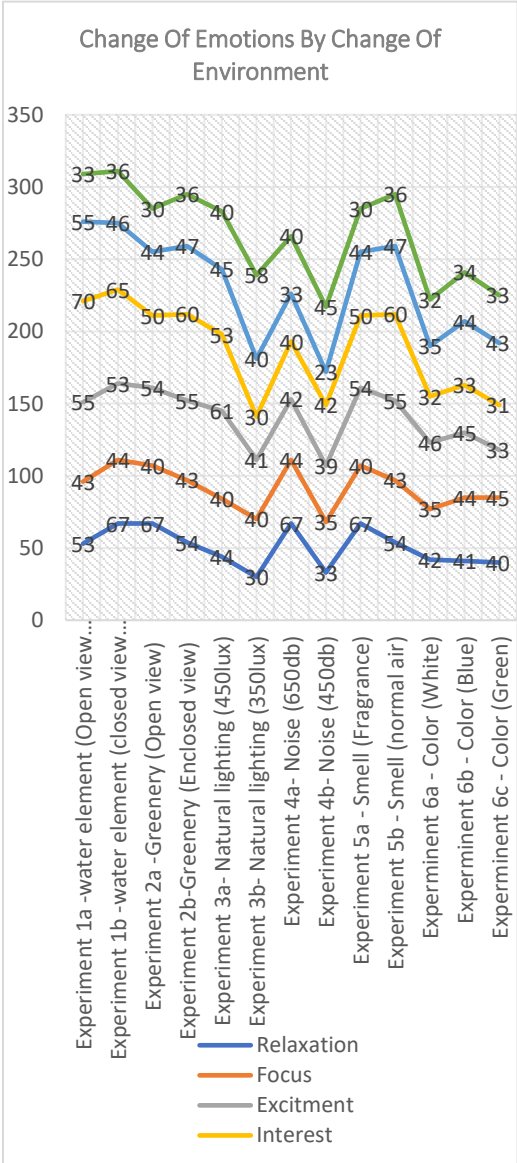


Figure 6. change of emotions by change of environment (Source: EEG device).

DISCUSSION

Anderw Newberg found the scientific-discovery, and Waldman's (2010) was concluded to prove the negative impact of words over the brain; therefore, genes. Newberg explained in his book about the effects of negative emotional experiences, such as, negative communications, or even looking at a list of negative words (or positive). It stimulates neural pathways in the brain; in turn, it leaves a negative trace on human's genetical system. In return, human gens rebuild another neural pathway which carries a negative feature. However, suppose that experiment emphasised negative emotional experience, which occurred by uncompassionate words, in contrast to that. In that case, architecture space also brings different feelings - some have the perfect amount of light, some space has a beautiful view, others are noisy. Architecture space has many elements that impact human emotional wellbeing—for instance, temperature level, the geometry of the form, materials used, and many other aspects. Suppose space is not designed in a way that comforts human. In that case, it will bring a negative experience such as not having enough lighting or probably excessive lighting.

Nevertheless, this research's argument is not about that different spaces have different feelings (many researchers know that), it is more into turning this philosophical thinking into scientific work. By analysing the issue (emotional coldness in contemporary architecture) (Pallasmaa, 2014), it was found that people dose not take negative emotional experiences very seriously (Adrian Bica, 2016), unlike physical experiences. If a kid were injured, the father would immediately take him to the doctor. The hurt is physical. It is seen visually, and it is easy to believe it. Many researchers believed in this idea, but scientist proved it. According to Alan Fogel, a Professor of Psychology at the University of Utah in Salt Lake City. When people feel emotional pain, the same areas of the brain get activated as when people feel physical pain. Still, it is hard for people to equalise these two aspects. However, one of the critical approaches in creating awareness is to turn philosophical ideas into science work because of the possibility to measure it. After all, this research is here to provide a piece of scientific evidence for the seriousness of a bad architectural space. Although, during the experiment, the presence of water was very significant in lowering the electrical activity of the brain and improving emotions of participates. Still, that is not the central information needed. What is significant is the change of electrical activity that occurred by the change of space and environment. Refer to Figure 5 and Figure 6—the change of emotional experiences which was detected, by a change of environment.

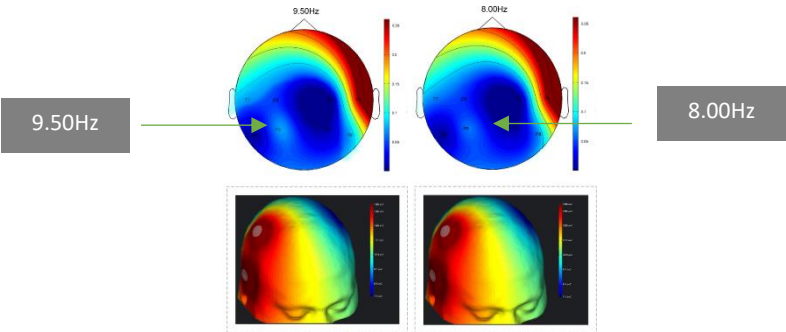


Figure 7. change of emotions by change of environment generated by EEG

Looking at Figure 7 is a comparison between two experiments only; the rest of the data is presented in Figure 5 and Figure 6. The data collected from thirteen different experiments using (EEG) were based on a study from diverse backgrounds about the principles that make a positive emotional experience in a space. Experiments tested those principles. The chart shows the impressive change in the electrical activity of neural pathways as the environment's condition changed. In contrast with Newberg's experiment, he said in his book (*Words can change your brain*), a single word has the power to change your brain and influence the expression of genes that regulate physical and emotional stress. Correlating that, the change of brain he referred to, is a change in the electrical activity of natural pathways, that change has the power to alter the expression of a gene that regulate physical and emotional stress. Change of space has also changed the brain of the participant. It changed the electrical activity in the neural pathways. However, this alteration of the brain by the change of space will suggest the modification of human genes in the long term. According to Andrew Newberg, and Waldman's (2010). Change of brain will alter the expression of a gene that regulate physical and emotional stress.

CONCLUSION

The research explored a scientific try to increase awareness for the seriousness of bad architectural space design, by turning philosophical and theoretical ideas into science. However, the paper concludes the following:

The awareness of human-centred architecture and aesthetic nourishment in design is essential for improving the quality of life on a spiritual, emotional and biological level. Contemporary architecture has received an enormous number of accusations of emotional coldness and restrictive aesthetics as well as its distance from human and life (Pallasmaa, 2015). The present research aimed to improve the understanding of an individual's neural underpinnings, which influences the emotional state and behaviour of a user, which impacted by the environment. By identifying the humans' emotional response impacted by different environmental and design elements using an EEG device to detect emotional response and better understand how to design better spiritual spaces. However, with the help of neuroscience, the research uses scientific equipment (EEG) to measure the emotions a human. This study's findings could provide architects, researcher and engineers scientific evidence for the Importance of "emotional design", and fill the knowledge gap of understanding "emotional design". For example, it is well-known for the positive impact of water element presence. But there are no studies that show the contrast between different water elements like the sea versus a lake, with an unobstructed view versus a small enclosed one. Both have a disparate impact on human emotions. The same thing goes to other elements like greenery. There is an open view vs enclosed. This part of the study is to show the differences between these different characters.

Design matters. It affects human emotions because the design allows natural lighting or prevents it. Building design can provide natural air, green view, etc..., and many other elements. Studies indicate that aesthetic qualities of architecture impact human mood, cognitive functioning, behaviour, and even mental health (Adams, 2014; Cooper, Burton, & Cooper, 2014; Hartig, 2008; Joye, 2007). Design can cause anxiety, insomnia, depression, weakened the immune system, muscle pain, heart diseases, and high blood pressure.

Emotional design and environmental has always been perceived as an expensive building. Based on a survey, 70% of people believed it is more costly than standard building with 27%. In contrast, a study was done of 146 green buildings, show a result of an actual marginal cost of less than 2%, university of California–Berkeley. The study inspected 694 certified green buildings and compared them with 7,489 other workplace buildings, each located within a quarter-mile of a green building in the sample. Researchers concluded that, on average, certified green office buildings rented for 2% more than comparable nearby buildings after adjusting for occupancy level.

People who argue that beauty is subjective has become possible, and there is no one particular good thing for all. Still, the result of savanna principle test tells us a different story, the experiment was carried by (Kanazawa, 2019), where they brought children from all around the world, showed them pictures of different landscapes, the kids were asked to pick the view which they like, 80% of the kids chose the landscape of savannah landscape. The Savanna theory concludes that no matter how subjective beauty is, there are good things for all humans.

This research explored a try to increase awareness about the seriousness of bad architectural space design by turning philosophical and theoretical ideas into science. Scientific data was collected for a different aim in previous research (Zaino & Abbas, 2020). Surprisingly, the change of electrical activity of the brain's neural pathways by change of environments, by studying Newberg's experiment, and merging this data with Newberg's findings. It was an awakening to realise that architecture space does not just change human feelings and brain but, alters the expression of a gene which regulate physical and emotional stress. This research concludes the establishment of this theory which hypothesis that: architectural space alters the expression of the gene that regulate physical and emotional stress.

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IMPACTS OF LAND USE AND LAND COVER (LULC) CHANGES ON CONSERVATION AREAS AND BIODIVERSITY AT MALAYSIAN TERRESTRIAL URBAN-NATURE AREA

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Abstract

Due to human population growth and migration, there will be nearly 2 billion new urban residents by 2030, yet the consequences of both current and future urbanization on biodiversity conservation are poorly known. Its consequences may be deciphered with the increase of awareness on the role of biodiversity in sustaining livelihoods and human wellbeing, in line with SDG 3 and SDG 15. Conservation areas in particular are meant to uphold the ecosystem sustainability for the purpose of biodiversity conservation. The study aimed to analyze the changes of land use and land cover (LULC) surrounding the Forest Research Institute of Malaysia (FRIM). The study used spatial data and satellite images of the year 2013, 2016 and 2019 and executed the analyses with ERDAS Imagine and ArcGIS. The study revealed a reduction in forest areas and addition in built up (housing) and water bodies. There was an encroachment of built-up area (housing) into the FRIM. Thus, the study strongly suggested buffer zones for FRIM, a shield to prevent the stresses caused by urbanization and encroachment activities that may jeopardize the intactness of the conservation areas. The study provided a better insight to the National Government policy makers, an effort to formulate a more effective strategy for enhancing the sustainable development, in line with the SDG Target 13-2.

Keywords: *conservation areas; buffer zones; biodiversity conservation; land use and land cover (LULC); Forest Research Institute of Malaysia (FRIM); SDG 3; SDG 15; SDG Target 13-2*

INTRODUCTION

By 2030, an additional 1.2 billion people are forecast in urban areas globally. Direct impacts are cumulatively substantial, with 290,000 km² of natural habitat forecast to be converted to urban land uses between 2000 and 2030. Studies of indirect urban impacts on biodiversity, such as food consumption, affect a greater area, but few studies have quantified urban indirect impacts on biodiversity (McDonald et al., 2020). Land use and land cover (LULC) change is fragmenting natural ecosystems, with major consequences for biodiversity (Liu et al., 2019). Conservation areas in particular are meant to uphold the ecosystem sustainability for the purpose of biodiversity conservation. The term "conservation areas" has been described as an area of notable environmental or historical interest or importance (natural or built up) (IUCN, 2016) which is protected by laws, legislation and policies against undesirable changes. It occurs in the form of protected areas, forest reserves, national parks, wetlands, Man and Bio Sphere reserves, geological parks, heritage sites, urban reserves etc. They are sometimes overlapping in terms of areas designated or names given, based on different jurisdictions

worldwide and nationally (Ahmad et al., 2018; Ahmad et al., 2012). As demand for efficient and pressing utilization of natural resources increase, the need for conservation areas must be clarified – to both decision makers and general public alike. This however, creates some difficulties as different types of conservation areas in Malaysia are managed by different authorities; for example, the Department of Wildlife and National Parks, Forestry Department, Fisheries Department and etc. and areas having double gazettments for example, permanent forest estates and national botanical garden. In addition, some conservation areas are under the jurisdiction of the federal government or state government, and in particular cases under parties as well as private land/parties and ‘no man’s land’.

The sustainable of biodiversity depends on the balance ecosystem of the conservation areas and the landscape as a whole. It covers a wide range of areas with the main purpose is to achieve the sustainable development by protecting the biodiversity and providing a wide range of benefit to human well-being. Based on the review of literatures on the scenario of the conservation areas worldwide and in Peninsular Malaysia, it can be concluded that conservation areas must be viewed in a broader context of landscape, not as isolation but inter connected. It may suggest that one way to properly managed conservation areas are by having a buffer zone around it, as fundamentally discussed by Bennet (2004).

In order for conservation areas to survive the pressures of those conflict, it must be justifiable in both biological, regional development and in socio-economic terms (Dudley and Stolton, 2010). This study aimed to analyze the changes of LULC surrounding the Forest Research Institute of Malaysia (FRIM) in Malaysia. The objectives were: 1) to quantify the changes of LULC, and 2) to construct the Digital Elevation Model, of FRIM and the surroundings, thus representing the Malaysian terrestrial conservation areas.

MATERIALS AND METHODS

Description of the Study Area and its rationale

The study area is Forest Research Institute Malaysia (FRIM) and its surroundings (Figure 1 & 2). FRIM, located in Kepong, Selangor, Malaysia is surrounded by Bukit Lagong Forest Reserve on one side, and developments, mainly residential and commercial areas, on the other. Being one of the largest man-made forests (562 kmsq) in the world, FRIM may be functioned as a model for reforestation, forest management and forest protection for the world.

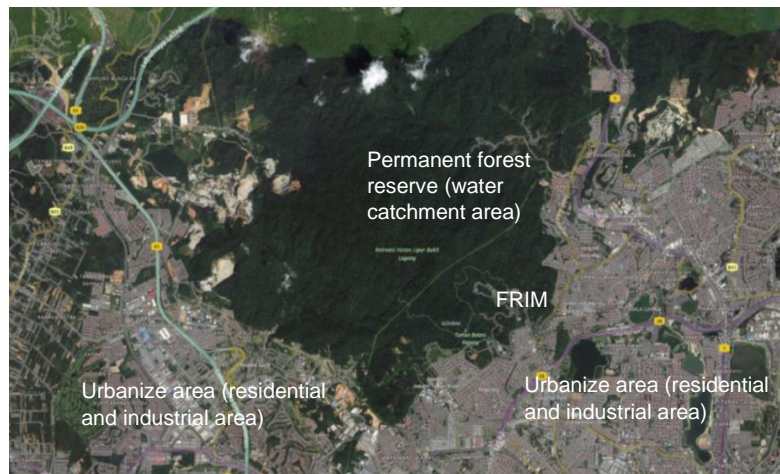


Figure 1. Forest Research Institute Malaysia (FRIM) and the surrounding land uses
(Source: PLANMalaysia, 2019)



Figure 2. Topographic map showing FRIM area and its surrounding
(Source: PLANMalaysia, 2019)

The significant character that worth noted here is the area was a mining area back then, leaving it as unfertile soils which contain high content of radiation. Fortunately, the high levels of radioactive materials in the soil has reduced due to the absorption by plants resulting from a massive reforestation activity, and the radioactive materials decreased quickly because of factors such as weathering and decay. The plants have helped recover the soil from the radiation by using efficient mechanisms for pulling nutrients, water, minerals and certain radioactive isotopes. Those radioisotopes mimic some of the nutrients that the plant takes up normally. So the plant really doesn't distinguish between those radioactive isotopes and some of the nutrients in the soil such as potassium and calcium that it takes up as a matter of course. This activity has transformed the area into a remarkable manmade natural forest area.

In addition to that, FRIM is one of Malaysia National Heritage site which was awarded in 2012 and is currently gearing towards UNESCO World Heritage Site. FRIM enjoys secure protection through the National Forestry Act 1984 and Heritage Act 2013. It's awarded the National Heritage status in recognition of its conservation efforts, its historical significance and legacy and being the largest and oldest man-made tropical forest in the world established since the 1920s as well as the one and only tropical forest research institute in Malaysia. Since FRIM is categorized under Environmental Sensitive Area (ESA) Rank 1, only certain activities are allowed in this area which is ecotourism, research and rehabilitation. The site is extremely important from an environmental conservation point of view because of its unique biodiversity. The area is considered as an outstanding representative of the tropical terrestrial ecosystems due to its species richness, endemism, high taxonomic uniqueness, and variability of habitats. Besides this ecological uniqueness there is also an inhabitant inside the FRIM (FRIM, 2017).

However, while the area is relatively large in local terms, it is relatively narrow in width and thus is vulnerable to disturbance and nonconforming physical development in the peripheries. The need for the study arise out of increasing pressure for various forms of development in these peripheries, which has the potential to negatively affect the integrity of the conservation area and the unique resources, especially their biodiversity, water production, and scenic values. Landscape transformation by a number of land uses such as agriculture, commercial, afforestation, and new settlements are found to be a significant threat to the natural beauty of much of the area. It is indeed a need for the area 'to hold to the part' due to significant changes of land uses around it. The study area is included in Environmentally Sensitive Area (ESA) Rank 1 of National Physical Plan II (NPP II) referring specifically to biodiversity and heritage conservation and climate mitigation. It is also included in ESA Rank 2 of National Physical Plan II (NPP II) whereby the ESA Rank 1 required a buffer zone at its surrounding (Federal Department of Town and Country Planning, 2010).

For the purpose of this study, the surrounding area means it could be a 25, 50, 75, or 100 km from the conservation area's boundary after drawing insights from a study by DeFries et al. (2004); Li and Coomes, 2016), on forest loss surrounding 198 highly protected areas throughout the world's tropical forests. De Fries et al. (2004); Li and Coomes (2016) ultimately applied a 50 km perimeter around the reserve as an 'arbitrary but reasonable' distance to capture ecological interactions between the reserves and settlements.

Data acquisition and LULC Dataset

The study took a quantitative approach whereby the spatiotemporal data; topographic maps and satellite images of the year 2013, 2016 and 2019 were used and the analyses were executed by ERDAS Imagine and ArcGIS. The acquisition of the data was divided into two (2) components: The first component is remotely sensed image data in which to determine the change detection of LULC around FRIM, and construction of digital elevation model (DEM) in which to generate elevations of the FRIM and the surroundings. The second data component is topographic maps obtained from PLANMalaysia (2019).

Change detection using remotely sensed data

Remotely sensed datasets depicting land cover over a period of time plays an important role in change detection study. In this study, the role of remotely sensed images towards LULC changes and forest reserved management is explored. The process of identifying changes using remote sensing technique is preferred choice as it is relatively fast and effective way of detecting changes of LULC at the macro (regional) scale. This is in consideration that it is the most practical in reaching the outcome within the constraints of given time to complete this research. Figure 3 showed the detailed flow of the process of identifying changes.

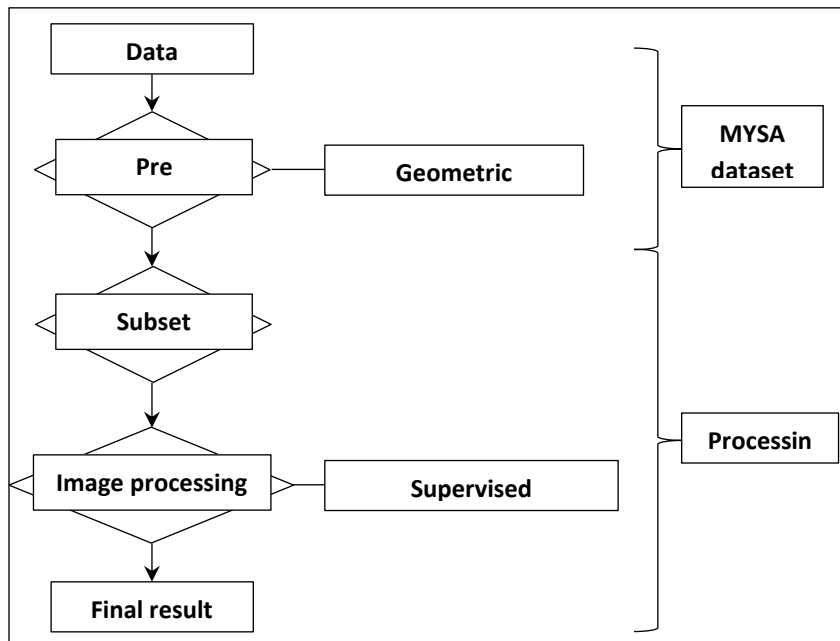


Figure 3. The process of identifying changes

Referring to Figure 3, the process covers three main stages; pre-processing, subset and image processing. The data used is optical images. LANDSAT Thematic Mapper (TM) optical images with 30m pixel size were obtained from the Malaysian Remote Sensing Agency and were captured in 2013, 2016 and 2019 with the areas of 5.5km X 11km covering approximately 60.5 km square. All the data have been registered into local coordinate projection. The study area covers from 3° 50'N, 101° 55'E (Upper Left) to 3° 35'N, 102° 25'E (Lower Right).

LULC patterns are classified by grouping its pattern. Some items are similar to each other, and a simplification is to be reduced the pattern to three (3) types namely; vegetation (forest), water body and built-up area (development mainly housing area). The three (3) classes of classification (refer Table 1) are enough for the purpose of this study which is mainly to identify the area and direction of the LULC changes especially vegetation and built-up area. Supervised classification is used and accuracy assessment has also been done to determine the accuracy of the classification process.

Table 1. Spatial parameters of LULC for supervised classification process

Type	Category	Description
Land cover	Vegetation	Forest (e.g., primary forest, secondary forest,)
		Agriculture (e.g., oil palm plantation)
Land use	Agriculture	Mono-typed plantation, mix-typed plantation
	Open space	Open space, grassland
	Built-up area	Residential, industrial, commercial etc.
	Accessibility	Railway, highway, carriage track, unsealed track, footpath etc.
Natural hydrographic features	Water bodies	Lake, river, pond, stream, swamp area etc.

(Source: Adapted from Li, G.V. and Coomes, D.A (2016)

Referring to Table 1, three main groups of classifications were used due to the consideration that the data from 3 classes are enough to represent the overall changes of LULC required for this study (Li and Coomes, 2016).

Construction of Digital Elevation Model

The study area is located partly in the districts of Sungai Buloh and Jinjang in the state of Selangor, Malaysia. The topographic maps of Sungai Buloh (Series DNMM 6101: edition 2-PPNM: 1:10,000) and Jinjang (Series DNMM6101; edition 3-PPNM; 1: 10,000) are acquired from *Jabatan Ukur dan Pemetaan* Malaysia (JUPEM), consist of the FRIM area and the surroundings. Two maps are joined together and the area for FRIM is clipped based on the boundary mark established on allotments certified maps. Based on the topographic maps the study area covers approximately 60.5 km square. Contours depicted on the topographic maps for study area are digitized to sustain x,y,z (position and height) points. 3D model - digital elevation model (DEM) is generated using ArcGIS software.

Figure 4 showed the flow chart of data processing to construct the Digital Elevation Model (DEM).

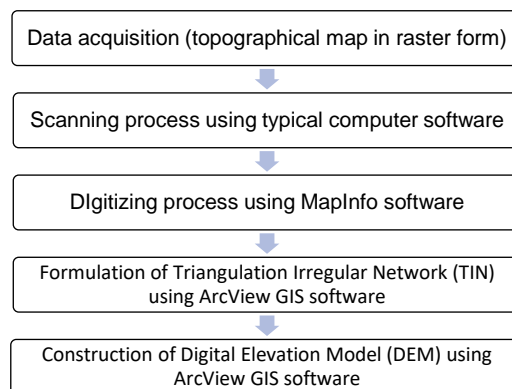


Figure 4. Flow chart of data processing to construct the Digital Elevation Model (DEM)

Referring to Figure 4, the topographical map is in scale 1:50,000 and the contour interval is 100 meter. This particular map is used due to its advantages of the availability, portability

and ease of use in the field and also the main source in developing a DEM. The scanning process is done to change the topographic map into the digital form. The contour lines then digitized and the vector contour lines were then converted into points using 'polytwopoints.ave' in ArcView. The contour points theme is converted into raster format before interpolation took place.

Data Analysis

Change detection

Digital classification is carried out through supervised classification approach using training areas and Maximum Likelihood Algorithm is employed to detect LULC types in ERDAS Imagine software. Maximum Likelihood classifier assumes that the statistics for each class in each band are normally distributed and calculates the probability that a given pixel belongs to a specific class. Unless a probability threshold is selected, all pixels are classified. If the highest probability is smaller than a threshold, the pixel remains unclassified. Implementation of the Maximum Likelihood classifications involves the estimation of class mean vectors and covariance matrices using training pattern chosen from known examples of each particular class (Shafri, Suhaili and Mansor, 2007).

The identity and location of feature classes or cover types (vegetation, agriculture and built-up) are known beforehand through available topographic map. Specific areas are typically identified on the multispectral imagery that represent the desired known feature types and use the spectral characteristics of these known areas to 'train' the classification program to assign each pixel in the image to one of these classes. An accuracy assessment has been done to determine how correct the classified is. Its involves the determination of the overall accuracy of the classification, errors of omission, errors of commission, producer's accuracy and consumer's accuracy (Natural Resource Canada, 2005). Accuracy assessment is critical for a map generated from any remote sensing data. Error matrix is the most common way to present the accuracy of the classification results (Fan, Weng and Wang, 2007). Overall accuracy and Kappa statistics are then derived from the error matrices.

Digital Elevation Model (DEM)

A Triangulation Irregular Networks (TIN) is widely recognized approach to develop elevation modelling which has relatively benefits. It is done using ARC/INFO and ArcView GIS 13 software. TIN represent results in flat surfaces for areas where only contour data is used; a set of triangles represents the terrain surface. Consider a set of coordinates marked on a map, these coordinates are 'triangulated' and their verticals represent the spatial point. Each triangulation covers its own area without overlapping each other. The map used to generate DEM is derived from TIN which represents the terrain surface. The DEM provides a digital description of the terrain surface, giving continuous elevation values over the entire study area. The study area can later be seen in 3D views.

RESULTS

Land use and land cover (LULC) changes from 2013 to 2019

The output of the remote sensing data included the thematic maps and change detection. The study explored the role of remotely sensed images towards forest reserved management. LANDSAT images with 30-meter resolution for three consecutive years (2013, 2016 and 2019) for the study area are acquired from the Malaysian Space Agency (MYSA). Unsupervised classifications are used. The process is carried out on acquired images to 3 main LULC classifications, namely vegetation (forest), waterbody and built up (housing area). Table 2, 3 and 4 showed the results.

Table 2. LULC and its area percentage for the year 2013





Row	Class name	Histogram	Color	Area (%)
1	Unclassified	1730		1.2%
2	Forest	64629		46.3%
3	Waterbody	21791		15.6%
4	Built-up (housing)	51352		36.9%

Table 3. LULC and its area percentage for the year 2016









Row	Class name	Histogram	Color	Area (%)
1	Unclassified	1730		1.2%
2	Forest	63529		45.4%
3	Waterbody	22692		16.3%
4	Built-up (housing)	51852		37.1%

Table 4. LULC and its area percentage for the year 2019

Row	Class name	Histogram	Color	Area (%)
1	Unclassified	1730		1.2%
2	Forest	62341		44.3%
3	Waterbody	23233		17.1%
4	Built-up (housing)	52198		37.4%

According to Table 2, 3 and 4, study showed a decreased in forest areas from 46.3% in 2013 to 45.4% in 2016 and further decreased to 44.3% in 2019. However, the findings showed an increased in waterbody from 15.6% in 2013 to 16.3% in 2015 and further increased to 17.1% in 2019. Similar to built-up area, study showed an increased from 36.9% in 2013 to 37.1% in 2016 and further increased to 37.4% in 2019. These proven that forest areas have been replaced by the built-up area, in this case, housing area. It is may be due to the urbanization activities that has taken place. The increased in water body may be due to additional drainage system to support the increased in population within that area.

Digital Elevation Model (DEM)

The purpose of construction of DEM is to obtain the elevation range of the area. For this study, elevation data is essential in order to determine the tendency of encroachment

(accessibility) of land-use activities of the area. ArcView GIS 10.4 software is used to generate the DEM. The map is derived from a Triangulated Irregular Networks (TIN) which represents the terrain surface. The heights for the constructed DEM range from 50 meter to 600 meter. The equal interval elevation of 9 classes was used to classify the contour.

Figure 5 showed the DEM and Figure 6 showed the overlaying of DEM onto the topographic map of FRIM area and its surroundings.

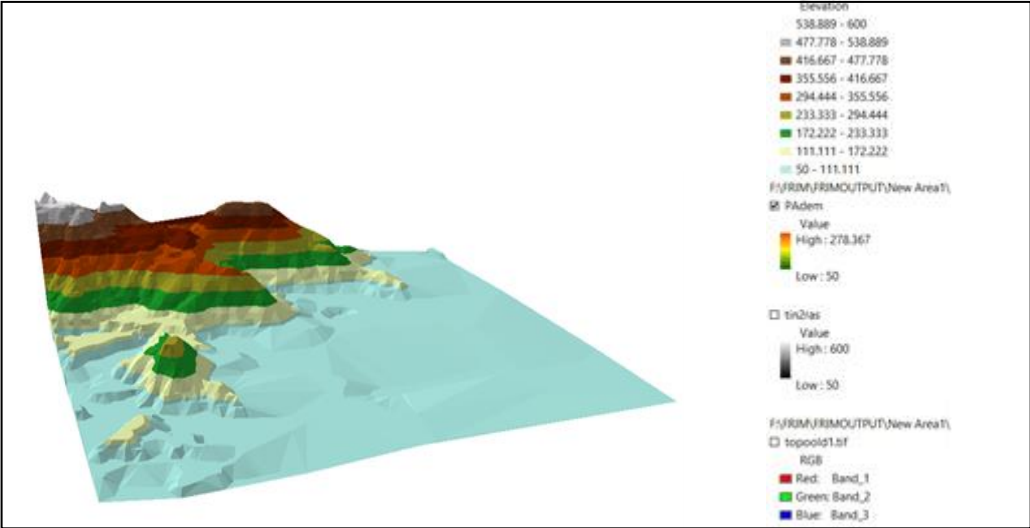


Figure 5. DEM of FRIM area and the surroundings

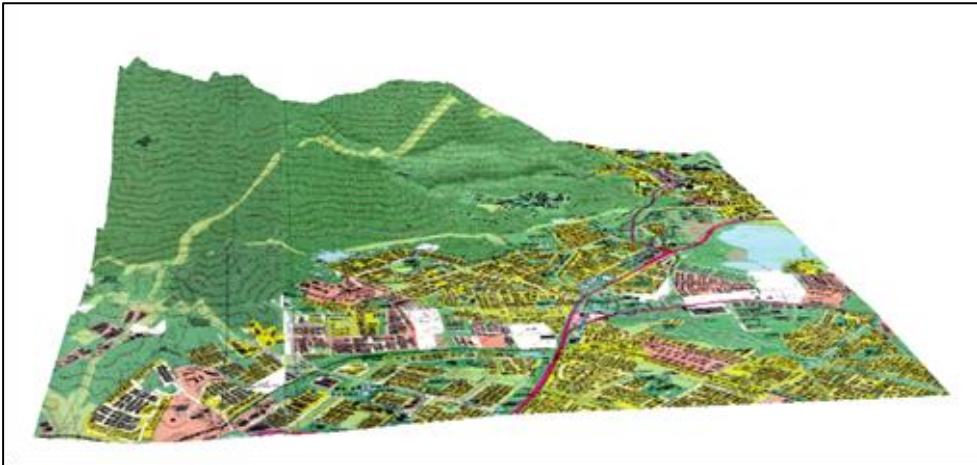


Figure 6. Overlay of DEM on topographic map of FRIM area and the surroundings

Figure 5 & 6 showed the undulating surface of the FRIM and its surrounding. The forest area covers the hilly part while the built-up area covers the flat part. In particular, it showed that south eastern part experienced a major built-up especially housing which may be due to the urbanizing activities. Some of the built-up are right next to the FRIM border with some encroachments. While the north western part of the FRIM area appears to be intact with forest. This is may be due to the area is gazetted as permanent forest reserve for water catchment purposes.

DISCUSSION AND CONCLUSIONS

The study quantified and maps the LULC changes and their impacts on the conservation areas – Forest Research Institute of Malaysia (FRIM) and its surroundings. The LULC, which are forest, waterbody and built up area (housing), has changed in the span of six years (2013 to 2019). It indicated that the vegetation area has decreased and the water body and built up (housing) have increased. The study also showed the area comprises of flat and undulating topography. Based on Digital Elevation Model (DEM), it is noted that built-up presents at flat areas and it may be due to the urbanization activities and type of land uses gazetted for the area. On the other hand, undulating and slopes are seen covering forest areas which are still intact. Flat and lower elevation areas may provide easy accessibility from the surrounding while undulating and higher elevation areas restricted the accessibility. Thus, human activities became limited.

On the overall, the changes in land use activities occurred mostly on the east and southeast of FRIM area. It is also shown that some of the built up (housing) has encroached into the FRIM areas. This might be due to the increased of population which required more opening of land for settlement and industrial area. Results demonstrated that urban expansion is the main reason of the area changes. The intactness of conservation areas and biodiversity may lose at the expanse of built up (housing) areas. The trend of LULC changes in Malaysia is conformity with other research findings (Ahmad et al., 2012).

The study contributed to investigating the spatiotemporal changes as the driving factors on the relationships with the conservation areas and biodiversity that could provide credible associations for future land use management and economic development, in various areas, as well as promoting biodiversity conservation of FRIM. The study emphasized the important link between LULC changes and impacts on the function and structure of sustainability of biodiversity in conservation areas. It is vital to explore how LULC respond to SDG 15 transformation and to ensure sustainable urban development. It is believed that this study can serve as a reference and basis for improving decision-making involving the management of land resources, and contribute to a trade-off between urban expansion and the reduction in biodiversity conservation.

The study also demonstrated that the advancements in remote sensing and GIS technologies provide powerful tool for mapping and detecting changes in LULC. Particularly, this study shows the importance of such information could be gathered by integrating various techniques ranging from remotely sensed images and also Geographical Information System (GIS) which provides such reliable information.

RECOMMENDATIONS

LULC changes contributed a greater impact to conservation areas. In the case of FRIM, it may jeopardize the intactness of its ecosystem for biodiversity conservation. Thus, one of the proven solutions is to have a buffer zone around it (Bentrup, 2008).). The LULC may act as dimensions or factors in which it is needed to be considered in determining the criteria for buffer zone; size, width and types, for FRIM particularly, and other terrestrial conservation areas generally. The study suggested that the area with higher prone to encroachment (lower elevation and flat) required bigger and wider buffer zone. However, the area with lower prone to encroachment (higher elevation and undulating) required smaller and narrower buffer zone.

The study suggested the other possible option whereby the entire forest area in the northern part of FRIM (Bukit Lagong Forest Reserve) may be used as a buffer zone for FRIM area and can become an extension buffer zone to conservation areas. With regards to the buffer zoning, the study also suggested the LULC may become factors influencing the criteria (width and size) of buffer zones. With this information and techniques, establishing of the buffer zones could be carried out systematically and efficiently.

Beyond the completion of these findings, it is seen that a further challenge will be to continuously put forward specific alternative strategies and future planning for improving the ecological environment and biological diversity for reducing the impact of human activities in the study area and elsewhere in Malaysia. The study strongly suggested a further exploration on buffer zone establishment, as vital for FRIM area, acted as a shield to prevent the stresses on the conservation areas due to urbanization. It is also to prevent the encroachment activities that may jeopardize the intactness of biodiversity and ecosystem of the conservation areas. Thus, it may contribute to provide a better insight to the National Government policy makers, in their effort to formulate a more effective strategy for enhancing the sustainable development. The Town and Country Planning Department (JPBD) may consider taking into account on the study findings when preparing various planning and development policy by incorporating the conservation actions that are capable of creating a sustainable development for the regions, in line with the SDG 15.

Any research undertaken is a learning process. Though the study carried out shows the convenience of Remote Sensing and GIS, it is recommended that for future studies the use and integration of other data set such as high resolution remote sensing image such as IKONOS and other spatiotemporal data as well as related policies will be very much essential.

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THE EFFECTIVENESS OF NATURE RECREATION FOR CHILDREN WITH AUTISM SPECTRUM DISORDER (ASD)

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Abstract

Recreation is the type of activities which require individual's preferences and enjoyments while engaging in the leisure time. It can be active or passive recreations. Nature recreation is the recreation which require engagement with natural environment and settings. Many researches proven that recreation is important for people including the disabilities, towards achieving the quality of life. Autism Spectrum Disorder (ASD) people usually categorized into three level which based on the severity of the two main symptoms which are in social symptoms and behavioural symptoms. Level 1 is the less severe level of Autism while Level 3 is the most severe level of Autism. This research aims to determine the effectiveness of the nature recreation for the children with ASD in a family with the objectives are: 1) to compare the changes of children with ASD in a family before and after participating in the nature recreation and 2) to identify the most preferable nature recreation activity for children with ASD in a family. The method used is questionnaire surveys, distributed to a focus group called 'Autisme Malaysia'. The research found that, nature recreation can benefit ASD children (aged from 0 to 12 years) and it is important for the children development in social, intellectual, emotional and also physical. The result for each child may vary depending on the factors such as age, level of autism and type of recreation activity. The ASD children have a positive change in the communication and sociability components. However, the physical behaviour of the ASD children showed the opposite sign whereby it showed more risk and sign of ASD after participating in nature recreation. It is suggested that identifying other type of recreation for intervention are important for future research in order to help various special needs children. Nature recreation may not help to cure the ASD children completely however, this study may help the parents and also the caretaker of the ASD children to use the nature recreation as the early intervention for children with ASD in the development of the children.

Keywords: *nature recreation, active recreation, passive recreation, Autism Spectrum Disorder (ASD)*

INTRODUCTION

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder which defined by the persistent deficits in the social communication and social interaction over multiple of contexts and restricted, repetitive patterns of behaviour and also interest. Diagnosing ASD can be difficult as there are no medical or blood test that can be taken except to base on the behavioural symptoms including the absence of delays in typical developmental milestones and presence of unusual behaviours. The prevalence of ASD in Malaysia was approximately 1.6 in 1,000 based on the feasibility study on the use of Modified Checklist for Autism in Toddlers (M-CHAT) among the children between 18 to 36 months in the child health clinics by the Ministry of Health Malaysia in 2006. The prevalence data is important in order to form a basis planning and also in establishing an intervention and choice of education for the children with ASD (Ramachandran, 2019).

The intervention of ASD on children may be in the form of leisure and recreation. Leisure is the time which an individual has free form of work or duties which may utilized for the

purpose of relaxation, diversion, social achievement or personal development (Gist & Fava, 1964). Recreation consists any activity that were chosen voluntarily by the participant for an immediate satisfaction. Recreation carried in leisure time with no work connotations. Outdoor recreation is one of the outdoor extension which defined as wholesome recreation that is done without confines of building. The outdoor activity act as a therapeutic tool which was previously described in relation to various disabilities in young people which may help in enhanced self-concept and self-esteem, personal growth, increased in social adjustment, positive behavioural changes and also growth in interpersonal relationship (Zachor et al., 2016). Thus, leisure and recreation may help in improving the social participants and behavioural of children. It is the form of activity which children enjoy the most, thus it may encourage the ASD children to participate in leisure and recreation activity while improving their wellbeing.

This study has the high possibility in determining the contribution of nature and recreation in helping children with ASD. It showed that being in a natural environment can have a lot of positive outcomes towards the physical health and also the psychological well-being specifically for children diagnosed with ASD. According to Hadder Abd El-Razak et al. (2018), being involve in nature environment is important for the children with ASD in improving the cognitive, mental health, physical health, social and also emotional benefits.

Studies have stated that the number of individuals with disabilities is increasing and there is no exception with ASD. The World Health Organization (WHO) estimated that, 1 in 160 children has being diagnosed with autism and its prevalence appears to be increasing globally, while the United States' Centres for Disease Control and Prevention's Autism and Developmental Disabilities Monitoring network has a higher figure with 1 in 59 children. According to Felina S.Y. Muhammad Feisol (2019), the chairman of the National Autism Society of Malaysia (NASOM), around 8,000 to 9,000 that were born yearly may have autism, based on the national gross birth per rate per year analysis. Unfortunately, there is no any official number of individuals diagnosed with autism. An early intervention for children with ASD is needed for the preparation of schooling and has led to higher demand on the early intervention centres. However, there is less option provided not only from government but also from the non-governmental organization (NGO) including the NASOM. The government has provided a pre-school option for the special needs students however, the number or the pre-school options are limited. On the other hand, the NGO were struggling with either funding or logical issues while tried to meet the need by opening the early intervention centres nationwide. The other option provide by a private centres can be pricey where the charges may be around RM150 per hour for specialized therapy session, or up to thousands ringgit monthly (Dina Murad, 2019). Therefore, it is important to find the alternative methods to help those children with ASD. One way is through recreation. The recreation may effectively be used to improving the social and behavioural changes and also wellbeing of children including the children with ASD.

Due to less interaction with others, the ASD children have difficulties to express the feeling to others and it may be difficult for others including the family member to understand the true feeling of the ASD children. Thus, it will be difficult for the family member to understand the true feeling that the ASD children express during participating in an activity. The family member will only be providing information based on an observation, not from the ASD children perspective. Other than that, there is no official registry number of individuals that were diagnosed with autism in Malaysia. There is no specific data which shown the

number of ASD children categorized in different groups such as age, gender and the locality of the of the ASD children. The objectives of the study were to compare the changes in development of children with ASD in a family before and after participating in the nature recreation, and to identify the most preferable nature recreation activity for children with ASD in a family.

BACKGROUND OF STUDY

According to Autism Navigator (2015) and the American Psychiatric Association's Diagnostic and Statistical Manual, Fifth Edition (DSM-5), Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder defined by persistent deficits in social communication and social interaction across the various context and restricted, repetitive patterns of behaviour, interests or activities. It is a new category in DSM-5 which replaced the pervasive developmental disorders (PDDs). ASD includes the former autistic disorder, Asperger's syndrome, and also PDD, while Rett's syndrome and childhood disintegrative disorder have been removed from the ASD category.

The sign usually can be found in early childhoods and with appropriate early intervention, the individuals with ASD can be productive, inclusive and have a fulfilling life. The sign of ASD usually found in both social and behavioural of the children who are diagnosed with ASD. In social sign, the children usually have difficulty in maintaining a conversation, have an inappropriate respond to others, avoid any eye contact, facial expression does not match on the communication context, difficult to understand except in their own perspectives and also only like to discuss their interest which is in great detail. In behavioural sign, the children have an inability to cope with changes to their routine and environment, distancing themselves with other people, developing a high skill in certain area and will have an obsessive interest, have a repetitive behaviour such as saying the same things repeatedly or rocking from side to side, and being either more or less sensitive on the sensory stimulation, for example a loud noise. According to Aaron Kandola (2019), some of the children with ASD may have balance, coordination and also motor problems.

There are three level of ASD which were based on the severity of the two main signs shown by the children with ASD. Level one is the least severe of autism diagnosis and requires some support. Without supports, the deficits in the social communication may cause a noticeable impairment. The person with ASD usually has difficulties in making friends. Level two requiring a substantial support and even with support, the people diagnosed with Level two ASD may have a struggle to communicate coherently and likely to respond inappropriately to others. They are more likely to only discuss in a specific topics based on their interest or only speak a few words. Usually people with Level two ASD did not cope well with changes which may results a significant distress. Level three is the most severe in the autism diagnosis which usually have significant impairment in verbal and nonverbal impairment. Have a minimal response to social interactions and often avoid others. However, the ASD people may interact in a limited way. The behaviour are highly inflexible and repetitive, and also extremely difficult in coping with any changes. The individuals may show a highly distressed if requires to changes the task which they were focus on.

Diagnosing ASD would be difficult and challenging because it is a spectrum disorder where a symptoms of a spectrum disorders may be range from mild to severe. Some have mild symptoms which make it difficult to diagnose the ASD. The most obvious sign of Autism can

be detectable usually by two to three years old, despite it is possible to show any symptoms at the older or younger age (Aaron Kandola, 2019). The diagnosis can be involved in two-stage process which are screening and comprehensive evaluation. In screening, it usually done by doctors using validated screening checklist that parents need to fill out. The screening from the parents provides early information about the children which led to further discussion on the child's behaviour, development and also family medical history. In the second stage which is the comprehensive diagnostic evaluation, usually conducted by a multidisciplinary team which gathers information from interview and also observation (Autism navigator, 2015). There are two common evaluation forms that can be used by the caretaker in order to identify the early signs of ASD which are the Autism Treatment Evaluation Checklist (ATEC) and the Modified Checklist for Autism in Toddlers (M-CHAT-R).

The number of children diagnosed with ASD has widely increase and many studies have underline the importance of the early identification and intervention programs for the individuals with ASD, thus the needs for a trained clinics and early intervention centres and school has also grow each year.

Recreation can be described as a voluntarily participation in any activity during free time to achieve benefits on the participation. Outdoor recreation is one of the extensions to recreation and it can be defined as a voluntary participation in free time that occurs in the outdoors and embraces the interaction of people with the natural environment (Plummer, 2009). According to Walsh (1986), recreation involves the consumer participation in distinguish the characteristics of the activity, whether it is passive or active activity. Passive activity refers to recreational activities which do not require intensive physical participation while active recreation involve more vigorous physical participation. One of the objectives of an outdoor recreation is to appreciate the nature because it can develop a learning process in understanding the nature which may lead to develop an environmental awareness. Nature also has been proclaiming as a healer to human wellbeing where a study shown that lacking of natural surrounding exposure may have been cause of the modern illness including depression and also anxiety attacks.

Spending time outdoors in nature area has benefits for all. A study shown that specific group of people such as children with deficits disorder gains attention from being outdoors in natural environment, it is a therapeutic tool which may help people with various disabilities in young people and adults. Nature recreation is important for the children with ASD because the children will experience in improving balance, agility and coordination in physical health. However, there is no study that compared directly the behaviour of children with ASD in natural environment (Mollie r. M., 2011). Figure 1 below show the hypothetical model of nature recreation effectiveness developed based on the earlier researches.

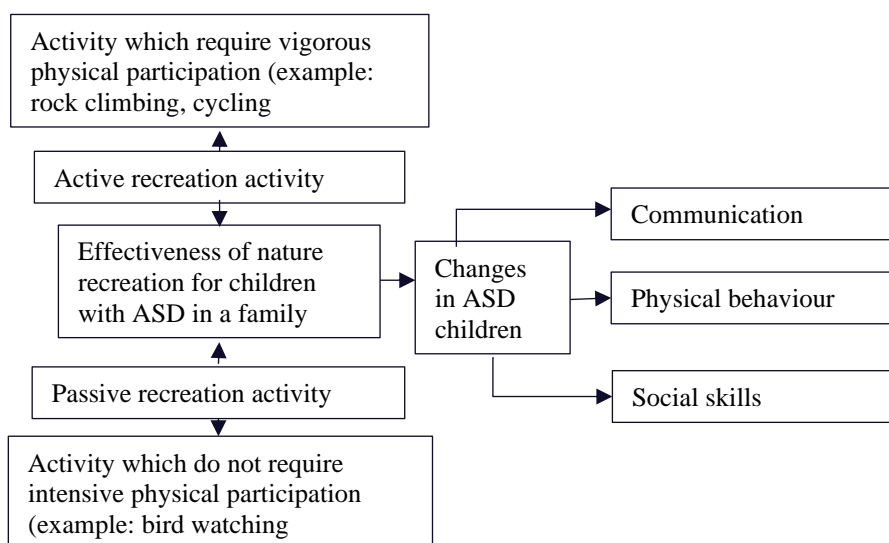


Figure 1. Nature recreation effectiveness hypothetical model

Referring to Figure 1, it shows the effectiveness of the nature recreation hypothetical model, where the nature recreation activity was divided into two categories which are passive recreation activity and active recreation activity. After the children went through the recreation activities, the changes of the development of children with ASD were monitored based on three aspects: i) communication, ii) social skills and iii) physical behaviour.

ANALYSIS AND FINDINGS

Demographic background

Table 1 showed the demographic characteristics of the children with ASD. A total of 108 respondents volunteered to fill up the questionnaire provided in the Facebook group. The total number and percentage of the respondents were shown in the table for easy analysing of the data.

Table 1. Demographic background of the ASD children

Demographic categories		Frequency	Percentage %
Gender	Male	76	70.4
	Female	32	29.6
Total		108	100
Age	0-1	6	5.6
	2-3	22	20.4
	4-6	41	38
	7-12	39	36.1
Total		108	100
Race	Malay	88	81.5
	Chinese	8	7.4
	Indian	6	5.6

Demographic categories		Frequency	Percentage %
	Others	6	5.5
Total		108	100
Family income	Below than RM 1,000	5	4.6
	RM 1,001 – RM 2,000	18	16.7
	RM 2,001 – RM 3,000	16	14.8
	RM 3,001 – RM 4,000	18	16.7
	RM 4,001 – RM 5,000	19	17.6
	More than RM 5,0001	32	29.6
Total		108	100

Based on the Table 1 above, the total percentage of male children with ASD were higher with 70.4% compared to female with 29.6%. According to Werling (2016), males are about four times more likely to be diagnosed with ASD compared to females which was characterized by strong sexual dimorphism. Several theories also have shown that the number of males diagnosed with ASD were increasing each year. Thus, the results have support the theories that male were most likely to be diagnosed with ASD compared to female.

The children with ASD were classified into four groups of age which are: i) infant - range from 0 year (newborn) to one-year-old, ii) toddlers range from 2 years to 3 years old, iii) early childhood range from 4 years to 6 years and lastly, iv) middle childhood range from 7 years to 12 years. The result showed that most of the respondents' children aged between 4 years to 6 years old with the percentage of 38%, followed by children aged from 7 years to 12 years old with 36.1% and the lowest aged was 0 year to 1-year-old with 5.6%. Based on a statistic of children in Malaysia 2019, the number of children went to kindergarten was 10.6% more compared to children who went to the primary school. (Department of Statistics Malaysia (DOSM) (2018).

Table 1 also showed that 88% of the children are Malay, 8% is Chinese, and the minority of the respondents are from other races in Malaysia which included Indian and ethnics groups for example Kadazan, Dayak and Bajau. Majority of the respondents' family income was more than RM 5, 001 a month with 29.6%, followed by family who earned between RM 4,001 to RM 5,000 with 17.6% and the respondents with family income between RM 3,001 to RM 4,000 and RM 1,001 to RM 2,000 shared the same percentages which were 16.7%. Meanwhile, respondents with family income below than RM 1,000 were recorded as the lowest from the group with only 4.6%. The result ties well with the Malaysia Household Income and Basic Amenities Survey Report 2019. According to the DOSM, the mean income in Malaysia was RM 7,901 and median income recorded was RM 5,873 in 2019 and the income grew by 3.9% per year.

Changes before and after recreation

The changes in development of the children with ASD were divided into three categories which were speech or communication, sociability, and physical or behavior. These three categories were chosen as it was the main symptoms or sign of the ASD. The changes were based on the children's parents or caretaker perspectives. Table 2 below showed the comparison of the changes before and after the children involved in the recreation activities.

Table 2. Comparing the changes in ASD children before and after involved in recreation activities

Statement	Answer	Frequency	Percentage %
Before recreation			
Have I ever wondered my child might have hearing problem	Yes	46	46.2
	No	62	57.4
My child respond well when calling his/her name	Yes	61	56.5
	No	47	43.5
My child understand when being told something	Yes	50	46.3
	No	58	53.7
After recreation			
Have I ever wondered my child might have hearing problem	Yes	34	31.5
	No	74	68.5
My child respond well when calling his/her name	Yes	76	70.4
	No	32	29.6
My child understand when being told something	Yes	62	57.4
	No	46	42.6

Based on the Table 2 above, for the first statement, 42.6% of the respondents have wondered that their children may have a hearing problem. However, the percentage has dropped to 31.5% after the children had participating in several recreation activities. For the second statement, 56.5% of the respondents stated that their children responded when their name was being called and the percentage has increased whereby 70.4% of the children respond when being called after participating in recreation activities. Responding in calling their name did not mean that the children need to answer the called, but looking back to the person who called them also count as a responds. For the last statement, majority of the children with ASD with 53.7% did not understand when being tell something however, after participating in recreation activity, 57.4% can understand what others people trying to tell them.

Children with ASD may have the difficulty in developing a language skill and also understanding what others were saying. According to an international team of researchers, giving an opportunity for them to choose their own activities can help boosting the enjoyment and improving the communication and social skill. After participating in nature recreation activities, the children with ASD showed positive changes in the speech or communication skills. They have learnt to acknowledge their own name by responding when being called by the caretaker. The have also learnt to follow some simple commands from the parents or caretaker and also know how to explain what they want. Children with ASD have the difficulties in expressing their feeling and sharing their thought. Thus, after participating in the nature recreation, they have shown slight changes towards the positive side. Table 3 below showed the findings with regards to the sociability dimension.

Table 3. Comparing the changes in ASD children ‘before and after’ involved in socialized activities

Statement	Answer	Frequency	Percentage %
Before recreation			
	Yes	34	31.5

Statement	Answer	Frequency	Percentage %
My child interested to socialize with other children	No	74	68.5
My child tried to get me to watch his/her	Yes	42	38.9
	No	66	61.1
When something happened, my child looks into my face to see how I felt	Yes	62	57.4
	No	46	42.6
After recreation			
My child interested to socialize with other children	Yes	52	48.1
	No	56	51.9
My child tried to get me to watch his/her	Yes	66	61.1
	No	42	38.9
When something happened, my child looks into my face to see how I felt	Yes	86	79.6
	No	22	20.4

Based on Table 3 above, for the first statement, majority of the children with ASD with 68.5% and 74 respondents did not interested with other children. Despite the children attended school with a lot of others children, they tend to stay alone as they did not perform any interest with other children. Although the majority of the children still do not interest with other children, the percentage has dropped to 51.9%. This showed that the children may have learned on how to interact with other children while participating in the same recreation activity. For the second statement, 61.1% of the children did not try to get their parents attention by watching their action. Understandably, children with ASD preferred to live in their own world. Thus, this may be the reason why the children did not try to get people attention. Surprisingly, after they had participating in recreation, 61.1% of the children tried to get their parents attention when they try to do something. For the last statement, 57.4% of the children tried to look at their parents when something happens, to know what others feel. The percentage increased to 76.9% whereby the children showed the same reaction after participating in recreation. This showed that the children with ASD also wanted to engage with other people's emotion when something happened to them. Reduced in social interaction is one of the core features that people with ASD needed to face. Not all of them faced the same social problems; some may talk normally but cannot socialize with others. By participating in nature recreation, they showed positive changes towards their sociability and their social skill has increase. The children have learnt on how to interact with other children while participating in the nature recreation activity. Figure 4 below showed the findings with regards to the physical behavior.

Table 4. Comparing the changes of ASD children in physical behaviour

Statement	Answer	Frequency	Percentage %
Before recreation			
My child plays 'pretend or make-believe'	Yes	55	50.9
	No	53	49.1
My child likes to climbs on thing	Yes	45	41.7
	No	63	58.3
My child tries to copy me	Yes	49	45.4

Statement	Answer	Frequency	Percentage %
My child likes movement activities	No	59	54.6
	Yes	68	63
	No	40	37
After recreation			
My child plays 'pretend or make-believe'	Yes	57	52.8
	No	51	47.2
My child likes to climbs on thing	Yes	68	63
	No	40	37
My child tries to copy me	Yes	60	55.6
	No	48	44.4
My child likes movement activities	Yes	95	88
	No	13	12

Similar to the communication or speech and sociability, the physical or behavioral have shown positive changes too. Based on Table 4 above, for the first statement, 50.9% of the children with ASD used to play pretend or make-believe with different object such as drinking in an empty cup or pretending to be on phone. The number has increase with the percentage of 52.8% of the children have the same behavior after participating in recreation activity. This is a good sign in the children behavior whereby their imaginative skills have improved. For the second statement, before participating in the recreation activity, 58.3% of the children with ASD do not like to climb on things and the number changes after participating in recreation activities where 63% of the children like to climbs on things. One of the good developments of children are when they like to climb on things such as furniture at home, this may be because they started to have a better control on their body movements. For the third statement, 54.6% of the children with ASD did not try to copy or imitate their parents while 60% of the children try to copy their parents after participating in recreation activities. It is a good improvement for the children with ASD because they try to learn by imitating their parents. In the last statement, the children who like the movement activities have increased from 63% to 88 percent after engaging in the recreation activity.

The children with ASD become more hyperactive and talkative after participating in nature recreation activity. This has proven why the children preferred the active recreation compared to the passive recreation. Hyperactive and talkative is one of the major sign of ASD in children. Nature recreation may help in improving several skills of the children with ASD, however, they also need help from the expert for the better changes in their growth development mentally and physically.

Most preferable recreation activity

Recreation activity provided for the children with ASD were categorized into two which are active recreation and passive recreation. There are five activity listed for each of the category which were nature walks, hiking or trekking, swimming, cycling and rock climbing for active recreation and picnic, cloud gazing, horse riding, camping and bird watching for the passive recreation. The children that participated in the recreation activity were aged range from 0 years to 12 years old.

Active recreation needs more vigorous physical participation and nature walks has the highest participation with total of 53 children with ASD while only 7 children with ASD participated in rock climbing. Nature walk was considered as an active recreation because walking also used a lot of energy and walking in a nature area usually take a lot of time compared to the normal environmental setting. Although hiking or trekking used more energy, but nature walk is fun and less pressure especially for the children. Thus, the children with ASD enjoyed the time more during the nature walks activity.

Passive recreation does not require intensive physical participation and the children with ASD have enjoyed picnic with a total of 49 participants. Picnic was an activity where a family gathered together in nature environment and having for example, a meal together. This activity is not only helping in strengthen the bonding between the family members, but it also gives a lot of benefits towards the needs of the children wellbeing. While picnic has been chosen as the most participated activity in the passive recreation, camping has been chosen as the least participated activity with a total of 9 participants only. Figure 5 below showed the findings of the comparison between active and passive recreation preferred by the children with ASD.

Table 5. The comparison of participation in active and passive recreation

Variables (age)		Frequency	Percentage %
Active recreation	0-1 year old	3	2.0
	2-3 years old	24	15.8
	4-6 years old	61	40.1
	7-12 years old	64	42.1
	Total	152	100
Passive recreation	0-1 year old	7	6.0
	2-3 years old	22	19.0
	4-6 years old	49	42.2
	7-12 years old	38	32.8
	Total	116	100

Referring to Table 5 above, a total of 152 children with ASD were recorded has participated in various active recreation compared to 116 children with ASD who participated in passive recreation, with 13.4% different between the two activities. The children aged from 0 year to 12 years old were categorized into four groups which were children aged from 0 year to 1-year-old, 2 years to 3 years old, 4 years to 6 years old. And 7 years to 12 years old. The children aged from 7 years to 12 years old enjoyed the active recreation activity the most while the children aged from 4 years to 6 years old enjoyed more on the passive recreation activity. Although many children with ASD remained the same symptoms, but the symptoms in children may be seen less severe as the children grow older. This showed the reason why some of the children enjoy more on the active recreation because it is the nature of the children to have a lot of fun exploring things without getting bored. Figure 6 below showed the findings of the satisfaction of children with ASD in nature recreation.

Table 6. The satisfaction of ASD children in nature recreation

Questions	Answer	Frequency	Percentage %
Does your child with ASD volunteer herself/himself to participate in recreation activities?	Yes	64	59.3
	No	44	40.7
Total		108	100
Does your child with ASD enjoy participating in recreation activities?	Yes	92	86.1
	No	15	13.9
Total		108	100

Based on Table 6 above, 59.3% of the respondents agreed that the children with ASD volunteered themselves to participate in any recreation activities, although 40.7% of them did not volunteer themselves to participate in the recreation activities. However, the number of children with ASD enjoying themselves while participating in the recreation activities were higher with 86.1% of the respondents comparing to children with ASD who did not enjoy recreation activities. Children with ASD usually tend to have less recreation interest, however if they were given a choice to engage in any activity, they may show interest later on. Thus, it is important to identify recreation activities that the children with ASD may enjoy most.

DISCUSSION AND CONCLUSIONS

The ASD is a type of disorder which cannot be cure using a drugs or medicine. It is a neurodevelopmental disorder which is a group of conditions with onset in the developmental period typically occur in the early development and are characterized by developmental deficits that produces impairments. It has the disabilities in the functioning of the brain that effect a child's behaviour, memory or the ability to learn. Although the ASD cannot be cure completely, but the severity of the symptoms of ASD can be changed. Nature recreation can be one of the early intervention processes that can help the caretaker of the children with ASD to improve the social and behavioural of the children with ASD. This study showed that the children with ASD have positive changes in speech or communication and also in sociability. The signs of the ASD in both aspects have shown less severe compared to before participating in the nature recreation. However, the physical behaviour of the children with ASD has shown more severity on the sign of ASD. The children with ASD became more hyperactive and talkative compared to before participating in the nature recreation. It is suggested that the children with ASD may require a psychological support from the experts should the hyperactivity become the main problem.

From the research, most of the children with ASD participated in the active recreations compared to the passive recreations with nature walks as the first choice for the children. Although some of them were forced to participate in the nature recreation, but 86.1% of the ASD children which were more than half of the number of the children with ASD participated in this study enjoyed the nature recreation activities. The parents or caretaker of the children with ASD need to identify what activities that the children like the most thus they may enjoy and participate in the nature recreation voluntary.

As an overall conclusion which strongly related to promoting social inclusion with regards to the Sustainable Development Goal – SDG Target 10-2, this study revealed five themes that support meaningful aspects of social inclusion from participants' perspectives: (a) creating

opportunities for children to communicate their interests and desires; (b) providing opportunities to choose self-directed activities; (c) strategically selecting and placing objects to support interactions among children; (d) directly encouraging interactions between children. This contributes to the children's sensory-motor, emotional, and social benefits. Although some benefits of nature exposure were recognized as having unfavorable consequences by the same or different participants. Nature offered attractions and elements for children to engage with. Natural elements captivated children's interests and held their attention for extended periods of time. In nature, children learned to tolerate and process information from multiple sensory modalities, such as visual, auditory, and tactile stimuli.

Children with ASD often experience negative emotions such as stress and anxiety but nature visits helped children relax, promoted positive emotions, or reduced negative ones. Children were happier, more energetic and lively. Whether there was an actual increase in interaction with others seemed to be contingent on the child's own level of acceptance of social interaction. However, nature provided opportunities for the children with ASD to be close to other children, the extent to which children took advantage of these opportunities and interacted with other children varied (Li et al., 2019; Edward et al., 2019). It is due to the level of the ASD that the children had.

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ASSESSING THE PRACTICES AND COST OF SITE WASTE MANAGEMENT IN INDUSTRIALISED BUILDING SYSTEM (IBS) PROJECTS IN MALAYSIA

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Abstract

The construction industry in Malaysia is still in high demand due to the development and urbanization of Malaysia. The increasing number of construction projects in Malaysia indirectly will contribute to the increase of construction waste. Thus, waste minimization is an important area of concern in implementing construction waste management in Malaysia's construction industry. Many construction wastes are produced with the increasing demand for major infrastructure projects, commercial buildings, and housing development programmers. The rapid development in Malaysian construction projects has generated a vast amount of construction wastes. Thus, there is a pressing issue of minimizing construction waste, which causes significant impacts on the environment. Malaysia is moving towards better construction waste management; however, there is still insufficient collection and improper construction waste disposal. Practices to reduce, reuse, or recycle waste have not yet achieved widespread implementation due to the cost incurred in handling and transporting the physical waste to the dumpsite. Some even believe that the cost of reusing or recycling waste is not worth the result. Thus, adopting an industrialised building system (IBS) has been an alternative to the conventional construction method to reduce construction waste. The research aims to investigate how or method IBS construction project on managing their site waste effectively to produce an output that is useful for the country's regulatory framework for construction waste management in the future. The research examines the types of site waste generated from construction activities, types of site waste management practices, and cost involved in managing site waste. Finding from a semi-structured interview based on comparative three (3) case studies revealed that the adoption of IBS is a practical construction method for waste minimisation, saving the cost of materials, and improve the environmental performance for overall site conditions. The adoption of IBS is a new way of minimising construction waste.

Keywords: *Waste Management, Construction Waste, Cost, Industrialised Building System*

INTRODUCTION

Site waste management is a sustainable development approach to minimize waste and avoid negative impacts on the environment. Management of waste includes monitoring, collection, transport, processing, and waste disposal. Introduction to and utilization of appropriate technologies and efficient facilities are essential in construction for the sake of environmental protection (Nagapan et al., 2012). The Malaysian Construction Industry Master Plan (CIMP 2006-2015) and the present Construction Industry Transformation Programme (CITP 2016-2020) aim to develop Malaysian construction into an environmentally sustainable industry. Moreover, the target of Sustainable Development Goals 12 (SDG 12), by 2030, there is significantly reduced waste generation through prevention, reduction, recycling, and reuse (Nor Faiza et al., 2019). Malaysians are moving

towards better construction waste management; however, there are still insufficient collection and improper disposal methods for construction waste (Mei, 2016).

Current research proves that construction is the main contributor to generating waste which can cause pollution such as environmental pollution and other harmful effects. The government has developed various site waste management solutions; however, it has yet to achieve the level of effectiveness required to manage construction waste adequately. Besides, practices to reduce, reuse or recycle waste have not yet achieved widespread implementation due to the cost incurred in handling and transporting the physical waste to the dumpsite. Employers with low initial funds may tend to allocate less to a waste management budget, leading to a reduced priority in site management (Eusuf & Ibrahim, 2012). Moreover, deficiency of construction waste data causes difficulty in planning the future of construction waste management (Hassan et al., 2018) and growing of construction wastes is due to the inefficient waste management practices (Hasmori et al., 2020). Therefore, government efforts to promote industrialized building systems (IBS) have been an alternative to the conventional construction method to reduce the amount of construction waste. Thus, the purpose of this research is to examine the types of materials waste generated from construction activities, types of site waste management practices, and cost involved in managing site waste in IBS projects. Thus, it is crucial to study IBS site waste management so that it could be possible to produce an output that is useful for the country's regulatory framework for future construction waste management.

LITERATURE REVIEW

Construction waste is considered one factor that leads to man and animals' problems, resulting in economic, environmental, and biological losses. Thus, waste minimization is an important area of concern in implementing construction waste management in the construction industry. The studied shows that the government's enforcement of the Industrial Building System (IBS) method can reduce construction waste by as much as 41-50 percent, which is a significant amount of reduction (Jayanthi, 2015). The relative level of waste generated at the site when using the IBS method and the conventional method also shows that IBS has a lower mean level of waste generated than the conventional method. This shows that our government is serious about reducing waste management at the site, and IBS is one factor contributing to less generation of waste at the site.

The focus on material waste and the low quality of waste management often causes schedule delays, increased time spent waiting for a decision, double material handling, and poor constructability (Saadi et al., 2016). Additionally, Wahi and Joseph (2015) noted that there are two principal components of construction waste. The first is time waste, including waiting periods, varied information, delays in plan activities, unusual wear of equipment, ineffective work, and required rework. The second is material waste, which includes ordering issues, incorrect storage and handling, manufacturing defects, and overproduction. Site waste has been criticized for producing a high quantity of waste. Lachimpadi (2012) compares site waste generates between conventional construction methods and IBS; there are not many differences in terms of types, but the differences resulted from the amount of site waste generated between them.

Adopting an IBS is more familiar with their effectiveness to reduce waste and method to hoist and install very neat and safe, which makes the working environment safer in a

construction site and shortens the construction period compared to the conventional method. The most important benefits of this system are relatively high in reducing construction time, reducing total cost, reducing material waste, increasing buildings' quality, promoting safety, and providing a cleaner and neater site. An IBS will manage waste by using the 3-Rs concept, which refers to reducing, reusing, and recycling since this method generates less waste. Thus, waste minimization is an essential area of concern in implementing waste management in the industry. Moreover, IBS projects' waste is lower and seems to demonstrate a 3-R concept as a tool to manage construction waste and reduce the effects on health, the environment, and aesthetics (Nitivattananon and Guilberto, 2007). As a result, government efforts have increased regarding promoting IBS usage as an alternative to the conventional, labor-intensive, and wasteful construction method (Saadi et al., 2016).

METHOD

The research used qualitative research and uses case study approach to elaborate on the practice of waste management. The literature on waste management practices on-site, site waste, quantification, and site waste cost were reviewed in achieving the objective. The multiple-case study design was selected for this research. Three cases were observed to obtain a comparison of the site waste management approaches practiced in IBS projects. The scope included the Johor Bahru area due to its notable development and the fact that it is a congested area that generates waste from its many construction projects. In the case study, semi-structured interviews were designed to obtain detailed, complex answers from the interviewees, to clarify unclear answers. An interview schedule was prepared based on literature. All interviews were conducted with the contractors, lasting approximately 45 to 60 minutes, and were recorded and transcribed verbatim. The analysis is based primarily on cross-case analysis and pattern matching technique, in which all data from each case study were compared to achieve the aims of this investigation.

RESULTS AND DISCUSSION

After analysing the data from the cases individually, the cross-case analysis is carried out. Its purpose is to examine the types of waste generated from construction activities, types of site waste management practices, and cost involved in managing site waste in IBS projects.

Respondents' overview

To critically compare and review the case studies, three (3) IBS projects were observed. All the data, information, and relevant ideas are gained from the respondents involved and experienced in the site waste management area.

Table 1. Details of Respondents

	IBS PROJECT		
	Project 1(Pulai, JB)	Project 2 ((Kulai Jaya, JB)	Project 3(Pulai, JB)
RESPONDENT	Respondent 1	Respondent 2	Respondent 3
AGE	31 years	44 years	35 years

GENDER	Male	Male	Male
POSITION	Contractor	Contractor	Contractor
WORKING EXPERIENCE	9 years	12 years	10 years

Table 1 exhibits the cases, respondents' position, and experience. Initially, the respondents were asked about the basic background and brief description of their position in the company's organization. The majority of the respondents were very experienced with more than five years, which portrays their high management level and decision that indicates the data obtained are reliable and accurate.

Types of Waste Generate in Industrialised Building System (IBS)

This section will explain the types of waste generated in IBS projects. Since the construction method applied in this case studies are IBS, the main IBS components are precast column and beam, slab, and blockwork systems.

Table 2. Types and Quantity of Site Waste between Conventional and IBS Projects

Types of Site Waste	INDUSTRIALISED BUILDING SYSTEM (IBS)			
	Project 1	Project 2	Project 3	TOTAL (tonnes)
Packaging Product	25.92	22.72	31.36	80.00
Tiles	11.30	16.81	8.54	36.65
Bricks / Blocks	-	-	16.38	16.38
Concrete	-	-	12.28	12.28
Timber and Plywood	-	11.30	-	11.30

As shown in Table 2, five types of site waste were found in IBS and included packaging waste, tiles, bricks/blocks, concrete, and timber. Packaging waste was the dominant waste across all IBS projects, followed by tiles, bricks, concrete, and timber; the lowest quantity of waste generated was timber waste. IBS construction method produced a vast quantity of packaging waste with a reading of 80.00 tons. The packaging products in the form of plastic or cardboard are essential for the precast component, which prevents the precast component such as beam, column, and slab from damage or scratch. All the IBS components need more extra protection to cover the components from cracks or crushes using plastic or others. It is to maintain the quality and value of the building's component; however, timber waste is produced in a minimal amount in IBS with a reading of 11.30 tons. The wastage has been produced due to the improper storage on-site by the workers where the timbers are placed in the area exposed to moist soil or rain that make it keep wet or moist. Construction waste is generally produced due to causes such as improper storage, incorrect material handling, lack of skill by the workers (Manaf & Samah, 2009).

Waste Management Practices in IBS Projects.

This section will explain the waste management practices in IBS projects. Reuse and recycle is the site waste management practices that have been practiced in IBS projects.

Table 3. Amount of Site Waste to Manage in IBS Projects

CATEGORY	PROJECTS	TOTAL CONSTRUCTION WASTE	SEGREGATION OF CONSTRUCTION WASTE (tonnes)					
			REUSED AT SITE		RECYCLED		DISPOSED AT LANDFILLS	
		(tonnes)	(tonnes)	(%)	(tonnes)	(%)	(tonnes)	(%)
IBS	1	37.22	11.30	30.36	25.92	69.64	-	-
	2	50.83	16.81	33.07	34.02	66.93	-	-
	3	68.56	37.20	54.26	31.36	45.74	-	-

As in Table 3, the waste management systems that have been implemented in IBS projects are to reuse and recycle. In IBS, the contractor decided to reuse all broken materials such as blocks and tiles as backfill material or manufacturing road-base. This process helps save time, money, energy, and resources. In reuse practices, the contractors provide several bags on a site for the workers to collect all the wastes and put them in different bags according to the types of wastes. The method of recycling that the contractor uses to manage the site wastes to be recycled is using a container or a bag put in a site then the recycling lorry has been transported the wastes to the recycling center for the separation process. Generally, the IBS projects' waste materials still have their quality and value to be recycled and reuse, such as packaging waste, broken tiles and bricks, and others. The results reveal that recycling and reusing the wastes can save more money, create a market for recycled products, minimize the quantity of waste to the landfill, and reduce environmental issues (Begun and Satari, 2010; Kozlovska and Spisakova, 2013). Thus, IBS could play an essential role in the 3Rs to overcome the construction industry waste (Azman et al., 2013)

Costs Involved in Managing Site Waste in IBS Projects.

This section will explain the cost involved in managing site waste in IBS projects.

Table 4. Cost Involved in Managing IBS Site Waste

PROJECT	INDUSTRIALISED BUILDING SYSTEM (IBS)					
	1		2		3	
	OVERALL COST (RM)	COST (RM)	OVERALL COST (RM)	COST (RM)	OVERALL COST (RM)	COST (RM)
Total delivery cost (RM)	4,043.52	Purchased cost = RM 156.00/tons	4,932.90	Purchased cost = RM 145.00/tons	3,825.90	Purchased cost = RM 122.00/tons

Total labor cost (RM)	33,600.00	Labour cost = RM 60.00/labour	23,760.00	Labour cost = RM 60.00/labour	18,000.00	Labour cost = RM 60.00/labour
TOTAL	37,643.52	-	28,692.90	-	21,825.90	-

As shown in Table 4, IBS projects only involved total delivery cost and total labor cost since they are not used disposed of at landfills as their waste management practices. Analysing costs involved in managing site waste is one of the most important elements to know how much money has been effective for the project cost. Based on the cost evaluation made, one can conclude that the third objective has been achieved. The costs involved in managing site waste from IBS projects are lower since these projects practice the 3Rs concepts as a tool to manage the waste. This approach only involved two types of costs, delivery, and labour, and did not include any landfilling methods. To conclude, proper site waste management reveals that it is economically viable to achieve significant cost savings from the process when the money would otherwise go into landfills in the form of waste (Tam, 2008).

CONCLUSIONS

Based on the research findings, the adoption of an IBS has the potential to reduce enormous waste generation, and this study contributes new insights and knowledge advancement in a new way to minimize construction waste. Proper site waste management reveals that it is economically viable to do significant cost savings from the whole process, which can save a vast amount of money that otherwise goes into landfills in the form of waste materials. The IBS can produce less waste than the conventional method, and the cost of site waste management would be reduced.

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PROJECT MANAGEMENT

A CONCEPTUAL APPROACH ON STRATEGIC LEADERSHIP FOR SUCCESSFUL STRATEGY IMPLEMENTATION

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Abstract

Strategic leadership is the ability to persuade employees to acquire company's vision. There is a knowledge gap of strategic leadership in construction industry. This paper covers an overview study of strategic leadership from various industry and listed which best fit for the complexity nature of construction industry in a conceptual framework. Systematic literature review (SLR) method is utilise in this research to produce a comprehend overview on previous research. Results from SLR identifies the key strategic leadership attribution include absorptive capability, adaptive capacity, analytical and emotion intelligent, inspirational, facilitating, intellectual stimulation, empowering, optimising resources and innovative. The findings from this research provide a basis for future extended research on strategic leadership for construction industry

Keywords: *strategic leadership, strategic leadership attribution, systematic literature review*

INTRODUCTION

In this demanding 21st century, effective strategic leadership is crucial. Basic leadership skills in operations are important, but it is not sufficient for strategic leadership (Norzailan, Othman & Ishizaki, 2016). The importance of strategic leadership is that it combines the strategy management aspect with the leadership functions (Ali & Zulkipli, 2018). Responsibility of strategic leader is about maintaining company's competitive advantage by being visionary and forward-looking (Tutar, Altınöz & Çakıroğlu, 2011). Strategic leadership helps to manage a company effectively (Bhardwaj, Mishra, & Jain, 2020). Managing a company under a stable and static environmental is relatively easy, however it is usually not the case, especially in this challenging construction industry (Tutar et. al., 2011). Strategic leaders should always predict and prepare for the unknown by maintaining the flexibility and not forgetting the ability to empower others to create strategic changes as necessary (Rahman et al., 2018).

RESEARCH GAP

Over the years, the studies of leadership have undergone so many changes due to the constants changes in terms of environmental, social and technologies. However, not much research has been conducted on the relation to leadership in the construction industry (Tabassi, Ramli, Bakar & Pakir, 2014). From that few, most focuses on the operational and project-base leadership. Therefore, there is a gap in strategic leadership studies in construction industry.

Developing strategic leadership competencies is different from developing supervisory skills and operational leaders (Norzailan et al., 2016) Strategic leadership requires to be

dynamic in unsteady environmental circumstances (Tutar et. al., 2011). Thus, this paper objective is to identify the strategic leadership attribution from an overview study of strategic leadership of previous research from various industry.

METHODOLOGY

A Systematic Literature Review (SLR) is a dynamic, flexible, and adaptable process to meet a variety of research questions (Berrang-Ford, Pearce & Ford, 2015). In this research structured questions kept in mind when reviewing the literature as followed:

“What are the strategic leadership attributes in other industry”

“What are the strategic leadership attributes suitable to be adapt in construction industry”

SLR method is utilised in this research to produce a comprehend overview study on previous research which includes journals, conferences proceedings and frameworks. In this research, SLR helps to narrow down relevant literature (shown in table 1) to answer a specific research question using pre-defined eligibility criteria such as in figure 1. This paper objective is to identify the strategic leadership attribution based on previous research from various industry and established conceptual strategic leadership framework for construction industry as shown in figure 2.

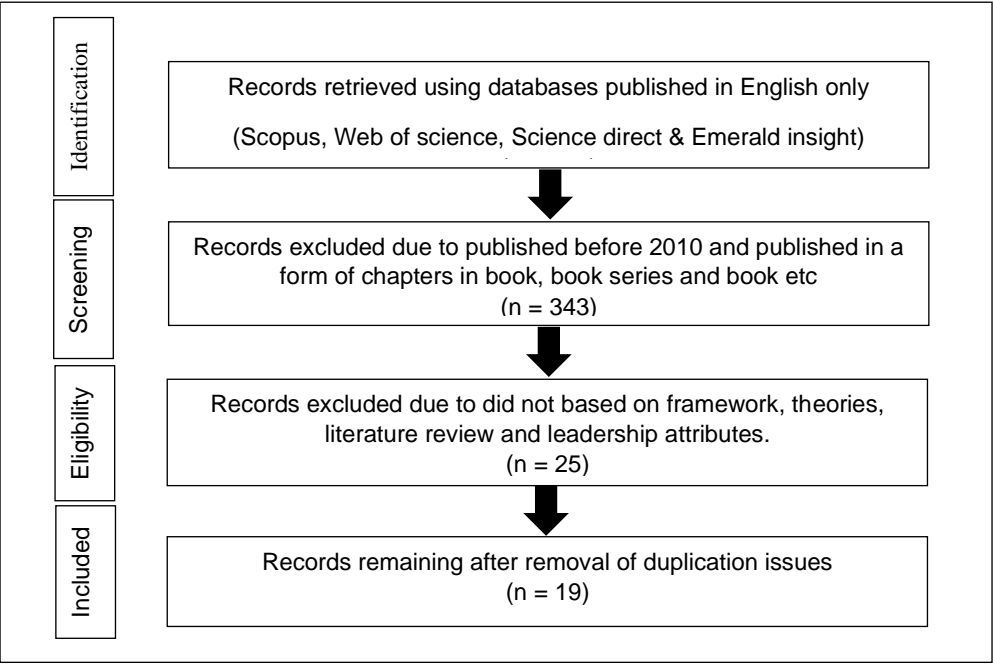


Figure 1. Flowchart of SLR on strategic leadership attributes

STRATEGIC LEADERSHIP ATTRIBUTES

Absorptive Capability

Absorptive capability is defined as the ability to recognize new information, learn and assimilate (Sinha, 2017). Absorptive leader is aware and always ready to learn and acquire

new information (Naim & Lenka, 2018). They will expose themselves to various different models and cultures (Schoemaker & Krupp, 2015). Strategic leaders are aware of new information and use the information to make decisions (Aslan, Diken & Şendoğdu, 2011). Absorptive capability helps leader to have a unique ability to change existing company patterns (Ali & Zulkipli, 2018). This ability helps prepare for various uncertainty (Samimi, Cortes, Anderson & Herrmann, 2020). Thus, a leader which have the ability to withhold information is important for construction strategic leader.

Adaptive Capacity

Adaptive capacity is defined as the ability to change by mastering the chaos and complexity (Naim & Lenka, 2018). It is a difficult task to keep up with the uncertainty and to make changes (Tutar et. al., 2011). Strategic leader needs to stay calm in times of distress and able to think clearly (Sinha, 2017). Adaptive leader identifies strategic opportunities by understanding the competitive context of environment (Thomas & Thomas, 2011). They not only open to changes but driven toward changes (Sinha, 2017). Adaptive capacity requires them to challenge their own ideas and adopt new ways of thinking (Ali & Zulkipli, 2018). Adaptive capacity includes the complex process of analysing and interpreting conflict (Fish & Wood, 2017). Adaptive leaders have high self-confidence, emotional maturity, initiative, and stress tolerance (Meng, 2012). Construction strategic leader definitely need to be adaptive because of the uncertainty nature of the industry.

Analytical & Emotional Intelligent

Wisdom is the capacity to act right first time by being aware of environmental perception and social relations (Naim & Lenka, 2018). Wise leader is analytically and emotionally intelligent (Ali & Zulkipli, 2018). This include the ability to rationally and critically think problems (Norzailan et al., 2016). It is the ability to judge situations correctly (Sinha, 2017). They don't allow pressures and stress cloud their judgment (Norzailan et al., 2016). They not only hide undesirable emotion, but also display certain social norms emotions (Ohlsson & Larsson, 2017). Humans can be emotional; thus, leaders should always consider sensitivity of employees (Bhardwaj et. al, 2020). Empathic leader tends be more favourable and able persuade employees toward desired company goals.

Influential & inspirational

Influential leaders can change the mindset and behaviour of their employees (Ali & Zulkipli, 2018). Influential leaders can aspire employees towards strategic vision (Tutar et. al., 2011). Behaviours displayed by leaders can unify and motivate employees (Samimi et. al., 2020). Giving employees recognition for their works can also aspire them (Bhardwaj et. al, 2020). Motivating employees will influence employee's morale and values towards better performance (Asif, 2020). Inspirational leader communicates with employees with optimism and enthusiasm (Shao, 2019). Construction leaders needs a charismatic leader which can influence employees' action.

Facilitating & Cooperating

Taking feedback from employees is a way to facilitate employees’ needs (Ellinger & Ellinger, 2020). Leader who collaborate with employees can create a climate of trust as well increase the company’s productivity (Meng, 2012). A cooperating team achieve a positive outcome in competitive advantages (Fish & Wood, 2017).

Knowledge Sharing & Intellectual Stimulation

Knowledge sharing usually conducted through mentoring and coaching (Ellinger & Ellinger, 2020). Strategic leader needs to serve as coaches and mentors provide support during difficult task (Norzailan et al., 2016). Establishing coaching behaviours enhances employees’ commitment (Ellinger & Ellinger, 2020). Mentoring helps to facilitate that employees’ development (Naim & Lenka, 2018). This encourage the employees’ ability to stimulate new ideas and improve responsiveness during complex situation (Meng, 2012). Construction strategic leaders need to intellectually stimulate employees to enhance employees’ performance.

Empowering & Inclusive

Empowering is a trust by transferring certain ownership of decision making to employees (Ellinger & Ellinger, 2020). Including employee’s decision-making help to empowered them (Kuknor & Bhattacharya, 2020). Thus, supportive leaders will help employees to become a good decision maker (Bhardwaj et. al, 2020).

Innovative

Innovation means the successful application of creative ideas (Aslan et. al., 2011). Strategic leaders are expected to have skills to accommodate changes and being innovative (Razak & Murray, 2017). Innovation includes stages of idea generation, elaboration, and implementation (Samimi et. al., 2020). Innovative strategic leader is crucial to allow company to stay competitive.

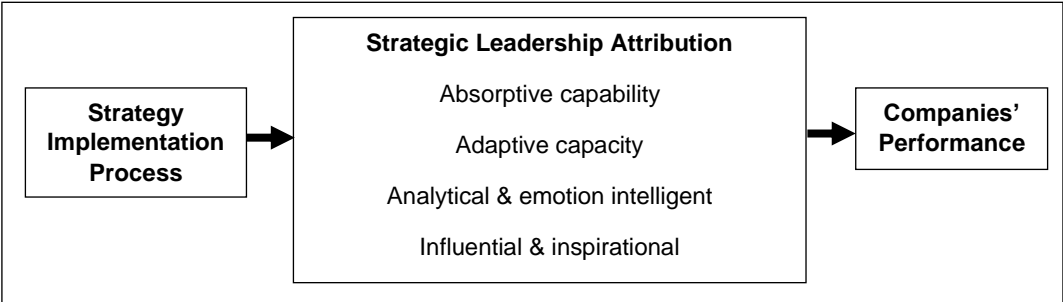


Figure 2. Conceptual strategic leadership framework

CONCLUSION

There are several strategic leadership attributes identified using the SLR studies such as in figure 2. However, this research only limited to English databases. Thus, it might not cover the whole studies on strategic leadership.

RECOMMENDATION

The findings from this research provide a basis for future researcher on strategic leadership in relation to strategy implementation. Future researcher can continue to further refine and enhance this research with empirical data.

Table 1. Strategic leadership attributes obtained from on SLR

Author	Strategic Leadership Attribution							
	Absorptive capability	Adaptive capacity	Analytical & emotion intelligent	Influential & inspirational	Facilitate & cooperate	Knowledge sharing & intellectual stimulation	Empower & Inclusive	Innovation
Ali & Zulkipli, 2018	/	/	/	/				
Norzailan et al., 2016			/			/		
Ellinger & Ellinger, 2020	/		/		/	/	/	/
Thomas & Thomas, 2011		/						
Naim & Lenka, 2018	/	/	/			/		
Sinha, 2017	/	/	/					
Fish & Wood, 2017		/			/			
Razak & Murray, 2017								/
Schoemaker & Krupp, 2015	/	/					/	
Kuknor & Bhattacharya, 2020							/	
Bhardwaj et. al, 2020			/	/			/	
Samimi et. al., 2020	/			/				/
Tutar et. al., 2011		/						
Meng, 2012		/		/	/	/	/	
Aslan et. al., 2011	/	/	/					/
Hitt et. al., 2010		/						/
Asif, 2020				/		/	/	
Shao, 2019		/		/				
Ohlsson & Larsson, 2017			/					

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PROJECT MANAGEMENT COMPETENCY FRAMEWORK FOR INTERIOR DESIGN PRACTICE

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Abstract

The study begins with the issue that, today, the role of interior designers has generated beyond creativity and aesthetics for a competent interior designer as a project manager. Therefore, one of the main requirements for the interior design project manager is the ability to effectively deliver the project to the client. In addition, the capabilities of the project manager are measured by the ability to handle internal tasks. Provided in this study, a summary of the competencies needed by project managers and interior designers to become a professional project manager in the field of interior design and what the industry expects of the interior design project manager. In order to understand the need for competence of the interior design project manager, a literature analysis of the 27 competencies divided into three domains, namely technical, contextual and behavioural, is addressed in this paper. Data collection is carried out through questionnaire surveys which assess the competence of interior design project manager to manage interior projects. The results of the literature review and data collection later minimize the validity of competency skills activities and provide a formal direct support for the recognition, evaluation and enhancement of activities within the project manager. From the results adapted to the study, it concludes that the validity of the expertise of the interior design project manager increases the efficiency of interior design projects. Following the review of the findings, guidelines on a further and broader scale of research are introduced in order to expand the precision and generalization of the study.

Keywords: *project management competency, interior design practice*

INTRODUCTION

Today, Malaysia's building industry sees interior design as a discipline that has become renowned. In interior design, project management plays a crucial part as it covers the nitty-gritty of the project between preparation and execution. This phase often requires constant contact working collaboratively with different teams that manage various resources between clients and consultants.

According to A. Noorhani et al., (2009), from an artist and creative interior designer to a responsible Project Manager, the personality of the interior designer in that industry can also contribute to the project's management. In addition, one of the essential requirements in the project manager is the ability to effectively deliver the project to the customer in time. This research paper therefore explores a description of the requirements of a professional design project manager. The skills of interior designers supervising interior projects are particularly discussed in the practices. Many people believe that the skills of interior designers in practice are particularly one-sided in design, but also in project management. This differentiates the expertise of the interior design manager from the selected skills system. However, there are difficulties in the responsibility of the interior designer as project manager. One of the problems is the lack of awareness by interior designers of project management skills while

serving as project manager (Nur Maizura et al., 2010). The interior designers are known to develop indoor spaces to suit the needs and desires of the occupants of these spaces. In addition, according to Aiza et al., (2013) Provided that the core designer trade is part of the strategy and the further creation of the project management, the knowledge and understanding of project management, technological and framework structures can be a prerequisite to successful project transmission.

Secondly, the small number of interior design experts in the industry has led to architectural and engineering consultants playing this crucial role in the execution of interior projects (Jasmani, 2016). These challenges have provided a renewed application for qualified interior design practitioners. Project management in the construction sector is a key field, given renewed importance in a deadline-oriented market by design consultancies and the building sector. In addition, the Interior Design Project Manager in Malaysia is very requested to oversee interior projects and lead them until they succeed.

LITERATURE REVIEW

Interior design and project management are very well connected. The part of the project manager within a commercial building structure plan may be of exceptional importance for a client to achieve his expected plans goals and capacities during the activities and through the execution of the project forms and stages. Interior design project managers' roles may vary from project to project, but an outline of these roles can consist of overseeing the architectural design and construction efforts of involved parties and trades, conducting market research and managing design reviews via planning meetings (Thomas & Mengel, 2008). Instead of gaining expertise in project management in the area of construction, interior designers need to learn about project management skills to develop their project management skills as well. Therefore, interior design and project management are intertwined, since interior designers need the experience and expertise to plan or manage a project that can contribute to project success. Coleman (2010), supports it, claimed that being able to communicate about all the main elements of a project, such as scheduling, risk management and collaborating with other contractors, shows the understanding of an interior designer and his willingness to rely on his expertise in a project.

A successful project manager should address the risks or issues accordingly and ensure that team members have an opportunity to share their opinions and concerns on the issue. Fox, Skitmore, Hon and Fong (2008) support it, the project manager as a leader should serve as role models for others, avoiding unethical behaviors that weaken faith and trust by others.

Competence a person's willingness to do a job properly. A competence may be a collection of specified practices that provide a structured direct support for the recognition, evaluation and improvable of a person's practices. According to Hayes (1979) stated in Trivellasa and Reklitisb (2014), competency skill is a combination of preparation and capacity in order for an individual to carry out a task, general knowledge, motive, social position or skill of a person that is related to the requirement and demonstrate superior performance such that in the meantime individual abilities must be able to use their skills in work.

The challenging skills in project management are all about competence as a Project Manager. For this analysis APM 's Competence Framework and the CCPM Competence Framework have somehow chosen to change the competence of the interior design project Manager. It not only integrates the main project management topics including planning and control techniques, but also the wider subjects under the managing projects. For example, the social, ecological, and specific areas such as technology, economy, finance, organization,

procurement and people (Noorhani, 2010). The 7th edition of the APM Information Body describes the 27 competencies for project management. Based on the APM Framework, the project manager has 27 competencies. The 27 main competences are divided into 3 project management components. The 3 parts are:

- i. Technical Competence (20 elements)
- ii. Behavioural Competence (6 elements)
- iii. Contextual Competence (1 element)

Technical competence defines as behaviors directly that are related to the nature of training and the technical proficiency required to exercise effective control. Behavior competence is attributes and personality traits of a person might have, such as knowledge and skill set which can help to determine on how successful they are applying on the job or task. Meanwhile, contextual competence defines beyond contextual intelligence and requires perceptive action to plan, resource, execute and achieve desirable results.

Table 1. Competency Skill Elements according to APM Framework are as following:

Competence 1 Professionalism, Ethics and Compliance	It is the capacity to promote the more extensive public good in all activities and to act in an ethically, lawfully and socially suitable way in dealings with partners and individuals of extend groups and the association to oversee the insides ventures together.
Competence 2 Management of the Team	The team management is ability to select, develop and manage teams accordingly with their job scope and responsibility towards a successful interior project.
Competence 3 Management of the Conflict	It is the ability to select, develop and manage teams to support group development and learning, and tackles negative conflict to prevent differences from becoming destructive elements in change initiatives.
Competence 4 Leadership	The ability to empower and inspire others to deliver successful change initiatives through leadership skill that lead to a project success.
Competence 5 Procurement.	The ability to secure the provision of resources needed for change initiatives from internal and external providers
Competence 6 Management of Contract	The ability to monitor compliance, agree contracts for the provision of goods services and manage variances. Moreover, proactive contract management is essential to ensure that agreed goods services are delivered on time and within budget, to address problems without delay and to maintain productive working relationships with internal or external suppliers.
Competence 7 Management's Requirement	It is the ability to prepare and maintain definitions of the requirements of change initiatives.
Competence 8 Development of Solution	The capacity to decide the leading implies of fulfilling necessities inside the setting of the alter creativity's goals and limitations.
Competence 9 Management of Schedule	The capacity to get ready and keep up plans for exercises and occasions for alter activities, taking account of conditions and asset necessities.
Competence 10 Management of Resource	The capacity to create, actualize and overhaul asset assignment plans (other than fund) for alter activities, taking account of availabilities and planning.
Competence 11 Cost Control and Budgeting	Capacity to create and concur budgets for alter activities, and to control estimate and real costs against the budgets.
Competence 12 Issue Management, Risk and Opportunity	The capacity to distinguish and screen risks to arrange and execute reactions to those dangers, and react to other issues that influence the alter activity.
Competence 13 Quality Management	The ability to develop, maintain and apply quality management processes for change initiative activities and outputs. Quality management in this context is the means by which the manager of a change initiative ensures that the outputs and processes through which they are delivered are meeting stakeholder requirements and are fit for purpose.
Competence 14 Planning's Consolidated	The capacity to solidify and record the elemental components of a alter activity: scope; plan; asset necessities; budgets; dangers, openings and issues; and quality prerequisites.

Competence 15 Management of Transition	The capacity to oversee the integration of the yields of alter activities into business-as-usual, tending to the preparation of clients, compatibility of work frameworks and the acknowledgment of benefits.
Competence 16 Management of Financial	The capacity to arrange and control the funds of programs or portfolios and their related alter activities, as implies of driving execution and as portion of the organizations by and large money related administration.
Competence 17 Capacity Planning of Resource.	The capacity to plan and keep up an in general plan for asset utilize in related alter activities, which maintains a strategic distance from bottlenecks and clashing requests, and which groupings results in arrange to empower the productive acknowledgment of benefits
Competence 18 Arrangements of Governance	The capacity to set up and keep up administration structures that characterize clear parts, duties and accountabilities for administration and delivery of alter activities, which adjust with organisational practice.
Competence 19 Communications Management and Stakeholder	The capacity to manage partners, taking account of their levels of impact and specific interface
Competence 20 Methodologies and Framework	The capacity to distinguish or create systems and strategies that will guarantee administration of alter activities will be comprehensive and reliable over distinctive activities.
Competence 21 Review	The capacity to set up and manage audits at suitable focuses, during and after alter activities, which can advise administration of the alter activities, through giving assessments of advance, techniques and proceeding significance.
Competence 22 Change of Control	The capacity to set up conventions to change the scope of alter activities, actualizing the conventions when essential, and upgrading setup documentation counting contracts to create, keep up and apply quality administration forms for alter activity exercises and yields.
Competence 23 Assurance's Independent	The capacity to accumulate independent prove that the data from the alter activity is substantial and the alter activity is likely to achieve its aims.
Competence 24 Case of Business	The capacity to get ready, pick up endorsement of, refine and upgrade trade cases that legitimize the start and/or continuation of alter activities in terms of benefits, costs and risks.
Competence 25 Allocation of Asset	Capacity to suggest how budgetary and other assets ought to be apportioned among alter activities in arrange to advance the organisation's return on speculation (ROI).
Competence 26 Development of Capability	Capacity to evaluate organisational development in connection to venture, program and portfolio administration; distinguish the extra capabilities required, and to assist with the enlargement of those capabilities.
Competence 27 Management of Benefits	Capacity to survey organisational development in connection to extend, program and portfolio administration; recognize the extra capabilities required, and to assist with the enlargement of those capabilities.

METHODOLOGY

The research develops from the issues on the competency skills for interior design project manager which from the issues and problem statement which has been highlighted to conduct the study. A root of the research where it highlighted the gap and significance of the research is the problem statement. Hence, after identify the problem statement, the aim and objectives are formulated and continued with the collection of data for the finding of the research.

Structured Interviews and questionnaire surveys are the collected data for this study, divided into three categories which are considered to be the form of collecting qualitative and quantitative data. These two data from the study are intended to support the study goal up to the research results. After the collection period, the data will be processed and reviewed. The data obtained is then compared and correlated to the literature review in order to confirm the results. Finally, the findings of the study concluded and recommended. Several selected organizations were approached for questionnaires surveys. All participants were targeted and selected for their backgrounds and contributions in the field of interior design. Somehow,

several companies have refused to participate in this survey. There is a director of the project (4 respondents), interior design project manager (15 respondents), assistance project manager (2 respondents), senior interior designer (8 respondents) and an interior design academic (1 respondent). All goal respondents are from the same internal design consultant company. This research only measures skills or competences among them in the organization of interior design consultants.

The semi-structured interview was conversational with one respondent at a time and uses a mix of closed and open questions, often followed by follow-up about why and how questions were posed. In addition, there are a range of interviewees for semi-structured interviews who are interested in giving their views and still achieving the goal of educating the interior design competence process for the interior design project manager. This study has culminated in a semi-structured interview to collect related information, knowledge and experience opinions in the area of interior design and project management also contribute to the objectives. The interviewees draw on their expertise in interior design and involve themselves in project management. The interviewees are therefore selected to provide accurate and persuasive research results according to their experiences and context. The expert panels are selected on the basis of their knowledge, experience and expertise to obtain accurate data. In addition, the advice and views of the expert panels are relevant for this study, since they make recommendations based on their experiences in this industry.

FINDING AND DISCUSSION

Most of the interviewees participating in questionnaires and semi-structured interviews come from the profession of interior design, some of whom are members of the project management team, who fulfil their positions as project managers, project management assistants and senior levels of interior designers. It can also have a positive effect on the analysis because its knowledge and opinion for this research study would be credible and correct. The data collected have been analysed to define, explain and explore the competencies of an interior design manager to assess the need for an interior design project manager to have experience in project management. On the results of the questionnaires survey, Sections A and B are covered. Section A focuses on the demographics of the respondents while Section B lists the competence skills under the APM Competency Framework which analyses the skills for an interior design project manager involved in the management of interior design projects.

Section A – Demographic Information: To gather the respondent's personal background

Section A is a demographic information section which collects the respondent's personal background, e.g. education level, educational background and registered MIID level. Furthermore, questions like the work experience obtained by the participants in the management of the interior design project are also asked to ensure that the respondents have sufficient experience in the management of interior projects. According to the study, most of them have five to ten years of experience in the management of interior projects.

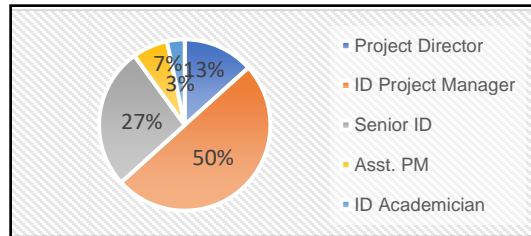


Figure 1. Position of respondents

Figure 1 indicates the positions of the respondents, the majority of survey respondents are project managers and project executives in the department of project management with more than 5 years' experience in handling projects in interior design.

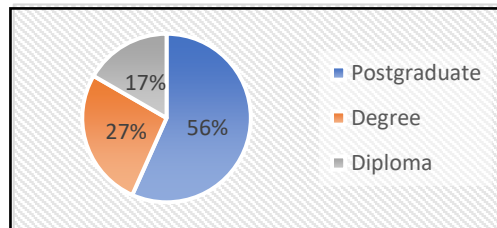


Figure 2. academic background of the respondents

In addition, most of the respondents are interior design consultants and design firms with 5 to 10 years' experience so that their knowledge is accurate in the research study because they are responsible for overseeing interior projects in all fields, including design, space planning, project planning, budgeting and interior design project execution.

Section B – Competency Skills according to APM Framework: To gather information about the validity of competency skills among Interior Designers or Interior Design Project Manager

Section B established APM Competence Framework skills to gather information on skills among interior designers or project managers. APM Competence Framework In this section there were 27 competencies focused on the APM Competence Framework divided into three areas: technical, contextual and behavioral. It consists of 20 technological skills, 6 interpersonal skills and 1 contextual competence. Based on the survey, respondents need to give rating scales on the important level of competency skills elements for an interior design project manager to manage interior projects which divided into five levels; (1) Expert (2) Practiced (3) Competent (4) Proficient and (5) Expert.

Table 1 below shows the summary level of competency skills elements by selected respondents according to 27 competency skills for each element. Moreover, the description based each element also stated below based on relation with the project manager in construction industry.

Table 2. Competency Skills rated by the Respondents

Competency Skills Elements		Level of Competency Skills for Interior Design Project Manager
Technical Competence		
1	Conflict Management <i>Problem solving skills</i>	Competent
2	Procurement <i>Contract administration (bidding/negotiation, Contract documents) and good knowledge of contract</i>	Practiced
3	Contract Management <i>Ability to agree contracts for the provision of goods and/or services, to monitor compliance, and to manage variances in interior design project.</i>	Practiced
4	Requirements Management <i>Ability to prepare and maintain definitions of the requirements of change initiatives of an interior project.</i>	Competent
5	Solutions Development <i>The interior design project manager expertise and knowledge will come all in use at this stage as the best problem solution</i>	Competent
6	Schedule Management <i>Project management (scope, schedule, Budget, fee) and able to read, analyse and execute time management programme</i>	Practiced
7	Resource Management <i>Ability to develop, implement and update resource allocation plans (other than finance) for change initiatives, taking account of availabilities and scheduling.</i>	Proficient
8	Budgeting and Cost Control <i>Ability to develop and agree budgets for change initiatives, and to control forecast and actual costs against the budgets for an interior project.</i>	Proficient
9	Risk, Opportunity and Issue Management <i>Ability to identify and monitor risks (threats and opportunities), to plan and implement responses to those risks, and respond to other issues that affect the project.</i>	Practiced
10	Quality Management <i>The ability to develop, maintain and apply quality management processes for change initiative activities and outputs.</i>	Proficient
11	Consolidated Planning <i>Knowledge of project planning</i>	Practiced
12	Transition Management <i>The ability to manage the integration of the outputs of change initiatives into addressing the readiness of users, compatibility of work systems and the realisation of benefits.</i>	Practiced
13	Financial Management <i>Accountability</i>	Competent
14	Resource Capacity Planning <i>Ability to prepare and maintain an overall schedule for resource use in related change initiatives, which avoids bottlenecks and conflicting demands, and which sequences outcomes in order to enable the efficient realisation of benefits.</i>	Proficient
15	Governance Arrangements <i>Ability to establish and maintain governance structures that define clear roles, responsibilities and accountabilities for governance and delivery of change initiatives, and that align with organisational practice.</i>	Practiced
16	Stakeholder and Communications Management <i>Ability to manage stakeholders, taking account of their levels of influence and particular interests and handle communication management with clients and other construction professionals.</i>	Competent
17	Business Case <i>The ability to prepare, gain approval of, refine and update business cases that justify the initiation and/or continuation of change initiatives in terms of benefits, costs and risks of any projects.</i>	Practiced
18	Reviews <i>Problem review and evaluation during alteration and construction</i>	Practiced

Competency Skills Elements		Level of Competency Skills for Interior Design Project Manager
Technical Competence		
1 9	Benefits Management <i>The ability to identify, define, evaluate, plan, track and realise the project benefits of change initiatives.</i>	Proficient
2 0	Asset Allocation <i>Ability to recommend how financial and other resources should be allocated amongst change initiatives in order to optimise the organisation's return on investment (ROI).</i>	
Behavioural Competence		Proficient
2 1	Team Management <i>Consultant work (consultation, collaboration, integration) and able to read, analyse and execute time management programme</i>	
2 2	Ethics Compliance and Professionalism <i>Professional certification, licensing, and/or registration requirements</i>	Proficient
2 3	Leadership <i>Able to identify job skills</i>	
2 4	Change Control <i>The ability to establish protocols to alter the scope of change initiatives, implementing the protocols when necessary, and updating configuration documentation including contracts to develop, maintain and apply quality management processes for change initiative activities and outputs.</i>	Proficient
2 5	Independent Assurance <i>Ability to gather independent evidence that the information from the change initiative is valid, and that the change initiative is likely to achieve its aims.</i>	
2 6	Capability Development <i>The ability to assess organisational maturity in relation to project, programme and portfolio management; identify the additional capabilities required, and to help with the development of those capabilities</i>	Proficient
Contextual Competence		
2 7	Framework and Methodologies <i>The ability to identify and/or develop frameworks and methodologies that will ensure management of change initiatives will be comprehensive and consistent across different initiatives. (In this context 'framework' means the parameters, constraints or rules established to standardise delivery of the project).</i>	Proficient

The project management for interior projects requires complete attention, details and informed understanding of the method of achieving the purpose of the project. In the construction industry, particularly in the field of interior design, it would be impossible to carry out a construction project without a project manager. The APM Competence Framework has therefore included 27 core competencies and defined three competency fields which are technical, contextual and behavioural and which may be carried out in the industry by interior design managers or interior designers. In the meantime, CCPM Modules reported that 15 modules are in place to become a project manager. Thus, the results of the questionnaire survey indicate that the level of competence of each factor used by the project manager is summarised. Table 2 provides the description by the chosen respondents of the degree of competence. In summary, all projects follow the same life cycle of project management from start to finish. It is during the life cycle of a project that successful project managers have demonstrated and evaluated which project management procedures or best practises are implemented. Process types and extent depend on the nature of the project. For example, the size, the probability of failure and the consequences of failure. Successful project managers who incorporate skills can help to ensure the success of the project. The summary concludes that each element is important for the level of skills of an interior design manager. Somehow, the degree indicates that an interior design project manager must apply these skills to become professional in project management.

Semi-Structured Interview

Based on interview, all the interviewees from the chosen expert panel from the construction industry specifically in interior design and project management. There are four selected expert panels which one of them is from Honorary and Fellow Member of Malaysian Institute Interior Designer (MIID), Member of Association of Construction Project Managers Malaysia (ACPM), Interior Design Project Manager from interior design consultation firm and lastly one Interior Design Academician from Public University. In this interview, the expert panels validate each competency skills for interior design project manager by level in regards to its important level for them to expert in that skills. Therefore, based on the interview, majority of them have 25-30 years working experience in managing project and involved with project management which is their information data is valid for this interview. However, the interviewees agreed that the competency skills level by each elements depending on time, situation and organization itself for an interior design project manager to practice the skills.

Table 3 shows summarize validate findings data from certified project manager from Association of Construction Project Managers Malaysia (ACPM).

Table 3. Competency Skills Validated by expert Panels

APM Competence Framework			
Competency Skills Elements		Level of Competency Skills for Interior Design Project Manager (Questionnaire Survey)	Validation (Interview)
Technical Competence			
1	Conflict Management	Competent	Expert
2	Procurement	Practiced	Expert
3	Contract Management	Practiced	Expert
4	Requirements Management	Competent	Competent
5	Solutions Development	Competent	Expert
6	Schedule Management	Practiced	Competent
7	Resource Management	Proficient	Competent
8	Budgeting and Cost Control	Proficient	Competent
9	Risk, Opportunity and Issue Management	Practiced	Expert / Proficient
10	Quality Management	Proficient	Expert
11	Consolidated Planning	Practiced	Proficient
12	Transition Management	Practiced	Competent
13	Financial Management	Competent	Proficient
14	Resource Capacity Planning	Proficient	Competent
15	Governance Arrangements	Practiced	Competent
16	Stakeholder and Communications Management	Competent	Proficient
17	Business Case	Practiced	Competent
18	Reviews	Practiced	Expert
19	Benefits Management	Proficient	Competent
20	Asset Allocation	Aware	Competent
Behavioural Competence			
21	Team Management	Proficient	Expert
22	Ethics Compliance and Professionalism	Proficient	Expert
23	Leadership	Proficient	Expert
24	Change Control	Proficient	Proficient
25	Independent Assurance	Proficient	Proficient
26	Capability Development	Proficient	Proficient
Contextual Competence			
27	Framework and Methodologies	Proficient	Expert

Competency skills are essential for the interior design project manager to manage a successful project. However, although project management is still new in the field of interior design, somehow interior design managers should develop and educate themselves for effective project management with all their skills. There are expertise areas to be mastered by an interior design manager, such as technical, contextual and behavioral.

It can be concluded that there are a few approaches for educating the interior design manager on a competence basis. Firstly, an overview of the competence skills framework for project management in interior design from expert professionals. For example, a seminar may be held within the organization with the intention of offering expert explanations or suggestions. Besides, the company trains its expertise and skills to the interior design manager. It is possible to train interior design project managers with expertise from time to time. Furthermore, leadership training and training for all project skills that cover IDPM 's maximum involvement would be benefits for the project to strengthen itself in the growth of its career. Other guidelines are that an IDPM be evaluated or reviewed, from time to time, on the skills coordinated by the company itself. However, it is advisable to approach each competency component phase by phase during project management. Finally, there are different approaches for training an IDPM, but it's always the same aim to offer a view of the competence skills framework of an interior design manager in this industry as well.

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THE ADOPTION OF BIM TECHNOLOGY IN MANAGING CONSTRUCTION RISKS AMONGST MALAYSIAN QUANTITY SURVEYORS

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Abstract

Building Information Modelling (BIM) is a technology that has received an impetus within the construction industry worldwide. It has also triggered a new approach of working in quantity surveying practice, replacing the conventional methods. However, there are few issues to be dealt with by the construction players in integrating BIM to manage risks in construction projects such as lack of experience and skilled individuals in an organization, lack of awareness amongst project stakeholders and the fragmented nature of the construction industry. Therefore, this study aims to explore the adoption of BIM technology in managing construction risks amongst Malaysian Quantity Surveyors. The objectives are to determine the BIM importance and to identify the challenges for the adoption of BIM technology in managing construction risks. Data were collected using a questionnaire survey and the survey results were analysed adopting descriptive analysis using SPSS. The findings confirmed that the importance of BIM adoption in managing construction risks amongst Malaysian Quantity Surveyors concerns on the enhanced quality of decision, the data coordination and visualization, the elimination of tedious traditional take-off methods and human errors and assistance in the early identification of risks. Meanwhile, the challenges to adopt BIM are related to the upgrade of hardware to match with new technology, lack of clear and specific BIM guidelines, provision of BIM training for employees and high cost for new technology. The results should direct to the Malaysian Quantity Surveyors to be BIM-ready in improving the number of quantity surveyors of becoming experts in BIM technology to manage risks in construction projects.

Keywords: *Building Information Modelling; Construction Risks; Quantity Surveyors; Malaysian Construction Industry*

INTRODUCTION

In every construction project, risks are inevitable as every stage of construction from the beginning to the end has its own risk that must be faced by the construction players. Risk creates both problems and opportunities for individuals, business or in other industries like construction. Thus, risk management is important to organize and control the source of risks systematically that may occur in each stage especially in the construction process. In the construction industry, the Quantity surveyors (Qs) play significant role in providing services for cost management from the feasibility phase until completion of the building. Qs are very synonymous with tasks related to building measurement where it is very time-consuming and is always exposed to human errors. Mitchell (2012) mentioned that 90 % of time are devoted by Qs in calculating building quantities.

However, with the adoption of Building Information Modelling (BIM) technology, these repetitive and time-consuming activities performed by Qs can be eradicated by automating the process as this technology may solve the problems and allow the Qs to commit their time to other services (Nagalingam et al., 2013). It reduces many tedious Quantity Surveying tasks such as measurement, take-off, and production of Bills of Quantities (BOQ). In general, Qs are involved in providing services related to cost and contract management from the initial

phase until building completion. Therefore, Qs are exposed to many risks in various forms in completing their tasks in a construction project. By adopting BIM technology, Qs can manage and reduce construction risks occurred in many ways since BIM has the ability to revolutionize the Quantity Surveying activities by eliminating repetitive activities and thus improving job efficiency among Qs. Quek (2012) stated that the Malaysian Quantity Surveying field should take the necessary action to undertake an evaluation of BIM's impact on its operation. Researching to what extent BIM integration might have spread into the Quantity Surveying field is worth exploring because there are few studies on the use of BIM technology amongst Qs compared to Architects and Engineers. However, there are some issues that arise in implementing BIM technology to manage construction risks within Quantity Surveying field. Hence, this research aims to explore the adoption of BIM technology in managing construction risks amongst Malaysian Quantity Surveyors.

LITERATURE REVIEW

The implementation of BIM on construction projects is gaining momentum around many parts of the globe. According to McGraw Hill (2014), the development and application of BIM in the global construction sector has been monitored since 2007 through comprehensive global surveys. From previous studies, they found that whilst BIM implementation has been led by countries such as the United States, the United Kingdom, Germany, Canada, and France relatively new adopters in countries such as Australia, Brazil, Japan, Korea and New Zealand are rapidly building momentum and even outperforming the more established countries in certain areas. Smith (2014) described that the latest main change of European Parliament's in January 2014 was to modernize European public procurement laws by promoting the use of electronic tools such as BIM technology. In developing countries, BIM awareness is rapidly increasing as adoption of BIM technology is claimed to have the potential to meet the needs of the construction industry (Enshassi et al., 2016).

In Malaysia, the Government has given the mandate to the Construction Industry Development Board (CIDB) to manage the BIM technology uptake in the country. The Department of Public Works (PWD) already started to introduce BIM technology to the Malaysian Construction Industry in 2007. Since 2009, BIM technology in Malaysia has been monopolized by the private sector in contrast with the public sector implementation. Numerous reactions received by PWD from different stakeholders about this new initiative have been noted as to the fact that the Malaysian construction industry is targeting to hit the second stage of the BIM development capability model by 2019 at that period of time. However, BIM implementation in Malaysia is still at an early stage. Most of the developing countries have a low implementation of BIM technology, including Malaysia (Ismail et al., 2016). In Malaysia, BIM adoption rate for architectural firms was 20% (Mohd-Nor & Grant., 2014), and about 10% of Quantity Surveying firms participated in adoption of BIM since it was introduced 10 years ago (Ali et al., 2013). Since the key stakeholders in BIM working environment comprise of architectural, engineering, and surveying practices, this may be a significant indicator that shows the poor uptake of BIM in Malaysian construction industry as a whole.

According to Quek (2012), the Quantity Surveying sector in Malaysia should take appropriate action to initiate an evaluation of BIM influence towards its practice. With the limited research on the use of BIM technology by Quantity Surveyors (Qs), it is worth exploring primarily to what degree BIM diffusion may have spread to this field. Developing this technology provides further impact on the practice of Quantity Surveying by leading

towards more accurate and precise assessments of construction costs. Despite the traditional roles of QSs are challenging, BIM benefits can provide the opportunities to enhance their imperfect practice and add few more values to their existing services. BIM capabilities for QSs in contact with time, cost and quality are to enhance the performance of the project (Wong et al., 2014). In the purpose to discover the impact of BIM technology on Quantity Surveying practice, Kulasekara et al. (2013) revealed that apart from offering more accurate cost estimates, BIM is theoretically automating the calculation, consequently reducing the time and cost of estimating the project. Moreover, the weaknesses in the conventional approach can be fixed by adopting BIM technology as it offers more reliable sources for cost estimating and quantity take off processes. Thus, it is significant to further explore the BIM adoption amongst the Quantity Surveyors in Malaysia, investigating how BIM assists their practice in many ways, including its importance and challenges, to manage risks for more successful construction projects.

RESEARCH METHODOLOGY

This study aimed to explore the adoption of BIM technology in managing construction risks amongst Malaysian Quantity Surveyors by determining its importance and challenges. A quantitative research method was employed which involved soliciting the responses of Quantity Surveyors in the Malaysian construction industry via a structured questionnaire. There are several stages conducted to accomplish this study such as preliminary stage, data collection, data analysis, findings, discussion, and conclusions. In the preliminary stage, data was gathered from books, recent published newspapers, journal articles and proceeding papers to develop a comprehensive literature review. Background of study, problem statement, aim and objectives were then established based on the information gathered from the literature review. As this study collected data through a survey, a questionnaire was constructed consequently according to the aim and objectives set in this study, in line with the previous reviewed literature. Sample of respondents was determined so that the questionnaire would be distributed to the reliable Quantity Surveyors meeting the requirements of the study. The survey was conducted online, in which the link created via Google form was sent to the selected respondents through emails, WhatsApp, LinkedIn, and other appropriate online platforms. The results obtained from the survey were then analysed using SPSS software in which finally findings, discussion and conclusion were made according to the surveyed results.

FINDINGS AND DISCUSSION

Analysis of surveyed results was done in line with the objectives of the study which are to examine the importance and challenges in adopting BIM technology to manage construction risks amongst Malaysian Quantity Surveyors. Table 1 indicates the importance of BIM technology in managing construction risks amongst Malaysian Quantity Surveyors in terms of efficiency, accuracy, and security.

In term of efficiency, the highest ranked statement (mean value = 4.05) outlined that BIM technology can enhance quality of decisions, visualization, data coordination as it offers a solution to the problem associated with the traditional method. According to Sunil et al. (2015), the advantage of BIM technology in detailed cost estimating is visualization as it helps in better comprehension of the design and features of the buildings. It can be interpreted that QSs feel that the adoption of BIM technology could improve and offer solutions in many

aspects particularly for the traditional practice in the construction industry. Thus, Qs have the abilities to increase their level of productivity in every task involved as the problems regarding the visualization, data coordination and quality of decision are reduced by the adoption of BIM technology.

Table 1. The importance of BIM technology in managing construction risks

Rank	Description	Mean Value	Standard Deviation
a) BIM importance in term of efficiency			
1	BIM technology can enhance quality of decisions, visualization, data coordination as BIM Technology offers a solution to the problem associated with the traditional method.	4.05	0.885
2	It allows the project team to perform value management efficiently if the integration between cost estimating with BIM design engine is in progress.	3.99	0.859
3	Reduce the risky gap between project members since BIM provide the transparency and accessibility to project information and documentation.	3.95	0.888
4	Reduce rework during construction because BIM contributes to the changes effectively by updating automatically over the quantities drawn from the existing model.	3.89	0.913
5	The estimation process of a QS has become simpler and transparent since BIM contributes to paperless construction in this field.	3.89	0.945
b) BIM importance in term of accuracy			
1	It eliminates tedious traditional take-off methods and reduces human error if BIM Technology is allowed to be fully collaborative and integrative.	3.95	0.873
2	BIM Technology can extract accurate quantities and spaces if it enables the estimator to produce reliable and accurate cost estimates in the early stages of the design phase.	3.93	0.898
3	BIM Technology provides a more extensive detailed information compared to the traditional method as it can prevent mistakes and wrong assumptions.	3.90	0.925
4	BIM Technology is a tool that will improve the Quantity Surveyors' decision-making since it is an essential driver in detailed cost estimating.	3.85	0.903
5	Bidders can identify and correct errors in the model further enabling more accurate bids as BIM offers training in quantity extraction and measurement	3.81	0.854
c) BIM importance in term of security			
1	BIM technology can assist in the early identification of risks since traditional risk management methods become ineffective in a certain situation.	3.80	0.905
2	It is easier to identify conflicts and risks that arise during changes in design as BIM technology act as an alternative way to enhance risk management.	3.77	0.899
3	BIM technology can manage well and the construction site also becomes more secure as this technology act as a collaboration tool which can increase safety awareness of the team.	2.67	1.047

Meanwhile, the highest value of mean in term of accuracy is 3.95 under the statement where BIM technology eliminates tedious traditional take-off methods and reduces human error if this technology is allowed to be fully collaborative and integrative. Qs are synonym with the production of Bill of Quantities (BOQ) and it involves many works to be done in a project. Traditional take-off is one of the tasks involved in producing a BOQ where the involvement of many drawings causing human errors. The automation of the production of bills of quantities eliminates tedious traditional take off methods and at the same time reduces human error (Raphael et al., 2014). BIM technology is effective in eliminating the lengthy and tedious ways of traditional taking off as well as decreasing human errors (Zainon et al., 2018). The statement where BIM technology can assist in the early identification of risks since traditional risk management methods become ineffective in a certain situation, has the highest mean value in term of security (mean value = 3.80). All risk management methods will become ineffective on the condition that any risks could not be realized before they occur and the interest in the application of BIM for risk management becomes increase due to it can

assist in the early identification of risks (Carter and Smith, 2006). Qs might feel that the traditional risk management is not effective if it is not able to detect the risks that will be faced in the future. Thus, the adoption of BIM technology enables the increased level of security in a project from any risks where the integration of BIM technology and risk management is performed.

The next Table 2 shows the results with regards to the challenges of adopting BIM technology in managing construction risks amongst Malaysian Quantity Surveyors. It is divided into four categories which are process, legal issues, people, and technology.

Table 2. The challenges of BIM technology in managing construction risks

Rank	Description	Mean Value	Standard Deviation
a) BIM challenges in term of process			
1	BIM technology requires to upgrade the hardware to match with new technology.	4.13	0.833
2	Difficulty for the firm financially to fix technical issues regarding BIM adoption.	4.11	0.796
3	BIM software needs compatibility with other hardware.	4.05	0.767
4	BIM Technology can cause any vital and fundamental changes to its operational procedures to the organization.	3.97	0.802
5	Difficulty in sharing model information among the team members.	3.50	0.865
b) BIM challenges in term of legal issues			
1	The lack of clear and specific BIM guidelines to be followed and the steps to implement.	3.85	0.789
2	The lack of BIM contract documents that highlight the legal aspects, and procurement.	3.85	0.822
3	Difficulty in responsibility and ownership related to the numerous designs, analysis, and datasets.	3.77	0.770
c) BIM challenges in term of people			
1	It is essential for providing the correct BIM technology training for employees in companies.	4.15	0.806
2	The low number of skilled technical experts	4.03	0.835
3	Fear to take the risk of changing their business process by adopting BIM due to the large cost that they have to bear.	3.83	0.878
4	The unwillingness to adopt BIM Technology among staff in a company.	3.70	0.954
5	The important people in a company are not willing to use new tools and technology such as BIM technology.	3.66	0.904
d) BIM challenges in term of technology			
1	High cost for new technology and its training programs.	4.29	0.805
2	A requirement for excellent practical strategies to be developed	4.05	0.712
3	The complexity to understand the new software.	4.05	0.797
4	A requirement for detailed and precise models to fix the issue of interoperability.	4.03	0.723
5	Difficulty to transform a company into accepting new technology.	3.98	0.863

It is shown that the highest mean value for process category is 4.13 under the statement of BIM technology requires to upgrade the hardware to match with new technology. The project may need some other tools to move the models between different environments or to combine them together (Zainon et al., 2018). This circumstance occurs if the team members use a wide variety of tools for modelling. In terms of legal issues, the highest mean value for this category is under the statement of the lack of clear and specific BIM guidelines to be followed and the steps to implement BIM technology. There must be some specific and clear guidelines to be followed and the standardized steps to implement BIM technology in projects (Zainon et al., 2018). Therefore, this has led to constraints in applying BIM technology. This is one of the challenges occurred and became a dilemma amongst Qs if the implementation of BIM is essentially required in construction projects. Concurrently, the statement where it is essential for providing the correct BIM technology training for employees in companies has the highest mean value in term of people at 4.15 mean value. The firms require to allocate money and time in order to find the best experts to assist them in implementing BIM

technology (Zainon et al., 2018). High cost for new technology and its training programmes has the highest mean value of 4.29 in term of technology. BIM technology is mainly used in large companies or known as blue chip companies such as Sime Darby, IJM and others due to their capabilities in many aspects, especially in the financial aspect. Meanwhile, most of the smaller firms are still loyal to the conventional method because they are not financially able to adopt BIM technology. There are many involvements of supplementary costs to adopt this technology. The organization needs to pay extra costs to train its staff and even recruit new workers who are equipped with the BIM experience and skills as they begin to internalize a new working atmosphere in their business (Zainon et al., 2018).

From the results discussed, the findings confirmed that the importance of BIM adoption in managing construction risks amongst Malaysian Quantity Surveyors concern on the enhanced quality of decision, the data coordination and visualization, the elimination of tedious traditional take-off methods and human errors and assist in the early identification of risks. In the meantime, the challenges to adopt BIM technology are related to the upgrade of hardware to match with new technology, lack of clear and specific BIM guideline, provision of the correct BIM training for employees and high cost for new technology.

CONCLUSION

BIM technology has been widely used by developed countries, but not to developing countries such as Malaysia where the level of adoption of BIM technology remains low despite of its introduction a long time ago. As known by the parties in the construction industry, there are several importance of BIM technology to manage risk and improve the productivity amongst stakeholders especially for Quantity Surveyors. In this study, the importance of BIM technology in managing construction risks is divided into several aspects of efficiency, accuracy, and security. In term of efficiency, BIM technology is claimed to improve quality of decisions, visualization, data coordination as it provides a solution to the problem associated with the conventional method. In addition, BIM technology in term of accuracy eliminates tedious traditional take-off methods and reduces human error if this technology is allowed to be fully collaborative and integrative by the QSs. Moreover, BIM technology can assist in the early identification of risks since traditional risk management methods become ineffective in a certain situation, in term of security. Perhaps, planning on the delivery of BIM technology especially for Quantity Surveying practice will reduce the risks in various ways and improve the productivity amongst Quantity Surveyors to fulfil their tasks.

Nonetheless, many challenges exist in adopting BIM technology to manage construction risks amongst Malaysian Quantity Surveyors, in terms of process, legal issues, people and technology. To adopt BIM technology in term of process, the challenges faced by QS are mostly on BIM technology requiring to upgrade the hardware to match with new technology. Legally, the lack of clear and specific BIM guidelines to be followed are one of the most challenging factors to implement BIM in an organization. Whilst in term of people, the challenges are the necessities in providing the correct BIM technology training for employees. Then, it can be seen that the adoption of BIM technology involves higher cost on its technology and training programmes. These difficulties lead to the reasons why the adoption of BIM technology in managing construction risks amongst Malaysian Quantity Surveyors are still at the low level of implementation. Thus, the Government needs to create several initiatives in facilitating many companies by giving certain incentives to maximize the current adoption of BIM technology in Malaysia.

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ASSESSING FACTORS AFFECTING COST RISKS IN HIGHWAY CONSTRUCTION PROJECTS: CONTRACTORS' PERSPECTIVES IN MALAYSIA

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Abstract

Several risks are characterised throughout the various stages of the life cycle of highway construction projects. Those risks are especially relevant due to their impact on the project performance, particularly in terms of cost and time. Numerous factors of projects risk had been determined and well explained in the paper. Major risks involved in highway construction in Malaysia are cost risk, safety risk and time risk. Due to lack opinion of the contractors regarding the critical factors that affecting the project risks mentioned, this study aimed to evaluate the contractor's perspective towards the factors affecting project risks for highway construction in Malaysia. The methodology used in this study is by using quantitative method. Questionnaire survey was developed by taking into consideration the factors affecting the cost risk, safety risk and time risk that had been explain in the literature. The respondents were chosen by purposive/judgemental sampling which enables the researcher to collect the data comprehensively. Results from this study revealed that the factors affecting cost risk, and time risk can affect the overall project performance. Besides the classification of these factors are high and the impact level were recorded moderate and high level. Further analysis was done where the relationship between the factors and the project objectives were tested. The significance of the research for the contractor's perspective towards the impacts of project objectives on highway construction project in relation to factors of project risk is very important as there is a lack of information. Therefore, this research paper is very important to the contractors who are involved in highway construction as a guideline for proper risk management specifically in terms of cost, and time risks in future.

Keywords: *highway construction, cost risk, time risk, safety risk, project objectives.*

INTRODUCTION

Highway is an important infrastructure and the main element for economic development worldwide including Malaysia. It is the roads that connect one town to another and from city to city. According to report from Malaysia Highway Authority (MHA) (2018), there are altogether 30 highways in Malaysia with a total length of 1,960.88 km. With the addition of several new highways that has been announced by Prime Minister on 11th Malaysian Plan including the Pan Borneo Highway, Central Spine Road (CSR), Kota Bahru-Kuala Krai Highway, West Coast Highway and the Pengerang Integrated Petroleum Complex road network, the link of the highway road increases in parallel to the nation aspiration.

In order to sustain the road and infrastructure projects in Malaysia, there must be continuation of a project either by way of rehabilitation or a new project. However, it is not easy when deal with construction industry in Malaysia, especially in infrastructure works because there are many factors such as risk, complexities and uncertainties need to be considered before the project successfully achieved (Adnan, 2013).

PROBLEM STATEMENT

Risks not only affect the achievement of project objectives but also influence the occurrence of one another. According to Loosemore, Raftery, Reilly, & Higgon, (2006), the perception of risk varies at both individual and organisational levels because different people hold different views and have different understandings of a particular risk's components, sources, probabilities, consequences and preferred actions. In relation to the construction of highway in Malaysia, there are certain risks that need to be considered in order to deliver the project within the targeted project performance. Therefore, there is a need to explore and identify the project risk involved in highway construction in Malaysia based on current situation.

There are several risks involved in the construction project. The major risks that usually occurs in the construction industry are cost risks, time risks and safety risks. Creedy, Skitmore, & Wong, (2010) stated that the factors affecting the cost risks are design and scope change in project definition, insufficient investigations and latent conditions, deficient documentation, client project management, services relocation, constructability, price escalation, right-of-way costs and last but not least, contractor risks and environment.

There are different perspectives of factors affecting project risk in highway construction in Malaysia. Furthermore, less research has been conducted to substantiate different perspectives or opinions of the project stakeholders. Thus, there is critical need to study on this field and this research intended to evaluate the relationship between factors of risk and its impact on project objectives in highway construction based on Contractor perspective. Therefore, the aim of this paper is to evaluate the contractors' perspectives on the factors affecting cost risks in highway construction projects in Malaysia.

LITERATURE REVIEW

Highway projects are often predictably recognized as high-risk projects due to its importance to a nation's economic, societal, and political development (Donaldson, 2018). According to Wibowo & Alfen (2015), highway projects are only established as successful if and only completed within the allocated time and budget, meets predetermined requirements and objectives, and affect minimal disruptions to the environment. The use of high technology machineries and equipment has been variously applied in the construction industry. Highway construction is not an exception from the utilization of high technology machineries and equipment. According to Presertrungruang & Hadikusumo (2007), the utilizations of machinery in high capacity mostly come from highway construction business as it relies more on it. The utilisation of machineries and equipment started since the earthwork construction commenced. Most of the machineries were used when the works need to be completed within stipulated time especially when the actual works on site are behind the schedule.

In relation to the nature of construction project, there are three main elements that cannot be avoided by the contractor in Malaysia such as risks, complexities and uncertainties (Yusuwan, 2008). These elements have their own significant impact to the project performance if it is not managed accordingly.

Risks in Construction Project

According to Laryea & Hughes (2008), construction industry has low reputation of risk analysis compared to other industries. Risks can be managed, transferred, shared and accepted but unfortunately risks cannot be ignored due to occurrences of any other effect of risks

impacts. Meanwhile Wiguna, Scott & Khosrowshahi (2005) stated that the project performance is affected by the risks due to its significant role in the project entity. Zhao, Vasconcelos, Zuo, & Zillante (2010) found that a construction project always plagued by various risks in project life cycle. Common stages in life cycle construction project are feasibility, design, tendering, construction and handing over and maintenance. Based on Goh & Abdul-Rahman (2013) findings, the construction stage was found as the project stage with higher frequency of risks due to involvement of many investments and longer completion period.

Risks in Highway construction project

The construction of highway projects have a higher risk compared to other construction projects, since it involves wider geographic area (El-Sayegh and Mansour, 2015). Similar to any construction project, road and highway construction projects facing three main aspects that are exposed to risks, namely cost, time and quality. Furthermore, these risks in road and highway construction projects are increased due to project size and duration and unforeseen underground conditions. According to Singh and Chugh (2016), risks that arise in highway projects will lead to failure to achieve desired project objectives. The negative effects of risk fundamental to highway projects are such as delays, cost overruns and reduction of availability of resources. Research done by Wang, Dulaimi, & Yousuf, (2013) concluded that risks associated with infrastructure projects in Malaysia which focused on highway projects are under the following categories: Political risks; Construction risks; Operating risks; Market and revenue risks; and Financial risks.

Factors of Cost Risk

Risk of cost in construction of highway encountered when actual project cost over the budgeted cost. Angelo & Reina (2002) found that cost overrun is a serious matter in construction and this issue need to be addressed urgently. Based on studied on cost overrun on different types of project, Aljohani, Ahiaga-Dagbui & Moore (2017) found that 173 causes of cost overrun have been found in seventeen contexts with the main potential causes being: frequent design change, contractors' financing, payment delay for completed work, lack of contractor experience, poor cost estimation, poor tendering documentation, and poor material management. 50 percent of construction project suffer cost overrun problem.

Many researchers have done studies with regards to the factor that contributes to the project cost risks. Flyvbjerg, Skamris & Buhl (2004) revealed that 9 out of 10 construction projects experienced cost overrun with an average budget overrun of 28%. 258 construction projects in 20 countries were studied where the cost performance was very poor. Another study conducted by Cantarelli et al. (2009) revealed that cost overrun is a common issue in construction projects, in which they investigated 87 no. of projects and found that on average 10.3% of projects faced cost overruns. Meanwhile Creedy, Skitmore & Wong (2010) found that there are 6 critical factors of cost overrun in construction of highway project such as design changes, contract tender price changes, increase in quantity measure, latent condition, removal and replacement of material due to change in design and design changes due to environmental issues. Controlling project budgets over project construction phases for large infrastructure projects is a key challenge for both the public and the private sectors (Singh and Chugh, 2016).

RESEARCH METHODOLOGY

This research applied a quantitative research design with 130 sets of questionnaires distributed to suit the aims and objectives of the research. However, only 65 questionnaires were returned and analysed. The questionnaires are replicated from previous researcher questionnaires and will be concentrated to G5, G6 and G7 contractors involved in highway construction within Klang Valley. Data gained will be gathered and analysed to get the findings. The research concentrated to key participants in highway construction projects i.e. Project Managers, Engineers, Quantity Surveyors, Site Supervisors and others.

Table 1. Landell Classification Scale.

Description	Classification Rating Scale (N=65)
Low	1.0 - 2.33
Moderate	2.34 - 3.68
High	3.69 - 5.00

The data collected is analysed by using Statistical Packages for Social Science (SPSS) version 21.0. After total average score mean values were analysed and arranged by its frequency and ranking, the results were further analysed by using Landell’s scale (refer Table 1). This was to determine the classification scale of all the variables from the rankings such as cost risk and time risk for this study.

FINDINGS & DISCUSSIONS

Demographic Background

The first part of the questionnaires consists of the respondent’s working experience. The data are tabulated as shown in Table 2.

Table 2. Respondents working experiences

Working Experience	Frequency	Percent (%)
Less than 5 years	6	9.2
6-10 years	13	20.0
11-15 years	30	46.2
more than 16 years	16	24.6
Total	65	100.0

Table 3. Company registration grade

Company Registration Grade	Frequency	Percent (%)
G5	6	9.2
G6	14	21.5
G7	45	69.2
Total	65	100.0

The results in Table 2 revealed that, 46.2 percent (%) of the respondents having working experience between 11 to 15 years, 24.6 percent (%) have experience more than 16 years, while 20 percent (%) have the working experience between 6 to 10 years, and the lowest experience which is less than 5 years constitute 9.2 percent (%) of the respondents only.

The second part of the questionnaire consists of company registration grade of the respondents. As shown in Table 3, the results revealed that 69.20 percent (%) of the respondents currently working with G7 contractor organization, 21.50 percent (%) works with

G6 contractor, while the remains 9.20 percent (%) of the respondents works for G5 contractor organization. Table 3 showed that majority of the respondents comes from G7 contractor organization and thus reflect that this organization constitute the majority of the respondents who are willing to answer the questionnaire and their involvement in highway construction is high.

In order to obtain further understanding on the respondent knowledge and related to their experiences, it is important to analyse the number of their involvement in the highway construction project. This is to make sure that all the respondents will answer the questionnaires with the most appropriate answer to fulfil the objective of this research paper. The tabulation of the data are shown as per Figure 1.

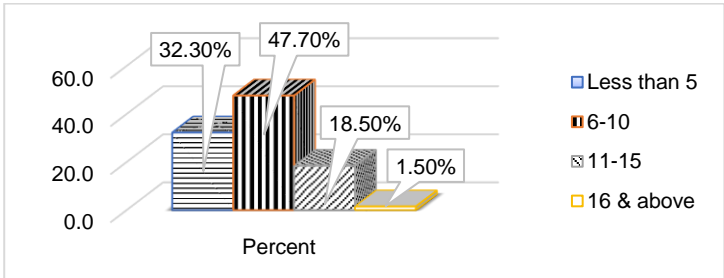


Figure 1. Number of highway project involved

Figure 1 exposed that 47.70 percent (%) of the respondents have involved between 6 to 10 numbers of highway projects, 32.30 percent (%) have involved with less than 5 projects and another 18.50 percent (%) of the respondents have involved between 11 to 15 numbers highway construction project. The remaining 1.50 percent (%) from the respondents have involved with 16 and above of highway project which is contribute the least response in the survey. To further understand the demographic pattern of the respondents, it is worthwhile to analyse their type of involvement in highway construction project. This is due to different type of involvement in the construction of highway constitute to different scope of works and responsibilities of the party. The results revealed that 55.40 percent (%) of the respondents involved as sub-contractor and another 35.40 percent (%) involved as the main contractor. While the remaining 9.20 (%) of the respondents involved as a supplier in the of construction highway. Further tabulation of the data is shown as per Figure 2 below:

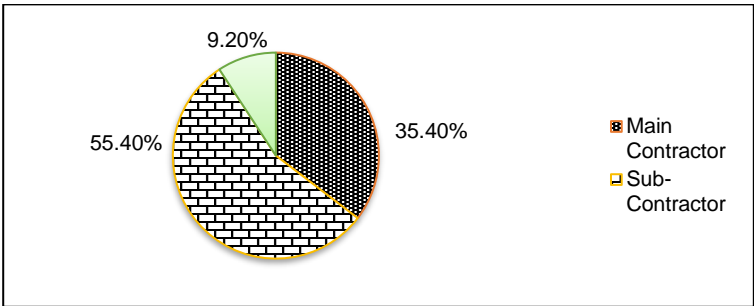


Figure 2. Type of involvement in highway construction project

Data tabulated as in Figure 2 shows that the majority of the respondents involved as the sub-contractor in the highway construction. This is due to there are several elements of

highway such as earthworks and turfing works, pavement works, buildings, slopes protection, bridges, highway accessories and electrical works that cannot be constructed by main contractor only. Therefore, the sub-contractors are appointed to construct those elements of highway in order to ease the completion of the highway construction.

Factors affecting Cost Risks

Table 4 indicates that the respondents ranked **service relocation** as the first position with the mean value of 4.42, followed by **removal and replacement of material due to changes in design** which ranked 2nd with 4.38 mean value and 3rd in ranking is **design changes** with a mean value of 4.34.

Table 4. Data analysis and finding on factors affecting cost risk in highway construction.

Factors affecting cost risks		Frequency of the respondents					Total (N)	Mean Value	Classification	Ranking
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree				
1.13	Service relocation	0	0	4	30	31	65	4.42	High	1
1.11	Removal and replacement of material due to changes in design	0	1	1	35	28	65	4.38	High	2
1.7	Design changes	0	0	2	39	24	65	4.34	High	3
1.2	Additional works	0	0	2	41	22	65	4.31	High	4
1.12	Design changes due to environmental issues	0	0	3	44	18	65	4.23	High	5
1.1	Price fluctuation	0	0	5	36	24	65	4.21	High	6
1.6	Inaccurate estimates	0	0	12	46	7	65	3.92	High	7
1.9	Increase in quantity measure	0	1	11	48	5	65	3.88	High	8
1.4	Low professional ethics	0	6	21	16	22	65	3.83	High	9
1.3	Delays	0	1	30	17	17	65	3.77	High	10
1.8	Contract tender price changes	0	5	42	15	3	65	3.25	Moderate	11
1.5	Shortens of contract period	1	13	35	14	2	65	3.05	Moderate	12
1.10	Latent condition	5	38	13	9	0	65	2.40	Moderate	13

Results as shown in both Table 4 was in line with Creedy (2005), where the service relocation and design changes ranked in the top of the factors of cost risk in highway construction. However, the results were different with the findings from research done by Abdul Rahman, Hameed Memon & Abd Karim in 2013 where they identified three (3) most significant factors of cost risks/overruns were fluctuation of material prices, cash flow and financial difficulties, and poor site management and supervision. Meanwhile, Vishwakarma and Salunkhe (2016) in their research found that there are several risks factors that imposed high risk on highway construction projects such as utilities relocation on time, obtaining government agencies approvals, construction in hilly terrain and land acquisition. From the

results shown in Table 4, it is found that most of the factors affecting the cost risks are associated to improper planning and management before the commencement of highway projects which leads to cost escalation and delay in project. Hence, to reduce the risks in highways project, suitable management strategies need to be developed (Dinesh Kumar & Deiveegan, 2018). They suggested that matters such as land acquisition, appointment of proper surveying team and adequate knowledge person for surveying, create affluent technical team to overcome the design deficiency and contractors should have extensive experience in the specific road construction to overcome the bad workmanship are crucial in reducing the construction and cost risks. In addition, adequate drawings and detailing should be provided to minimise the risks due to design changes. It is also suggested that the creation of new technologies and trends in construction are vital for minimizing the occurrences of risk in highway construction.

CONCLUSION

Based on the research findings on the contractor's perspective towards the identification of the factors affecting cost risks, it necessary for project participants to take necessary actions and improvements on proper risk management of highway construction in the future. The results of this study can help to understand the critical factors that caused the costs risks in highway projects. Future research may focus on client and consultant perspectives in design stage of the project and the impact to overall process of the construction. Cost overruns and time overruns are always being inter-related. Hence, in large infrastructure projects such as in highway and road constructions, the cost risks and time risks have been widely recognized as critical risks impacting project performance. It is considered a major challenge for both the public and the private sectors in controlling project budgets over a long period of project construction life cycle especially for mega infrastructure projects.

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APPLICATION OF ARTIFICIAL INTELLIGENCE FOR QS SERVICES IN MALAYSIAN CONSTRUCTION INDUSTRY

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Abstract

Artificial Intelligent (AI) is the innovation that will set out a new or additional approach to governing and managing organizations. It is also to possess similar cognitive abilities as humans, and it can now help the Quantity Surveyors (QS) make decisions about the resource allocation and utilisation, operational and management problems solved, and strategic development advice. AI also helps to monitor and improve connections and interactions without human intervention and error and improve the accuracy of decisions made. It is used as the main driver for the competitive advantage and sustainability of companies. Therefore, this paper aims to investigate the application of AI for QS services in the Malaysian construction industry. The main objectives were to investigate the application of artificial intelligence for quantity surveying services in Malaysian construction industry and the challenges on implying it to the services. An extensive literature review was done to obtain the application of AI for QS services, at large. To acquire the result in depth, 50 questionnaires were distributed and the data were analysed by using frequency and average index interpreted by Statistical Package for Social Science (SPSS) version 24. As a conclusion, among all of the issues that have been highlighted, majority agreed that the cost of the software that is too expensive and create barrier in the implementation of AI in QS services. Government initiatives should be taken in order for AI to be implemented and thus making the construction industry moving along towards era of digitalisation.

Keywords: *Artificial intelligent; Construction; Quantity Surveyor*

INTRODUCTION

A standard construction project may face multitudes of open issues, hundreds of Request for Information (RFI)s, and a great number of change orders that are open on any given day. A number of cost overrun problems have over the years been experienced by the complex and dynamic nature of construction projects (Afzal, Yunfei, Nazir, & Bhatti, 2019). AI is a form of machine learning that is an intelligent assistant, helping teams recognize the most important risk factors that need immediate attention from the perspective of construction safety and quality, also a field of science that aims at developing computers to execute tasks that would otherwise require human intelligence (Venugopal, 2018). According to Pan (2016), industry, political organisation and the media have set out a strong interest in AI. While other fields such as manufacturing, healthcare and transport push towards automation and smart technology, many people in the construction industry are already benefiting from this (Adamtey, et.al, 2019).

AI can help in increasing quality of works in construction industry by learning the algorithm from the collected data. One of the effects that gives beneficial in productive developments in the construction production can do is by improving the system methods in learning of the AI economically (Klashanov, 2016). During the decision-making process, AI is directed by the previously defined human instructions and selects decisions from the known samples. Faced with a situation for which there are no guidelines, AI is useless and passes control on to humans. A significant proportion of a digital company's business

processes often anticipate contact with individuals (Bogoviz, 2020).

When it comes to AI, it mainly refers to two specific areas: machine learning and deep learning (Vanugopal, 2018). Machine learning involves algorithms which enable computers to learn from data without explicit programming. Deep learning is a form of specialized, neural network-based machine learning. It is a more recent development that has allowed image processing and language processing to make breakthroughs, opening the door to advanced applications. Human intelligence and AI are combined into one framework and one of the main factors of development is digital entrepreneurship, and creating a new intellectual capital market (Bogoviz, 2020). The intellectual capital market is an arena where human intelligence and AI interact, being the alternatives.

LITERATURE REVIEW

Application of artificial intelligence in Quantity Surveying services

Construction is not yet a commonly used concept for AI relative to compare with banking or medical services, and growing applications are based on finding designs in large databases that would either be unreasonably difficult to process or take unnecessarily longer for individuals to process. The significant applications of AI in construction industry are under the accompanying classes of planning and design software, safety and efficiency, autonomous equipment and monitoring and maintenance (Bharadwaj, 2019).

According to pbctoday.co (2019), AI can make a broad contribution to the development of company-specific and industry-wide benchmarks that can reduce bias in optimism and manipulate strategy. While the debate about whether or not the data is new oil rages, it is clear that large volumes of data that are available due to the widespread nature of digitisation can help to improve project estimates. AI-based data analytics can help organizations develop meaningful insights from historical data across the organization and across the industry (PBCtoday.co, 2019). Nowadays, there a lot of software for project estimation for quantity surveying services that applies AI technology.

Glodon software

Cubicost provides cost-management solutions based on BIM and AI technology for construction owners, consultants, major contractors and subcontractors around the world. It consists of Cubicost BIM takeoff quantity and cost management solutions with 3 products covering architecture and structure, finishes, MEPs, rebars, cost estimates and supports standards and rules for the quantity takeoff and cost estimation around the world. Moreover, it offers efficient tendering, diverse cost analysis methodologies and cost comparisons (Glodon, 2019).

Autodesk Software

Autodesk Revit is software information modelling organisation designed for architects, landscape architects, structural engineers, mechanical, electrical and plumbing engineers, designers, and contractors. The software enables users to design a construction and structure and its 3D components, record a model with 2D design elements and access information from the database for the building model. Revit is a 4D building information model that can plan and track the various phases of the life cycle of the building (Autodesk, 2019).

CostX by Exactal Software

CostX by Exactal is a cloud-based and on-site construction estimation solution designed for construction and property industries. Key features include 2D drawings, 3D drawings, reporting, subcontractor comparisons and bid management. CostX helps users to measure counts, lengths, and areas from scanned documents and computer-aided design (CAD) drawings. Using the digital data, the cost and quantity can be estimated using BIM (Building Information Modelling). The solution provides functionality for spreadsheet-based workbooks linked to drawings and cost databases (Exactal, 2020).

THE CHALLENGES IN IMPLEMENTING ARTIFICIAL INTELLIGENCE

Making of AI requires immense expenses as they are exceptionally a complex machine. Their fix and upkeep require huge amount of expenses. They have programming software which need regular up degree to oblige the necessities of the changing condition and the requirement for the machines to be more astute constantly. Furthermore, replacing people with machines can lead to unemployment on a large scale. Unemployment is a phenomenon that is socially undesirable. If the use of AI is widespread, humans can be highly dependent on machines unnecessarily. There is also a constant fear that machines will take over or replace human beings. Additionally, while AI can help design and create, they do not match the power of thinking that a creative mind has in the human brain or even the originality of it. Human beings are intellectuals who are highly sensitive and emotional and the thoughts are driven by the emotions in the machines that are completely absent. The human brain's intrinsic imaginative abilities cannot be replicated. Communicative barriers could also emerge from AI. The inability to understand faltering speech or specific phrases and emotions and the inaccurate treatment of the information received; and from humans will lead to difficulty of the interpretation of computer communication algorithms (Reddy, 2016).

RESEARCH METHODOLOGY

An extensive literature search was conducted to obtain information on the use of AI by quantity surveyors in the industry. Additionally, to endorse the information in terms of application of AI in QS services in Malaysian construction industry, a questionnaire survey was done. 50 questionnaires from various surveyor designations were distributed, but only 30 numbers of respondents are received. The target population for this research are quantity surveyors that came from different backgrounds such as from a consultancy firm, developer, G1-to-G7 contractor class and others. The questionnaire component consists of two main sections; the application of AI in quantity surveying services and the challenges faced. The questions were outlined in a frequency and five Likert scale points and the data gathered were analysed using SPSS software.

FINDINGS AND DISCUSSION

The application of artificial intelligence in quantity surveying services

Figure 1 indicated the majority that used software in their services was Buildsoft Cubit which contributed of 43%. 29% of the respondents were using software called Revit by Autodesk in the company and 21% of respondents stated the usage of CostX by Exactal

in their services. The lowest percentage of only 7% was the usage of Glodon software in the QS services. There were not many respondents that used Glodon software due to its subscription fee that is a bit pricy compare to others.

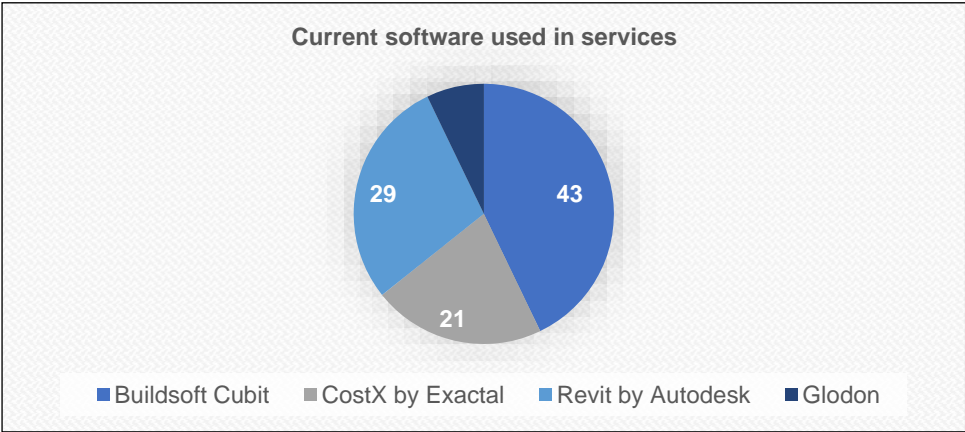


Figure 1. Current software used in QS services

Table 1 shows the 4 major fields of AI involved in the construction industry Most of the respondents agreed that monitoring and maintenance was important in applying the AI application in the construction that gives mean value of 4.07. Next is followed by 3.93 mean values on the fields of planning and designing software. Moreover, machine and equipment and safety and health management field stated the mean value by 3.80 and 3.57 respectively.

Table 1. The importance of applying AI in the following fields

No.	Fields	Rating Scales					Mean	Level
		1	2	3	4	5		
1	Planning and Design Software	2	2	3	12	11	3.93	Important
2	Safety and Health Management	1	2	10	13	4	3.57	Important
3	Machine and Equipment	1	3	2	19	5	3.80	Important
4	Monitoring and Maintenance	1	2	2	14	11	4.07	Important

In terms of planning and design software, 12 of the respondents (40%) agreed that AI is important to be implemented whereas 11 numbers of responses (36.7%) believe that it was very important. Next, there were 3 respondents who are neutral (10%) on thinking whether it was important to apply or not. However, out of the 30 of total respondents, there were 2 responses (6.65%) who think that it is not important to apply AI in planning and design software and 2 respondents (6.65%) thinks that it was not very important. For safety and health management field, there are 43.3% agreed that it was important of AI to be implemented and 13.3% agreed that it is very important. However, there were 10 number of response (33.33%) responses in neutral followed by 6.67% who thinks that it is not important and 1 respondent (3.33%) believed that it is not very important. 38

Findings also highlighted that for the machine and equipment, there were 69.3% of the respondents agreed to importance or AI being implemented and about 16.7% who thinks that

it was very important. However, there were 10% of respondents believed that it was not important to implement AI in machine and equipment. For monitoring and maintenance field, there were 14 respondents (46.7%) who agreed on the important of implementing AI. Other than that, 11 numbers of respondents (36.7%) believed that it is very important in implementing it. Despite of that, there are 2 numbers of respondents (6.7%) who believe that it is not important and 1 respondent (3.33%) thought it is not very important.

Challenges in implementing AI for QS services

Table 2. The issues and challenges in implementing AI

No.	Issues	Mean	Level
1	Lack of knowledge on AI application	3.80	Agree
2	The price for the software that are using AI application is too expensive	4.10	Agree
3	Lacking on training and seminar in using the software	4.03	Agree
4	Insufficient market demand for AI application in QS services	4.00	Agree
5	Difficulties in the development of people using the software	3.67	Agree
6	Unaware of AI application in construction industry	3.73	Agree
7	Lacking on the need of using a software that apply for AI	3.63	Agree

Table 2 shows the challenges faced by the QS in implementing the AI in their services and it shows that the highest mean value was 4.10 for the factor of expensive price of AI software. This issue had been highlighted to be the major issue on why AI is not being implemented in QS services in the current construction industry and thus most of the respondents are agreed with it. Next, followed by mean value 4.03, lacking on training and seminar in using the software that makes the quantity surveyors did not implement AI in their services, insufficient market demand which contributed mean value 4.00 and lack of knowledge on AI application (mean= 3.80). For the other challenges such as unaware of AI application in construction industry, difficulties in the development of people using the software and lacking on the need of using AI software, the mean value contributed of 3.73, 3.67 and 3.63 respectively.

The construction industry in Malaysia was still not being advanced by technology especially in quantity surveying services. This can be proved from the analysis where the number of respondents who have been using AI software as a tool in their services was very low. They tend to practice in the traditional way rather than having software where it believes can help reduce the time preparation for a contract document and can work more efficiently. This was due to issues of purchasing the software because the price for it was very expensive for a small or medium company to afford since for some company, their capital was just enough for the project to be conduct and they did not get much profits due to economic situations. Without capital, companies will not be able to adopt AI as an AI that needs advanced technology and state-of-the-art facilities in its governance and business operations.

Furthermore, a large amount of capital needs to be provided for AI's research and development, and this situation could be rejected by directors and managers due to failure to see the significance of the benefits acquired in the future or to try to avoid a cost situation that surpasses the benefits. AI was one of the technologies developed in IR 4.0 and the key changes that cover not only how companies are managed, but also how goods and services

are produced, delivered and consumed by end users or customers. Based on the feedback, majority agreed that lacking on training and seminar was the issues in implementing the AI application in their services.

Continuous development and evolution of AI will trigger unfavourable reactions on the part of employees, as they need to follow the rapid pace of both IR 4.0 and AI to perform better. The learning process will be continuous and the competitiveness of each other will be intense. Thus, more training and awareness need to be conduct for a more effective implementation. Eventually AI could produce the Bills of Quantities, maybe not in a conventional format but acceptable for clients and contractor to start a project. QS profession on contract administration may also be replaced with the AI as the information was well recorded and easily assessed compared to manual or hardcopy. But the challenges in this was that to compare the data with the other company on which the data was confidential was reluctantly making people to accept what AI offers.

CONCLUSION

The implementation of AI in QS services can change the future of QS industry and can help in minimising the human mistakes in preparing the contract document and hence can also help in increasing the accuracy, time and cost saving, minimizing the risk and more efficient in work. This can eventually reduce the laborious work carried by the human. Hence, it can reduce the time and minimise the human mistake in preparing the contract document. With the current rapid digital technology development, it is time to change the way of working. AI need to be implemented in the quantity surveying industry as it has become essential in preparing the contract document to be more efficient. The government can support by giving incentive or subsidies in order for AI to be implemented in the services. With AI, the bill of quantities can be more accurate and faster to prepare. However, for a detailed bill of quantities, the QS intervention are still required as it is crucial in getting reliable cost data estimates thus for the thoughts of implementing AI in their services will vanish the employment of the quantity surveyors is unacceptable since human intervention is still needed to control it.

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CONSTRUCTION INNOVATION FOR MALAYSIA CONSTRUCTION INDUSTRY: G7 CONTRACTORS' PERSPECTIVE

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Abstract

There are many issues in implementing innovation and its make the industry left behind in the aspect of productivity and efficiency. Conversely, the implementation of innovation is crucial to enhance the economy and improving the quality of construction performance. Therefore, this paper aims to investigate the construction innovation in the Malaysian construction industry. Three objectives support the aims; to identify the importance of construction innovation in construction industry, to determine challenges in implementing construction innovation and to investigate the possible solutions to overcome the issues. An extensive literature review was done to analyse the concept of construction innovation at large. A total number of 350 questionnaire surveys were distributed to G7 contractors registered under Construction Industry Development Board (CIDB), and received 120 numbers of responses. The data was analysed by using the descriptive statistics in SPSS. The research revealed that the concept of construction innovation can be divided into a technological and management basis. Furthermore, to overcome the issues, education and training policy, support for the transfer of R&D results into practice, coordination with universities and scientific research institutes and direct budget subsidies were essentials. Therefore, by considering the concept, issues and the possible solutions, the construction innovation can be implemented effectively and will lead to construction efficiency, cost saving and improve the long-term value of the project performance.

Keywords: *Innovation; Construction; Contractor; Challenges*

INTRODUCTION

Construction industry is a complex sector of economy and has a lot of connection to other industry (Ibrahim, Roy, Ahmed & Imtiaz, 2010). It also contributes to economy growth at all levels and almost all aspects of life with generating income and employment for the people (Rameezdeen, 2007). Malaysia focus on innovation as the main factor of economic growth and aware the importance of innovation as long term success and this aim can be accomplished by prioritizing the development and improved performance of the industry through innovation (Zuhairy, Tajuddin, Iberahim & Ismail, 2015). Most of construction organisations already archive and have a quality standard, but the quality implementation is only to follow the construction standards and to promote the reputation of companies to other (Janipha & Ismail, 2013). Productivity growth in construction innovation as compared to other industry is far below the national average, as is not easy to implement innovation due to the challenges in implementing innovation (Kulatunga, Amaratunga & Haigh 2011). Research by Zuhairy et al. (2015) revealed that in Malaysia the awareness of construction innovation is very scarce and to improve it, construction industry needs to change and countries should plan a program to enhance the quality of construction industry. Construction innovation is the lowest to compare with five other industries and there is a need to enhance the implementation of innovation in construction industry. (NESTA, 2007; Xue, Zhang, Yang and Dai, 2014).

CONSTRUCTION INNOVATION IN CONSTRUCTION INDUSTRY

Concept of construction innovation

The concept of construction innovation engages the improvement of service, development of process and product. Blayse and Manley (2004) stated that innovative procurement systems also encourage construction players in integration to improve the outcome of innovation. BIM identified as a wide range of determinants such as scheme and building mixing, work management with administration of services (Salahaddin, 2016). Constructions automated and robotic are better products and processes compare to manpower because it increases the efficiency of construction activity, more endurance and precise of predicting the whole works, better security of the environment and give a lot of satisfaction for beneficiaries and set new benchmarks to create a collaborative team (Călbureanu et al, 2019). Internet of Things was used in smart construction due to the increasing need for big data processing improvement and the existing availability of useful data. The implementation of Big Data used for data management during planning and monitoring, procurement method and BIM from internal IT systems (Sørensen, Olsson & Landmark, 2016; Umashankar, 2019). Moreover, AR and VR technologies gives many benefits in construction industry with decreased project cost by giving more than what client request, make working site training and safety more easy and fast, increase design and planning development and interaction that involved all construction player (Wang, Wu & Chi, 2018).

Challenges in implementing construction innovation

Suprun and Stewart (2015) indicated many challenges that influence the implementation of construction innovation. Any innovations in the construction technologies scarcely occur during economic crisis, construction industry players often use conventional technological solution from available resource and having limitation of investment, add-on knowledge and involvement (Šuman and Semič 2013). The challenge of innovation is the nature of construction industry that need a large number to undertake but only small participants involved and that give another issue due to limited resources (Blayse & Manley, 2004) and (Shelton, Martek and Chen 2016) added construction industry well known with slow change and the structure of construction become the challenges. Environmental regulations that enforced by the regulator are also significance to safety practices. The regulator is obligate in managing the construction industry's needs and to ensure issues and challenge faced by construction can be solved by preparing a new policy that makes the future of the construction much better (Kulatilake, 2016; Zuhairy & Iberahm, 2016). Lack of client involvement and commitment to innovation also become a barrier to implement innovation (Blayse and Manley, 2004). Furthermore, lack of understanding benefit to an employer and lack implementation of research and development contribute to lack of innovation. Financial resource is important and if organisation lack of finance resource it gives a challenge to business growth (Salahaddin, 2016).

Possible solutions to overcome the construction innovation challenges

Blayse and Manley (2004) stated that to overcome the challenges in construction innovation, recommendation is needed to enhance the performance, with creating effective organisational resources, including a supportive community, establishing an efficient

innovation plan, improved in-house technological expertise and promoting of innovation to improve the resource. Salahaddin (2016) added that management team should arrange meetings more often to enhance performance with evaluation, overcome any issue raised and improve future work, regular meeting to discuss and coordinate and plan the work progress. Innovation in construction more effective if all construction player manages to work together in team rather than through competition (Akintoye, Goulding & Zawdie, 2012). Development of the new product through R&D will create new materials and technology and innovation can be reached with cooperation between construction players. Benefit in innovation, the newness of product and implementation of the invention are the main elements in innovation especially for construction industry (Shelton, Martek & Chen, 2016). Collaboration also will enhance the time and cost saving and this can reduce the project period with delivered ahead of project completion (Zuhairy & Iberahim, 2016).

RESEARCH METHODOLOGY

A structured questionnaire was used to obtain the importance of construction innovation, the issues in implementing it and the possible solutions to overcome the issues. The target respondents were the G7 contractors within Klang Valley area, registered under Construction Industry Development Board (CIDB). A total number of 350 questionnaires were distributed and only 120 respondents that were available and willing to participate during the data collection process via Google Form. This was due to time constraint during Movement Control Order (MCO). The data were analysed by using Statistical Package for Social Sciences (SPSS). The questionnaire is divided into three (3) main sections; (1) importance of construction innovation, (2) the issues in implementing construction innovation and (3) possible solutions to overcome it. A five-point Likert scale was used to measure the activities (first objective: level of important and for second and third objectives; level of agreement). The Descriptive Statistic: Frequencies-Mean-score method was used to achieve the objectives.

DATA ANALYSIS AND INTERPRETATION

Concept of construction innovation in construction industry

Table 1 shows that procurement system management for construction was the highest mean value of 4.38 (s=0.842) for the importance of construction innovation implemented in construction project. The second highest mean was the Internet of Things which has a mean value of 4.38 (s= 0.889) and followed by the design of smart material and green building, software adaption, on-site IT application, off-site construction management, waste management, autonomous equipment and AR & VR with the mean value of 4.33 (s = 0.892), 4.30 (s= 0.949), 4.28 (s=0.881), 4.27 (s=0.976), 4.19 (s=0.981), 4.10 (s=1.024) and 4.04 (s=1.064) respectively. The lowest mean value was 3D Printing that only contributed of 3.95 (s= 1.099).

Table 1. Concept of construction innovation implemented in project

Construction innovation concept implemented in project	Mean	Standard Deviation
Off-site construction management	4.27	0.976
Waste management	4.19	0.981
Procurement system management	4.38	0.842
Design of smart material and green building	4.33	0.892
Software adaption	4.30	0.949

Construction innovation concept implemented in project	Mean	Standard Deviation
Internet of Things (IoT)	4.38	0.889
On-site information Technology (IT) application	4.28	0.881
Augmented & Virtualization Reality (AR & VR)	4.04	1.064
3D Printing	3.95	1.099
Autonomous equipment	4.10	1.024

Generally, the concept of construction innovation has been identified and there were two basis of construction innovation; innovation in management and innovation in technology. Concepts of innovation based on innovation in management were off-site manufacturing management, waste management and procurement system management. While, software adaption, automated and robotic construction, 3D scanning & photogrammetric and 3D printing, artificial intelligence (AI) and big data, augmented reality (AR) and virtual reality (VR), internet of things (IoT) and on-site IT applications (GIS, GPS, RFID) were identified as innovation in technology. Innovation of procurement system management such e-tender concept help the bidders and it makes information distributed easier compared to traditional method. Next, with the lowest mean was 3D painting because this concept has less awareness or lack of usage of 3D printing in Malaysia construction industry.

Challenges on construction innovation in Malaysian construction industry

Table 2. Issue and challenges on construction innovation

Issue and challenges on construction innovation		Mean	Standard Deviation	Rank
Economic conditions	High construction cost	4.61	0.569	1
	Substantial economic risk	4.41	0.783	4
	Financial constraint	4.53	0.635	2
Regulations, policy and supporting mechanisms	Restrictions imposed by regulations or government policy	4.24	0.830	14
	Difficult tendering and procurement	4.26	0.893	13
	Administrative barrier	4.28	0.916	11
Research component	Unwillingness to change for R&D	4.40	0.703	5
	Time constraint	4.31	0.896	9
	Unable data and resources for R&D	4.38	0.780	6
Availability of information, methods and tools	Lack of technology	4.37	0.788	7
	Lack of qualified and experienced staff	4.40	0.834	5
	Poor nature and quality of organization resources	4.29	0.864	10
Cooperation between all construction stakeholder	Fragmentation of the industry	4.34	0.783	8
	Bad relationship between individual and firm	4.26	0.855	13
	Disinterest of designers and architect	4.27	0.896	12
Client and developer understanding	Low demand of clients and developers	4.38	0.779	6
	Lack willingness of clients and developers	4.40	0.715	5
	Fear of innovation implementation	4.42	0.795	3

Table 2 indicated the challenges faced by the construction players in implementing the construction innovation. For economy condition challenge, the factor of high construction cost become most challenges in implement construction innovation with mean value of 4.61 ($s=0.569$). Administrative barrier factor contributed highest mean value 4.28 ($s=0.916$) for the component of Regulations, policy and supporting mechanisms. Moreover, for the components of research (unwillingness to change for R&D factor), availability of information, methods and tools (lack of qualified and experienced staff issue), cooperation between all construction stakeholder (fragmentation of the industry factor) and, client and developer understanding (issue on fear of innovation implementation), the respondents indicated that

the mean value were 4.40 (s=0.703), 4.40 (s=0.834), 4.34 (s=0.783) and 4.42 (s=0.795) respectively.

High construction cost was the crucial challenges in implementing construction innovation due to most of the construction project involve high cost especially for mega project or civil project compared to another normal project. Not all contractor or client has enough money to invest to the innovation in construction. Meanwhile, the least ranked by respondent, was the restrictions imposed by regulations or government policy. This may due to contractor or client does not follow the regulation or policy by the government. This can be seen that the contractors involved with private projects avoid implementing innovation due to lack of policy or regulation enforcement in private projects as compared to public projects.

Possible solutions to overcome issue in construction innovation

Table 3. Possible solution to overcome the challenges

Possible solution to overcome the challenges		Mean	Standard Deviation	Rank
Resource	Direct budget subsidies	4.48	0.721	4
	Tax incentives	4.43	0.796	6
	Funding of pilot projects	4.44	0.765	5
	Reward System	4.33	0.822	9
Management	Improved legislation	4.48	0.788	4
	Promotion of non-traditional forms of construction procurement	4.40	0.749	8
	Collaborative Partnering	4.41	0.728	7
	Education and Training Policy	4.56	0.671	1
Research and Development	Supported of R&D by scientific research institutes	4.53	0.697	2
	Supported for the transfer of R&D results into practice	4.53	0.660	2
	Supported of R&D technological and technical capability	4.43	0.774	6
	Coordination with universities and scientific research institutes	4.51	0.661	3

Table 3 shows the possible solutions to overcome the construction innovation challenges in construction industry. For resource factor, the component of direct budget subsidies ranked the highest mean value as compared to funding of pilot projects, tax incentives and reward system. The mean value contributed were 4.48 (s=0.721), 4.44 (s=0.765), 4.43 (s=0.796) and 4.33 (s=0.822) respectively. For the management factor, the highest mean value (4.56, s=0.671) was Education and training policy, and the lowest ranked was promotion of non traditional forms of construction procurement, that contributed of 4.40 mean value (s=0.749). The other possible solution under management factors were improved legislation with mean value of 4.48 (s=0.788) and collaborative partnering (m=4.41, s=0.728). Under the factor of Research and Development the highest components shared the same mean value of 4.53 were supported for the transfer of R&D results into practice (s=0.660) and supported of R&D by scientific research institutes (s=0.697), followed by coordination with universities and scientific research institutes, with mean value 4.51 (s=0.661) and support of R&D technological and technical capability, with mean value 4.43 (s=0.774).

Overall, most of the respondents' strongly agreed that most three factors contributed to the possible solution to overcome construction innovation challenges in were education and training policy, support for the transfer of R&D results into practice and support of R&D by scientific research institutes. With education and training policy, improvement can be made to the knowledge and created awareness for personnel in the industry with continuous work-

training and seminars for development and commercialisation of new technologies. Management team should arranged meetings more often to enhance performance with evaluation, overcome any occur issue and improve future work also regular meeting to discuss, coordinate and plan the progress of projects.

CONCLUSION

In general, there are ten (10) concepts of construction innovation that can be categorised into two (2) main components which are management, comprises of 3 concepts and the other seven concepts are in technological component. Most challenge in implementing construction innovation is high construction cost. Construction involved with a high project cost due to the structure and nature of construction. The second factor contributes to construction innovation challenges is a financial constraint. This is due to not all construction players have a stable financial capability to implement the construction innovation. Moreover, to run innovation in construction, the construction players have scarcity for resource to invest for it and some of them having fear complexity of technological advancement. Therefore, education and training policy become the best possible solution to overcome the challenges. Education and training are important in creating awareness to construction players for the implementation of innovation in the construction industry. This will create a generation with a new idea or be able to enhance the quality of innovation in construction. Another possible solution is by supporting for the transfer of R&D results into practice as it makes construction industry comparable with other industries.

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ISSUES IN IMPLEMENTING THE MODULAR CONSTRUCTION SYSTEM IN THE MALAYSIAN CONSTRUCTION INDUSTRY

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ABSTRACT

Nowadays, several developments have been implemented with the growing demand in the Malaysian construction industry. Some modern construction methods have been promoted to build product quality of a construction project better. One of the contemporary construction methods is the modular construction system. Modular construction is a construction process to produce a building component or modules with the same design and standard in a manufacturing facility, then transported and installed to become a building at the site. In the Malaysian construction industry, the modular construction system (MCS) is in the beginning stage of its implementation. This research aims to determine the factors considered in implementing the modular construction system, identify the issues in implementing the modular construction system, and recommend implementing the MCS in the Malaysian construction industry. The data obtained by the questionnaires survey. From the findings, factors need to be considered in implementing the modular construction were under design factor which is the material of the modules must be strong and durable, the connection of the modules must be carefully design, and it is practice off-site construction. Furthermore, implementing the Malaysian construction industry's modular construction was lack of innovation in modular construction system, lack of experience of modular construction among general contractors, and higher initial cost. The Malaysian construction industry is recommended to increase modular construction awareness, especially to those new generations of practitioners and specialists, and implement strict quality control procedures during the process. Thus, it will provide a platform for assisting the industry players in modular projects in the Malaysian construction industry.

Keywords: *Modular Construction, Issues, Implementation, the Malaysian Construction Industry*

INTRODUCTION

In the 1940s, modular buildings were introduced. Modular construction has improved since then and has revolutionized over the years. A modular system is a revolutionary building method using the same principle as mass production systems and modules (Modular Building Institute, 2008). Many technologies have now been implemented with rising demand in the construction industry. Some of the modern construction methods have been promoted to improve the quality of the construction product. One of the ways is modular construction.

Modular construction was a construction method for producing building components or modules of the same design and specification in a manufacturing facility, and then to be transported and assembled to become a building at the site (Musa, Yusof, Samsudin, & Muhamad Halil, 2017). Because of its advantages, modular design was popular for off-site prefabrication and used in developed countries such as the United States, the United Kingdom, Japan, Europe and Australia. A new approach was envisaged to encourage a new model in the construction industry and to enable IBS industry to address its current problems (Azree et al., 2015).

Different types of modular construction interpretations have come from all over the world. From the selected journal, it was highlighted some other definitions of modular construction. First and foremost, modular construction according to the US is a process which builds a building on-site using the same materials, in regulated plant condition and made around half the time, by the same codes and regulations. As conventionally constructed plants. The buildings were produced in "modules" and installed without compromise, reflecting the same design purpose and characteristics of the old most advanced facility (Hamid & Mohamad Kamar, 2012).

Besides, modular construction was defined as a stand-alone or combined unit that was fully assembled in 3D modules by joining on-site, forming a modular building, consisting of several connected and stacked modules with suitable cladding functionalities and volumetric modules, possibly stacked up to a few storeys building high based on module construction and requiring additional structural components (Azree et al., 2015).

Modular construction has many features because it depends on customers, owners, manufacturers, consultants, contractors, environment, building usage, projects, local authority requirements and end-users. The main characteristic of modular construction is identical or standardized modular or room size volumetric units (Musa, Yusof, Fadhil, & Mahbub, 2014).

It is mass-produced in a controlled manufacturing or production facility, producing less waste and high-quality module. In terms of structural strength, modular buildings were stronger than conventional construction (Aziz & Abdullah, 2018). Modular building factors, which are more vital due to each modular unit, are designed independently. Quality-engineered modular buildings can withstand the struggle of transport to ensure that they can be moved to the foundations.

Then, the modular building that used the modular construction method was flexible and can be reused. Modular buildings are transportable and flexible where they can be dismantled, refurbished and relocated to another destination for a new use, thus reducing the consumption of raw materials and reducing the amount of energy needed to construct a building to meet the new requirement (Lawson, Ogden, & Bergin, 2012).

MODULAR CONSTRUCTION SYSTEM

Definition and concept of the modular construction system

Based on an article, Musa & Mohammad (2015) classified an MCS as a method for constructing a building using three-dimensional or modular units installed and manufactured in a factory. A stand-alone or combined unit (fully-assembled 3D modules) forms a modular on-site construction. It consists of several linked modules with appropriate cladding features. Volumetric modules could have stacked a few storeys high based on module size, and it requires extra structural components. Those are off-site building, which is an economical construction option and quick construction. Manufactured modular buildings are designed to combine appropriate building codes. It's based on-site and occupancy context. After that, units were transported to the site, established, secured at the mate lines and linked to utilities. Doors can be reached by mounted decking or concrete flatwork. Finally, finishes apply to build modules such as brick façade, peaked roof or canopy entrance. This element of finishes applied to buildings for the building's aesthetic appeal involves exterior appearance.

Characteristics of the modular construction system

From the literature review, there are a few characteristics of modular construction that had been highlighted. From McGraw-Hill (2011), the modular construction's critical component is the same or standardized modular or volumetric component size of the room. It is produced in mass in a strictly controlled factory or warehouse that produces less waste. Production lines or factories have precise Quality Assessment / Quality Control (QA / QC) programs with self-governing auditing protocols that promote superior construction quality every step. Since customers and designers try to enhance their environmental impacts through sustainable design and construction approaches, modular building is entirely natural. Construction in a controlled environment reduces waste by upstream prevention rather than a downstream diversion. This inherently contributes to sustainable development and enhances quality control in the construction process and significantly less on-site operation and disruption.

Benefits of the modular construction system

- a) Speed up the construction period
According to Gunawardena, Ngo, Mendis, Aye, & Repair (2014), much of the activity is removed from the modular construction site. Faster and efficient manufacturing processes replace slowly unproductive construction work. The construction of modular constructions is carried out simultaneously with the site work, enabling projects to complete half the conventional building period.

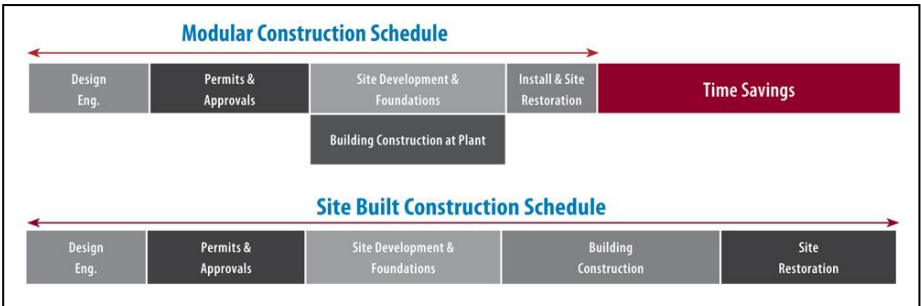


Figure 1. Comparison between modular construction and conventional construction (Musa, Yusof, Mohammad, & Samsudin, 2016)

- b) Flexibility and reuse
Moving and flexible modular buildings can be removed, refurbished and transported to new locations, reduces demand for raw materials and reduces the amount of energy needed to build a structure to meet unique needs (Modular Building Institute, 2010).
- c) High quality identical modular / room size volumetric units
According to Mohammad et al. (2016), the modular structure's main feature is similar modular or standardized volumetric units or room sizes. They are mass-produced in a controlled plant or factory which generates less waste and high-quality modules. Constructing off-site ensures a better regulation of construction quality. Materials delivered to the plant site are stored safely and securely in the warehouse of the

manufacturer. This is intended to prevent degradation or decay of the elements and the moisture.

d) Promotes sustainability in the construction environment

Based on Musa et al. (2014), sustainability could be accomplished by producing modular units in the warehouse. Like a factory, modular units and construction eliminate waste by escaping upstream and not a downstream diversion in the managed area. Modular building can minimize environmental impact, reduce waste, reduce site activity and disturbance significantly, and promote sustainable development.

e) Reduced Construction Costs

Modular structures have proved to be more environmentally friendly than conventional steel or concrete buildings. Much less waste is created by modular design, thereby giving it the advantage of making a lower effect on the atmosphere, contributing to time reduction and cost savings over decreased waste disposal costs. In previous studies by Aye et al. (2012), more than 80% of the original modular steel system's energy can be saved by reusing the modules.

f) High strength

Modular homes are structurally more robust than conventional buildings since each 3D, or modular structure is individually engineered to withstand transport harsh realities and raise the foundation. Once sealed together, the units become one integrated wall, floor and roof assembly and a completed modular building (Carlos José Borba Valiente, 2012).

RESEARCH METHODOLOGY

A primary data is first handed accounts of gathering on the information for this paper. In this paper, the primary data is collected through the quantitative method, which is questionnaire surveys. The questionnaires were declared randomly to 248 contractor G7 that had been registered with CIDB. According to Krejcie and Morgan's table, for a population of 700, the sample is enough about 248 only. After the data were collected, it will be analyzed. The data accumulated from the study is analyzed and measured by the frequency occurrence using a computer program and shown as a percentage and shown in the graph to better understand the result. Next, the data will be the key to the statistical software called the Statistical Package for Social Sciences (SPSS) and used to evaluate the respondents' data through the questionnaire survey. All the data gathered are shown in the graph, pie chart, and diagram to be better visualized than others and better understand the result. This paper's scope is focused on the issues of implementing modular construction in the Malaysian construction industry.

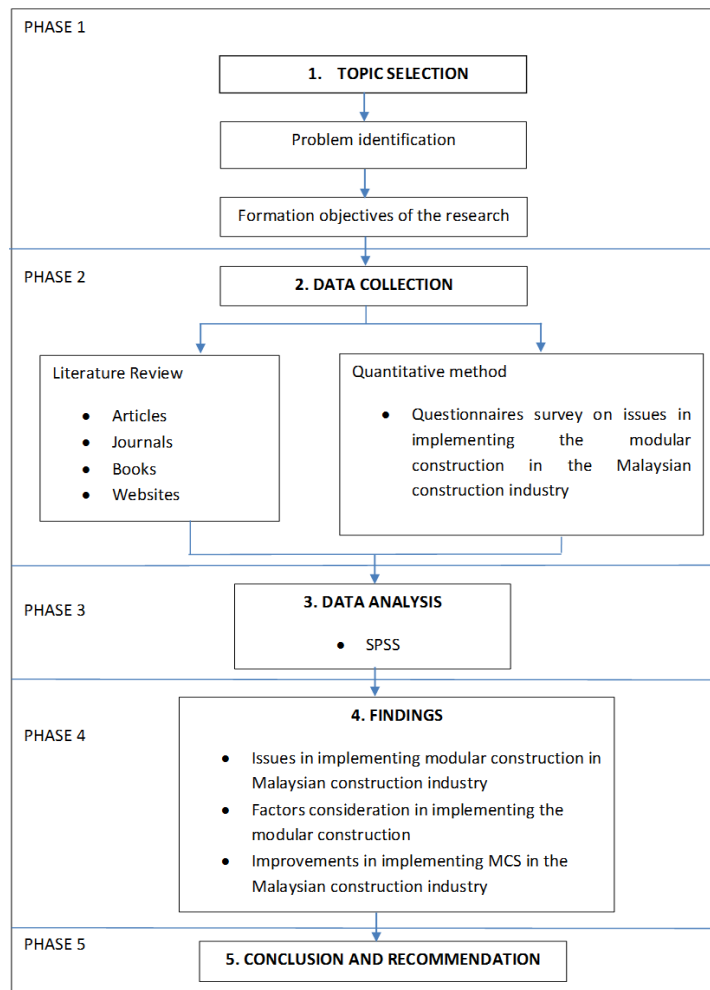


Figure 2. Flow chart of research methodology

FINDINGS AND DISCUSSIONS

This paper has been done to promote the modular construction system among the G7 contactors in the MCI. This paper has three objectives: to determine the factors considered in implementing the modular construction system in Malaysia construction industry, to identify the issues in implementing the modular construction system in Malaysia construction industry; and to recommend the improvement in implementing the modular construction system in Malaysia construction industry. There were five areas in each of these objectives: design, technical and logistic, technology, financial and managerial.

Demographic information

From demographic information (see Figure 3), The respondents of this questionnaires consisted of three positions: project manager, quantity surveyor, and site supervisor. The result showed that about 39% of the respondents consisted of the site supervisor, 32% were

quantity surveyor, and about 29% were the project manager. All of these building players were representing their contractor that had experience in the modular construction.

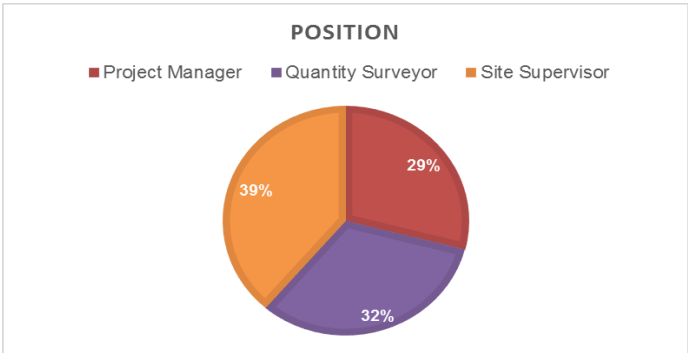


Figure 3. Position of the respondents

Next, from the figure, it shows the type of project involves by the respondent who is from grade G7 contractor. Majority of the respondent was involved in the commercial project that is 32% of the respondents. Then second familiar project that concerns from the respondent is a residential project which is 29%. This probably there too many demands for commercial project development. Meanwhile, there 29% and 10% of respondents involved in industrial and infrastructure projects.

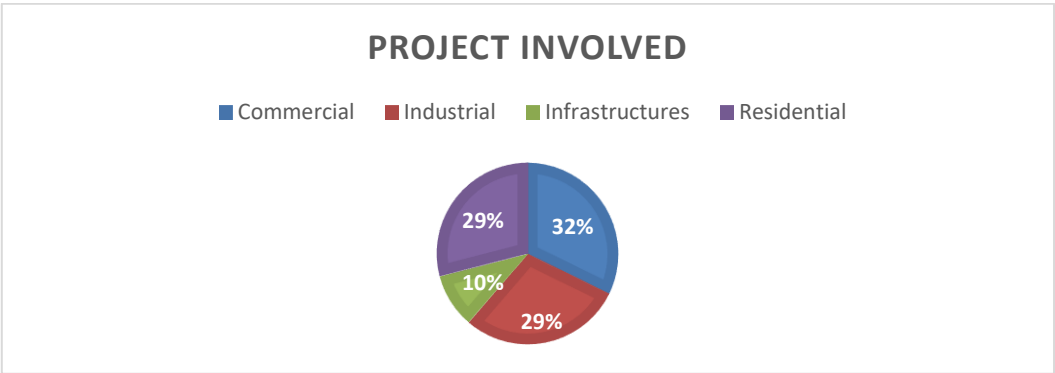


Figure 4. Project involved

Factors to be considered in implementing the modular construction system

Generally, there is some significant factor in implementing MCS in the Malaysian construction industry. First and foremost is under the technology aspect, which is it must practice off-site construction. This factor has the highest-level agreement among the respondents. This is because building off-site can be a mostly complicated procedure, but this comes with the additional benefit of time reductions each time a work is conducted in a controlled environment. Through once the operation is finished, the time taken will be reduced. The outcome is also more likely to be completed on time and in the construction sector where time constraints can be tight, that can be a significant advantage. This statement

also has supported by Smith (2014), which is that off-site construction is one of the factors to be considered in implementing a modular system.

Next, the other factors to be considered is the connection of the modules. The modules' association must be appropriately designed to fit the module that will be assembled correctly. This statement is agreed by The American Institute of Architects (2015). It is said to ensure ease of installation and possible dismantling. It is necessary to consider how the modules should attach carefully.

Lastly, it is a safer environment for the worker. This is because the modular construction is implementing off-site construction. This type of construction will reduce the number of incidents in the site, preventing the workers from exposing to the physical hazard at the site. This finding is supported by The American Institute of Architects (2015), in off-site construction, the labors are working in a controlled environment. They are not exposed to the risks of extreme weather and other worksite dangers.

Table 1. Factors to be considered in implementing the modular construction system in the Malaysian construction industry

Item	Description	Mean Score μ	Std. Deviation σ	Ranking
DESIGN				
1	The module's design must be entirely adaptable so that it can be placed in a different site when it has to relocate.	4.19	0.749	3
2	High quality modular and volumetric unit.	4.26	0.682	2
3	The material of the modules must be strong and durable.	4.45	0.568	1
TECHNICAL AND LOGISTIC				
1	The foundation built to hold the modular building should perfectly fit the structure's measurements to be placed above it.	4.29	0.783	2
2	Connection of the modules must be carefully design.	4.35	0.661	1
3	Transportation of the modules to the site.	3.87	1.176	3
TECHNOLOGY				
1	Practice off-site construction.	4.48	0.570	1
2	Promotes sustainability to the environmental.	4.26	0.815	2
FINANCIAL				
1	Less vulnerable to delays due to poor weather conditions.	3.42	1.119	1
MANAGERIAL				
1	Speed up the construction period.	4.16	0.779	1
2	Requires a high level of coordination and collaboration among team members.	3.61	1.054	3
3	Safer environment for workers.	3.71	1.131	2

The issues in implementing the modular construction system in the Malaysian construction industry

Generally, from the findings, some issues happened in implementing the MCS in the Malaysian construction industry. The significant problems that occurred in the Malaysian construction industry are the lack of innovation in MCS. The lack of innovation in materials, structure and technologies in MCS has become a challenging issue for MCS implementation in the Malaysian construction projects. This statement is supported by Aziz & Abdullah (2018), that there is a lack of innovation in the modular construction system.

Besides, the other issue is general contractor lack experience in modular construction. Their lack of knowledge is intended to reduce modular production's widespread support as the recommended construction process. Many general contractors have had unsatisfactory experience with incompetent modular products and are therefore reluctant to work with modular products or manufacturers again. This statement was agreed by Harvey (2016), which is he decided that the general contractor had lack skills in MCS.

Table 2. The issues in implementing the modular construction system in the Malaysian construction industry

Item	Description	Mean Score μ	Std. Deviation σ	Ranking
DESIGN				
1	Defective design and change order.	3.48	1.122	1
2	Lack of knowledge in structural analysis and prefabricated components design among civil engineers.	3.52	1.092	2
3	Architects are unfamiliar with modular designs in the architectural design process.	3.45	1.028	3
TECHNICAL AND LOGISTIC				
1	Delays in delivery of modular components to the site.	3.45	1.179	2
2	Technical failures on previous IBS project that give effect in implementing the modular construction system.	3.35	1.112	3
3	Transportation restriction because of the weight and size of the modules.	3.65	0.985	1
TECHNOLOGY				
1	Lack of innovation in the modular construction system.	4.35	0.608	1
2	Deficiency in superior and high technology equipment and machinery.	3.74	0.999	2
FINANCIAL				
1	The conventional system is more cost-saving.	3.52	1.092	2
2	Higher cost in term of material and cost of labour.	3.52	1.122	3
3	Higher initial capital cost.	3.90	0.978	1
MANAGERIAL				
1	Reluctance to change.	3.55	1.060	2
2	Lack of government support.	3.03	1.278	4

Item	Description	Mean Score μ	Std. Deviation σ	Ranking
3	General contractors lack experience with modular.	4.10	0.831	1
4	Lack of policymaking framework of green growth and green technology in Malaysia.	3.45	1.150	3

Recommendation to be improved in implementing the modular construction system in the Malaysian construction industry

First and foremost, to fix the researcher's issue to increase modular construction knowledge in the new generation of construction specialists. This can be achieved by guiding the development of their unique manufacturing processes and growing demand for modular training courses and programs. It will understand the advantages of modular construction among building players and make them more open to it. This recommendation was supported by Harvey (2016), which he agreed to this recommendation to increase awareness in the new generation about the modular system.

Next is to implement strict quality control. This is because the modular construction is produced off-site in the control manufacturing facilities. Thus, to create a high quality of modules, it is essential to monitor quality control. Using this way, it can avoid defective design and wrong duplication of the modules, so generally, it can reduce the production cost. This recommendation is supported by Jeanne (2017), which is agreed to implement strict quality control guidelines.

Table 3. Recommendation to be improved in implementing the modular construction system in the Malaysian construction industry

Item	Description	Mean Score μ	Std. Deviation σ	Ranking
DESIGN				
1	Increase awareness of modular construction in the new generation of specialists.	4.19	0.654	1
2	Implement strict, quality control procedures.	4.16	0.735	2
3	Provide training specializing in designing for their unique manufacturing requirements.	4.13	0.846	3
TECHNICAL AND LOGISTIC				
1	Create internal site servicing and installation teams.	3.65	1.018	1
2	Invest in trucks and trailers to ensure timely, coordinated deliveries of the modular units to the construction site for final assembly.	3.55	1.028	2
TECHNOLOGY				
1	The design must strategically plan the use of the technology available in the factory.	3.84	1.003	1
2	The building player needs to invest a significant amount in R&D in modular innovation.	3.29	1.419	2

Item	Description	Mean Score μ	Std. Deviation σ	Ranking
FINANCIAL				
1	Educate the clients about the productivity gains and business profit of modular construction.	4.13	0.670	1
2	Develop and cultivate relationships between modular companies and alternative financiers.	3.97	1.048	2

CONCLUSION AND RECOMMENDATIONS

Based on the questionnaires' analysis, the answer to the objectives and research questions that have been documented in the study has found. Implementing the MCS in the Malaysian construction industry will depend on many factors. So, the paper had analyzed the element to be considered in implementing modular construction. Based on the data that had been examined the three major factors that had been found out is practice off-site construction, the material of the modules must be strong and durable. The connection of the modules must be carefully design. In conclusion, the first objective of this research is achieved. This objective is to identify the issues in implementing modular construction. The problems are divided into design, technical and logistic, technology, financial and managerial. The reaction of the respondents has observed all the result of this research. The major issues were highlighted: lack of innovation in the modular construction system, followed by general contractors lacking experience with a modular and higher initial capital cost. This result achieved the second objective of this research to identify the issues in implementing the modular construction in the Malaysian construction industry.

Some of the recommendations had been made in this research to overcome the issues in implementing the MCS in the Malaysian construction industry. First and foremost, to overcome the problems the researcher had found out to increase awareness of modular construction in the new generation of construction specialist. It can guide the development of their specific manufacturing processes and increase demand for modular-specific training courses and programs. In this way, it will raise the awareness of the benefits of modular construction among building players, making them more exposed to it. In conclusion, it can develop their skills and experiences on the modular construction system. Besides, the other recommendation that had been found out is to implement strict quality control procedures. This is because, as we know, the modular building is produced in mass production in factories. So, this process requires high-quality control to have a high quality of modular units. So, as we implement the firm quality control, it can monitor the production, and it will reduce cost because it will prevent it from repeating produce the module if there are errors. In conclusion, implement strict quality control can overcome the issues in implementing the modular construction system.

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ISSUES OF LEAN CONSTRUCTION IMPLEMENTATION IN THE MALAYSIAN CONSTRUCTION INDUSTRY

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Abstract

Lean Construction (LC) is a philosophy based on lean production that emphasizes minimally invasive and maximally profitable production. The construction industry in Malaysia is one of the biggest polluting industries, causing a lot of environmental pollution. Furthermore, the construction industry is also the most extensive industry with lots of construction wastes generated. Thus, this LC philosophy was introduced to further enhance Malaysia's construction industry by implementing this LC. The primary purpose of this paper is to promote the usage of LC in the Malaysia construction industry. This paper aims to identify LC implementation issues, determine the impact of LC implementation, and recommend enhancing the LC implementation in the Malaysia construction industry. Data was obtained from G7 contractors registered with the Construction Industry Development Board (CIDB) of Malaysia by distributing questionnaire surveys. Based on the findings, it can be concluded that most of the respondents agreed with the issue that occurred during the LC implementation. The primary point was lack of knowledge. The respondents also agreed that this LC positively impacted the LC practitioners' organization to encourage them to undertake construction materials appropriately without wasting it and improving handling the resources. It is proposed that the government should introduce this LC as a policy in managing a construction site, implement the best construction practices to obtain the best results. Furthermore, it is also suggested to educate the construction workforce on implementing this LC concept and create more ongoing seminars or training to organize management. By implementing this LC, it is hoped that future construction projects in the Malaysian construction industry (MCI) can produce a better quality of end products towards a better quality of life.

Keywords: *Lean Construction, Implementation of LC, the Malaysian construction industry*

INTRODUCTION

There was a lot of wastage of construction materials in Malaysia due to construction to achieve the 2020 vision. De Souza et al. (2011) said that building is unique because it was one-of-a-kind projects, location development and multi-agency temporary. Failure to set up a good management system for the building infrastructure would bring in many issues that would lead to increased project costs and late completion of the low-quality project, ultimately reducing the contractors' gain. This problem calls urgently to adjust its processes, such as waste management and disposal. Thus, the industry adds an alternative approach to the construction industry to change its practices LC.

According to Shah and Ward (2007), LC was a concept derived from the construction sector's production industry to minimize waste to buildings' renovation. Yahya and Mohamad (2011) added that LC is an established method of managing and improving the construction process to transmit income using the things that define and funds and deliver on time. This research aims to promote LC background of literature and future projects of the MCI. This research seeks to identify LC implementation issues, determine the impact of LC implementation, and recommend enhancing the LC implementation in the Malaysia construction industry. Through this research's recommendations, it is hoped that it can accelerate the usage of LC in future construction projects in the MCI.

LITERATURE REVIEW

The Malaysian construction industry

The Malaysian construction industry was considered to be very important to the country. Nonetheless, the sector's growth slowing with records from 2000 to 2007, with an average gain of only 0.7% and gross domestic product (GDP) share dropping from 3.3% to 2.5% over the same period, which was reported to be the lowest percentage in the country (CIDB, 2009). The Malaysian construction industry was currently facing many challenges and difficulties. One of them is the lag in the completion of the project. According to Wan Muhammad, Ismail, and Hashim, (2013), the failure to complete projects on time was a global crisis in the construction industry, particularly in developing countries. This issue was evident from the underachieving the MCI with the latest public project delayed rate of 80 % (CIDB, 2009; Jorgensen, 2008). Besides, Abdullah (2009) also recorded a 90% delay rate for projects controlled by Majlis Amanah Rakyat (MARA). This government agency plays a significant role in the implementation of the construction policies of the Malaysian government. Abdul Rahman (2006) found that 45.9% of the completion dates were postponed during the construction phase. According to CIDB (2009), the main factors for time overruns in Malaysian construction projects are due to partial confidence, negative relationship and crisis in communication and coordination.

Also, Yahya and Mohamad, (2011) added that the lack of building capacity during the construction phase, which fails to deliver the project due to a flow effect that causes delays and disruptions throughout the entire organization, was the most significant contributor to the state rule. These delays are known to cause losses to the client or developer and industry as the whole as construction has a significant impact on the economy (Ibrahim, 2010). There was, therefore, a need to enhance the alignment and efficiency of the construction process flow, which means project evaluation and management by reducing duplication and optimizing quality. Current construction practice in Malaysia has also resulted in duplication of jobs, extended authorization and working time, lack of transparency and increasing costs (Ibrahim, 2010). Pratt (2000) pointed out that in the last decade, Malaysian projects, particularly magnificent monuments, have not been cost-effective and functional. He added that the budget had been exceeded in some cases and the expected completion dates have not been reached. Moreover, the quality has not always been up to expectations. The weaknesses of the construction industry, among others, are the low image of the sector, the lack of formal and organized education and training of industry professionals, the lack of adequate appreciation of the role of construction technicians and technologists, the confrontational attitude of consultants and contractors, the lack of cooperation and sense of belonging (Adamu, 2012). It is time to rapidly reflect and respond before many more people are frustrated by the construction industry. In the face of the twenty-first century's challenges, the construction industry should thrive through consistent efficiency, increased value-added operations and enhanced product quality (Ibrahim, 2010). The implementation of an LC approach to the construction industry seems to apply to the current situation. The need for change reflected the role and principles of LC, which can be deduced from the LC method, can be well adapted to the current circumstances of the MCI.

Lean construction

The implementation of lean thinking to construction was pioneered by Krippendorf, (2005) who proposed that construction development should be seen as a combination of conversion and waste disposal processes. The use of the lean definition has been promoted in the United Kingdom. There is a range of workshops and campaigns have been conducted to promote its acceptance. Examples of organizations founded include the Construction Industry Research and Information Association (CIRIA), the Construction Productivity Network (CPN), the Construction Lean Improvement Program (CLIP) and the Lean Construction Institute UK (LCI-UK). Seminars and conferences have been arranged to address critical issues related to the development and understanding of LC concepts with real-life case studies provided by some construction organizations (CIEF, 2009). Despite these efforts, there seem to be some obstacles to the successful implementation of LC. Generally, lean adoption in the UK construction industry is relatively low (Mossman, 2009). Some studies have found obstacles to the implementation of LC. Such challenges must be resolved so that the building industry can reap the benefits of LC. The lean theory application to construction has been provided with improved quality, improved safety, reduced waste, increased productivity, increased customer satisfaction, increased reliability, and improved design (Ogunbiyi and Goulding, 2013). A study by Sarhan and Fox, (2012) showed significant trends in the growth of a lean culture among UK construction organizations. Lack of understanding how lean design concepts can be successfully applied to different 15 building processes has also been exposed. A study of lean culture within UK construction organizations was carried out after study by Jorgensen et al., (2008). Since Egan's study, the lean theory has become an essential concept within the UK construction industry. Significant improvements have been made to the plan for change in the UK construction industry. Several studies have been carried out to assess the current level of awareness and application of lean design in the UK construction industry. The application of the Last Planner to the UK construction project is an example of such a study. Last Planner is one of the lean tools and techniques and perhaps the most sophisticated method. The methodology was applied to the UK construction project to assess its quality and its potential obstacles.

Nevertheless, the study posed some significant systemic and cultural problems for the Last Planner's UK performance. Shah and Ward, (2007) point out that it is necessary to differentiate between those studies which consider lean on guiding principles or overarching objectives from a conceptual perspective and those which analyze the term from a functional perspective as a set of directly measurable management processes, methods or techniques. The application of LC was targeted at specific tools and concepts without full integration into various aspects such as supply chain, security, planning and control, production and management, culture and human elements (Alves, 2007; Pavez, 2008). Framing a concept that incorporates all facets of lean is seen as challenging (Pettersson, 2010). Alves et al. (2007) argued that there is a lot of sense to lean when applied to the building. Accordingly, this study considers it essential to discuss the different definitions of lean applied to construction. Table 1 offers a variety of lean concepts. Lean offers significant resource management gains and improved collaboration and alignment in the organizational and supply chain. Elimination of waste contributes to cost-benefit advantages, although these are prerequisites for developing a lean method. Part one of the lean implementation strategies focuses on reducing waste from a technological and operating perspective (Green, 2005). System Mapping, Value Stream Mapping and 5S (Workplace Organization) are some of these operations' methods. There are seven categories of waste listed under lean: overproduction, overcrowding, waiting time,

delay and transport, overcrowding, defect and reprocessing. In the same way, there is a different methodology for achieving lean production: just in time (JIT), Full Quality Control, Concurrent Design, System Redesign, Value-Based Management, Total Productive Maintenance and Employee Engagement.

Table 1. Adopted and modified from Ogunbiyi and Goulding (2013)

Authors	Definition
Radnor et al. (2006)	Lean is a philosophy that uses tools and techniques to create a change of organizational culture to implement the excellent practice of process/operations improvement that reduces waste, improvement of flow, more focus on customers' needs, and takes a process view.
Shah and Ward (2007)	A socio-technical integrated framework, whose primary goal is to reduce waste by simultaneously eliminating or decreasing manufacturer, consumer and internal variability.
Ballard et al. (2007)	Lean is a fundamental business philosophy – one that is most effective when shared throughout the value stream.
Maudgalya et al. (2008)	Lean is a systematic approach to enhancing value to the customer by identifying and eliminating waste (of time, effort and materials) through continuous improvement, by 18 flowing the product at the customer's pull, to pursue perfection.
Lean Construction Institute (2013)	LC is a project delivery system focused on production management that emphasizes efficient and prompt value delivery.
Construction Industry Institute (2013)	The continuous cycle of disposing of waste, meeting or exceeding all customer expectations, focusing on the entire value stream and achieving excellence in executing a designed project.

RESEARCH METHODOLOGY

In general, the research methodology carried out using a flow to accomplish the three-goal of paper, which involves the following stages. First, it started with a preliminary review of literature related to the issue. It was performed to concentrate on the research area. Second is to investigate and identify the problem statement about the topic. And then it continued by finding the aim and objectives of the studies. Literature studies have done for better understanding of the paper. Next is the data collected by using two types of method which is primary and secondary data. The preliminary data will be done after collecting the information from the distribution of the questionnaire. The secondary data is compiled using the internet such as the construction website, reading and organizing the information from the book, article, and related journal. Data analysis will then be processed, and the last stages are the conclusion and recommendations made from based on the outcome from the data analysis. This research was conducted in Malaysia, and it focuses specifically on the CIDB registered contractor G7. The data analysis involved only 20% of the respondents out of the 278 questionnaires distributed to all contractors in Malaysia.

In general, the research methodology carried out using a flow to accomplish the three (3) goal of this paper, which involves the following stages (see Figure 1). First, it started with a preliminary review on the literature related to the topic which is more to the sustainability approach through the lean construction. It was performed to concentrate on the study area. Second is to investigate and identify the problem statement about the topic. And then it continued by finding the aim and objectives of the studies after that literature has done for better understanding of the studies.

The data is collected using two (2) types of method: primary and secondary data. The primary data will be done after collecting the information from the distributed the questionnaire to the person involved and related in the final dissertation. Besides that, the

secondary data is collected using social media such as construction website, reading and organizing the information from the book, article, and journal that has been related in studies/paper. The next stages have collected the questionnaire distributed and produced the data analysis from that questionnaire by presenting into the form of sentences, including the chart and table that relevant to the paper needed.

Data analysis will be processed, and getting the result can know that the objective will be achieved. The last stage is the conclusion and recommendations made based on the outcome of the data analysis that has been done.

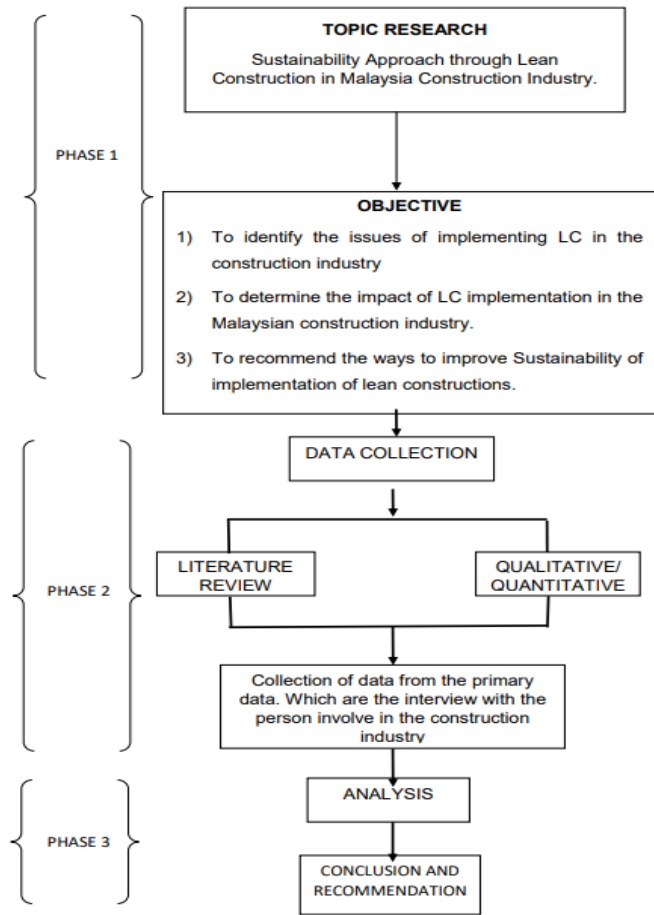


Figure 1. Methodology process of research paper

FINDINGS AND DISCUSSIONS

This paper has been done to promote LC among the G7 contactors in the MCI. This paper has three objectives: to identify the issues of LC implementation, determine the impact of LC implementation, and recommend enhancing the LC implementation in the Malaysia construction industry. There were five areas in each of these objectives: managerial, financial, education, technical, and human.

Demographic information

From demographic information (see Figure 2), after analyzing SPSS, it was found that the majority of respondents who answered this paper questionnaire consist of the Quantity Surveyor (QS), which is 42%. This was because the quantity surveyor played a vital role in the construction industry from the beginning of the project until fully completed the task. And LC has closely related to QS that QS determines whether a building can save cost or not control construction material costs. For analysis of working experiences, it was found that most respondents and the highest percentage answering this question consisted of respondents working less than five years which is 74%. Today, many construction workers are young; this was because young people are easy to understand and learn and can work more time as the economy boomed and grew.



Figure 2. Designation in Company

The issues of LC implementation in the Malaysian construction industry

The first objective of this paper is the issue of LC implementation. There are five parts to issue, namely management issue, financial issue, an education issue, technical issue and human issue. It is divided into three different topics for a management issue, each analyzed individually and then referred to each other. The mean of the other problems was 3.37 (standard deviation = 1.058). It has received a great deal of support from the contractors; this is because of Malaysia’s downsizing, which lacks supply chain and low integration due to improper management. For the financial issue, there are also three issuers distributed under this economic condition. It was then analyzed and compared to see the highest problem supported by the contractor. Therefore, the highest financial issue was low skill salaries with the highest mean of 3.58 (standard deviation = 1.073). This is because most local companies pay wages that are not comparable to the jobs workers do, which causes some of them to quit. Whereas for issue under education, it can be seen from the comparison table that the highest point is the issue of lack of holistic implementation, with a mean value of 3.62 (standard deviation = 0.993). The contractor strongly supports this issue due to the lack of knowledge in some communities, especially those working in the construction sector on the importance of holistic implementation. Besides, the technical issue was that there was an issue with high mean value and good support from the contractor, i.e., the problem of incorrect and

incomplete design with a mean value of 3.23 (standard deviation = 1.131). Most of these issues occur due to a lack of agreement within a team while doing the work. For the last part of this issue, this human atheism is three issues in it and analyzed. After being analyzed and identified, one point stands out among the others, namely the case of misconceptions about the lean practice. This is because the human attitude lacks knowledge and the inability to ask if it does not know why this issue exists.

Thus, there are still many issues that cannot be adequately handled. Therefore, those who are new to the construction sector need to consider and address it effectively and effectively so that further development and less waste can be created later.

Table 2. The issues of LC implementation in the Malaysian construction industry

Item	Description	Mean score (μ)	Std. deviation (σ)	Ranking
Managerial				
1.	Lack of top management support and commitment	3.27	1.031	2
2.	Unsuitable organizational structure	3.27	1.050	3
3.	Lack of supply chain and integration	3.37	1.058	1
Financial				
1.	Low skill Salaries	3.58	1.073	1
2.	Insufficient project financing	3.48	1.075	2
3.	Risk aversion	3.35	.883	3
Educational				
1.	Lack of technical skill, high-level illiteracy	3.44	1.145	2
2.	Lack of Holistic implementation	3.62	.993	1
3.	Lack project team skills	3.40	1.125	3
Technical				
1.	Lack of buildable designs	2.98	1.093	3
2.	Poor performance assessment methods	3.27	1.012	1
3.	Incorrect and incomplete designs	3.23	1.131	2
Human				
1.	Poor understanding of client's brief	3.46	1.038	3
2.	Misconceptions about lean practice	3.71	.977	1
3.	Fear of Unfamiliar practices	3.67	1.080	2

Impact of LC implementation in the Malaysian construction industry

The second objective of this paper was to determine the impact of LC implementation in MCI. For the first impact, under management, three parts are analyzed and then compared to each other (see Table 3). One of the highest has implications under management support from the contractor, which can be useful feedback and measures the system for review and correction with a mean value of 4.02 (standard deviation = 0.918). This LC implementation can be referenced again to determine what went wrong with each project being run by a company, which will prevent them from losing. For the impact of financial underwriting, there are two highest impacts supported by the contractors or respondents who answer this question. The effect increases the growth in profit margin and increases sales growth lowering the cost of production. Both have the same mean and std deviation of 3.90 and 8.69, respectively. From this impact, it can be seen that with the implementation of this LC can avoid wasting mainly on the cost of construction. That cost can be used for other purposes, and automatically it can benefit more. Besides, there is also an impact on education. The effects are divided into three (3) parts, and it analyzed and then made a comparison between those effects. For impact under education, it is found that there is a very high impact supported by the contractor and

has a high mean value. The result is like enabling the stakeholders to identify the problems, with a mean value of 3.62 (standard deviation = 0.993). This education is essential because, through education, we can learn many useful pieces of knowledge, especially in this construction industry. For impact under technical, it is found that there is one of the highest impact value means, the effect is that design helps to optimize the use of several resources, especially for engineers and architects. This LC allows them to design appropriately and quality without wasting. The last impact is under human influence. Also divided into three effects and analyzed and compared. There is an impact that is strongly supported by the contractor and has a high mean value. The effect is empowering workers to reduce waste and pollution by taking appropriate action, with a mean reading of 4.13 (standard deviation = 0.715). Usually, focus on the top, if their management is right, then the implementation of a project is exemplary.

Thus, there is a lot of impact on the implementation of this LC the MCI. Even if the implementation of this technique is comprehensive, the effect will be huge too. Perhaps the construction industry in this country is comparable to the international one.

Table 3. The impact of LC implementation in the Malaysian construction industry

Item	Description	Mean score (μ)	Std. deviation (σ)	Ranking
Managerial				
1.	Helping contractors increase productivity while protecting workers from injuries and hazards to occupational health	3.98	.874	3
2.	Can be useful feedback and measures the system for review and correction	4.02	.918	1
3.	Enabling stakeholders to identify problems and provide continuous improvement efforts as each constraint increases time and cost.	3.98	.860	2
Financial				
1.	Increase the market share and growth rate	3.75	.789	3
2.	Increase the growth in profit margin	3.90	.869	1
3.	Increase the growth in sales, lower the cost of production or production cost per unit	3.90	.869	1
Educational				
1.	Helped to incorporate knowledge and information relevant with lean construction	3.44	1.145	2
2.	Enables the stakeholders to identify the problems	3.62	.993	1
3.	Provide continuous improvement effort	3.40	1.125	3
Technical				
1.	Design helps to optimize the use of a number of resources	4.08	.710	1
2.	Product design leads to less energy consumption by ensuring that product design is compatible with current manufacturing processes and procedures.	3.85	.777	3
3.	Have a positive impact and a positive relationship between product design and company economic results	3.96	.766	2
Human				
1.	Empowering workers to reduce waste and pollution by taking appropriate action	4.13	.715	1
2.	Enhance creativity among employees effectively using materials	4.08	.710	2
3.	Potential for increasing maintainability, as well as sustainability	3.94	.669	3

Recommendations the ways to improve LC in the MCI

For the third objective is the recommendation for improving LC in MCI. For guidance under management, there are three recommendations below (see Table 4). For proposal under management, one good suggestion was found and supported by a higher mean value contractor than the other. The recommendation is the environment, building facilities of long-term value and protecting and or restoring the natural environment, with a mean value of 4.25 (standard deviation = 0.682). This is because the environment is essential not only to humans but also to other lives. In recent times, environments are polluted as a result of these construction industries. Simultaneously, the recommendation under financial is also divided into three offers and analyzed and compared. It was found that there was a high recommendation of the mean value. It suggests increasing output flexibility with a mean value of 4.12 (standard deviation = 0.704). This is because increasing the output flexibility has a positive impact on a company's income. Next is the recommendation under education. After analyzing and comparing, the proposal on improving strategies for various business outcomes was the highest supported by the converter, with a mean value of 4.19 (standard deviation = 0.742). This is because the right strategies result in significant and organized work. For the recommendation under technical, it is found that the most recommended contractor support is about encouraging communication between project team members, with a mean value of 4.25 (standard deviation = 0.711). With good communication, they can share their ideas and ideas for working on a great project. For the last recommendation is under recommendation. There is one recommendation under humans with a higher mean value than the other, establishing problem-solving groups, with a mean value of 4.13 (standard deviation = 0.658). This shows that the team members and being knowledgeable, talking about the project, and team members are also the place to solve problems and ask each other questions. They must have an open attitude in accepting all the advice they give.

Therefore, this recommendation is intended further to enhance the effectiveness of this LC in Malaysia. This is because the implementation of this LC gives the benefit of being correctly implemented. Not only waste can be avoided but also the benefits that can be gained. Even the environment is not contaminated.

Table 4. The recommendations ways to improve LC in the Malaysian construction industry

Item	Description	Mean score (μ)	Std. deviation (σ)	Ranking
Managerial				
1.	Minimization of waste in the use of production resources, whether human or material	4.02	.700	3
2.	Combining lean techniques with recycling to reduce waste, both material and financial	4.17	.617	2
3.	Environment, building facilities of long-term value and protecting and/or restoring the natural environment	4.25	.682	1
Financial				
1.	Increase output value through systematic consideration of customer requirements	4.10	.748	2
2.	Ensuring high quality of the end product, boosting confidence level and safety of the construction workers; and maintaining the sustainability of the project itself	4.04	.713	3
3.	Increase output flexibility	4.12	.704	1
Educational				
1.	Improving the management system,	4.17	.785	3

Item	Description	Mean score (μ)	Std. deviation (σ)	Ranking
2.	Improving diversifying techniques for detecting waste,	4.17	.648	2
3.	Improving strategies for various business outcomes	4.19	.742	1
Technical				
1.	Eliminating contractual barriers that prevent communication and innovation among designers and contractors	3.88	.900	3
2.	Integrates an organization across disciplines,	4.10	.774	2
3.	Encouraging communication between project team members	4.25	.711	1
Human				
1.	Creating your own workforce	4.04	.791	3
2.	Establishing problem solving groups	4.23	.703	1
3.	Holding formal training programs	4.13	.658	2

CONCLUSION AND RECOMMENDATIONS

The main objectives and objectives have been identified and followed by respondents from construction workers such as architects, QS, engineers, site supervisor, managing director, project manager and many others working in this construction industry to implement of this LC. Therefore, the method of this paper was developed subsequently. The findings can be obtained very relevantly based on information analysis, and the conclusions are drawn. This research aims to promote the usage of LC in the MCI. The results of this paper met all of the aim and objective, which are stated above. The success of the goals is vital to assure that the objective is achieved in this research. Based on the results of the data analysis in this research, it is found that the paper objectives set have been achieved successfully. The results showed that all G7 contacts in this research agreed with the stated objectives. This proves that implementing LC is very important in the construction industry today.

There is some recommendation to overcome the issue of LC, such as held workshops to enhance knowledge and skills in LC. Companies should provide seminars to their employees to improve their knowledge and work practices. They would have been more aware of the importance of LC and added the right skills and techniques when implementing this LC. This is important for the future towards more advanced technologies. Furthermore, a worker should explore more about LC practices in the daily construction process. Learning self-study is better than expecting others to teach it first. Lastly, it is suggesting to introduce practical tips or rewards when applying this LC. It can be practised before, during, or after completing a project. It is relatively new in the construction world; there is a need for tips or rewards and strategies to control it and make it the right decisions.

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SUPPLY CHAIN COLLABORATION FOR INDUSTRIALISED BUILDING SYSTEM (IBS) CONSTRUCTION APPROACH IN MALAYSIA

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Abstract

Malaysia has been progressing towards adopting a more modern approach to construction, i.e. an Industrialised Building System (IBS), to enhance the level of productivity within the construction industry. At present, the adoption of IBS implementation has been relatively less than the expectations of the Malaysian government. One of the key hurdles has been related to supply chain issues. Therefore, this study aims to propose a new concept surrounding supply chain collaboration (SCC) within this industry. At present, limited guidelines exist regarding the collaboration processes amongst construction players, thus making it difficult for construction players in projects to efficiently work together and accomplish mutual targets in terms of costs, time, quality, and productivity. The objectives of this study are to validate the current issues, identifying critical success factors, challenges and also to determine how these issues influence SCC regarding the IBS construction approach adopted in Malaysia. The current research utilises a structured questionnaire survey involving 11 respondents from multidisciplinary industry backgrounds and academicians in the IBS Professional Training Module Development Workshop at the Dorsett Hotel in Putrajaya, Malaysia. The outcome from the questionnaire validated the need for construction players to collaborate towards improving the issues within the supply chain (SC) of the IBS construction approach, indirectly helping to enhance the implementation of IBS implementation in Malaysia. The research conducted in this study was a preliminary review which will be supported by further research for developing a SCC framework amongst construction players in the IBS construction industry in Malaysia. The contributions of this research will help to provide further insights and understanding in this industry to key stakeholders and aid in developing plans and strategies in future, including guidelines towards the effective implementation of IBS projects.

Keywords: *Supply Chain Collaboration (SCC); Supply Chain Management (SCM); Collaborative Advantage (CA); Industrialised Building System (IBS); Malaysian Construction Industry*

INTRODUCTION

The Malaysian government has been progressing towards the adoption of a modernised construction approach, termed the Industrialised Building System (IBS), to improve both productivity and performance within the construction industry. However, the acceptance of IBS in the industry has been less than previously envisaged by the government. The main obstacle given the poor level of acceptance level regarding IBS is related to the process of project delivery and the supply chain (SC) (Nawi et al., 2018).

Likewise, both procurement and the supply chain have been categorised as one of the main contributing factors leading towards the barriers in the adoption of IBS within the construction industry (Kamar et al., 2009; Nawi et al., 2007), that in turn, impact numerous stakeholders such as manufacturers, contractors, suppliers, local authorities, or clients in the IBS value chain. As mentioned by CIDB (2009), to successfully introduce IBS in the Malaysian construction industry, both the supply chain and the procurement system need to be improved.

The Coronavirus (COVID-19) pandemic continues to have an unprecedented impact on societies and industries worldwide. According to Remuzzi and Remuzzi (2020), the circulation of COVID-19 globally will be difficult to contain from spreading, given the virus has already met the necessary epidemiological criteria in declaring it a pandemic by the World Health Organisation (WHO). Many industries continue to be affected by this outbreak, that also includes the construction industry. As such, to meet the needs in overcoming this challenge, a synchronised response with the involvement of all countries is required. Already, many industries globally, including the construction industry, are experiencing issues within respective supply chains, impacting production schedules and delivery and at the same time introducing new measures to combat and safeguard the workforce against this virus.

One of the measures introduced by governments' worldwide, has been through social distancing measures in reducing the circulation and spreading of the virus. Social distancing requirements for construction companies have become the new norm to avoid a second wave of the virus. Accordingly, this has presented an insurmountable challenge to control and coordinate activities on construction and building sites that require multiple contractors, specialist trades, and thousands of workers to work together at the same location or site, let alone enforce social distancing measures. On the other hand, in safeguarding workers from this virus, one of the suggestions proposed is for the industry to migrate or transition to adopting the IBS approach. The adoption of IBS technology is perceived as the best approach to reduce the risk of COVID-19 spreading in the construction sector. This is due to the use of IBS technology to lessen the workforce, especially the less skilled labour, as many construction components can be manufactured directly in the factory (Bernama, 2020).

Supply chain collaboration (SCC) and management (SCM) have already been adopted in several industries, namely in automotive manufacturing and retail trading (Akintoye et al., 2000). The notion surrounding supply chain collaboration initially surfaced during the 1980s within the manufacturing industry (Tan, 2001). Moreover, supply chain collaboration and accompanying techniques have been shown to offer many advantages to those players involved in supply chains by improving relationships, reducing costs, enhancing value, and increasing the level of satisfaction (Emmett & Crocker, 2016). However, even though supply chain collaboration has become popular in many of these sectors, there remains no one definition of supply chain collaboration that is accepted universally. Mentzer et al. (2000), defined supply chain collaboration, as involving firms in the supply chain collaborating as a single entity having mutual goals and objectives. Whereas, Simatupang et al. (2004) characterised supply chain collaboration multiple companies collaborating in aligning their supply chain practices and processes in creating value to consumers or customers and other stakeholders having significant success compared to working in isolation from other companies.

However, the construction industry has lagged in engaging the concept. Within the building and construction industry, numerous notions surround supply chain collaboration, namely, forming a joint alliance and partnering (Anvuur & Kumaraswamy, 2007; Xue et al., 2010). Numerous research studies have suggested many of the determinants depicting a collaborative arrangement or relationship in the construction industry. For instance, Bennett and Jayes (1995), proposed that there were three key aspects associated with successful partnering, such as continuous improvement, resolving problems and having mutual objectives. Similarly, Packham et al. (2003) suggested several features associated with collaboration such as profit sharing, building trust and teamwork. Many of the more common measures of a collaborative relationship that have been suggested by other scholars consist of continuous improvement, risk-sharing, problem-solving, open communication, integrated

teamwork, clearly defined responsibilities, trust, mutual benefits and common objectives (Sui Pheng, 1999; Naoum, 2003; Chan et al., 2004; Chen & Chen, 2007; Markert, 2011).

The construction management is important for the successful of implementation of IBS project. As mentioned by Kanji and Wong (1998), supply chain management (SCM) within the construction industry, adopted alongside partnerships and total quality management (TQM), can potentially address and overcome many of the issues in the industry. Therefore, this preliminary study aims to view and validate current issues, key success factors (KSFs), and challenges leading towards the successful implementation of IBS in the construction industry from a supply chain collaboration perspective by introducing the concept of supply chain collaboration (SCC) in the Malaysian construction industry.

METHODOLOGY

Questionnaire Design

The questionnaire survey developed for this research attempts to find the participants’ opinions on SCC associated with the IBS construction approach. Given the investigatory nature of this research, a questionnaire developed to collect data was deemed an acceptable approach (Bailey et al., 1995).

A five-page structured questionnaire was distributed to the 11 participants involved in this research at a Professional Training Module Development Workshop for steel structure and reusable formwork. The workshop was held from 19th December until 22nd December 2019 at the Dorsett Hotel in Putrajaya, Malaysia. The participants represented multidisciplinary industry backgrounds such as Clients, Manufacturers, Consultants, Contractors, Academicians, and government constituting a range of disciplines such as policymakers, designers, and those involved in quantity surveying, construction, and client recipients of projects in the construction industry.

The questionnaire was separated into five sections in order to investigate the connection of the IBS construction approach and SCC. The participants were requested for their feedback and opinions on present issues relating to their organisation’s experiences towards adopting the IBS construction approach, and the necessity for the collaboration between IBS construction players in the SC. The questionnaire used a 5-point Likert scale in which, 5 = “very important” and 1 = “not important”.

Descriptive Analysis

Table 1. Likert Scale

Scale	Indicators (N = 11)
1	Not Important
2	Slightly Important
3	Moderately Important
4	Important
5	Very Important

Employing descriptive statistics (DS) helps to gauge standard deviation (SD), variance, median, mean, and distribution (Sekaran & Bougie, 2016). Furthermore, DS can also help summarise the collection of data employing research techniques and other approaches. The questionnaire was structured to incorporate a rating scale, as reflected in Table 1, in managing the collection of data and analyse at a later stage. The rating scale and score assisted in determining present issues in the IBS construction approach, SCC aspects and considerations,

the objectives of SCC, KSFs and challenges towards the implementation of SCC in the construction industry.

Table 2. Landell Classification Scale

Description	Classification Rating Scale (N = 11)
Low	1.0 – 2.33
Moderate	2.34 – 3.68
High	3.69 – 5.00

In addition, the average of the sum of mean scores was then assessed by frequency and ranking, in which the results were analysed further employing Landell's classification scale (Landell, 1997). In other words, the classification scale for all variables refers to the classification of the rating scale, as shown in Table 2.

RESULTS AND DISCUSSION

Current Issues of the IBS Construction Approach

The findings derived from the analysis of present issues associated with the IBS construction approach are shown below:

Table 3. Findings based on data analysis for the present issues associated with the IBS construction approach

Issues	Frequency of Respondents					Total (N)	Mean Value	Classification	Rank
	1	2	3	4	5				
1. Logistic of transporting IBS components	0	2	0	4	5	11	4.10	High	1
2. Economies of scales	0	1	2	5	3	11	3.91	High	2
3. High cost	0	2	3	2	4	11	3.73	High	3
4. Lack of competency from industry players	1	0	4	5	1	11	3.46	Moderate	4
5. Lack of collaboration in supply chain management (SCM)	1	2	1	6	1	11	3.36	Moderate	5
6. Lack of integration in digital IBS processes	1	2	1	6	1	11	3.36	Moderate	6
7. Lack of incentives from the government	2	2	2	3	2	11	3.10	Moderate	7

Regarding Table 3 above, *the logistics of transporting IBS components, the economics of scale and high cost* were found to contribute to the topmost scores and extent of present issues concerning the IBS construction approach.

In contrast, other issues such as the *lack of competency from industry players, lack of collaboration in SCM, lack of integration in digital IBS processes, and lack of incentives from the government*, were shown to have a moderate influence. However, the issues listed all exceeded the mean value of 3.00, indicating the importance of the issues that need to be addressed. These results are consistent with other studies (Mohd Amin et al., 2017; Nawi et al., 2011; Kamar et al., 2014), who also highlighted that these issues contributed to a lower level of IBS adoption in the context of the Malaysian construction industry.

Factors Considered for Establishing Supply Chain Collaboration (SCC)

The data analysis and findings related to the factors for consideration in establishing SCC are presented in Table 4 below:

Table 4. Findings based on data analysis of the factors considered for establishing SCC

Factors	Frequency of Respondents					Total (N)	Mean Value	Classification	Rank
	1	2	3	4	5				
1. Cost benefits	0	0	1	1	9	11	4.73	High	1
2. Better quality service	0	0	1	1	9	11	4.73	High	2
3. Creating standardisation of processes	0	0	1	2	8	11	4.64	High	3
4. Simplifying the construction process	0	0	2	2	7	11	4.45	High	4
5. Simplifying the ordering process	0	0	1	5	5	11	4.36	High	5
6. Simplifying the tendering process	0	0	2	3	6	11	4.36	High	6
7. Simplifying the design stage	0	0	1	5	5	11	4.36	High	7

The table above reflects the factors that construction players may take into account when establishing SCC such as *cost benefits, better quality service, creating standardisation of processes, simplifying the construction, ordering, and tendering process, and simplifying the design stage* were considered as those factors rated as high. The findings indicate that respondents' agreed with the factors deemed important when establishing SCC among construction players, which are in line with those findings of Akintoye *et al.* (2000).

Objectives in Establishing Supply Chain Collaboration in the Construction Industry

The findings derived from the analysis in formulating the key objectives in establishing the SC within the construction industry include those presented in Table 5 below:

Table 5. Findings derived from the analysis in formulating the main objectives in establishing SCC in the construction industry

Objectives	Frequency of Respondents					Total (N)	Mean Value	Classification	Rank
	1	2	3	4	5				
1. Cost reductions within organisation	0	0	1	1	9	11	4.73	High	1
2. Increased profitability	0	0	0	3	8	11	4.73	High	2
3. Increased market competitiveness	0	0	1	2	8	11	4.64	High	3
4. Improved customer service	0	1	0	3	7	11	4.45	High	4
5. Benefits to client	0	1	2	0	8	11	4.36	High	5
6. Reducing bureaucracy/ paperwork	0	1	1	2	7	11	4.36	High	6
7. Improved quality assurance	1	0	1	1	8	11	4.36	High	7
8. Overall supply chain reduction	1	0	2	3	5	11	4.00	High	8
9. Benefits to the supplier	1	1	2	1	6	11	3.91	High	9

The main objectives rated as “High” in the above table include: *cost reductions within the organisation, increased profitability, increased market competitiveness, improved customer*

service, benefits to the client, reducing bureaucracy/paperwork, improved quality assurance, overall supply chain reduction, and benefits to the supplier.

Accordingly, based on the responses received from respondents', SSC, cost reduction within the organisation and increased profitability were the principal objectives in establishing SSC amongst players within the construction industry. However, all nine factors were considered important; cost reduction within an organisation the topmost factor, followed by increased profitability, and the least important being the benefits to the supplier.

Moreover, these findings are supported by those of Potts & Patchell (1995), who discovered that the limitation or the delayed supply of information, delivery of material to the construction site and equipment impacted the success of the IBS project. This is made much worse if both site locations and manufacturers are too distant from one another, indirectly causing logistical and transport costs to increase in the construction project (Nawi et al., 2011).

Key Success Factors in Effective Construction Supply Chain Collaboration

The findings derived from the analysis for the effectiveness of SCC in the construction industry are shown in Table 6 below:

Table 6. Findings derived from the data analysis for the key success factor in the SCC construction industry

Success Factors		Frequency of Respondents					Total (N)	Mean Value	Classification	Rank
		1	2	3	4	5				
1.	Reliability of supply	0	0	0	3	8	11	4.73	High	1
2.	Trust	0	0	1	2	8	11	4.64	High	2
3.	Mutual interest	0	0	0	5	6	11	4.55	High	3
4.	Closer links between demand/supply	0	0	2	3	6	11	4.36	High	4
5.	Manpower development	0	0	3	2	6	11	4.27	High	5
6.	Joint business planning	0	0	3	3	5	11	4.18	High	6
7.	Integrated information systems	0	0	2	5	4	11	4.18	High	7
8.	Top management support	1	0	1	4	5	11	4.10	High	8
9.	Free flow of information	0	1	3	3	4	11	3.91	High	9
10.	More frequent meetings	2	3	1	3	2	11	3.00	Moderate	10

The KSFs reflected as “High” as presented in the above table include; *reliability of supply, trust, mutual interest, closer links between demand and supply, manpower development, joint business planning, integrated information systems, top management support, and free flow of information*. Indeed, contrary to these findings, *more frequent meetings* resulted in a Moderate extent. Here, the KSFs rated by the participants all exceeded the mean value of 3.00, thereby suggesting all factors are important towards SCC amongst the construction players. Given the feedback received by the respondents, the *reliability of supply* was rated highest regarding the effectiveness of SCC amongst construction industry players which are supported by the findings of Akintoye et al. (2000).

Challenges of Implementing Supply Chain Collaboration in the Construction

Data analysis and findings for the challenges of implementing SCC in the construction industry are reflected in Table 7 below:

Table 7. Findings derived from the data analysis of the challenges of implementing SSC in the construction industry

Challenges	Frequency of Respondents					Total (N)	Mean Value	Classification	Rank
	1	2	3	4	5				
1. Lack of top management commitment	0	0	2	4	5	11	4.27	High	1
2. Strategic benefits unclear	0	0	0	8	3	11	4.27	High	2
3. Poor understanding of the concept	0	0	1	7	3	11	4.18	High	3
4. Inappropriate organisation structure to support system	0	0	3	6	2	11	3.91	High	4
5. Low commitment of partners	0	2	2	6	1	11	3.55	Moderate	5
6. Lack of appropriate information technology	0	1	4	6	0	11	3.45	Moderate	6

The main challenges dignified as “High” as presented in the above table include; *lack of top management commitment, strategic benefits unclear, poor understanding of the concept, and inappropriate organisation structure to support system*. Other challenges included; *low commitment of partners and lack of appropriate information technology* resulting in a Moderate extent. The table also displays a range of factors that may pose significant challenges or difficulties for the construction industry when establishing and implementing SCC in the industry which include; *lack of top management commitment, strategic benefits being unclear, poor understanding of the concept and the lack of an inappropriate organisation structure to support the concept*. The mean value that represents all challenges exceeded the value of 3.00, therefore, signifying that all represent challenges to some extent towards the implementation of SCC in the construction industry (Akintoye et al., 2000).

Based on all the findings, this study is expected to contribute new information to the existing body of knowledge. The first area of contribution is conceptual, which is a replication of previous research conducted by Cao & Zhang (2011) to uncover the nature of supply chain collaboration (SCC) and its impact on organisational performance based on a paradigm of collaborative advantage (CA). The second area is methodological, which is to verify and validate the scale to measure the relationship between supply chain collaboration (SCC) and organisational performance. Furthermore, the methodology can be extended by statistical testing of the mediating effects of collaborative advantage (CA). The third area relates to empirical contributions, in which research analysis can be conducted to extend and verify the integrated effect of supply chain collaboration (SCC) with collaborative advantage (CA) as a mediator. Managing the supply chain collaboration (SCC) will enhance organisational performance in project and finance performance. Lastly, future studies can also be conducted to replicate and test the proposed research model (Figure 1)

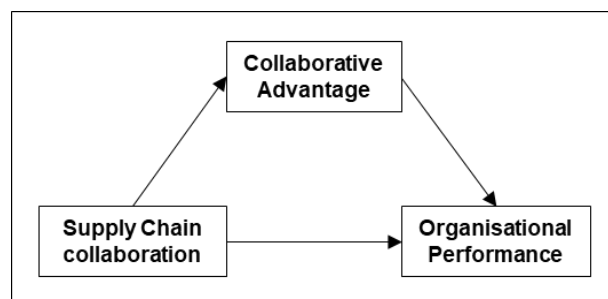


Figure 1. Proposed Research Model

CONCLUSION

The key findings based on a preliminary study were presented in this paper. This comprised validating the challenges and issues regarding the IBS implementation approach in the construction industry directed on the necessity and importance of supply chain collaboration (SCC) in the construction industry. The questionnaire's outcomes from the workshop validated that construction players need to collaborate to improve the issue and challenges in the supply chain (SC) concerning the IBS construction approach. This will indirectly assist in increasing the adoption or take-up of IBS implementation in Malaysia. IBS could be seen as one of the best options post-COVID19 by adopting new procurement methods, collaborative strategies, and creating new supply chain (SC) ecosystems. This will be driven by the construction industry's need to adopt an approach that utilises less labour with fewer workers to meet the needs of sustaining productivity levels with plants, along with mechanisation, automation, and faster completion. Moreover, to manage these new demands and technology, a novel supply chain (SC) ecosystem and strategic collaborations are needed to support the IBS initiative. In conclusion, the research conducted in this study was a preliminary review which will be supported by further research for developing the supply chain collaboration (SCC) framework amongst construction players in the IBS construction industry in Malaysia. This research's contributions will help provide further insights and understanding in this industry to key stakeholders and aid in developing plans and strategies in the future, including guidelines towards the effective implementation of IBS projects.

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DETERMINATION OF ROOT CAUSES IN INTERIOR DESIGN PROJECT DELIVERY

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Abstract.

Despite being a minor part in the architecture, it is still considering new to the industry, yet it is not new to us anymore. Besides, interior design is one of the key contributors to the country's economy. The interior project process is quite similar to architecture project process, which usually consists of three major phases; design – construction/installation – completion, in which practitioners are keen to implement projects successfully. Unfortunately, it is very difficult and limited, where only a few have been identified from literature on the process and practice of interior design projects. Many literature references have been found on design, profession establishment and academic accreditation. But, thousands of interior projects have been carried out to meet the clients' desires. Interior designers carry out projects according to project needs, cases and scenarios. They also use their own methods, experiences, thinking and practices to deliver projects. These contribute to the various phases, processes and working systems that pose issues, effects and consequences for stakeholders, i.e. clients, project teams and designers themselves. This makes way to aim at determining the root causes interior designers practicing interior project delivery. The objectives are to identify the gaps of interior designers in managing interior project process. It is also intended to expose the factual complications or problems in the delivery of interior design projects. A qualitative approach was used in this studies, using semi-structured interviews to 17 interior project team members and stakeholders for 5 interior projects. The findings could be extended to varying future research on the practise of the implementation of interior design projects. Where, the gaps may be useful for future research, to helps clients, interior designers and projects' stakeholders, in minimizing job interruptions, clashing of works, coordination of work and any disputes.

Keywords: *Interior Design, interior design project practice, interior design project delivery, interior design scope of work*

INTRODUCTION

The world economy is moving slowly due to the explosion of the Covid19 pandemic, making people stay calm in their space. This situation may lay down their sensitivity to their space/s, so people may have an indirect interest in designing the interior spaces. Despite the fact that people have already begun to appreciate the beauty, function and comfort of their spaces. People with no basic knowledge and education in interior design have begun to dabble with colours, fabrics and finishes in their spaces, especially residential ones (Padula, 2014). That, however, is just a small part of the expertise of an interior designer.

The high demand on interior design projects in the industry may force the owner and designer to use the most appropriate delivery method for the projects. In the context of the requirements for interior design projects, the interior designers should carefully select and better analyse the types of delivery projects they can execute. The same method is used for

both interior design and architecture project delivery. However, depending on the owner's decision to choose the best method of project delivery for their project, with reference to the driving values of time, cost and quality, the delivery type of project somehow reflects the procurement and contract system. Traditionally, there are three sequences of the construction project delivery as planning, design and construction (McCarthy Holdings Inc., 2017).

Four types of interior projects normally exercised in Malaysia, namely new work, refurbishment, renovation and conservation. There are four types of interior design work entries for new works:

1. Interior designer that comes in together with an architect (the project manager) at the early stage of the project or at the initial stage;
2. Interior design work starts after design completed by architect;
3. Interior design work entry after architect complete design and starts construct building structures
4. Interior design works entry after building constructed.

This study is narrowing to conventional type of project, though design and build is getting popular in Malaysia practice. Procurement as a merging of activities commenced by the client of the project, with major concerns of finishing the project on time, being cost effective and having high quality in terms of both design and construction (Slideserve.com, 2021).

There are many architects nowadays do interior works. As such, the questions may arise; how intense for architects to do such a detailed job while simultaneously handling other bigger jobs? What are the differences between an interior designer and an architect? Obviously the scope of work is a bit different, yet they are still related to each other. This has been said that, there are sets of standards for any respective discipline which becomes the backbone of any profession. Additionally, that knowledge is known to be systematically exercised through improvising with the current state that includes the architecture and construction industries. Architects and other professionals in the construction industry are struggling in their attempt to work as a team in the successful delivery of projects (Robson, Caldwell, and Reynolds, 1996), thus the interior designer must be incorporating with the design team while being equally and effectively responsible to portray a client's preferred spatial identity. The needs of integration of consultants' involvements from various angles in interior design project are also important in helping managing client's time and cost (Ismail, 2018).

By carrying a client's mandate, the roles and tasks of an interior designer in producing a client's corporate image and identity becomes important for the identification of the building's interior (Mustapha, 2019). Interior designer is responsible for highly creative designs for a functional space, by having a clear understanding of the technical requirements of projects, acquiring soft skills and management strategies (ProCure21+, 2010) which by then, they can be referred to as a 'Master of Space' (Mustapha, 2013; 2011).

LITERATURE REVIEW

The increasing demands of interior design projects in this country, makes the architects claim they can do interior design works too. The scope of work between those two disciplines is obviously different, yet they are still related to each other. Interior design is only a partial of architecture and is categorized as a sub-sector of the construction industry. Therefore, a standard work process and scope of work (SOW) for any respective disciplines becomes the backbone for any profession. And those standards are unique, regarding to the knowledge upon which each profession is built (Birdsong and Lawlor, 2001).

Both interior designers and architects are grounded in similar fundamental training and education, knowledge and skills (Mustapha, 2019). The difference lies with the fact that architects are trained with structural knowledge, shell aesthetics and many more. Whereas, interior designers are trained with the interior of enclosed spaces, solving spatial problems to the needs of the client without neglecting the technical and technicality needs of the spaces, and both disciplines equipped with its own professional practice and project management knowledge. However, by these close similarity, tend to produce overlapping of works, as well there were always disputed cases and variation orders (v.o). Table 1 explains on the priority of needs and skills required for an interior designer (A. Norhani, 2017), when working in a fragmented industry.

Table 1. Three Needs and Skills for Interior Designer

Needs and Skills of Interior Designers	Description
Artistic and Technical Requirements	Execute planning of space and communicate very well in paper and verbally to client. Expert in selecting choice of materials and products to be used in creating and furnishing of spaces wisely. Understand the structural requirements of space layout, health and safety issues, building codes and by Laws, and mechanical and electrical, plumbing and sanitary, and many other technical aspects.
Interpersonal Communication	Comfortable meeting and dealing with many kinds of people and professionals. Communicate clearly and effectively, as well as be attentive listener. Working with architects, contractors, mechanical and electrical engineer, plumbing designer, and client, interior designer shall be good as team players. Negotiate and mediate when necessary to solve problems.
Management Strategies	Excellent time and project management abilities since them frequently work on more than one project at a time under demanding deadlines. Understand business planning, selling ideas, creative and informative, and persuasive proposals and presentations, ability in maintaining good relationship with client and other team players. Able to commit to construction project management in planning and scheduling, coordination and control of a project merely interior project from inception to completion aimed at meeting a client's requirements, in order to produce a functionally and financially viable project that to be completed within time, cost and quality authorized off. (Project Management Hut, 2008).

(Source: A. Noorhani, 2017)

Agreed by a Malaysian architect from the preliminary survey, interior design job scope is much more sensitive to the client's needs (Mustapha, 2019). The context of his explanation, he stressed on the capabilities of interior designer interpreting client's needs into stylish quality spaces, matching to the client's exact identity. Interior design project practice executes the same fragmented work process and are related to multi-discipline work types. This is where the needs of a clear and comprehensive scope of work is desired. Compiling to that, Bodies of Knowledge have been established for every disciplines.

The Body of Knowledge of Interior Design (IDBOK, 2010) pinned 65 Elements in six Knowledge Areas, for a guideline. The Project Management Body of Knowledge (PMBOK, 2017) registered five basic work stages and processes with ten Knowledge Areas. Including project initiation, planning, execution, monitoring and controlling as well as closing. While, Royal Institute of British Architect (RIBA, 2020) Plan of Work 2020 (PoW) organises process of briefing, designing, constructing, and operating building projects into eight stages of project delivery. Therefore, the needs of clarity and established scope of work is important (Spool, 2004) to minimise the problems, clear concise of coordination, smooth project delivery, within time, quality and cost.

METHODOLOGY AND RESULTS

Semi-structured interview was conducted for this paper, as an exploratory research, however is relevant when there was scant of information (QuestionPro, 2020). This exploratory preliminary method was used after having shortened of secondary data on interior design project delivery practice. The interviews were executed with the two questions developed as mentioned in the aim and objectives section. The sessions were conducted to five interior projects with the team players, two were using snowball technique and three were randomly selected. The selected interior projects, two was at the final stage of construction/installation, three were newly completed, involves of residential, offices, hospital and post office.

However, the interviews to the team players from five projects were not in complete circles. The team players for small interior projects were normally inclusive of interior designer, contractor, suppliers, carpenter and sometimes an artisan. However, the sub-project players like supplier, carpenter and artisan were not counted for the survey. Whilst, the team players for the bigger project are usually involving the complete scheme of project team. The interviews were upon five architects, a quantity surveyor for interior works, two interior contractors, two construction manager, an M&E engineer, a client representative, five interior designers including an interior project manager and a resident interior designer. The interviews were taken in different day, time, place and duration, in Klang Valley. The interviews were recorded, and verbatim analyzed. This is the method of exploring focal phenomenon (Creswell and Clark, 2009) to be identified at the early stage in qualitative research.

DISCUSSION

Data from the exploratory survey is presented from the beginning of this paper as an analysis of the data collected. The survey was executed to audition the preliminary findings based on the observations from the literature study.

Exploratory Survey by Semi-Structured Interview

The exploratory preliminary survey was resulted amongst seventeen respondents were totally agree there were huge case of problems happened in interior project delivery practice in Klang Valley, Malaysia. Thirteen issues were questioned and amongst those, issue on the interior design scope of work were the most frequently answered by the respondents, and those who answered were not from interior designer. The second highly mentioned was on the project management knowledge amongst interior designers. From the literature, it was found that only issues on education syllabus, accreditation and training as well as design were frequently discussed.

From the literature review found that not many writers and researchers had written on professional practice or projects case or project management in interior design area. However, a classification and theme, upon possible problems/issues were tabled into thirteen significant themes (Table 2). The number in the box indicates the ratings of the issues. Scope of work, knowledge on technical and project management (in the blue dotted circle) seems to be the primary sources of gaps determined from the industry's current situation. Compared to the literature sources, they more focus on the design theme and none in from the industry (in the green dotted circle) because the survey was on interior works.

However, the education theme on the syllabus, accreditation and training is quite high. The concentration to education theme has also highlighted from the industry's view. This is shows that (Table 2) the needs of knowledge, skills and training are prior for interior designer. Interior designer needs to make and urge increment knowledge on 'soft elements' (interior project management and strategies) and the crucial of clarity of scope of works as the initiatives to be proved in this study.

While, Table 3 shows the extraction of the answers from the interview, which focussing on clashing scope of work, interior design scope of work (SOW), interior design project management knowledge and problems facing by each other in the team. The highest issues found were clashing of work, interior design scope of work and project management knowledge. Eleven times were responded for interior design scope of work, which inclusive the extraction on:

- | | |
|---|--|
| 1. Lacking on the understanding of interior design scope of work. | 14. Stressful consultation and documentation. |
| 2. Confusion on scope of work between architect and interior designer towards a space given. | 15. The important of SOW |
| 3. Interior design scope of work not clearly stated. | 16. Poor understanding on integration of work with other consultants |
| 4. Scope of work was not clearly stated in the contract. | 17. Clash of SOW in design and implementation |
| 5. Problems in scope of work in terms of participation and coordination. | 18. Poor understanding of coordination |
| 6. Lack of project manager's knowledge in design. | |
| 7. Problems in communication hierarchy and level. | |
| 8. Contradiction of scope of work between interior designer and architect. | |
| 9. The clash of architect's scope of work and interior designer's scope work in the contract. | |
| 10. Unclear SOW, no guide in doing PM | |
| 11. Clashing of work scope did not know to management project. | |
| 12. Unclear work scope and happened taking other's work. | |
| 13. Only depending SOW states in the contract. | |

Table 2. Literature Review versus Exploratory Interview from Experts; Matrix of Industry Issues and Interior Design Research Issues

No.	Interior Design Research Issues	From Literatures	From Design Research Issues												
			Scope of Work	Project Management	Technical Knowledge	Negotiation	Coordination	Communication	Teamwork	Integration	Integrated Technology	Education – syllabus, accreditation	Design Issue	Professionalism	Book of Knowledge
From Practice															
1	Scope of Work		9	-											
2	Project Management			2	8										
3	Technical Knowledge				7	-									
4	Negotiation					2	-								
5	Coordination						5	-							
6	Communication							1	5						
7	Teamwork								1	3					
8	Integration									4	-				
9	Integrated Technology System										3	-			
10	Education – syllabus, accreditation, Training											12	3		
11	Design Issue												3	1	
12	Professionalism													7	2
13	Book of Knowledge														4

Table 3. Analysis Summary by Interview

Main issues and problems		Extraction from the respondent	Respondent
1	Clashing of scope of work	<ul style="list-style-type: none"> • Unclear SOW, no guide in doing PM • Clashing of work scope did not know to management project. • Unclear work scope and happened taking other's work. • Only depending SOW states in the contract. • Stressful consultation and documentation. • The important of SOW • Poor understanding on integration of work with other consultants • Clash scope of work in design and implementation • Poor understanding of coordination • Lacking on the understanding of interior design scope of work. • Confusion on SOW between architect and interior designer towards a space given. • Interior design SOW not clearly stated. • SOW was not clearly stated in the contract. • Problems in SOW in terms of participation and coordination. • Lack of project manager's knowledge in design. • Problems in communication hierarchy and level. • Contradiction of scope of work between interior designer and architect. • The clash of architect's SOW and interior designer's SOW in the contract. 	1, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16
			11 nos
2	Problems with contractors	<ul style="list-style-type: none"> • Lacking of contractor's responsibilities on the project. • Contractor refused to follow the instructions from interior designers. • Lacking of the contractor's integrity towards a project. • Lacking of the contractor's commitment towards a project. • Lacking of the interior designer's trust • Lacking of materials knowledge among contractors. • Lacking of the contractors knowledge in construction. 	4, 5, 14, 12, 6, 13
			6 nos
3	Problems in roles and responsibility by interior designer	<ul style="list-style-type: none"> • Lacking in project management's knowledge and skills. • Lacking of knowledge in construction phase. • Lack of knowledge in project management • No field exposure to the some of the interior designers • Inexperience 	2, 4, 6, 14
			4 nos
4	Problems in managing project	<ul style="list-style-type: none"> • Lack of knowledge on project management • Ignoring of others' work specifications • Act of ignorant of own weakness, while giving excuses • Do not know how to manage project principally 	1, 6, 10, 11, 12, 14, 15, 16
			8 nos
5	Problems with clients	<ul style="list-style-type: none"> • Wrong perception of client towards a task by interior designer. • Contradiction on design with interior designer. • Variation and changes caused by client during construction phase. • Problems with client's budget. • Problems with demanding client • Lacking trust in making decision by the interior designers • Lack of communication on site. 	1, 3, 4, 5, 14
			5 nos
6	Problems with architects	<ul style="list-style-type: none"> • Double counting from architect and interior designer. • Wrongful communication • Go beyond architect's work specifications • Clash of work scope with architect. • Redundant of work. 	7, 8, 10

	Main issues and problems	Extraction from the respondent	Respondent
			3 nos
7	Problems in technical knowledge and understanding towards other experts' work scope	<ul style="list-style-type: none"> • Ignorant of others' work related to interior of spaces • Lack of quantity and cost contract knowledge 	7, 10, 11, 12, 13, 14, 17
			7 nos

The second highest is problems in managing project, which is eight respondents respond to the issue. The respondents (amongst the interior project team players) were asked on the managing interior project, it happened that the interior designers (respondents) admitted they can manage the project given smoothly. While, the contradiction (from similar question) from the other players of the named project, answered oppositely, as stated:

1. Lack of knowledge on project management
2. Ignoring of others' work specifications
3. Act of ignorant of own weakness, while giving excuses
4. Do not know how to manage project principally

CONCLUSION

As for the conclusion, there are gaps in interior design practice especially in project delivery practice definitely that needs to be explored in many ways. This study discloses for the crucial needs of guideline in managing interior design project. This paper may be used to gives opportunity to help in filling the gaps or issues, as to improvise the quality of project delivery process.

Briefly, it can be summarized that there was a huge gap of research area of interior design project delivery practice. Interior works are sometimes being wrongly interpreted by people for merely a decoration work. Although interior design has been practiced many years before, hence it is still considering as a new bud in the construction industry. In Malaysia, there were two interior design organizations amalgamated into one (Malaysian Institute of Interior Design), emerged and regulated under the Architect Acts 1957 in 2016. This proves that the industry is structuring and enhancing for the establishment in the Malaysian construction industry players. Therefore, the inauguration of interior design project delivery practice is becoming essential tool and standard for the interior design practitioners.

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EMPLOYABILITY FORECAST FROM PERSPECTIVE OF CONSTRUCTION INDUSTRY

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Abstract

The tertiary in education institutions in Malaysia are facing increasing demands from employers and stakeholders to equip graduates with relevant skillset needed by the current organizations. This paper aims to identify employers' perspective skills required to help graduates to forecast on the employability by referring to five (5) selected field of employment from developer, contractor, consultant, supplier and entrepreneur which consume of 57 (38%) respondents in total from 150 questionnaires distributed. An exploratory factor analysis (EFA) conducted using five (5) main categories of courses on knowledge skills. The finding indicates project management, measurement and estimating and legal study knowledge required in handling a construction. This finding, able to facilitate in closing the gap between graduates' skills and employers' requirements, by presenting the forecast employability of construction management students through promoting student learning and development focusing on skills related. It also, provides a significance implication to educational institutions to enhance the program according aligning to the needs of the industry with an appropriate guidance platform to the future graduates.

Keywords: *employability, forecast, graduates, employer*

INTRODUCTION

The Construction Industry sector is known to be fundamentally uncertain and structurally complex (Hasan, Ahamad, & Mohamed, 2011) influence on the economy of a country. The important roles of construction industry are developing socioeconomic, improving life quality, and helping a country to be successful in a globally competitive market. It indicates that the construction industry can give people, including fresh students, more opportunities for work in the sector. It aligned with the role of higher education institutions to produce eligible graduates to meet domestic development and employer needs. The ability for graduates to be absorbed by the industrial world after graduated is a critical component reflects to the accomplishment of the program commences attended by the graduates with the specific duration. Hence, in Malaysia, more universities at higher education system are offering similar programs related to construction industry to satisfy the market workforce demand (Alastair, 2016) with highly trained and skills for graduate's marketability (Hasan et al, 2011). The aims of this study explore the main area of courses to assist the future graduates forecast on the employability based on the perspective of the employer reflected from the five (5) main field of employment which consist of developer, contractor, consultant, supplier and entrepreneur using the Bachelor of Construction Management program as the content of the study.

LITERATURE REVIEW

Bernama by Rosman (2019) mention that Construction Industry Development Board Malaysia (CIDB) stated construction sector in Malaysia remains as the economic driving force for the country. It was highlighted in the budget 2020 on the allocation for infrastructure and social services construction and maintenance grants. Hence, in Malaysia, higher education system is offering more courses which is related to construction industry to satisfy the market workforce demand (Alastair, 2016). However, the economic growth is not providing enough number of jobs as number of graduates keep increasing which contribute to the increase rate of unemployment among fresh graduates (Cleveland et al., 2013 & Menon et al., 2012). Issues of unemployment graduates is varied globally including Malaysia as the numbers increased 5.5 between 2019 and 2018 which contributed to 170.3 thousand unemployed graduates (Leo.M, 2019). The truth, being a university graduate no longer guarantees for a job.

Therefore, university should be able to formulate a competitive future graduate to increase higher possibility of employability referring to the expectation of the working industry. Yorke and Knight (2004) stated that employability is a set of achievements consist of skills, understandings and personal attributes that make graduates more likely to gain employment and be successful in their chosen occupations, which benefits themselves, the workforce, the community, and the economy. Employability refer to 'work readiness', that is, possession of the skills, knowledge, attitudes and commercial understanding that will enable new graduates to make productive contributions to organizational objectives soon after commencing employment (Mason, Williams & Cranmer, 2006). Connection with employers while at school through work experience, career days, mentoring, as well as other activities improves the job prospects and earning potential of the young people once they leave their education. It is strongly aligned with the academic valuing of good learning (Yorke,2006).

Furthermore, it states that employability is as a collection of capacities or achievements which constitute a necessary and is strongly aligned with the academic valuing of good learning (Yorke,2006). For that reason, future graduate should be equipped with three (3) types of skills to be successful in the job occupational skills, employability skills and basic academic skills (Bailey, 2003). It is supported by Chhinzer & Russo (2018) which indicates employers expect graduates to have professional maturity and soft skills (problem solving, continuous learning and academic achievement) as well as sufficient generic skills.

Bachelor of Construction Management of Faculty Architecture, Planning and Surveying UiTM program prepared graduates to be employed in construction industry and it was used as basic references for this study to evaluate the expectation from the perspective of employers. The two (2) years program consist of 33 courses segregated precisely within five (5) main area consist of Management, Construction Technology, Building Science and Services, Quantities and Estimating, and Legal Study in addition each of the courses integrate excellently with related seven (7) soft skills as listed by Ministry of Higher Education (MoHE) to reflects the outcome of the program. Moreover, the program created by incorporating the feedback from employers of construction industry to ensure the future graduate a competitive to suit the required expectation for the employment fields. However, it led to differences expectation based on skills, and qualities required from the perspective of employer (Baharun and Suleiman, 2009).

For that reason, this study is significant to facilitate in closing the gap between graduates' skills and employers' requirements, by presenting the forecast employability of construction management students through promoting student learning and development. Besides, it

provides a significance implication to educational institutions to enhance the program aligned with the needs of the industry as well as having an appropriate guidance platform to the future graduates to forecast on the respective field of construction employment based on their personal preference.

METHODOLOGY

This research focuses on the employability forecast among construction management graduates from the perspective of employer. To achieve this, a quantitative approach to the data collection process. The study consisted of a series of well-structured questionnaires on the five (5) specific main area of courses that is required for a construction management student to be employed based on the five (5) field of construction employment which are developer, contractor, consultant, supplier, and entrepreneur related to constructions. The questionnaires consist of two sections demographic specifications and analyzing the specific main area of courses.

Åkerblad (2020) stated that, theories are essential in the development of questionnaires to guide data collection and analysis of findings to address the research objective. In fact, each section of the questionnaires has been structured and classified to respond to each study objective. Part A identify with demographic data on the work experience, qualifications, achievements, and skills. Part B analyzing the specific main area of courses of employability to achieve the first objective.

The site study focusses on the five different (5) filed of employability among Construction management graduates which are developer, contractor, consultant, supplier and entrepreneur related to constructions. This study applies both on-site and on-line surveys for the distribution of questionnaires. An online survey is one of the most popular sources of data collection, where a set of survey questions are sent to the target sample. Respondents receive online surveys through various media such as email, embedded websites, social media and other related social media platforms. As a result, this study used the google form survey as the main survey tools for data collection as it is easily analyzed and answered the research questions.

RESULTS AND DISCUSSION

The first section (Part A) of this questionnaire gives information about the demographic profiles of the respondents. The second section which is (Part B) is the main are of courses offered in the program required to be employed to addresses first objective.



Figure 1. The information of the respondents.

57 respondents in total able to be capture after more than 150 questionnaires was distributed both on-site and on-line surveys at each of the five (5) main field of employment in the construction industry which include of developer, contractor, consultant, supplier and entrepreneur related to constructions. Although the huge respondent was from the field of consultants, the different percentage of kept low making the percentage of respondent distribution was equally distributed. 56% (32 respondents) has more than 5 years of working experience in the construction industry and involved within 1-10 million of construction cost. Therefore, the information gain from the respondents is very much reliable to ensure the objective of the study achieved.

The main area of courses offered in the program required for the employability.

Table 1. The significance of courses required among Construction Management graduates based on Various field of employment.

			Developer	Contractor	Consultants	Supplier	Construction Entrepreneurs	Ranking
THE 5 MAIN AREA COURSES OFFERED IN THE PROGRAM (HARDSKILLS)	HS1	Project Management	5.00	4.40	4.07	4.50	4.60	1
		Construction System & Analysis	4.36	4.20	3.71	4.10	4.00	
		Project Planning & Control	4.36	4.00	4.21	3.90	4.20	
		Project Evaluation & Development	4.36	4.40	4.07	4.30	4.50	
	HS 2	Construction Technology	4.76	4.33	4.19	4.25	4.37	3
		Site Surveying	4.45	4.00	3.86	4.10	4.00	
		Structures	4.36	4.20	3.93	4.20	3.80	
	HS3	Building Services	4.55	4.25	4.11	4.25	4.10	5
		Environmental Science & Engineering	4.55	3.85	3.54	3.70	3.45	
	HS4	Measurement & Estimating	4.64	4.40	3.98	4.37	4.57	2
		Construction Economy	4.73	4.05	3.75	4.10	3.80	
	HS5	Legal Study	4.73	4.30	3.96	4.35	4.50	4

Source: (FNM Yussof, 2019)

The analyzation to hard skill is categorized into HS1, HS2, HS3, HS4 and HS5 in order to determinants the employability forecast among construction management graduates from the perspective of employer are based on varies field of work inclusive of developer, contractor, consultant, supplier and entrepreneur related to constructions area.

Developer

As the data gained from 11 respondents from the developers, three core area within HS1, HS2 and HS4 which consist of project management, construction technology and construction economy subjects. These courses are important as they are particularly important for the graduates to know in the fundamental view to work in developing a project. Furthermore, a good understanding of managing a project, able to capture the fundamental of construction knowledge as well as the ability to forecast on the pattern of economic construction are the fundamental expectation from the Developer's perspective.

Contractors

Based on the 11 respondents from contractors, the hard skills that are most critical in their perspective views covered within the area of HS1 and HS4 which are project management, project evaluation & development and measurement & estimating courses. This indicates that, good managing skills in a project, the ability to comprehend the process of evaluating and developing as well as estimating a project cost in tendering process are crucial in the employment in the contractor's field.

Consultants

Referring to major respondents of consultant organizations (15), the core skill required are HS1, HS2 and HS3 they required the most by them are project planning & control, construction and building services subjects. Those subjects are important for this organization to plan a good consultation and designing related to a particular project. In addition, by having a fundamental of technology of construction and building services will be additional value in the consultant's field.

Suppliers

As 10 numbers of respondents, the mean score shows that most of the respondents from suppliers highlighted the core of HS1, HS4 and HS5 which consist of project management, measurement & estimating and legal study subjects are important for that organization. This might be due to the nature of the working needs as purchasing material and quotation estimation regard to the bill of quantities for the project as well as having basic legal knowledge when dealing with project agreements.

Construction Entrepreneurs

Based on the 10 respondents of entrepreneurs related to construction field. The core area is remained within HS1 and HS4. They project management and project evaluation & development was highlighted again as well as measurement & estimating course. It is important for a graduate to have basic knowledge in estimating the cost and the process involved aligning toward to nature of the business itself as it is based on profitable approach.

CONCLUSION

The significant criteria on both hard skill and soft skill of employability among construction management graduates was captured from the perspective views of construction industry. It aims to understand the quality and criteria of employability from five (5) different field of employment within the construction industry. Although all five (5) main area of

courses learned in the programme is important, the most critical hard skill that need to be obtained by any construction management graduates is project management skills as it consists the essential knowledge in managing a project regardless the field of employment the graduates will attempt. By having the employment forecast, the graduates will have a good understanding toward the nature of expectations based on employment field required from the day upon registration occurred. It can be accomplished by having appropriate exposure through applicable industrial linkages between university and the related field of employment. It is important to ensure the program is currently aligned with the needs of the construction industry. Eventually it helps the graduate to forecast by having proper guidance on which field of employment they intend to pursue upon graduation based on their interest and preference. Graduates without a proper guidance is far from achieving employment.

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