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Journal Objectives

International Surveying Research Journal (ISrJ) is an international journal dedicated to the publication of theoretical and empirical refereed articles, case studies or critical literature surveys in the field of surveying research and policy. The scope of the journal is international in two aspects: it presents to a worldwide readership a view of the surveying practices of particular countries, and it encourages knowledge sharing among researchers, policy makers and practitioners.

The purpose of the **International Surveying Research Journal (ISrJ)** serves to provide a forum for discussion and research to keep abreast of the new technologies developments and to stimulate research in the various surveying disciplines.

Journal Content

Editor Message

Welcome to this International Surveyor Journal (ISrJ) Vol. 1, Issue June 2021 for the Royal Institution of Surveyors Malaysia (RISM).

This Journal gathers publication of all four divisions in RISM namely Quantity Surveying (QS), Property Surveying (PS), Geomatic and Land Surveying (GLS), and Building Surveying (BS). The publication of ISrJ gives opportunity to the academicians, practitioners as well as students to share their research outcome. There is a vast area of coverage within these four divisions waiting to be explored.

This particular issue consists of five selected papers reviewed by the editorial committee and international experts which include conservation process, health and safety in MRT construction, time overrun, carbon emission and innovation adoption in construction.

Sr Wan Ainon Zuraiha W A Khalid
Editor
June 2021

The Conservation Process Involved in The Restoration Of Bas-Relief And Mural of Sultan Suleiman Royal Mosque in Klang, Malaysia

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Abstract
This research aims to identify the conservation process involved in the restoration works of bas-reliefs and murals in the Sultan Suleiman Royal Mosque located in Klang, Selangor, Malaysia. Inductive research approach was employed on a single case study research strategy and this cross-sectional study was conducted in November 2017. Data collection method includes semi-structured interview and document review. The result revealed three phases of conservation process involved which are pre-conservation, during conservation and post-conservation stages. As a conclusion, the problems encountered during the conservation process can be categorised into two, technical and environmental factors. These issues can be overcome by allocating a clause in the contact extension on conditions for time and provision for comprehensive documentation of the conservation process involved for future reference.

Keywords: Heritage mosque; conservation process; restoration; bas-relief; mural

Introduction

Most of the mosques built during the colonial period are architecturally different from the vernacular mosques in terms of scale and proportion, form, features and building materials. Domes (either onion-shaped or top-shaped), turrets, classical columns, pilasters, pointed arches, keystones, pediments and plastered renderings on cornices and capitals are common features found in the colonial mosques. This is due to the appointed British architects who had combined the Moorish influence and the classical styles to represent the new image of mosques. Rather than a mosque, the building depicts a public building commonly built in the 17th and 18th century.

Generally, scholars and academicians categorized the architectural styles of the mosques built during the colonization into non-traditional roof feature with influence from Mogul, European Classical and North Indian architecture (Nasir, 1984 and Rasdi, 2007). As an example, a distinctive colonial architectural style which can be found in Sultan Suleiman Royal Mosque in Klang, Selangor. It is probably the only mosque in Malaysia that featured Art Deco and Neoclassical style that emulated cathedral design into the entire mosque design (Aziz, 2016). Among the design articulation elements of this mosque is the bas-relief and mural as decorations on the wall, arches, ceilings and dome. However, through the test of time, these elements have been dilapidated and faded. In 2012, this building was gazette as a national heritage (Aziz, 2016). For purpose of restoring these decorative elements, an effort to conserve the bas-reliefs and murals began in March 2015 and completed in October 2017. The project duration was 32 months which included three requests for extension of time and the total project cost of RM 12 million (approx. USD 3 million).

Bas relief (in French) or 'basso-relievo' (in Italian) means low relief. It is actually a sculpture technique in which figures and/or other design elements are just barely more prominent than the (overall flat) background. Bas relief is created either by carving away material (wood, stone, ivory, jade, etc.) or adding material to the top of an otherwise smooth surface such as strips of clay to stone (Esaak, 2017). Meanwhile, mural is a painting applied to and made integral with the surface of a wall or ceiling. It may also include painting on fired tiles or mosaic decoration which form part of the overall scheme of painting (Britannica).

The main purpose of this study is to determine the conservation work process involved in the restoration of the bas-relief and mural of Sultan Suleiman Royal Mosque in Klang. Secondly, this research also revealed the problems and issues encountered during conservation work which may be used as a guide for future conservation works on similar decorative design elements.

Literature Review

Various scholars have described building conservation as the action, the management, the refurbishment works, the restoration works, the repairing work as well as the processes involved to avoid, to prevent and to safeguard buildings or structures from decay and if possible, restore and preserve historical monuments as cultural heritage (Fieden, 2003; Burden, 2004; Othman, 2006; Hamsah, 2006; PERZIM, 2006). Another popular definition of building conservation is by the Australian ICOMOS known as the Burra Charter as displayed in Table 1.

Table 1: Definition of types of building conservation (Harun, 2010)

Conservation concepts	Explanation
Conservation	The work of repairing the building's condition using materials is almost as same as the first time the building was built.
Restoration	Repairing works by maintaining the authenticity of the architecture and its material to a certain time as it is suitable or as good as the original and subsequently to the original use.
Reconstruction	Reconstruction is done on a building that has been destroyed due to human and environmental factors. The construction uses original materials and techniques in their original form.
Preservation	Works to ensure that a place is in its original state and prevented from any obstruction or damage.

Fielden (2000) argues that if a building had survived at least 100 years of age, it should be given the title of a historical building. In Malaysia, most of the buildings that had been listed as heritage buildings are built between the year 1800 and 1900. An inventory survey on heritage buildings in

Malaysia conducted by the National Museum in 1992, estimated a total of more than 35,000 pre-war buildings inside 265 cities that had been studied (Idid, 1995).

The conservation activities for old mosque were started around 1990's. In those years, tourism industry had seen as a promising economic contributor to the nation. Among the mosques that has already through for conservation works are the Old Mosque of Jalan Batu Uban, Penang, Kampung Jenang Mosque and Kampung Gagu Mosque in Negeri Sembilan, Old Tinggi Mosque in Bagan Serai, Perak, which are recognized by the uniqueness of their architectural heritage.

Meanwhile, among the basic principles of conservation of a UNESCO heritage building is as follows:

1. Minimize interventions such as overhaul only the structure and fabric of the damaged historic building while still good to be maintained in its authenticity.
2. Apply scientific research and laboratory tests to identify the content and nature of the building materials and the degree of damage. The results of scientific studies and laboratory tests can be used as proof of support in making any decisions on the conservation work to be done.
3. Carry out documentation activities on prior, current and post conservation work. This documentation is very important not only as a medium in decision making but also as a record and a reference material in the future.

Methodology

This is a full qualitative research design where the main methodology is a single case study and document reviews. Therefore, the unit of analysis was the selected mosque building namely Sultan Suleiman Royal Mosque in Klang, Selangor. Case study approach is employed as it enable to explore the interaction between the significant factors about the characteristics of the phenomenon being studied, which describes the conservation work on the bas-relief and murals carried out in Sultan Suleiman Royal Mosque. As suggested by Yin (2014), the use of case studies in qualitative research is appropriate when the main question of the study points to the question of how or why.

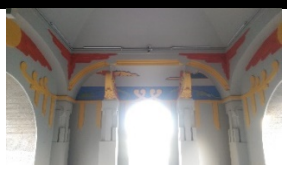
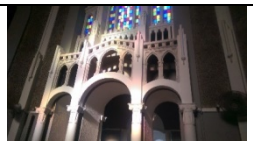
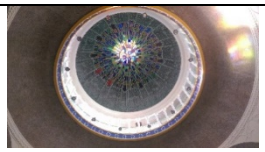
Prior to the interview, a pilot study was conducted with a respondent throughout November 2017 until December 2017. The purpose of the pilot study was to provide researchers with an initial exposure to this study. Pilot study will help researchers in gaining experience to manage semi-structured qualitative interviews and consultation agreements with respondent.

This research utilizes semi-structured interviews to obtain data on conservation work processes on bas-relief and mural. The interview was conducted in two series on a single respondent who was fully involved on the conservation process. He is a staff of the National Art Gallery who became the head of this conservation project and he oversaw every single process that had taken placed. The interview

was then recorded using smartphone's recorder apps and the interview transcripts was typed out in dialogue format. Data was then analysed using thematic analysis in order to categories the themes which represented the conservation process involved.

Besides interview, data was also gathered from document review of the technical report, published booklet as well as photographs which recorded and documented the conservation work process of the bas-relief and mural prepared by the National Art Gallery. Content Data was then analysed using content analysis in order to support and add up information forming the framework of conservation process involved. Table 2 displays the location of bas-relief and mural that had been restored and for which this research was carried out in order to document the process involved.

Table 2: The bas-relief and mural at Masjid Diraja Sultan Suleiman, Klang

Photo of the bas-relief	Location of the bas-relief in the building
	Decoration of arch above car porch
	Reredos in inside and outside of mosque entrance
	Mural at ring beam of dome
	Ceiling cornice in main praying hall (Trumpet shape)
	Main beam, internal bean and column in main praying hall
	The luminous trough
	Decoration on stilted arch

Result

Based on the data analysis, three stages of conservation process were involved in the restoration work of the bas-relief and mural. They are as follows.

1) Pre-conservation stage
2) During conservation stage
3) Post conservation stage.

The first process which is the pre-conservation stage involved four tasks, namely:

1) Site visit and observation,
2) Comprehensive report,
3) Quotation and,
4) Mock-up and treatment proposal.

Site visits and observations are made to identify the types of damage and bas-relief conditions. In this first process, it included colour sampling and data analysis to obtain relevant information in completing this conservation process. Even in the report, the condition also stated about the types of damage and cause of damage occurred. The result of the document review indicated that this mural was completely covered with paint layer and partly with new lime and cement. The current condition of the survey was found to have mechanical damage such as tap and hole effects. Some of the bas-reliefs also broke and disappeared. There is also the effect of dirt from dust, dust, animal fences, insect nests and fine fractures.

The results of the site visit and observation will be included in the comprehensive report and given to National Heritage Department. Comprehensive report recorded all the findings in site visits and observation to facilitate the process of conservation. National Art Gallery also provided quotation for a bas-relief and mural conservation project and provided to National Heritage Department. The quotation helped to assume the total cost of bas-relief and mural conservation project. The quotation of this project is made refer to the information and data obtained during site visits.

Mock-up and treatment proposal were the process that showed and presented to all the parties involved in this project about how the treatment will be going on. Mock-up means a simulation for the treatment process on the murals thoroughly, before the onset of the actual treatment process. Mock-up helped to convince the parties involved in the project about the methods and techniques of treatment to be carried out. The treatment proposal aimed at identifying and providing a guideline involving the method of conservation work to be carried out in actual. This treatment proposal also involves the selection of materials to be used in the conservation work. Indirectly, what can be assumed, this treatment proposal helped and facilitated conservation work when carried out as it has been thoroughly described.

The second stage is during conservation stage, which explained on conservation works. After the process, conservation work began in late October 2016 until April 2017. The conservation work took about 6 months. The first stage, the preliminary stage has an interrelated relationship with this stage. All the conservation processes to be carried out, need to refer and followed the process which already set out. The process is called as a treatment proposal, where this process will provide guidelines on how to work in the actual way. All methods of conservation, selection of materials and so on have been specified in the treatment proposal. All conservation work needed to be linked and referred again in the first stage. The methods or techniques used in this conservation project are the latest and current developments. The content analysis of the documents revealed four processes during conservation work, namely:

1) Documentation and technical check-up,
2) Curative conservation,
3) Preventive conservation and,
4) Progress report.

The last stage is post conservation stage, where this stage elaborated on how the precaution method after the completion of this conservation project. There are two processes in this stage:

1) Final presentation and,
2) Precaution method.

After having completed the last process of conservation work, they made a presentation about what they had done. This presentation is dedicated to Public Works Department (JKR), parties from Palace, National Heritage Department, Selangor Islamic Department (JAIS) and any parties involved in this conservation work. It has been stated where they described the processes involved in the conservation work and demonstrated the outcome of the treatment performed as well as the bas-relief and mural conditions after treatment. They showed bas-relief and murals by visual and reality (site visit). They also explained the precaution method to keep bas-relief and mural in the future.

The precaution method of bas-relief and mural was set after the completion of the mock-up process. The mock up process was able to see the extent of the effectiveness of the treatment and from that precaution method could be set. For the precaution method of bas-relief and mural, National Art Gallery recommended to the management of the mosque about how to prevent it. This precaution method can have helped to maintain the origin of the colour and shape of the bas-relief itself. The National Art Gallery also suggested to the management of the mosque to report to them in the event of any problems with bus-relief and murals, such as repeated damage or unexpected damage.

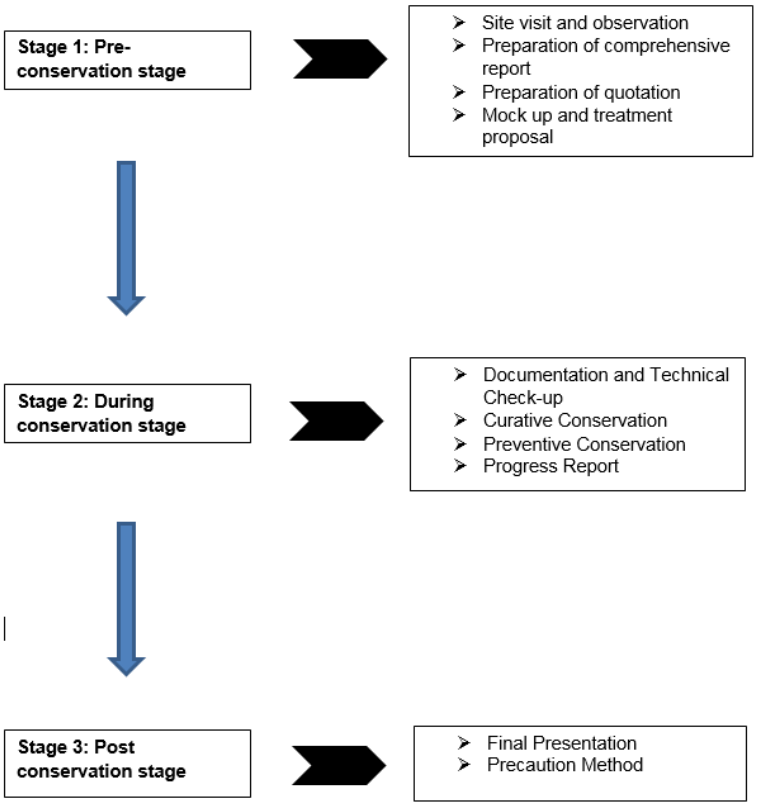


Figure 1: The process of restoration work on bas-relief and mural of Sultan Suleiman Royal Mosque.

Discussions

The issues identified related to the restoration of bas-relief and mural of Sultan Suleiman Royal Mosque are as follows:

1. time constraint for conservation work and,
2. lack of previous documentations.

Time constraints stressed the conservator. This is due to the immediate treatment process or the second treatment for solving new problems in the bas-relief and murals. Sometimes, the second treatment had somehow interfered with other conservation work, which had been set on a scheduled basis. They need to achieve the predetermined time as had been set before the process of conservation started. To achieve that time, they need to complete the bas-relief and mural conservation work as well as possible. However, conservation work needs to be done with careful and much detail, so it will put pressure to the conservator.

Lack of references in form of previous documentation is among the major issues in the conservation process as they lacked information and references of records or documents on Sultan Suleiman Royal Mosque. This was experienced during the conservation process where the original colours of the bas-relief were unknown due to no past record. As a result, a complete restoration of the original colours of the bas-relief cannot be undertaken.

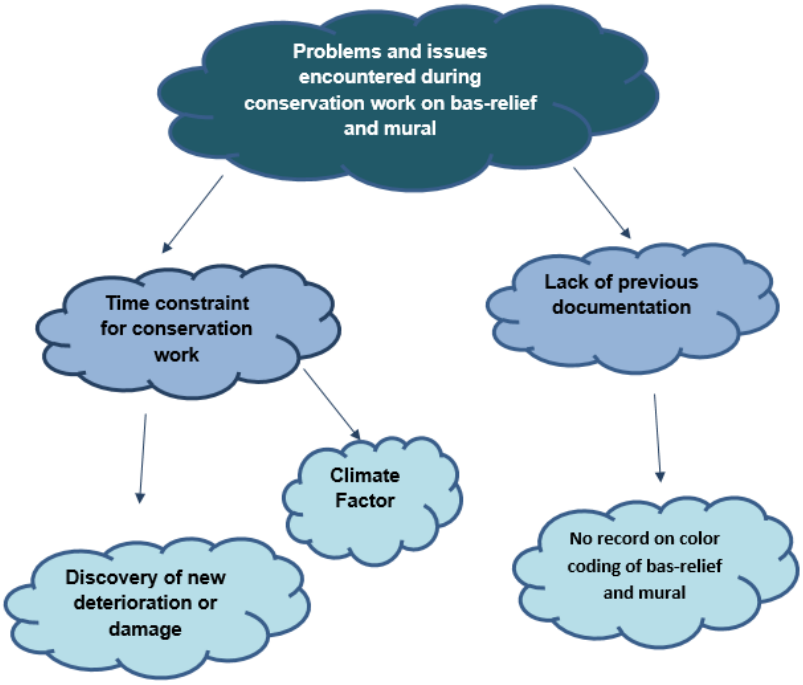


Figure 2: Issues encountered during conservation work on bas-relief and mural of Sultan Suleiman Royal Mosque

Conclusion

In summary, the Sultan Suleiman Royal Mosque Suleiman is a unique historic building, which completed its conservation work on 17 October 2017 and reopened on 2 November 2017. The architectural style of this mosque differs from others which identity is evident in the design articulation of bas-relief and mural that represent the influence of the era.

A few recommendations can be suggested for the purpose of facilitating future conservation work on bas-relief and mural in a heritage building. Based on the analysis, it is hope that information in form of a proper documentation on the conservation work carried out can be widely and easily disseminated among the community regardless of age, religion and race. This documentation aims to explain the process of conservation work and the importance of this project. Additionally, this project's documentation can tell the public why elements in this building are preserved and conserved as well as possible. Delivery of information to responsible parties was very important in this conservation work. Certain parties need to know what is in a building such as decorations, paintings or architecture of the building itself, because the objects are valuable and have their own history. This is important because the party should know what to do if there is a problem.

In order to address the climatic factor, contactors involved in conservation works should be well informed and well prepared to deal with this issue. The parties that involved in conservation work, need

to prepare well the information to solve the problem. Any action must be properly dealt with if the act involves any party. The conservationists need to have a good relationship with certain parties, to facilitate this process. If there is a problem in relation to the party, it will give rise to a problem, for example time delay in the conservation process. This becomes critical if the process is slowly resolved and will interfere with other parties in completing this conservation project.

Table 3: Recommendations to facilitate the conservation process on bas-relief and mural in heritage buildings in Malaysia.

No.	Problems and issues encountered during conservation work on bas-relief and mural	Solution and recommendation
1)	Time constraint during conservation work ➢ Carrying out the conservation work due to unforeseen circumference, like new deterioration found on bas-relief and mural ➢ Climate factor especially rain hinder conservation work on external element	• Conduct comprehensive site visit and observation in order to identify the potential deterioration. • Make a discussion with certain parties in the conservation project to solve problems that suddenly happen. • Knowledge and experience are important to handle any conservation work. • The information about conservation need to well prepared to face any unpredictable issues happen.
2)	Lack of previous documentation ➢ Lack of information colour coding for bas-relief and mural	• To practice documentation the project of conservation work on bas-relief and mural for future conservation references. • Any documentation about conservation work need to disseminate to the public.

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Operational Health and Safety in Malaysian MRT Construction: Flaws, Challenges and Solutions

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Abstract
The Malaysian MRT system was one of the most expensive projects by the government when it was introduced in 2011. Integrated into existing rail systems, the new lines will boost local tourism, turning the Greater Kuala Lumpur metropolitan area into a developed city. It is also expected to benefit the country economically. However, recent accidents at MRT construction sites raises the concern of health and safety standards on site, as well as the credibility of those who manage them. A detailed literature review has been conducted to establish the reasons behind the accidents, and how they were resolved. Health and safety standards in Malaysia will also reveal if the parties behind the MRT construction were lacking in their responsibilities. Questionnaires were sent out to MRT contractors to establish their views on existing flaws in the health and safety procedures. This study found that there was poor management on site, owing to poor construction culture; and more inspections and spot checks was the best way to improve the safety culture. This study also concluded that improving the construction culture is the first step towards improving the health and safety standard in MRT construction sites.

Key words: MRT, Construction, Accidents, Improving Health and Safety

Introduction

The MRT system is Malaysia's first mass rapid transit system when it was introduced by the Prime Minister, Datuk Seri Najib Tun Razak. Construction of the 3-line mass rapid transit system began in July 2011 and expected to be completed in 2017. It will cost around RM35 billion, becoming one of the most expensive projects in Malaysia (Kuala Lumpur Mass Rapid Transit, 2014; MRT Corp, 2013a; MRT Corp, 2013b). All three lines will be fully integrated with existing rail systems, shown in Figure 1, providing service to high density areas previously without rail systems.

Once completed, the new lines will increase the rail coverage in Kuala Lumpur from 15km per million citizens to 40km per million. This will help boost local tourism and transform the status of the Greater Kuala Lumpur metropolitan area into that of a developed city (KL MRT Information, 2014; MRT Corp, 2013a). The Sungai Buloh - Kajang line alone will serve a corridor of 1.2 million people, connecting them to the heart of Kuala Lumpur. A total of 58 trains on this line allows for a frequency of one train every 3.5 minutes during peak rush hour, with every train having a carrying capacity of 1,200 passengers. Carrying 20,000 passengers per hour per direction, the MRT system can transport up to 2 million passengers in a single day. The Malaysian government aims to have the MRT system cater for 50% of all the public transportation journey in Kuala Lumpur.

The MRT system will benefit the government and the citizens in terms of economy and lifestyle improvement. Throughout the construction process, 130,000 jobs can be provided and a Gross National Income (GNI) of RM3–4 billion per annum can be generated. A 2.5-3.5 multiplier impact from construction will generate an additional RM8-12 billion per annum. Over the next ten years, an estimated average of RM21 billion will be generated (MRT Corp, 2013b).

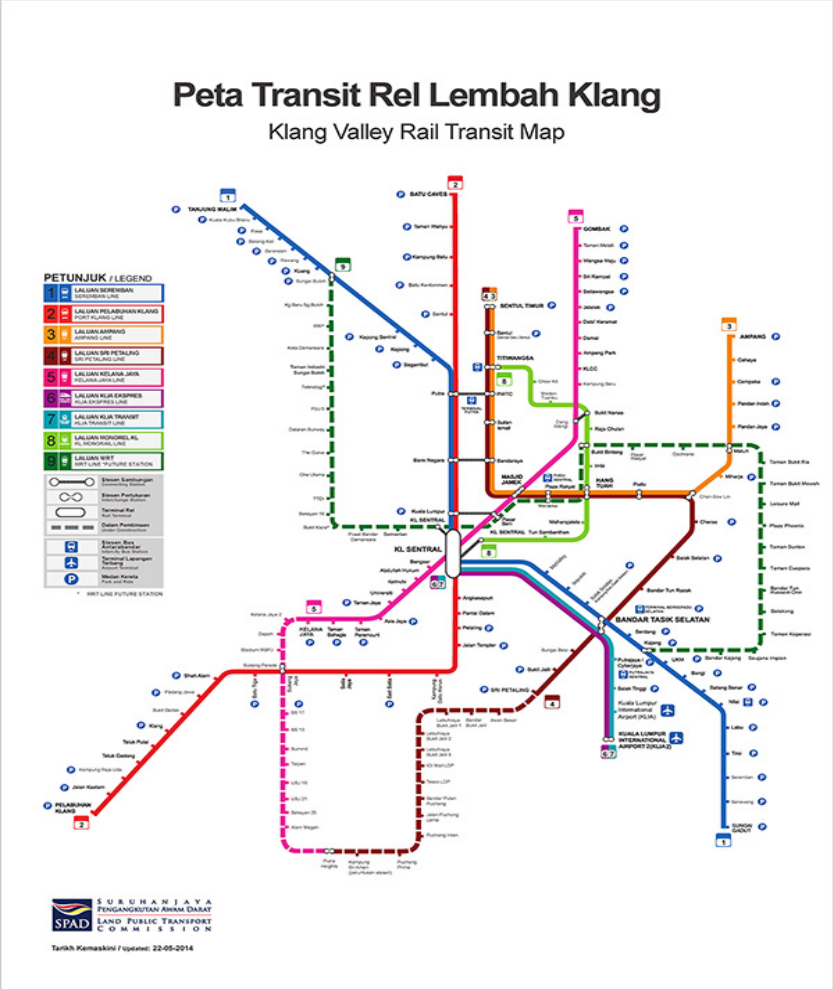

Figure 1: Klang Valley Rail Transit Map (Retrieved September 20, 2014 from SPAD)

Issues

With large corporations at the helm of a project that boasts development requirements conforming to international standards, one can expect the construction process to proceed smoothly and safely. However, Tan Sri Lee Lam Thye (2013), chairman of the National Institute of Occupational Safety and Health, begs to differ. He has written numerous letters to a local newspaper, The Star, to highlight the inadequate conditions that exist in and around MRT construction sites. From his letters, he was urging contractors to minimise inconveniences to the public and to improve site conditions before serious accidents can occur. Even ordinary citizens have voiced their concerns in the same method. Sadly, their words were not taken seriously by the MRT contractors.

Then, it finally happened. Within the span of one year, five accidents related to MRT construction sites and material transportation have been reported in local newspapers. The accidents varied in severity, some caused structural damage to roads and traffic jams, others resulted in the death of workers. If the words of Tan Sri Lee Lam Thye were taken seriously, these accidents may have been preventable. As a result, the contractors suffered economical losses, construction delays, scrutiny from the public and legal consequences from the government.

The accidents occured suddenly and in close proximity to motorists using the road. Both the public and the government are demanding an explanation as to why these accidents occur and who should be blamed. The standard of health and safety in construction sites will also be reviewed to reveal potential flaws. Further study will also be conducted to determine the challenges in mitigating the flaws, as well as solutions to be taken. There are also gaps to be filled as to how these accidents can be prevented in the future, in MRT construction and also other similar rail construction projects.

Research Objective

The objectives of the study are as follows:

(1) To identify the flaws (weakness) and challenges in MRT construction in terms of safety
(2) To establish methods of overcoming the flaws and challenges

The Accidents

1. *When, Where And What Happened*

Table 1: Details of accidents that occurred

When	Where	What	Injuries/ Fatalities/ Damages	Actions taken
April-May 2014	Jalan Bukit Bintang, KL	Sinkholes and soil depression	None/ None/ Structural	Sinkholes backfilled
June 24, 2014	Pusat Bandar Damansara, Petaling Jaya	Falling metal sheet pile	Light/ None/ Vehicular	Blacklist sub-contractor
August 18, 2014	Kota Damansara, Petaling Jaya	Falling concrete span	Severe/ Three/ Structural	CEO resigned/ Blacklist contractor
August 24, 2014	Jalan Cheras, Petaling Jaya	Falling concrete segments	None/ None/ Structural	Pending/ Unknown
February 28, 2015	Semantan, KL	Falling steel bars	Light/ One/ Structural	Pending investigation

2. *How The Accidents Happened*

There were five different incidents related to MRT construction reported in newspapers between April 2014 and March 2015. The first incident occurred between April and May 2014. Three separate occasions of sinkholes and soil depressions occurred at three locations along Jalan Bukit Bintang. Underground excavations were being conducted at the time. The locations where the sinkholes and

soil depressions occurred were the meeting points of two different soil conditions: a geographically predictable rock and sand formation and a difficult limestone formation often filled with voids (Daniel & Khoo, 2014).

On June 24, 2014, a sheet pile that was being placed on a stack within the Pusat Bandar Damansara MRT construction worksite had slipped and hit an oncoming car. The driver suffered minor cuts and was given outpatient treatment in a nearby hospital (Brown, 2014a).

According to a report released by MRT Corp in The Star (Patrick Lee, 2014a), absence of necessary equipment and poor management and supervision led to the death of three foreign workers after they were crushed by a 300-plus tonne concrete span. Shims, or metal boxes filled with grout, are placed on a pier head to support spans of viaducts as they are placed on temporary jacks during construction. On the day of the accident, it was found that the concrete span had toppled from its piers because there were no shims beneath it during the installation of parapets on one of its sides; instead, the span was only resting on temporary jacks.

The next incident happened on August 24, 2014. A trailer was transporting 16 concrete segments for the Pudu underground MRT project when a sudden stop in traffic led to the falling of 12 concrete girders onto the road. The incident resulted in a 2-hour traffic jam along Jalan Cheras. MRT Corp had released a statement that they are investigating the matter and are planning to take action on those responsible (Avineshwaran, 2014).

The most recent accident happened at the Semantan MRT construction site in Kuala Lumpur. Seven steel bars, each weighing 40kg, had fallen onto two Bangladeshi workers. The workers were busy assembling a circular rebar cage at the time when the rope carrying the steel bars above them snapped and released the bars on top of them (Cheng, 2015). Rijaul Abdul Goni, 40, was pronounced dead at the scene, while Shanaullah, 37, was rushed to the Kuala Lumpur Hospital to treat injuries to the face.

3. *How The Accidents Were Resolved*

The MRT contractors had taken different approach to address each accident. For the sinkholes and soil depressions, stabilization was achieved quickly through backfilling the loose soil using compaction grouting (cement). The roads where the sinkholes appeared were temporarily foreclosed, while part of the traffic were diverted into other usable roads (Vincent Tan, 2014).

The sub-contractor and staff supervising the Pusat Bandar Damansara site where a car was partially crushed were sacked and blacklisted, meanwhile MRT Corp was reviewing safety practices on site (Brown, 2014). It was unclear if any compensation would be given to the driver who suffered bodily and vehicular damage.

Until the end of 2014, the falling concrete span at Kota Damansara that killed three foreign workers garnered the most attention on local newspapers. The following day at the site after the incident, MRT Corp. CEO Datuk Azhar Abdul Hamid has announced his resignation in a press conference, at the same time vowed to see the case through and obtain justice for the deceased and their families (Kanyakumari, 2014). Initial investigations of the accident suggested that the contractors and subcontractors had complied with safety regulations (Bedi, 2014). However, a thorough investigation by European investigators revealed the opposite. As a result, MRT Corp has sacked those contractors and sub-contractors, and possibly blacklisting them from participating in future MRT projects (Patrick Lee, 2014b). MRT Corp also deployed 60 safety superintendents to various MRT sites to provide tighter supervision and better staff training, in an effort to prevent further accidents (Lim, 2014). Meanwhile, the next-of-kin of the three foreign workers had received RM 25,000 each as compensation (Hamdan, 2014a, 2014b).

There were no reports yet on the investigation on the trailer that dropped 12 concrete segments and caused traffic jams. As for the falling steel bars that killed the one foreign worker and injured another, an investigation is being carried out by MRT Corp and the relevant authorities (Spykerman, 2015).

The Health and Safety Aspect

1. Why Is It Important?

The term occupational health and safety is applicable in all industries but weighs much heavier in the construction industry due to the significantly higher risks in the construction process. According to Malaysia's Department of Occupational Safety and Health (2015b), the construction industry recorded 72 deaths between October and December 2014, the highest among all occupational sectors within that period. Christopher Pass (2006) describes health and safety as "the regulation of organizations' working methods so as to discourage dangerous practices.

Ed Ferrett (2012a, 2012b) has listed down four good reasons for an organisation to practice good safety and health management. The first reason is in terms of moral. A reasonable standard of care should be provided to reduce accident rates as well as industrial diseases and ill-health rates. The second reason is in terms of social. An organisation has a duty of care to provide a safe place of work, which also includes access and egress; safe plant and equipment; safe system of work; not to mention adequate levels of supervision, information, instruction and training. Society naturally expects this level of safety and health standard.

Ed Ferrett (2012a, 2012b) also mentioned that an organisation successful in providing a good safety and health standard can obtain a highly motivated workforce, in turn improving the rate of production and product quality. They can also benefit from an improved public image and reputation with their

stakeholders, but most of all they will not suffer economically, which happens to be the third reason. If an accident that was preventable in the first place happens, an organisation is bound to suffer direct and indirect losses. Some of these losses can be insured, but legal representation fees for the compensation claims and prosecutions (which are classified under legal reasons, the fourth reason) are not. From a project and financial management standpoint, it is better to be safe with a strict safety and health standard than to suffer the consequences.

2. Health And Safety Legislations And Agencies In Malaysia

From 1967, the health and safety standard in Malaysia was in compliance to the Factories and Machineries Act. While this act was an improvement over earlier legislations, it still had its shortcomings. It is prescriptive in nature, whereby overcoming hazards identified were already stipulated, and the command-and-control approaches were overly dependent on the effectiveness of the government's enforcement (Industrial Safety: Malaysian Profile of the Occupational Health and Safety, n.d., pg 6). Also, the sectors which are covered by this act are manufacturing, mining, quarrying, works of engineering and construction. This was only 24% of all the manpower in Malaysia at the time. A newer, more comprehensive legislation was needed to address the new hazards in the workplace due to wider employee base. Thus, the Occupational Health and Safety Act (OSHA) 1994 was introduced.

The act explains the general duties of employers, employees, self-employed persons, designers, manufacturers, and suppliers. The act also caters for appointment of enforcement officers, establishment of a National Council for Occupational Safety and Health, and formulation of an organisation's policy and arrangements to secure the safety and health arising from the activity of people at work. Powers of enactment and investigation, and liability for offences are clearly spelt out. (Master Builders, 2006). The act is also a means by which existing safety and health requirements can be replaced and updated through a system of regulations and approved codes of practice prepared in consultation with the industry.

There are two agencies established under the Ministry of Human Resources to oversee the health and safety standards of workplaces in Malaysia: Department of Occupational Safety and Health (DOSH), and National Institute of Occupational Safety and Health (NIOSH). The DOSH is responsible for the study, review and enforcement of legislations related to occupational safety and health of the country, one of which is the OSHA 1994 (Department of Occupational Safety and Health, 2015a). The NIOSH, on the other hand, provides training, consultation services and research in the field of occupational health and safety. It works closely with industries, organisations, training providers and agencies to increase their performance and capabilities in occupational health and safety related activities (National Institute of Occupational Safety and Health, 2015).

3. Health And Safety In MRT Construction

The MRT construction work is spilt into packages and tendered out to different contractors. Elevated works and underground works make up a majority of construction; therefore, these works have the greatest risks of accidents and have the greatest need for health and safety management. While the variable density tunnel boring machines currently used by the MRT Corp and its contractors have significantly reduced the risks of occurrence of sinkholes and soil depressions, there are other risks of accidents happening during excavation that are not related to sinkholes. The risk of fire occurrence is possible, as shown in the excavation of the SMART Tunnel in 2007 when the collision of two cars resulted in a fire (Meng, Miho, & Mitropoulos, 2009, pg 9). Help may not be immediately possible if the location is far away from the surface.

The risks of accidents occurring during construction of elevated works are much higher. The risks associated with working at height include crane collapse, scaffolding failure and falling of persons or material from height. While crane collapse has not occurred in MRT construction yet, this situation has happened in LRT construction numerous times, proving the possibility. Scaffolding failure may be caused by strong winds, or if the material has become brittle after extensive exposure to the weather (Ferrett, 2012c, pg 194). While there was no occurrence of falling personnel yet, there were numerous cases of falling heavy objects.

Even though these risks cannot be fully negated, they can still be managed. All the workers should be knowledgeable on providing first aid and calling for help immediately in the event of an accident, and how to put out fire and evacuate safely if the fire is too intense. There is also an Emergency Response Team (ERT) on standby to handle other emergencies such as repair works and traffic diversions. MRT Corp also has Traffic Management Plan (TMP) in place to reroute traffic to facilitate the ongoing construction or during emergencies (MRT Corp, 2013b). There are also programmes such as the Environmental Management Plan (EMP) and the Safety, Health & Environment (SHE) Programme. These programmes are designed to manage noise, dust, vibration, hygiene and safety impacts in general.

4. *Why Do The Accidents Still Happen?*

Even with an excellent health and safety policy in place, accidents can still happen. The accident that claimed the lives of three foreign workers was caused by the contractor's poor management. MRT Corp chief Datuk Azhar Abdul Hamid in a press conference, stated that there was insufficient supervision on site, failure to communicate risks between the various parties involved, and poor subcontractor management (Lee, P., 2014a).

Two other reasons for the accident were a lack of method statement of parapet erection and failure to provide inspection. Even if the concrete segments were installed wrongly, a proper inspection would

have led to the correction of working methods. No work should be carried out under large objects without assurance that the level of required safety is achieved. If the workers feel that their safety is not guaranteed, they can make a report to the relevant authorities, or even refuse to work until the work conditions have been improved.

The contractor also failed in identifying risks and implementing preventive measures. The area deemed to be hazardous to personnel or pedestrians should be fenced or barricaded. While this is not always possible (some construction works are carried out over roads and highways), care should be taken to ensure the operations, i.e. metal beams carried by hoists, are performed with utmost caution. The operations should be closely supervised by qualified personnel for potential problems.

5. *Is It Difficult To Mitigate These Flaws?*

An organization's culture determines the level of safety to be attained (Manuele, 2003). The management's commitment to safety and system of expected behaviour reflects the organization's culture. However, poor construction culture is very common among clients and contractors in Malaysia. When the management's commitment to safety is lacking, those that they manage will surely deviate from the ideal behaviour. Among the workers' behaviour that can lead to accidents are not working to agreed methods, not following instructions, lack of awareness on site and poor housekeeping (Howard & Watson, 2009).

Communication barriers also make it harder to promote health and safety. Foreign labours are comparatively cheaper than local workers, often becoming a contractor's choice. However, they may not understand Bahasa Malaysia, while local supervisors have trouble communicating in the workers' native language. So, hand gestures and simple instructions are mostly used, but both methods are not sufficient enough when it comes to complex operations such as the transportation and installations of materials.

Another challenge in mitigating the flaws is the climate. Extensions of time are given to contractors for delays caused by abnormally adverse weather conditions (Kartam 1999, cited in Nguyen, Kneppers, de Soto, & Ibbs, 2010). There are situations where the weather is adverse and work should be stopped for safety purposes; but since the weather is not classified as abnormally adverse, no extension of time will be given. Every year in Malaysia, the monsoon season wreaks havoc on construction sites for months. Contractors and their workers often have no choice but to continue work despite the dangerous conditions on site.

It is the safety and health manager's duty to monitor the safety levels on site and to convey the above challenges to the organisation he works for. However, like other managers in the organisation, his department must compete for enough resources in order to do their job efficiently (Goetsch, 2011, pg 55). Under normal circumstances, the health and safety requirements are outweighed by production

and operational requirements (until a disaster strikes), most likely because the health and safety department puts more emphasis on rules and regulations than on profits. There are also those who believe “encouragement of safe working methods can slow down production speeds” (Pass, 2006).

6. *Overcoming These Flaws*

To mediate these flaws, the challenges must first be addressed, starting with construction culture. Even though influencing an organisation’s safety culture is difficult and time consuming, it is not impossible. A good first step towards creating a good safety culture is to establish accountability. Accountability for safety performance should be established at every level of management through the use of performance review systems. The level of safety performance achieved will impact the financial and promotional potentials of those in charge of promoting and managing safety.

The next step is to improve the safety awareness among the employees in the organisation. The proper education and training, either through formal classroom settings, or on the job demonstrations, is essential in developing the employees’ attitude and behaviour towards a positive safety culture (Howard, & Watson, 2009). Safety talks and awareness-raising campaigns should be regularly conducted to remind employees of the everyday risks and the best ways to manage them. Random spot-checks can also be a deterrent to poor worker behaviour.

Two other methods of reviewing the organisational safety culture are through safety culture audits (Ludborzs, 1999, cited in Lingard & Rowlinson, 2005) and safety climate survey. Safety culture audits observe and interview employees and other key individuals. Both documented and lived aspects of the OHS management system can be analysed to reveal shortcomings such as the difference between what employees say and do. Safety climate deals with the psychological aspect of workers. It deals with their attitude and perceptions regarding health and safety management (Howard, & Watson, 2009, pg 152).

To make sure health and safety awareness in instilled in foreign employees, the gap in communication must first be bridged. Canales et al. (2009) described a bilingual construction course which helped to bridge communication gaps between American supervisors and Hispanic construction workers in the United States. Both supervisors and workers are provided with a booklet containing basic words and interactive pictures of daily construction activities tools, and equipment. This method can be adapted in construction projects in Malaysia.

Climate is probably the hardest challenge to overcome, given that it is one of the most common sources of disputes in construction projects. Nguyen, Kneppers, de Soto, & Ibbs (2010) provide seven methods in adverse weather analysis for time extension, but each will produce a different result. The best way around this is to establish an agreement beforehand between client and contractor as to which method should be used and the calculations that follow. A better guarantee would be to obtain data

from the nearest weather stations as a basis for calculations. The data is credible, yet unbiased, therefore a viable option.

Methodology

This study will be conducted on the entire MRT project announced in the 10th Malaysian Plan. The focus will be on how the accidents occurred, and what flaws exist in the occupational health and safety procedures used at the time of the accidents. Questionnaires are sent out to the Grade G7 contracting firms who are involved with ongoing MRT construction.

The focus is on site construction safety issues; hence the targeted respondents will be on site personnel who will provide a comprehensive insight on the health and safety procedures on site at the time of the accidents. To overcome this limitation, the parties will provide feedback and comment on the mitigating measures to be taken to prevent similar accidents from happening in the future.

The first section of the questionnaire requires the respondents to rate their level of agreement on the flaws in MRT construction safety procedure, the challenges in overcoming those flaws, as well as the ways to overcome those challenges. The second section is on demographics. The respondents will list their working experience but shall remain anonymous to protect their privacy.

Findings

The following findings were obtained and ranked based on the collective agreement of the respondents.

Table 2: Flaws in MRT construction safety procedure

Rank	Flaws in MRT construction safety procedure	Level of agreement
1	Poor management on site	Very high
2	Insufficient supervision on site	Very high
3	Failure in implementing preventive measures	High
4	Failure to communicate risks	High
5	Failure to provide inspection	High
6	Lack of training	Moderate
7	Reluctance to input resources into safety	Low

Table 3: Challenges in overcoming these flaws

Rank	Challenges in overcoming these flaws	Level of agreement
1	Poor construction culture (Human Behaviour)	Very high
2	Communication barriers between supervisors and workers	High
3	Bad climate	Moderate
4	Lack of resources dedicated to safety	Low

Table 4: Ways to overcome these flaws

Rank	Ways to overcome these flaws	Level of agreement
1	Nurture a good safety culture	Very high

2	Conduct random spot checks	Very high
3	Establish accountability for safety performance	Very high
4	Improve safety awareness among employees	High
5	Conduct safety culture audits	High
6	Establish bilingual construction course to teach foreign workers	High
7	Conduct safety climate survey	Moderate
8	Establish agreement as to method of calculating extension of time	Low

Respondents were also asked to provide additional comment on the above categories. They believed that inadequate management and supervision is the main culprit. When there is no supervision on site, no one will remind the workers, so they tend to be more careless. Even if there is supervision, there is bound to be missed-look by the person-in-charge. The next major factor is the failure to implement preventive measures. A fine example would be the latest accident in Semantan. A worker was crushed to death in an accident not unlike the ancient that killed three workers last August. Areas under and close to places of hoisted and suspended objects must be vacate, especially given what can happen. Yet, despite the promises by MRT Corp to improve the standard of safety, it is clear that preventive measures on site had not been properly taken.

The respondents believed that accidents also occur because construction workers take safety precautions for granted despite attending safety and health meetings, and that accidents are more likely to happen in the beginning stages due to the fact that people on site are more concerned with the preparation work. However, this does not match the fact that the accidents occurred during the middle of the construction process, probably when supervision is lax as the accidents were least expected to occur.

When the respondents were asked to comment on the solutions taken by the MRT Corp after the accident, most of them agreed that more inspections and supervision is more effective that blaming the contractors responsible and the CEO's resignation, in terms of psychological effect. Random inspections and spot checks will ensure the workers are constantly aware of their surroundings. Failure to comply with safety regulations will also reflect poorly on those who manage and promote safety, and this will jeopardise their financial and promotional potentials.

Conclusion

It is generally accepted that risks of accidents occurring during construction can never be fully negated, only managed. Governments that establish safety regulations, clients that commission the projects, the contractors and workers that do the building, even the general public, all have a part in constantly reviewing and reinforcing the standard of safety in construction sites. The accidents reveal the lack of management by the government, as well as the disregard of safety regulations by the contractors.

The difficulty in mitigating those flaws comes down to human behaviour and psychology. Because no accidents occurred in the earlier stages of construction, the workers will start to lapse in their

judgement of safety, especially in the event of no supervision. By enforcing the regulations through random inspections and heavier penalties, the workers and their employers must either change their behaviour or risk expulsion.

The steps to overcome these flaws are not new. They are constantly emphasized by governments and safety journals, but achieving optimum health and safety requires vigilance and proper education at every level, starting from the workers and the contractors. If the workers are given the proper education and remained under constant supervision, the safety standards will definitely improve in time.

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Investigating Time Overrun in Telecommunications Tower Projects In Malaysia

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Abstract
Delay is a very frequent phenomenon and is almost associated with nearly all construction projects. Inadequate or weak preparatory work before starting construction of any structure may cause serious problems during the construction period. Consequently, the cost of construction increases, the construction duration of the project extends, and the quality of construction is affected adversely. This paper aims to identify the challenges the occurred in telecommunication tower projects which resulting to the project delay. This study adopted quantitative methodology through case study approach in 65 selected telecommunication tower sites. Several documents and reports from project stakeholders and Malaysian Communications and Multimedia Commission (MCMC) and Thirty-six (36) questionnaires were analysed to identify the challenges and causes of project delays that need to be faced by the related stakeholders. The result from this study revealed that site acquisition and construction are 2 main categories of challenges and 8 main factors that cause delays in telecommunication tower construction projects. The findings conclude about the time overrun gap that still exist in the construction industry. External causes, client related causes, equipment, material, subcontractors' selection, improper planning, site management and inadequate contractor experience are the identified as the main causes to the project delay in telecommunication tower construction.

Keywords: *Time overrun, Telecommunication tower, Construction project, project delays*

Introduction

Delays in construction project are still the common global issue that cost billions of dollars to the construction industry (Kog, 2018; Mensah, 2017; Viles, Rudeli, & Santilli, 2020). Delay in construction if defined as the time overrun in construction project which exceeds the original completion date as agreed in the contract between related stakeholders (Assaf & Al-Hejji, 2006). In simple definition, delay is referred as "the inability to meet the scheduled time" (Mensah, 2017). Unfortunately, delays in project not only means loss of profit to these stakeholders but also bring dissatisfaction to clients. Mensah (2017) has found 15 categories of causes that lead to construction project delays in the United Kingdom, Kog (2018) identified 10 delay factors in construction projects in several selected European countries and US while the latest review done by (Viles et al., 2020) highlighted 3 mains causes of delay in different stages of whole construction projects. These statistics are actually the numerical proof experienced by the construction industries in developed countries, which makes no exclusion for still-developing countries to face the same issues like Malaysia, for instance (Yap, Goay, Woon, & Skitmore, 2021).

Despite of lots of research have been conducted in identifying construction delays' factors internationally or locally, majority of these researches are looking at the general context of construction projects and not focusing on different type of projects that may lead to different causes of delay. A research by Satyanarayana (2010) highlighted on the time overrun issue that occurred specifically in communication tower construction project in India which caused by labor, unavailability of supervisors,

timely availability of material, weather, holidays and no proper written work schedule. A research in Ghana has found that there are fifteen (15) delay factors in telecommunication tower construction project itself (Danso & Antwi, 2012). However, the absence of data has left a big gap on this field, where very little empirical evidence on the challenges and causes that lead to the delay in communication tower construction project.

Considering that telecommunication tower construction projects in Malaysia require participation from various and different stakeholders, i.e. Malaysian Communications and Multimedia Commission (MCMC) and contractors, there is a need to understand the issues that may or already occurred in telecommunication tower construction projects which resulting to the project delay. For this reason, this study objectively to understand the challenges and barriers, as well as to identify the cause of delay in telecommunication tower construction projects in Malaysia, by taking sixty-five (65) telecommunication tower projects in Kelantan and Pahang, Malaysia as the case study.

Telecommunications Tower Projects in Malaysia

The telecom sector in Malaysia is still expanding and developing which makes the sector has undergone reinforcement period in recent years (Rosbo, 2020) and this includes consolidation of the infrastructures. According to the most recent statistics which is on 2018's data, there were almost 22,682 cellular or telecommunication towers owned by private telecommunication companies in Malaysia that have been constructed under Universal Service Provision (USP) programme as shown in Table 1 (Wolff, 2019).

Table 1: Statistic of telecommunication towers constructed in Malaysia in 2018
Source: Wolff, 2019

Company	Number of towers
Edotco	4000
State-backed towercos	3200
YTL	5000
Naza communications	300
OCK	222
Omnix	148
Inforient	50
DiGi	3400
Maxis	3800
Telekom Malaysia ™	1000
Umobile	1000
Other	732

MCMC collaborated with all stakeholders to plan the USP program rollout in a comprehensive manner, which includes providing service that meets the need of the local residents, choosing an appropriate technology as well as creating strong support and collaboration from Federal, State and Government agencies (Suruhanjaya Komunikasi dan Multimedia Malaysia, n.d). In addition, MCMC will

continue its partnership with the universal service providers appointed to ensure the effectiveness of the project implementation mechanism as well as service usage level among the underserved communities.

Considering that the USP projects require close attention and participation by various parties, MCMC collaborated with capable, professional and experienced project management consultants to ensure that the project management runs on schedule. In addition, early monitoring and detection in a continuous manner on the performance of the USP projects could ensure that appropriate action is taken to prevent interruption of universal service in the underserved areas.

Challenges and Factors Affecting Time Overrun In Construction Project

Stumpf (2000) defined delay as an act or event that extends the time required to perform the tasks under a contract. Mensah (2017) simply defined delay as the "inability to meet the scheduled time". It usually shows up as additional days of work or as a delayed start of an activity. Delay in a project affected by many factors. Many studies have been carried out to assess the causes of delay in construction projects. In the view of time performance gap or overrun, delay is a usual drawback that results in financial consequences in the construction industry. According to Kaming et al. (1997) time overruns is defined as the extension of time beyond planned completion dates traceable to the contractors. In relation to Malaysia, Alaghbari et al. (2007) finds that financial problems also are the main factor followed by coordination problems causing delay in construction projects.

Tawil et al. (2013) on the other hand identified 22 factors responsible for delays in higher education construction projects where insufficient capital, delay in getting progress payment, delay in getting work approval, contractor management problems and scarce/insufficient construction materials as the top five delay factors. Another study by Mydin, Sani, Taib, & Alias (2014) identified weather conditions, poor site conditions, poor site management, incomplete documents, lack of experience, financial problems, contract modifications, delay in the approval of major variations, contractor coordination problems with other parties, and construction mistakes and defective works as the top ten factors causing delays in private housing projects in Malaysia. Another study by Sambasivan (2007) found that contractor's improper planning, contractor's poor site management, inadequate contractor experience, inadequate client's finance and payments for completed work, problems with subcontractors, shortage in material, labor supply, equipment availability and failure, lack of communication between parties, and mistakes during the construction stage as causes of delays in construction projects in Malaysia.

A literature review of 13 studies on construction delay factors in the UK, Portugal and the US by Choong (2018) identified variation orders/changes of scope by owner during construction, mistakes and discrepancies in design documents by consultants, late issuance of instructions, information or drawings/incomplete drawings/inadequate information/delay in revising design documents, and

approving works or materials/delays in design work as the major project delay factors common for construction projects in the US, the UK and Portugal were.

Choudhury & Phatak (2004) listed the major factors causing the project delay are underestimation of project cost, lack of timely progress payment, poor working relationship between client and the contractor, changes to design during construction, incomplete project information, timeliness of project information, lack of communication between the client and the contractor, number of sub-contractors and inclement weather conditions.

Various studies have categorised delay factors differently. For instance, Amoatey, Ameyaw, Adaku, & Famiyeh (2015) categorised delay factors according to their degree of occurrence into financial, resource, technical, economic, environmental, operational, government and political, relationship, security/safety and legal on the effect of delay causes on state housing construction in Ghana. Among the identified factors, the study found that the major five factors causing project delays were delay in payments to contractor and supplier, inflation and price fluctuation, funding from sponsor or client, and variation orders.

In a study on construction project delays in the UAE, (Mpofu, Ochieng, Moobela, & Pretorius, 2017) classified delay factors into majorly factors related to client, designers, project managers, contractors, labour-related, contractual matters, problems of finance, problems of communication and information, problems of site and environment, and problems of government and local authorities. The study found that, unrealistic contract duration imposed by client, too many scope changes and changed orders, slowness in decision-making process by owner, late in revising and approving design documents, and selection based on cheapest price were the five major factors causing project delays. Shahsavand, Marefat, & Parchamijalal (2018) utilised a similar categorisation and found that delays in sub-contractor work, poor site management and supervision by contractor, difficulties in financing projects by contractor unqualified workforce, and change orders by owner during construction were the five major causes of project delays in Iranian construction projects.

In a comparative study of construction projects in Libya and the United Kingdom, Shebob, Dawood, Shah, & Xu (2012) found that the major factors causing project delays in both countries were related to external factors, followed consultants, then early planning and design, then owners, then contractor/materials, the contractor/manpower, then contractor/project management, and contractor/equipment.

Ntshangase & Tuan (2019) identified 20 delay factors out of which financial constraints, project lifecycle model not followed, poor communication, lack of staff competency, and human resources constraints were the main five factors in that order causing project delays in electrical distribution projects in South Africa.In a study by Oyegoke & Al Kiyumi (2017), selecting the lowest not the best bidder by the client, main contractor poor financial condition, delay in decision-making by the client, poor construction planning of the project by the main contractor, and changes in design by the client

were the five major factors from the perspective of both clients, consultants and contractors in megaprojects in Oman.

Toor & Ogunlana (2008) found that the top five causes of delays in the construction industry in Thailand were Lack of standardization in design, lack of contractor's experience and control over the project, inadequate experience of staff, lack of competent subcontractors/suppliers and an unrealistic project schedule. While in Hong Kong, five major causes of delays in construction projects were: poor site management and supervision, unforeseen ground conditions, low speed of decision making involving all project teams, client-initiated variations and necessary variations of works (Chan & Kumaraswamy, 1997).

Odeyinka & Yusif (1997) classified the causes of delay in Nigeria as project participants and extraneous factors. In this study, project participants are client and contractors. Client-related delays included variation in orders, slow decision-making and cash flow problems. Contractor-related delays identified were financial difficulties, material management problems, planning and scheduling problems, inadequate site inspection, equipment management problems and shortage of manpower. Extraneous factors that causes of delay identified were inclement weather, acts of nature, labor disputes and strikes.

The result of study indicated that the main causes of delay in construction of public projects in Jordan were related to designers, user changes, weather, site conditions, late deliveries, economic conditions and increase in quantity (Al-Momani, 2000). The study suggested that special attention to factors will help industry practitioners in minimizing contract disputes. Delays have strong relationship with failure and ineffective performance of contractors. Ubaid discussed the performance of contractors as one of the major causes of delay. Thirteen (13) major measures, related to contractor resources and capabilities were considered. Similarly, Odeh & Battaineh (2002) also conducted a survey aimed at identifying the most important causes of delays in construction projects with traditional type of contracts from the viewpoint of construction contractors and consultants. Results of the survey identified that contractors and consultants agreed that owner interference, inadequate contractor experience, financing and payments, labor productivity, slow decision making, improper planning, and subcontractors were among the top ten most important factors of project delay.

In India, a recent study by Prasad, Vasugi, Venkatesan & Bhat (2019), delay in settlement of contractor claims, contractor's financial difficulties, delay in payment for extra work/variations, late payment from contractor to subcontractor or suppliers, and variation orders/change of cope by owner were the top five delay factors in transport, power, buildings and water/irrigation projects in India.

Methodology

Present study adopts quantitative approach in achieving research objectives through 65 selected telecommunication tower sites in rural area of East Malaysia, Pahang and Kelantan as case study. The

area were selected as they are included as the telecommunication tower projects under the USP program (Suruhanjaya Komunikasi dan Multimedia Malaysia, n.d).

Data for this study was sourced from both primary and secondary sources. The primary data was obtained through documents review of past performance report from project stakeholders to MCMC and through questionnaire survey. The secondary data in the other hand was obtained through journals, books, conference papers, theses, magazines and newspapers.

Document Review

Document review approach was adopted for this study in order for the researcher to investigate the real-world situations occurred that lead to the challenges and project delays. The reviewed of documents involved material such as letters, memos, notes, photographs, e-mails, and data from internal automatic remote monitoring systems were inspected. In the document examination, certain factors such as lack of awareness in project management and its benefits, operational barriers and other challenges were established as the source of the observed cause of delay emerged. Descriptive statistics was used to analyse the data obtained from document review.

Case Study

Case study selected for this study are the construction project of telecommunication towers in 65 sites that have been awarded by MCMC to a valid Network Service Provider (NSP) and Network Facility Provider (NFP) license holder through a tendering process.

Questionnaire Survey

Questionnaires were administered to the main awarded license stakeholders by the MCMC who involved with telecommunication tower construction project to identify the challenges and delay causes that usually occurred in telecommunication tower construction projects. They are the clients, project consultants and project managers who have directly engaged with telecommunication tower construction projects in selected case study. The total number of populations was 75 for all 65 sites. Based on the population size, Krejcie and Morgan (1970) suggest a minimum sample of 63 required to represent the population. Thus, in total of seventy (70) questionnaires were distributed to the respondent. Data obtained from the questionnaire survey were analysed using analysis packages namely Statistical Package for Social Sciences (SPSS) Version 22 software. Descriptive statistics provide information regarding the distributions and ranking of variables such as measure of central tendency (mean, mode and median), standard deviation and rank analysis using relative importance index (RII). Thirty-six (36) questionnaires were returned, resulting in a 51.4% response rate.

Relative importance index was utilised as the appropriate analysis technique as the analysis technique for ranking the delay factors in terms of their perceived level of importance as it is a widely used technique in studies on delays in construction projects (Amoatey & Ankrah, 2017; Marzouk & El-Rasas, 2014; Shahsavand et al., 2018; Shebob et al., 2012; Tawil et al., 2013).

Result and Discussion

The demographic characteristics of the respondents are shown in Table 2.

Table 2: Demographic characteristics of respondents (n= 36)

Demographic characteristic	Percent %
Age	
Less than 20	0.0
20 – 29	25.0
30 – 39	36.2
40 – 49	19.4
50 and above	19.4
Gender	
Male	55.6
Female	44.4
Education	
Lower secondary (Form 1 - 3)	0.0
Upper secondary (Form 4 - 5)	2.8
Pre-university or Form 6	8.3
Diploma	33.3
Degree	38.9
Post graduate	16.7
Type of organization	
Consultants	66.7
Contractors	33.3
Cluster(s) involved	
Pahang	16.7
Kelantan	8.3
Both	75.0
Occupational level	
Non-executive	30.6
Executive	36.1
Managerial (Manager and above)	33.3
Number of years working experience	
Less than 2 years	0.0
2 - 5 years	11.1
6 - 10 years	50.0
More than 10 years	38.9
Scope of Work involved	
Tower	19.4
Infrastructure	47.2
Both	33.3

To achieve first objective which is to identify the challenges and barriers that occurred in the project, respondents were firstly asked to indicate their experience on time overrun during the project. The result is shown in **Error! Reference source not found.** below.

Table 3: Completion status for telecommunication tower construction projects

State	Number of Sites	On-time	Delay	Percent
Pahang	35	6	29	82.9
Kelantan	30	22	8	26.7
Overall	65	28	37	56.9

Table 3 indicated that the project in Pahang experienced the most delays (82.9% of the projects) compared to 26.7% of the projects that experienced delays in Kelantan. Following to this data, respondents were asked about the challenges and barriers that they have to face in relation to the time overrun in telecommunication tower construction projects. The results are covered all 65 sites Table 4.

Table 4: Challenges and barriers that lead to project delays both Pahang and Kelantan states (n=36)

Challenges	Frequency
OSA and late confirmation	7
OSA	6
OSA and late confirmation by Land Office	6
Site access flooded	3
OSA, late rejection and late confirmation	3
OSA, rejection due to high rental and late confirmation	2
OSA, work commenced, Owner complaint then site relocated	2
Vandalism	1
No response from owner	1
Site change due to access to bridge collapse and site access flooded	1
Site shift due to comment from District Council	1
Site change due to proposed site rejected by MCMC	1
OSA and rejection of first proposed location	1
Island site – Regional Development Agency	1
OSA and late response from Owner	1

Results in Table 4 shows that to obtain permission from One Stop Agency and late confirmation are the key challenges that need to be faced by stakeholders in telecommunication tower construction projects. It takes a longer time to obtain permissions for new sites or relocation of sites, which as a consequence, delays the entire process. Interestingly, flood or natural causes is also found as one of challenges that leads to project delays.

Then, apart from the focus of this study on the acquisition challenges that lead to delay in telecommunications tower construction, this study also extends its attention by observing challenges

and barriers in relation to the construction process of telecommunication tower specifically in Pahang and Kelantan as shown in Table 5.

Table 5: Construction Challenges in Pahang and Kelantan (n=36)

Challenges	Pahang	Kelantan
Access Issue/ Double Handling	4	3
Retaining Structure Required	0	3
Piling	11	1
Percent	*68.2*	*31.8*

For Objective 2 which is to identify the causes that lead to delays in telecommunication tower construction projects, respondents were asked to indicate which factors that mostly influenced to the delays in project. The results of factors influencing delay in telecommunication tower construction projects are presented in Table 6 categorized under eight major groups: client related factors, contractor related factors, consultant related factors, material related factors, labor and equipment related factors, contract related factors, contract relationship related factors and external factors. Relative importance index (RII) was then used to rank the factors by comparing with all cause of delays.

Table 6: Causes of delays in telecommunication tower construction project

Cause of delays	RII
1)Client related causes	
Financing and payments of completed work	0.844
Owner interference	0.722
Slow decision making	0.717
Unrealistic contract duration and requirements imposed	0.439
2)Contractor related causes	
Subcontractors selection	0.811
Site management	0.767
Construction methods	0.739
Improper planning	0.778
Mistakes during construction stage	0.611
Inadequate contractor experience	0.750
3)Consultant related causes	
Contract management	0.461
Document preparation and approval	0.689
Quality assurance/control	0.456
Waiting time for approval of tests and inspection	0.444
4)Material related causes	
Quality of material	0.450
Shortage in material	0.828
5)Labor and equipment category causes	
Labor supply	0.833
Labor productivity	0.700
Equipment availability and failure	0.683
6)Contract related causes	
Change orders	0.528

Mistakes and discrepancies in contract document	0.372
7)Contract relationships related causes	
Major disputes and negotiations	0.728
Inappropriate overall organizational structure linking to the project	0.344
Lack of communication between parties	0.611
8)External causes	
Weather condition	0.872
Regulatory changes	0.361
Problem with local communities	0.739
Unforeseen condition	0.600
Site location	0.794
One Stop Center/Agency (OSA)	0.839

Results in Table 6 indicate the overall ranking of ten (10) most important causes of telecommunication tower construction delays as: (1) Weather condition (RII = 0.872); (2) Financing and payments of completed work (RII = 0.844); (3) One Stop Center/Agency (RII = 0.839); (4) Labor supply (RII=0.833) (5) Shortage in material (RII = 0.828); (6) Subcontractor selection (RII = 0.811); (7) Site location (RII = 0.794); (8) Improper planning (RII = 0.778); (9) Site management (RII = 0.767) and (10) Inadequate contractor experience (RII = 0.750).

Findings and Discussion

For the first objective, it was found that OSA and late confirmation are the main challenges that leads to project delays. These challenges are involved with the local authority, government agencies such as land office, MCMC and regional development agency, as well as with the land owner. Other challenges that also affecting the project timeline are natural cause – flood and vandalism. From the results, challenges and barriers can be divided into two categories: (1) acquisition challenges (2) construction challenges.

a) Site Acquisition Challenges

Site acquisition and permitting is always done in close tandem with local associates whose useful insight, knowledge of local bureaucracy and confidential connections usually help to drive the permitting process forward as fast as possible. It often requires a special mix of ingenuity, persuasion and smart technical skills. Once a perfect cell tower location has been found further research and evaluation regarding its candidacy for the job is carried out. When the ideal cell tower location has been selected, negotiations begin with the site owners and both sides sign leasing agreements.

Contrary to what one may expect, the telecommunication site construction cost is not dominated by electronic equipment, but rather by other deployment related costs (site acquisition, towers, wiring, building, network connections) and maintenance costs (Giles, 2004). A study in the UAE, found that delays in obtaining permit was a key factor to the delays in construction projects and ranked it first according to perception of participants of the survey (Faridi & El-Sayegh, 2006).

b) Construction Challenges

The main challenges of handling construction of telecommunication towers are:

MCMC awarded the sites based on cluster. Each cluster would comprise of an average of ten (10) sites. Once the tender being awarded, contractor has 150 days to complete the construction of all the towers awarded to them. Hence any unfortunate event at any phase shall become a major hurdle to coop-up with the next milestones.

Each site has its own characteristics, which differ it from one another. Hence the same management and planning cannot be imposed the same throughout the whole entire sixty-five (65) sites. For example, site located in island would require extra attention on material mobilization planning as it involves double handling management, site located near to slope would require further treatment on the retaining structure and site that require piling work more than earlier proposal.

Causes of Delay in Telecommunications Tower Construction

In this section, the study shall compare the ranking derived based on overall and category ranking to discuss the identified causes of delay.

1. *Overall Ranking*

Result in Table 3 indicate that the ten (10) most important causes of telecommunication tower construction delays were: (1) Weather condition (RII = 0.872); (2) Financing and payments of completed work (RII = 0.844); (3) One Stop Center/Agency (RII = 0.839); (4) Labor shortage (RII = 0.833); (5) Shortage in material (RII = 0.828); (6) Subcontractor selection (RII = 0.811); (7) Site location (RII = 0.794); (8) Improper planning (RII = 0.778); (9) Site management (RII = 0.767) and (10) Inadequate contractor experience (RII = 0.750).

2. *Weather condition*

It goes without saying that merely the occurrence of unusually severe weather does not necessarily constitute a delay nor warrant a time extension. The contractor must demonstrate that the unusually severe weather actually delayed the critical path work on the project. Should a contractor experience two days of unusually severe weather in terms of rain it may well occasion a delay, which is greater than two days. For instance, should the contractor be performing site work and experience two days of unusually severe rain, the site may become saturated such that the contractor is unable to work for five or six days. Therefore, the time extension, which is requested, is for the five or six days, which is the actual time frame during which the contractor was delayed because of the unusually severe weather. Several studies have found that weather is a major contributing factor to delay in a construction project (Choudhury & Phatak, 2004), Al-Monami, 2000; Vidalis & Najafi, 2002).

In this study, sites especially in Kelantan were experiencing heavy downpour at the time of construction, a period when the monsoon season is striking west coast of Peninsular Malaysia thus affecting the whole construction progress. The northeast monsoon is the major rainy season in the country from November to March. Monsoon weather systems, which develop in conjunction with cold air outbreaks from Siberia produce heavy rains which often cause severe floods along the east coast states of Kelantan in Peninsular Malaysia, and in East Malaysia.

3. *Finance and payments for completed work*

Construction works involve huge amounts of money and most of the contractors find it very difficult to bear the heavy daily construction expenses when the payments are delayed (Oyegoke & Al Kiyumi, 2017). Work progress can be delayed due to the late payments from the clients because there is inadequate cash flow to support construction expenses especially for those contractors who are not financially sound Choudhury & Phatak (2004).

4. *One Stop Center/Agency (OSA)*

The use of any approved State Land for the purpose of erecting telecommunications structures is subjected to the Relevant Authorities' approval. OSA has to make sure that all the existing and to be established towers in the State obtain approval and permit of acceptable standard. Nevertheless, the process at each OSA is very much State-centric whereby there is no regional standard for its operating procedure. Consequently, in this study, Kelantan's OSA requires less duration for approval whereas Pahang's OSA need longer duration.

5. *Labor supply*

Labor shortage affect the delivery time of construction projects and labor productivity has been found to be an important factor to project delay (Odeh & Battaineh, 2002). It is also one of the biggest challenges facing the Malaysian construction industry. Malaysian construction has problems in the ability to get the source of labor as well as retained skill people and has to depend on foreign worker to respond to the high demand of skilled workers due to rapid development in Malaysia and poor participation from local people. Moreover, according to Master Builders Association Malaysia (MBAM) delay of renewal of permit and licenses by the relevant authorities also cause disruption in the construction industry supply chain.

6. *Shortage in material*

Shortages in basic materials like sand, cement, stones, bricks, and iron can cause major delays in projects. Since Malaysia is a country that is developing very fast, often times demand exceeds supply and this causes prices to increase, causing contractors to postpone purchases until the prices decrease. This is supported by Manavazhi & Adhikarib (2002) and Sambasivan & Soon (2007) who found shortage of material was a factor causing delays and cost overruns in projects.

7. *Subcontractor selection*

Subcontracting has become a great subject to all the practitioners in construction industry due to the common practice of subletting construction works into smaller packages. Several studies conducted in Malaysia have shown that subcontracting practice is creating problems to the construction industry (Assaf et al.,1995; Sambasivan, 2007). There are many subcontractors working under the general contractors particularly for huge projects in Malaysia as claimed by Sambasivan & Soon (2007). But subcontractors are found to be among the top five reasons contributing to project delay.

8. *Site Location*

Remote construction projects introduce many challenges not witnessed in urbanized locations. The difficulty faced by construction contractors when trying to staff their remote sites was one of the major issues highlighted. Geographical factors perhaps make contractors concerned about acquiring, training and supporting employees to keep productivity at good levels. Difficulty in accessing materials and equipment in remote areas also has a considerable effect on productivity and sourcing options need attention at project planning stages (Al-Momani, 2000).

9. *Contractor's improper planning*

Local contractors often fail to come out with a practical and workable ''work program'' at the initial planning stage. This failure is interrelated with lack of systematic site management and inadequate contractor's experience towards the projects. The consultant only checks and reviews the work program submitted by the contractors based on experience and intuitive judgment. Improper planning at the initial stages of a project manifests throughout the project and causes delays at various stages as supported by Odeh & Battaineh (2002). Only a project that is well planned can be well executed.

10. *Contractor's poor site management*

Contractor's poor site management is one of the most significant causes in causing construction delays (Mydin et al., 2014; Shahsavand et al., 2018). The results of this research indicate that local contractors face deficiency in site planning, implementation and controls. A poor site management results in delays in responding to the issues that arise at the site and thus causes negative impact on the overall work progress.

11. *Inadequate contractor experience*

Inadequate contractor experience was an important factor, and this could be linked to the contract awarding procedure where most projects were awarded to the lowest bidder. A contractor with inadequate experience cannot plan and manage the projects properly and this can lead to disastrous consequences (Odeh & Battaineh, 2002).

Overall, Table 7 shows the comparisons between result identified from challenges and cause of delays in telecommunication tower construction project for this study. This is based on top ten (10) overall ranking of the cause of delay.

Table 7: Comparisons between challenges and barriers with the cause of delay based on top ten (10) overall ranking.

Challenges	Cause of delay (Based on top 10 ranking)
One Stop Center / Agency Government Agency Land Office District Council MCMC Regional Development Agency Landowner	External causes One Stop Center / Agency
Vandalism Natural disaster - Flood	External causes Weather condition Site location Client related causes Financing and payments of completed work Labor and equipment category causes Labor supply Material related causes Shortage in material Contractor related causes Subcontractor selection Improper planning Site management Inadequate contractor experience

Conclusion

The aim of this study was to understand the challenges the occurred in telecommunication tower construction which resulting to the project delays by taking 65 sites in Pahang and Kelantan states of Malaysia as the case study. This paper presented the challenges and barriers faced in constructing the telecommunications towers. Thirty (30) causes of delay were identified through the research and categorised into eight (8) main groups. The study concludes that causes of delay are related to external causes which are weather condition, One Stop Center / Agency and site location; client related causes which are financing and payments of completed work and labor; equipment category causes which is labor supply; material related causes which is shortage in material and contractor related causes, which are subcontractor selection, improper planning, site management and inadequate contractor experience. While the study does not offer any guarantees a quick solution to solve the issues on challenges and causes of project delays, but researcher belief that significant strategies could be formulated through this study in order to avoid delay and its consequences. The findings also highlight about the time overrun gap that still exist in the construction industry, specifically in telecommunication tower construction project in Malaysia.

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Investigating Level of Awareness on Carbon Emission among Malaysia Construction Players

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Abstract
The construction industry has become one of the world's biggest carbon emitter with the rapid urbanization process and rapid economic growth. It is actually believed that the built environment is a major contributor to a nation's Carbon emissions. Carbon emission can be defined as the release of carbon into the atmosphere through construction activities such as combustion of fossil fuel and cement production in the construction industry which thus leads to an increase of greenhouse gas emissions. The aim of this research is to increase an awareness on carbon emission among construction players in Malaysia. This research will study about the the level of awareness on carbon emission among Malaysian construction players. Out of 385 questionnaires set out, a total of 382 surveys have been received from targeted respondents which are Architects, Engineers, Quantity Surveyor, Project manager and Contractor in the area of Klang Valley. All the data received were thereby analysed and interpreted using SPSS tool. From the data analysis, the main factors determined behind a lack of awareness for carbon emission among construction players are the lack of green initiatives, lack of knowledge and experience and involvement of government. Henceforth, this research is expected to raise an awareness regarding the carbon emission issues from construction industry.

Keyword: *carbon emission, construction players, level of awareness*

Introduction

The building industry is now one of the world's biggest carbon emitter with the accelerated urbanization and rapid economic expansion (Shen et al, 2016; J.Chen et al, 2017). It is actually believed that the building sector is a major contributor to a nation's Carbon emissions (Huang and Bohne, 2012). Carbon emissions connected to the construction industry include carbon production from the built environment's operational stage which is known as operational carbon emissions and carbon emissions from other stages, such as stages of material production and construction. The amount of carbon release in a building is assumed to rise in the long run from a life cycle analysis compared to its operating carbon emissions (Ibn-Mohammed et al., 2013). This is because several energy efficiency methods have been adopted to reduce operating energy and the related pollution. In addition, these energy efficiency innovations may raise the level of renovation of buildings and thus trigger more Carbon pollution (Hamilton-Maclaren et al., 2009; J.Chen et al, 2017).

Subsequently, the construction sector is expected to contribute more than 31% of global emissions by 2020 and 52% by 2050 (Y.Lu et al, 2017). During a building's life cycle, the energy and building-related construction used can consume between 10% and 60% of the total energy used. (Y.Lu et al, 2017) . For example, about 23 % of overall carbon emissions in Australia are the product of the building sector's energy demand and as for the construction activity in the United States (U.S.), it accounts for 40% of carbon emissions from non-transport mobile sources and emissions from construction equipment.

Nevertheless, the construction industry generates carbon dioxide in the atmosphere in different ways such as carbon dioxide is commonly used as compressed gas for pneumatic system; to control and transmit energy, which is universal in constructive applications. Moreover carbon dioxide in the atmosphere, is used to protect weld puddle from the surrounding air and from oxidation and it also helps to ensure hardness and rigidity while manufacturing cast molds. Consequently the emission of carbon dioxide from construction industry is through building processes such as extraction, manufacturing, transportation, construction phases, maintenance and disposal.

According to a recent study, buildings worldwide consume three billion tons of raw material every year and produce 10-40% of solid waste in all countries (R Soetanto, 2014). In Malaysia, statistics indicate that the buildings represent around 20% of green-house gas emissions from materials used that are mainly fossil fuel. As result, the country's construction sector accounts for 24% of total carbon dioxide production. Malaysia is thus rated 30th in the world among countries which contribute to the highest level of carbon emission.

Therefore, building sector must inescapably replace its historic operating procedures to a revolutionary way which makes environmental issues the highlight of its initiatives, with little regard for environmental impacts. The initial step starts with the construction industry to work and meet environmental protection and sustainability needs (Gan, X., Zuo, J., Ye, K., Skitmore, M., & Xiong, B. 2015). This concept is to influence how a project is conducted in order to build a healthy environment through efficient resources and to strike a balance between environment protection and preservation of the stability of development.

In a nutshell, the purpose behind this research is to raise awareness about the carbon scheme in the construction industry and to explore deeply about the ways that the construction sector release carbon in the atmosphere. Thus it also includes potential suggestions to overcome this issue in the industry so as to protect the built environment by the concept of minimizing carbon emission.

Background of Research

Carbon emission has been a serious issue in the construction sector for the past few years, attracting the world’s attention (Lu et al, 2016). As a major sector with high development and pollution (Yan et al., 2017), the construction industry accounts for around 36% of global emissions. According to recent studies, China is the world's largest emitter of carbon with its 9.1 billion tons resulting in 27.6 % of the global total in 2016 (BP p.l.c, 2018). Henceforth to address this situation, at the 2009 Copenhagen Conference, China's government initiated a target of 45% reduction in carbon intensity from 2005 to 2020 (Wu et al., 2016). On the other hand, according to statistics in Malaysia, the buildings account for about 20% of the output of GHGs compared to transport which represents 27% and 21% for the industries. The building materials used, compose mainly of fossil fuels which thus results in 24% of total carbon comes from the country's building industry (Samad M. et al, 2008). In fact, in both developed

and developing countries, buildings are responsible for more than one-third of total energy uses and related GHG emissions in society. As result, despite the fact that the construction sector plays an important role in the economic sector of a country, it however contributes to the emission of greenhouse gas in the atmosphere, leading to severe effects such as global warming and ozone depletion.

Subsequently, there are two types of Carbon Emission in the construction sector which are direct and indirect emission. Direct carbon emissions are those from on-site construction operations such as construction, maintenance or demolition while indirect carbon emissions are emissions resulting from the supply of construction operations with both products and services such as upstream operations like manufacture of bricks (kokoni and Skea, 2014). Those emissions are actually contributed to the atmosphere by various causes. Thus, it is important to highlight those factors leading to an increase in carbon intensity in the atmosphere so as to raise awareness of the construction players in the respective industry.

Well, the basic emission of carbon in construction sector is the production of building materials followed by energy consumption. Transportation is another major contributor of carbon especially plant machineries through the combustion of fossil fuels. Buildings are actually a major consumption of energy, generated from burning of fuels, for electricity production which therefore released carbon dioxide. Majority of these carbon production are from burning of fossil fuel to be used as a source of heat, light and cooling, as well as power & electrical appliances. According to some research in U.S, buildings are responsible for 39% of carbon emission and use 70% of electricity. By the next 10 years, carbon emissions from buildings are projected to grow faster than any other sector - 1.8% annually by 2030. The consequence is an even greater impact on the environment when considering certain carbon emissions due to construction, such as pollution from the manufacturing and transportation of steel structures and demolition materials and transport associated with urban sprawl. Consequently, buildings last 50 to 100 years and consume energy continuously which then produce Carbon emissions, affecting the climate and provoking global warming.

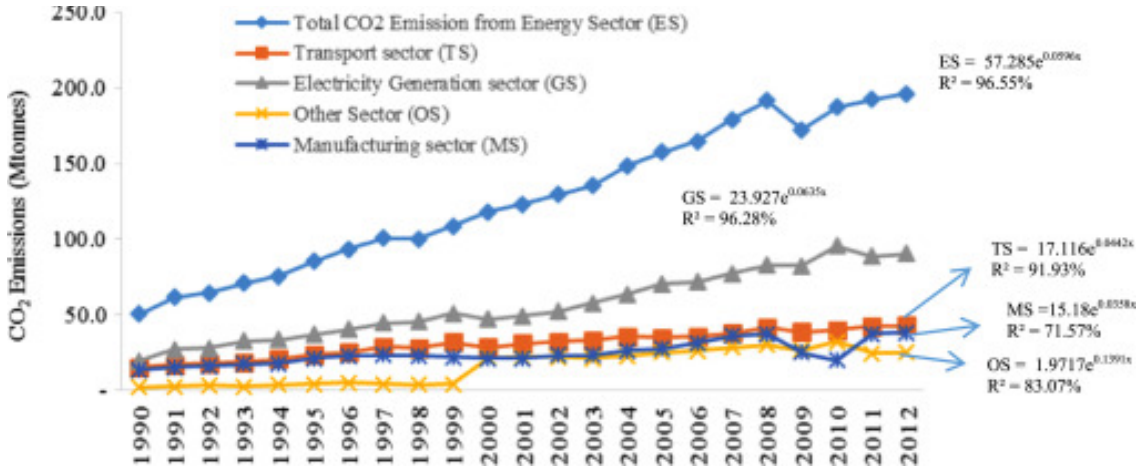

Figure 1: Carbon production representation from energy sub-sectors in Malaysia (1990–2012). Source: IEA (2014b).

Figure 1 shows a graphical representation of carbon emissions from different sector of energy consumption in Malaysia. It can thus be seen that over the past years, the carbon emissions have been increasing in the energy sector of Malaysia; accounting for 196 million tons of carbon production in 2012. The main sectors provoking this increase are electricity generation (46%), transportation (22%), manufacturing (19%) and others such as residential and industrial (13%).

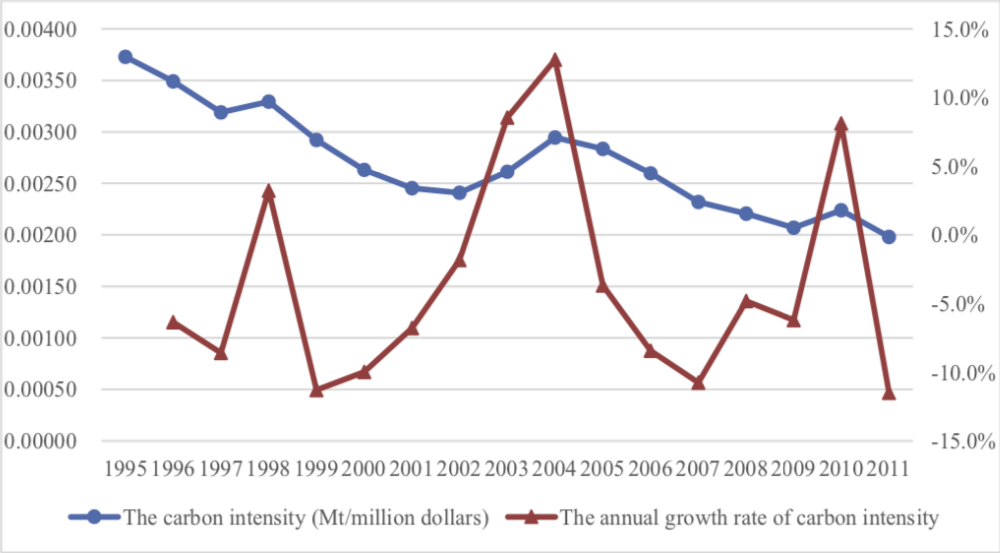

Figure 2: The annual carbon intensity and their growth rate in the construction industry Source: IEA (2014b).

It is possible to determine the annual carbon intensity and its rate of growth in the construction industry from 1995 to 2011, as shown in Figure 2. From the study, during the period 1995 to 2011 the Chinese construction industry's carbon intensity reduced from $0.00373 Mt / million to $0.00198 Mt / million, resulting in a mean annual fall of 2.9%.

The construction players were the one targeted to increase knowledge and practice of this concept. Henceforth sustainable construction is a way to raise awareness of public concerning the CO2 pollution. Likewise, international conference held in the construction industry helps to increase the knowledge as well as interest of construction players about the strategy of reducing carbon pollution. As result, these components are crucial in increasing knowledge on the side effects of carbon emission in construction industry.

On the other side, the reasons why the construction players are not aware of this topic are mainly because of a lack of enforcement and lack of building codes and regulations. Despite Acts concerning the environment such as the Environmental Protection Act, due to lack of monitoring and enforcement, people do not bother to consider the need for sustainable development (Vineeta Singh, 2014) to reduce

the impacts of carbon emission. Since many years ago a concept of sustainable development has been launched in Malaysia, but this concept still focuses less on the parties in the construction industry. Although the government of Malaysia has initiatives to promote sustainable construction so as to overcome the issue of carbon emission, laws and legislation are still lacking in enforcement and supervision. In addition, the majority of development plans take a long time for local council approval. Normally, the approval process is complicated to achieve sustainable development, so developers are not prepared to waste time and money in the implementation of the concept. Therefore, the government has to establish new regulations or statue so that the players in the construction industry will care to consider reducing the carbon emitted by the adoption of sustainability. Because of poor regulations and policies, entrepreneurs are not ready yet for green practices to minimise carbon pollution, but sustainable building is always identified as a major industry to expand. As a result of the lack of strict law about the matter of obligatory regulations, standards or protocols for green buildings, construction players are not conscious of carbon emission in construction sides.

It can be concluded that it's high time for the construction industry to take action concerning the amount of carbon released since they are responsible for the largest emission. Henceforth the aim of this research is to grant a clear vision of Carbon Emissions in the construction industry as well as to study on the level of awareness among construction players.

Carbon Emission – An overview

Carbon dioxide (CO2), also known as a greenhouse gas, is a colorless, odorless and non-toxic gas produced from coal combustion and through breathing of living organisms. Emissions are the emancipation into the atmosphere of greenhouse gases or their precursors over a particular region and time span. Carbon emissions from construction activity are the release of toxic carbon resulting from fossil fuel combustion and cement production; they include carbon dioxide emitted during heavy, fluid and gas fuel consumption and also flare stack.

According to Marc Lallanilla (2019), Carbon Emission is the production of a greenhouse gas in from construction phases that absorbs and emits radiant energy within thermal infrared range. Corinne Le Quéré et al, (2018) defines carbon emission as release of carbon from activities such as combustion of fossil fuel from construction sector. Referring to CP Ramesh et al, (2018) statement, Carbon Emission is the overall Carbon released from individuals, events, organizations and communities. According to Makoto et al, (2015), Carbon dioxide emissions are those resulting from fossil fuel combustion and cement manufacturing in the construction part. J.Watkins, (2012) elaborates carbon emission as production of a natural gas which is a by-product of combustible and biomass, land-use changes and other industrial procedures. As per F.Ascui et al, (2012), Carbon Emission is an estimation of total carbon emancipated globally to the atmosphere. M.Brander (2012) states that Carbon is a natural gas in the atmosphere and results from human actions like combustion of fossil fuel and thus increasing concentration of GHGs. T.Wiedmann (2007) interpreted Carbon Emission as a certain amount of

gaseous production which provokes climate change through human activities. According to B.Mertz et al 2005, it is the capture and storage of carbon which composed of separation of carbon from industrial and energy-related sources to a long-term atmospheric isolation.

In a nutshell, Carbon Emission can be summarised as the release of carbon into the atmosphere through human activities in the construction industry such as combustion of fossil fuel and cement production where it is stored thereby increasing the concentration of greenhouse gas emission.

Table 1: Level of awareness on carbon emission among Malaysia construction players

No.	Factor / Author	Jun Li et al (2009)	A.Sourani et al (2011)	S.Balasu-bramanian (2012)	M.Samari et al (2013)	TJ.Wen et al (2015)	S.Durdyev et al (2018)	Times referred
1	Lack of knowledge & experience		✓	✓	✓		✓	5
2	Lack of incentives/ interest				✓	✓		2
3	Involvement of government	✓	✓		✓	✓	✓	5
4	Lack of technology and expertise	✓	✓	✓	✓			4
5	Lack of green initiatives			✓	✓			2
5	Shortage of demand from stakeholders and requirement		✓		✓		✓	3
6	Poor organisational culture			✓				1
7	Insufficient research and development	✓	✓				✓	3
8	Lack of building codes and regulation				✓			1

The level of awareness among construction players concerning carbon emission and hence sustainability can be determined. The above table consists of factors that contribute to a lack of awareness among the players in construction industry. The main reason behind a lack of awareness of this issue is due to lack of knowledge and experience followed by involvement of government and lack of technology and expertise. According the mentioned authors, other reasons such as lack of incentives, lack of green initiatives, shortage of demand from stakeholders, poor organizational culture, insufficient research and lack of building codes with regulations are also considered to be barrier to sustainable development to prevent carbon emission.

1. *Lack of Knowledge and Experience*

It has been indicated that developers have poor knowledge of sustainable development and sustainability. A decade ago, environmental issues were not relevant and education was not given

priority. However, the new generation is exposed to sustainable building, but they have problems spreading the theoretical understanding of sustainability knowledge into practice so as to raise awareness of carbon emission. In Malaysia, technology lacking is one of the obstacles and some green technologies and materials are hard to get. Technologies for the construction of solar panels and grey water systems, for example, have to be imported from abroad. As a result, sustainable construction is increasingly difficult to develop and hence making it difficult to explain on reduction of carbon emission. One of the obstacles to implementing sustainable development is the lack of expertise in sustainable design. Most architects and designers lack knowledge and experience in this field (Kibert Charles J, 2016). This concept is therefore limited in understanding and takes more time to learn and design sustainable buildings which therefore leads to the reason for poor knowledge of carbon emission. The limited number of professionals who are experts in the concept prohibit the company from including the sustainability in its design. They lack the know-how to offer effective suggestions and recommendations for sustainable design and contractors will not take the risk of building green building due to the lack of expertise in sustainable construction. Henceforth the designers or consultants must propose a good quality design within the budget of the project so that clients can accept the proposal.

2. *Involvement of Government*

The lack of involvement of the government in encouraging policy and regulatory enhancement is also a major obstacle to the implication of sustainable concept which therefore makes the construction players to neglect the matter of carbon production in the sector. It is assumed that the government should play a major role in reducing carbon emission through measures such as strong legislative enforcement, the development of new policy, or incentives for developers seeking sustainability in their projects. The developer needs to be aware that sustainability will add value to modern development while minimising the side effects of carbon in construction sector and that the public is willing to pay higher entry costs to benefit from this privilege. According to Shaikha AlSanad (2015), it is recommended that the government should continue the incentives for the construction industry to implement sustainable green construction so as to raise awareness of the fact that carbon emission level in construction industry has become a serious issue until the necessary rate of demand for green construction is reached.

3. *Lack of Technology and Expertise*

It has been indicated that developers have poor knowledge of sustainable development and sustainability. A decade ago, environmental issues were not relevant, and education was not given priority. However, the new generation is exposed to sustainable building, but they have problems spreading the theoretical understanding of sustainability knowledge into practice. In Malaysia, technology lacking is one of the obstacles and some green technologies and materials are hard to get. Technologies for the construction of solar panels and grey water systems, for example, have to be imported from abroad. As a result, sustainable construction is increasingly difficult to develop. One of the obstacles to implementing sustainable development is the lack of expertise in sustainable design.

Most architects and designers lack knowledge and experience in this field (Kibert Charles J, 2016). This concept is therefore limited in understanding and takes more time to learn and design sustainable buildings. The limited number of professionals who are experts in the concept prohibit the company from including the sustainability in its design. They lack the know-how to offer effective suggestions and recommendations for sustainable design and contractors will not take the risk of building green building due to the lack of expertise in sustainable construction. Thus, this act as a barrier to raise awareness of carbon emission through sustainability globally.

4. *Shortage of Demand from Stakeholders and Requirements*

Construction industry stakeholders usually include a diverse range of people and organizations, including customers, governments, contractors, architects and the community. A lack of awareness of Carbon emission in Malaysia is also due to stakeholders who do not make the decision-making of sustainability their priority so as to reduce the carbon production. Market lacks and community demands have also been identified as a major barrier to implementing the concept of sustainable housing (Bon-Gang Hwang, 2012). It can be said that in Malaysia, the development of sustainable building is still prohibited by many obstacles. High building costs for sustainable homes are the main reason. As a result, there is no strong financial background for many companies to consider carbon reduction projects. In order to raise awareness of carbon pollution and to promote this concept to minimize the carbon emission, as discussed above, it is high time for the government to take an action in enhancing new rules and regulations which will encourage stakeholders to consider the implementation of sustainability in their projects so as to attract worldwide attention concerning the carbon issue.

Methodology

The method applies to the data obtained which will be focused on the research goal of raising awareness among construction players in Malaysia on the Carbon Emission issues in construction industry. This chapter will thus clarify every single component involved in carrying out this research. Questionnaires will be distributed in order to receive feedback which will be considered for the accuracy of the research. The two ways of data collection to be used for this research study are mainly primary data and secondary data.

For this research, the methods used are extensive literature review and quantitative analysis whereby questionnaires were designed and distributed to receive response which would be considered for the outcome of the research. Henceforth, the research was first carried out by an extensive literature review whereby secondary data such as journals and articles were used as references to expand a deeper understanding and obtain further details for the research, followed by quantitative method. Table 2 shows a clear understanding about how the methodologies were used for the objectives of the research.

Table 2: Research Objectives and Methodologies

No	Objective	Methodology
1	To identify the factors contributing to carbon emission in construction activity	Extensive literature review and Quantitative methods
2	To determine the implication of carbon emission to the construction activity	Extensive literature review and Quantitative methods
3	To investigate the level of awareness on carbon emission among Malaysia construction player	Extensive literature review and Quantitative methods

Secondary data collection consists of data which has been previously collected and this form of data is known as past data which is generally accessible through past investigations, government documents, and other resources. For this research the secondary data are obtained from extensive literature review such as articles as well as journals which were analysed and used in order to attain the objectives of the research. Figure 3 shows the total number of journals referred for this research as well as the year published.

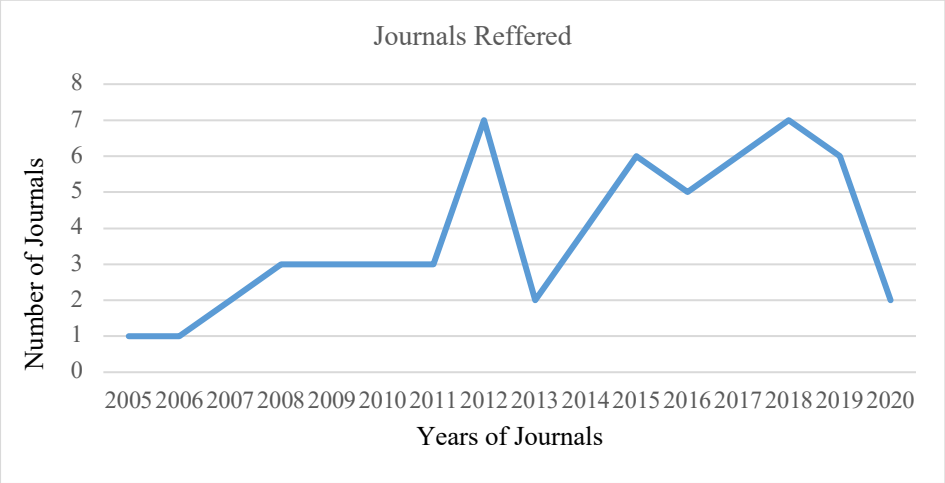

Figure 3: Total Journals referred

Primary data collection can be broken down into two categories: qualitative and quantitative. Quantitative methods of collecting data are based on questionnaires while qualitative methods are based on interviews. As discussed above, the primary data collection method used for this research is quantitative one as the results are normally easy to present, summarize and compare.

According to the scope of the research the target respondent are construction players such as Architects, engineers, project managers, site supervisors and quantity surveyors. The area intended for the research is in Klang Valley which includes districts such as Petaling, Putrajaya, Kuala Lumpur, Klang, Gombak and Hulu Langat. Referring to Krejcie & Morgan table 3, for a population of one hundred thousand, a total of 384 surveys are required. Therefore, a sum of 385 questionnaires were set out randomly to respective respondent.

Table 3: Sample size for population

Source: Krejcie & Morgan (1970)

Table for Determining Sample Size for a Given Population

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	246
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	351
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	181	1200	291	6000	361
45	40	180	118	400	196	1300	297	7000	364
50	44	190	123	420	201	1400	302	8000	367
55	48	200	127	440	205	1500	306	9000	368
60	52	210	132	460	210	1600	310	10000	373
65	56	220	136	480	214	1700	313	15000	375
70	59	230	140	500	217	1800	317	20000	377
75	63	240	144	550	225	1900	320	30000	379
80	66	250	148	600	234	2000	322	40000	380
85	70	260	152	650	242	2200	327	50000	381
90	73	270	155	700	248	2400	331	75000	382
95	76	270	159	750	256	2600	335	100000	384

Note: "N" is population size
"S" is sample size.

Source: Krejcie & Morgan, 1970

After receiving the targeted response, the data obtained will be analysed and represented as chart and table form to provide a clear vision of the outcomes for this research. In this way, the accuracy of the research objectives shall be determined.

Data Analysis and Finding

Referring to Figure 4 and Table 4, lack of green initiatives was the factor with the highest positive response, which demonstrates that it is one of the major reasons behind a lack of awareness of carbon emission among construction players. From the data collected and elaboration, for each factor behind the lack of awareness of Carbon Emission in construction industry the overall mean, median and standard deviation have been calculated and represented in Table 5 and figure 5 respectively.

Table 4: Level of awareness on Carbon Emission

Factors	Strongly Disagree	Disagree	Moderate	Agree	Strongly Agree
Lack of knowledge & experience	13	17	37	161	134
Lack of incentives/ interests	4	15	48	195	100
Involvement of Government	8	10	59	155	130
Lack of technology & expertise	4	21	41	181	115
Lack of green initiatives	13	11	39	168	131
Shortage of demand from stakeholders & requirements	4	18	46	190	104
Poor organizational culture	6	10	65	180	101
Insufficient research and development	8	18	41	184	111
Lack of building codes and regulation	14	9	54	170	115

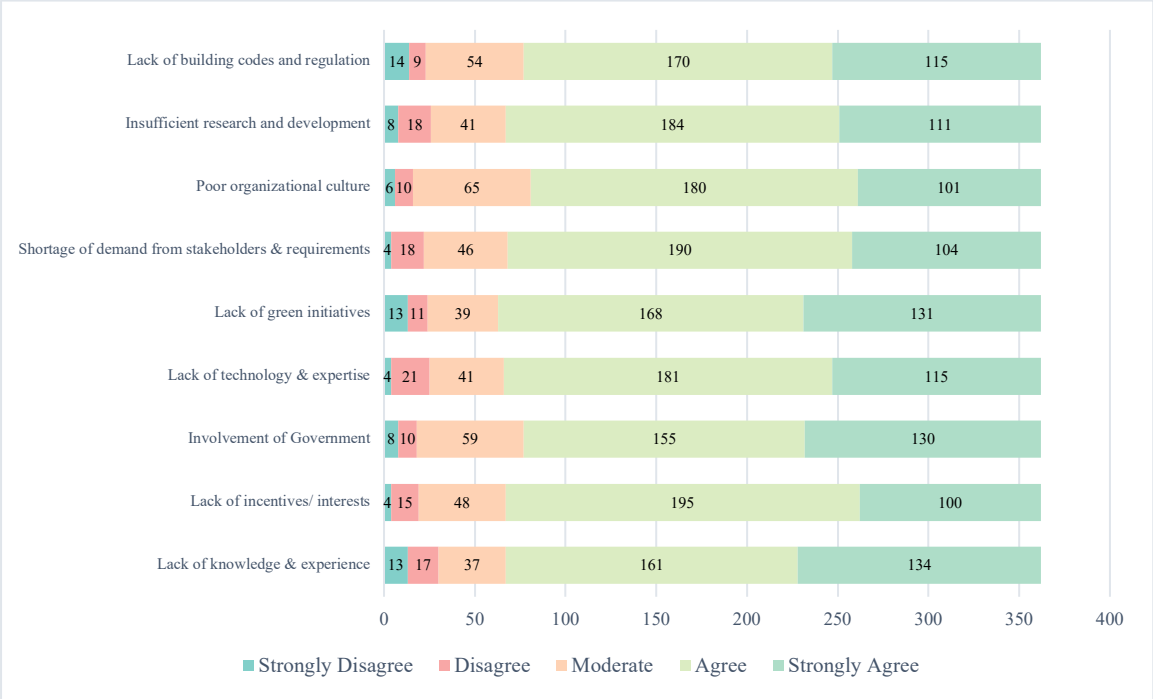

Figure 4: Graphical representation of overall data

Table 5: Mean, Median and Std deviation of 3rd Objective

Factors	Total	Mean	Median	Std Deviation
Lack of Knowledge	362	3.97	4.00	1.017
Lack of Incentives	362	3.96	4.00	.874
Lack of Government involvement	362	3.98	4.00	.953
Lack of Technology	362	4.00	4.00	.910
Lack of Green Initiative	362	3.99	4.00	.996
Shortage Demands	362	3.96	4.00	.911
Poor Organization	362	3.92	4.00	.888
Insufficient Research	362	3.98	4.00	.938
Lack of Building Code	362	3.93	4.00	.988

Figure 5: Graphical Representation for Mean, Median and Std deviation

Conclusion

The level of awareness on carbon emission among Malaysia construction player has been set as the last objective of this study. In order to find a solution to reduce overall carbon emission level, it is necessary to investigate the reasons behind a lack of awareness of this issue among the construction

players. Therefore, the prime causes behind a lack of awareness on carbon emission are lack of incentives/ interests, lack of technology and expertise, lack of green initiatives and insufficient research and development.

Most of the people are aware of this carbon emission issue indirectly hence they do not feel, however, that this issue should be in their list of priorities and sustainable construction should be incorporated into their projects. There is low demand for sustainable buildings as companies still want to buy a conventional building because of the lower price (Ashiru Bello, 2014). Secondly, In Malaysia, technology lacking is one of the obstacles and some green technologies and materials are hard to get. Technologies for the construction of solar panels and grey water systems, for example, have to be imported from abroad. As a result, sustainable construction is increasingly difficult to develop. Thus this act as a barrier to raise awareness of carbon emission through sustainability globally. The lack of green initiatives is another barrier of carbon emission awareness; without the concept of sustainable construction, construction players ignore the risk factors of carbon production in construction activity. Lastly, insufficient research and development in construction industry is one of the prime reason for a lack of awareness on carbon emission as construction players are not exposed much to the facts of carbon issue in the daily life activities which thus leave them in ignorance of this global issue's seriousness.

The recommendations can be made are given that can be useful for further research. First of all, to reduce carbon emission from buildings, caused by heating, air conditioning, hot water or lighting, new low-energy buildings need to be built as well as existing buildings need to be renovated (Hussein Abualrejal, 2017). The concept of green building is to implement renewable source of energy such as wind and sun in order to prevent carbon emission by the combustion of fossil fuels to generate energy. Well buildings should be planned and constructed in the proper direction so as to minimize use of energy (M Zhu, 2012). For example, to maximize the use of daylight to prevent the use of lighting during daytime and to adopt insulation material such as double-glazed windows for buildings so as to prevent energy loss.

Secondly, the government should initiate leadership roles by introducing green-related regulations and take into action projects to implement sustainable building henceforth reducing carbon emission. Governments around the world have introduced a number of regulations to reduce the environmental impact of construction, such as setting environmental standards for materials and technologies (Shi et al., 2013), setting fines for non- compliance and environmental accidents (Qi et al., 2010) and taxing landfill (Pitt et al., 2009; Jaillon et al., 2009). Government should also provide and facilitate financial incentives with favourable terms for green construction (Robert Woodbury, 2009). Simple actions by the govt such as raising campaign to educate the public about the current issue of global warming and hence to support green construction can make a significant difference.

To reduce carbon emission by construction waste disposal, waste reduction can be through standardization and prefabrication; on-site segregation through multi-skip supply; supply recovery schemes; intensified site education; and use of incentives to lead to improved waste management.

In a nutshell, a legal framework needs to be put in place with respect to the carbon emissions standards around different types of buildings, intended use and location. This should relate to life cycle analysis of the construction materials used, disposal of materials at the end of its useful life, health hazard and toxicity following disposal and durability of materials.

Local production and locally available materials should be favoured in as much as possible to avoid GHG emissions related to transportation. Furthermore, there should be a standardised code of construction that should be promoted and incentivised to allow compliant bidders a margin of preference especially on governmental projects and to a slightly lesser extent to the private sector. Nevertheless, a database of GHG emissions should be set up and those owners of 'green buildings' should have a form of income tax credits or long-term loans at cheap interest rates. All construction sites should have an environmental specialist that reports on the GHG emissions throughout the construction. Therefore, by using these methods and recommendations, it will raise the awareness and consciousness of construction players towards carbon emission in construction industry and hence will be useful towards the target of reducing the level of carbon production from construction activity.

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An Overview Of The Influence of Transformational Leadership on Innovation Adoption Among Malaysian Construction Companies

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Abstract

This paper is an overview on the influence of transformational leadership towards innovation adoption among Malaysian construction companies. The Malaysian government has always been pushing for innovation adoption among construction companies but this effort has always been hammered by the lack of support from industry players due to varies of reasons. The review of literature has identified that leadership within the organization plays an important part in innovation adoption to be successful. The research used a quantitative method for its methodology through a structured questionnaire survey as its instrument. Malaysian Grade G7 construction firms were the respondents. Findings from the survey found variables such as transformational leadership, perceived use, ease of use, satisfaction, and continual improvement had a strong influence on adoption intention for these construction companies.

Keywords: *Transformational Leadership; Innovation adoption; Malaysian construction companies*

INTRODUCTION

In Malaysia, the construction industry plays a major role in contributing to the nation's growth and social development. At the end of 2015, the Malaysian government came up with a revised version of the CIMP and rebranded it the Construction Industry Transformational Programme (CITP) 2016 – 2020. Inside the second master plan also contained the nation's agenda to continue improving quality practice and innovation adoption. Based on this national agenda, it provided the researcher a strong purpose and research agenda for the study.

Firstly, the Malaysian construction sector has been encouraged to solve the quality problems through the adoption of innovative processes and products. The construction firms initially were merely encouraged to implement the ISO 9001:2000. CIDB resorted to downgrading the construction firms' registration grade if they do not obtain the ISO certification. A downgrade means that the affected companies could not tender for construction projects with monetary value category associated with the former higher-grade status. As a result, the number of construction firms that have obtained the ISO certification had increased (Mohammed & Asmoni, 2006).

Malaysian regulatory bodies in the construction industry frequently use compulsion to get various stakeholders to adopt new practices that are perceived to improve the industry. This is done through regulations and legislation on the professional registration, business registration, continued work operations or eligibility etc. of these parties. Examples of such regulations are the compulsory

participation in Continuing Professional Development participation for the practice licence renewal for professional architects, surveyors and engineers. Another example is the regulation for project contractors to have safety plans for their work. The regulation that is relevant to this study is the need for CIDB registered contractors to adopt ISO 9001:2000 to maintain their operating licence. This standard is continually improved. Hence, there are upcoming versions of ISO 9001. It is argued that compulsion will cause the affected parties to only perform the minimum actions to adhere to the requirement. In the case of the process innovation called ISO 9001:2008, the contractors may not upgrade to the improved ISO 9001:2008. This is because CIDB does not state the compulsory use of improved versions of 9001:2008. Thus, there is a need to be informed as the factors that would make these parties to go beyond the minimum compulsory requirements (Feurtey et al., 2016; Rossi et al., 2016).

Secondly, there are many past studies on leadership. Likewise, there are many theories of leadership. The established theories on the importance of considering the leader, followers and decision-making in forming effective leadership. However, the literature on leadership in construction is fairly limited when compared with the large amount of leadership research in other industries. A review of past literature indicated that transformational and transactional leadership related to construction found in (Aga et al., 2016; Hoffmeister et al., 2014; Tyssen et al., 2014). This shows that more on researches on these two charismatic theories are needed.

Thirdly, past research literature on innovation adoption and diffusion is abundant but limited in the construction field. Innovation adoption research commonly use a cross-sectional approach where the mediating and moderating influences of external variables on the innovation adoption are investigated. An alternative approach to innovation adoption research is from the perspective of the intention to adopt the innovation. Yet another alternative approach to innovation adoption research is from the perspective of the intention to adopt the innovation. There is a continual stream of studies on the technology adoption intentions. Most research were based on the Expectation Confirmation Model (ECM) (Oliver, 1980), the Technology Acceptance Model (TAM) (Davis, 1989), the Theory of Planned Behaviour (Ajzen, 1991) or/and Diffusion of Innovation Theory (Rogers, 2003). Latest articles reporting innovation adoption intention research have tended to use Structural Equation Modelling (SEM) and Partial Least Squares (PLS) modelling (Eboli & Mazzulla, 2012; Ege Oruç & Tatar, 2017; Henderson et al., 2012; Koç et al., 2016; Valaei et al., 2017; Xiong et al., 2015).

Another conclusion regarding research on innovation adoption is the nature of the innovation itself in the research. There are two types of innovations that is product innovations and process innovations (Edquist et al., 2001). A category of innovation that has not been researched in the past is the innovation that is basically an upgrade or improved version of a currently used product or process.

Past researches on innovation adoption in the construction industry have focused on factors that ‘indirectly’ affect innovation activities within organizations rather than the factors that directly cause the innovation activities. The scope of research varies from product adoption to strategies (Alrowwad et al.,

2020; Bhatti et al., 2021; Dost et al., 2020; Kapoor & Dwivedi, 2020; Oduro, 2020; Singh et al., 2020; Watson et al., 2020; Zhao et al., 2021).

Thus, evaluation of the literature highlights several gaps in the body of knowledge. Firstly, there are no research findings on the adoption and adoption intentions of improved versions of a currently used innovation. Secondly, there is no past research findings on intention to adopt innovations in the construction industry. Thirdly, there is no research on leadership styles upon innovation adoption or adoption intentions of construction related processes. Fourthly, there is no past research about the effect of leadership styles on both the adoption intentions and the realized adoption of the improved version of a currently used product or process innovation.

In conclusion, the problem statement can be summarised as follows. Process innovations plays an important role in realizing the goals of the Malaysian Construction Industry Master Plan (CIMP) 2006-2015 and the Construction Industry Transformational Programme (CITP) 2016 – 2020. The CIDB use compulsion to make construction companies to adopt process innovations through the threat of downgrading the registration grade of non-complying companies. However, there is no guarantee that companies would adopt upgrades of process innovations voluntarily beyond the minimum compulsory requirements by CIDB. The evaluation of the literature highlights gaps in the body of knowledge in general and specific to the construction industry. There is no past published research that reported the effect of leadership styles on both the adoption intentions and the realized adoption of an improved version of a currently used process innovation.

The aim of this research is to investigate the driving factors towards adoption of an improved version (ISO 9001:2008) of a currently used process innovation (ISO 9001:2000) among contractors in the Malaysian construction industry.

THE LITERATURE REVIEW

Hence, the evaluation of the literature starts with a review of past research on leadership including those on the construction industry. This is followed by a review of past research on innovation diffusion and adoption including those on the construction industry. Next, the review of past research on intention to adopt innovations is given. Then, past research on leadership influence upon innovation adoption is discussed. Finally, the research gap is described.

The literature on leadership in construction is fairly limited when compared with the body of leadership research done in other industries. Construction industry-related leadership research articles appear in management research journals, leadership journals and journals focusing on management in construction work and engineering. Research articles in these journals either focused specifically on leadership styles; the effect of leadership styles on organisational outcomes such as workers' creativity, project success etc.; and the mediating and intervening role of leadership on organisational outcomes.

Research articles on transformational and transactional leadership include (Alrowwad et al., 2020; Ardi et al., 2020; Bayraktar & Jiménez, 2020; Khattak et al., 2020; Lai et al., 2020; Monje Amor et al., 2020; Shafi et al., 2020; Siangchokyoo et al., 2020). The focus of these studies are either the effect of transactional and transformative leadership styles on organisational outcomes such as workers' creativity, project success etc.; and the mediating and intervening role of role of transactional and transformational leadership on organisational outcomes. However, there was none regarding the direct, mediating or intervening role of transformational, transactional and laissez-faire leadership on the innovation adoption intentions and actual innovation adoption.

Past research literature on innovation adoption and diffusion is abundant. There is evidence of confusion regarding the terms "innovation adoption" and "innovation diffusion" in the past research. It can be argued that innovation adoption is part of innovation diffusion but not vice versa. Innovation diffusion is normally done using a cross-sectional historical documentary analysis approach involving measuring either indexing or keywords because longitudinal studies on innovation diffusion process would seem unfeasible. Innovation diffusion research also investigated the effects of moderating and mediating variables on innovation diffusion.

There is a continual stream of studies on the technology adoption intentions. Most research were based on the Technology Acceptance Model (Davis, 1989) or/and the Theory of Planned Behaviour (Ajzen, 1991) and Oliver's (1980) Expectation-Confirmation Theory. The focus of these past research included consumers, health and waste management. The predominant technology that was the focus of the past research was information and communication technologies.

An approach in the area of research is that regarding the factors that influence the intention to adopt innovations. The initial theoretical basis of this line of research is Technology Acceptance Model (Davis, 1989) and Theory of Planned Behaviour (Ajzen, 1991). The two theories have been used in many contexts such as consumer behaviour, waste management behaviour, health behaviours etc. However, most research was on information and communication technologies. The use of the structural equation modeling and partial least squares modeling in innovation adoption intention research are also becoming popular (Jou et al., 2011; Li et al., 2005; Ooi et al., 2011; Yen et al., 2010).

Another perspective of studying innovation adoption is that of the continual intention to adopt innovations. This refers to the adoption of an innovation and its continual usage. Oliver (1980 Expectation Confirmation Theory (ECT) is a theory used in past research on continual intention to adopt innovations. Most of the past research using this theory focused on the individual's continual intentions to adopt ICT innovations such as (Alraimi et al., 2015; Chen et al., 2013; Kim, 2010; Park et al., 2012). The next area where this theory is most used is this marketing related continual adoption intention research. The research includes (Matzler et al., 2013). Past research using this perspective of innovation adoption that focused on organisations include (Lee, 2010; T.-C. Lin et al., 2012).

A category of innovation that has not been researched in the past is the innovation that is an upgrade or improved versions of a currently used product or process. Computer software such as operating systems, word processing software often offer improved versions to their customers. In many cases, these improved versions are adopted because of the positive experiences with the older versions. However, there are cases where there are groups of people who do not adopt these improved innovations and continue with the ones currently being used. A notable example is the Microsoft's Windows XP computer operating system that was superseded by more advanced Windows operating systems. Groups of people continued to use the Windows XP operating system despite the discontinued vendor support. These groups of people cannot be categorized as adoption laggards in Roger's diffusion of adoption theory. This is because the innovation may not be adopted for non-attitudinal reasons.

Innovation adoption researches commonly use a cross-sectional approach where the mediating and moderating influences of external variables on the innovation adoption are investigated. An alternative approach to innovation adoption research is from the perspective of the intention to adopt the innovation. Latest articles reporting innovation adoption intention research have tended to use structural equation modeling and partial least squares modelling (Jou et al., 2011; Ooi et al., 2011; Yen et al., 2010).

Another conclusion regarding research on innovation adoption is the nature of the innovation itself in the research. There are two types of innovations. These are product innovations and process innovations. Product innovations used in past innovation adoption research included transportation (Jou et al., 2011; Seebauer, 2015), information and communication technologies (Nugroho, 2011; Ooi et al., 2011), manufacturing technologies (Chang et al., 2015; Gao et al., 2012), medical technologies (Hendy & Barlow, 2013), design practice technologies (Panuwatwanich & Stewart, 2012; Ramilo & Embi, 2014) and construction technology (Arora et al., 2014; Hjort & Widén, 2015).

Process innovations used in past research on innovation adoption include medical treatment motivational procedure (Walitzer et al., 2015), design practices (Panuwatwanich & Stewart, 2012), strategic arrangements (Wong & Zapantis, 2013)(Osborn & Marion, 2009; Wong & Zapantis, 2013), manufacturing (Chang et al., 2015) and construction (Kramer et al., 2010).

The categorization of innovations as being product innovation or process innovation is problematic. Some are product innovations also incorporate innovative processes. When a product innovation is adopted, parts of the users' operational processed have to be replaced with ones that are compatible with the product innovation. These processes or procedures are either standard processes bundled with the product or other proprietary customized processes from other vendors. In some cases, the user has to develop process innovations to suit the new product innovation that was adopted. Past research are either vague on the innovation categorization or clearly stated that both categories were used. These research include computer software advanced features (Talukder, 2012), electronic

government (Arduini et al., 2010), logistics (C. Y. Lin & Ho, 2008), supply change management systems (Liu et al., 2010), data processing (Bilal et al., 2016) and construction (Merschbrock & Munkvold, 2015).

Another problematic issue is the definition of the term “innovation” in the past research work. The majority of research focused on new discontinuous innovations. According to (Gao et al., 2012), discontinuous innovations have attributes that the adopters or potential adopters had no prior knowledge of. The need to familiarize with the innovation will influence the user’s perception of the innovation’s ease of use and perceived benefits.

Research on innovation adoption in the construction industry had focused on influencing factors on upon adoption of innovations within organisations. The scope of research varies from product adoption to strategies. Three research approaches to studying innovation adoption and diffusion in the construction. Firstly are the drivers and barriers approach (Arora et al., 2014; Hjort & Widén, 2015; Kramer et al., 2010; Ramilo & Embi, 2014). The second research approach is the innovation adoption enablers approach (Kramer et al., 2009; Merschbrock & Munkvold, 2015). The third research approach is the statistical relationship approach (Wong & Zapantis, 2013).

Most studies use the influences of innovation climate, creativity, tendencies to innovate etc. for studying the effect of leadership upon innovation within organisations across different industries (Alrowwad et al., 2020; Branstad & Solem, 2020; Khattak et al., 2020; Siangchokyoo et al., 2020; Singh et al., 2020; Zach et al., 2020). There is no research on leadership influences upon the innovation adoption in the construction industry found.

THE RESEARCH METHODOLOGY

A quantitative methodology was use for this research to achieve the research aims and objectives. The research instrument used was a questionnaire survey which contained a modified version of the multifactor leadership questionnaire (MLQ) and the expectation confirmation model questionnaire. Prior to using conducting a quantitative method using a questionnaire survey instruments, procedure such as pre-test and pilot test that was carried out in the early stage, the sampling and response rate received from the survey were selected and analysed accordingly, and the validity and reliability testing was done before a final data collection and data analysis could be conducted. The process of analysing the data is done using the Statistical Package for Social Science (SPSS). A breakdown for the instrument is illustrated in Figure 1.

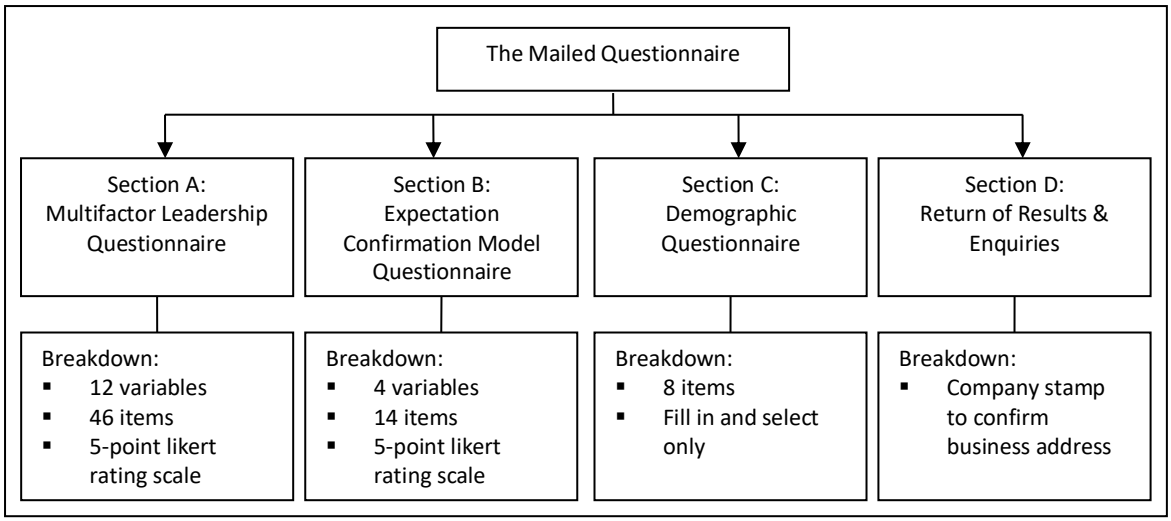

Figure 1: The Research Instrument Breakdown

Each sets of questionnaire contain sixty eight (68) numbers of questions. An introduction and explanation of the purpose of the survey was also included in this questionnaire. In each section also stated the instruction for those answering the questions and objective that is hoped to be achieved. Since Malaysia is considered as non-English-speaking country, the questionnaire was also provided with a Malay Language translation to help ease the response from the respondents.

Table 1: Reliability test result for the research questionnaire survey

No	Items Measured	Cronbach's Alpha
	Multifactor Leadership Questionnaire (MLQ) scales	
1	Transformational Leadership (TFORL)	.90
2	Transactional Leadership (TSACL)	.72
3	Passive Avoidant Leadership (PAL)	.76
	The Expectation Confirmation Model Scales	
4	Perceived Usefulness (PU)	.84
5	Ease of Use (EOU)	.74
6	User's Satisfaction (satisfy)	.80
7	Intention of adopting the improved version (CI)	.71

Table 1 indicates the reliability test for the research instrument. For the Multifactor Leadership Questionnaire (MLQ) scales, the alpha for the five dimension of transformational leadership was calculated to be .90 while for the two dimension of the transactional leadership is .72. Finally for the two dimensions of the passive and avoidant leadership is .76.

For the Expectation Confirmation Model scales, perceived usefulness has an alpha value of .84. Ease of use has an alpha value of .74 while user's satisfaction has an alpha value of .80. Finally for intention of adopting the improved version the alpha value is .71.

FINDINGS

Presented below are some of the findings from the survey conducted.

Company's Demographic Information

Table 2: Year of ISO 9001:2000 Implementation

		Frequency	Percent	Valid Percent	Cumulative Percent
Year of ISO 9001:2000 Implementation	2003 & before	123	33.2	33.2	33.2
	2004 - 2007	163	43.9	43.9	77.1
	2008 & after	85	22.9	22.9	100.0
	Total	371	100.0	100.0	

Table 2 presents the year of ISO 9001:2000 implementations in the respondents company. From the table most of the company started implementing ISO 9001:2000 between the year 2004-2007 (43.9%). This was followed by 33.2% of the respondent company implemented ISO 9001:2000 in 2003 and before. Only 22.9% of the respondent company had implemented in year 2008 and after.

Table 3: Company's Construction Industry Development Board (CIDB) Registration Grade

		Frequency	Percent	Valid Percent	Cumulative Percent
CIDB Grade	G3	1	.3	.3	.3
	G5	12	3.2	3.2	3.5
	G6	4	1.1	1.1	4.6
	G7	354	95.4	95.4	100.0
	Total	371	100.0	100.0	

Table 3 presents the company's CIDB registration grade. Majority of the respondents are registered under CIDB grade 7 (95.4%). Only a handful of the respondent's company is registered in other CIDB grades. They are CIDB grade 6 (1.1%), grade 5 (3.2%) and grade 3 (0.3%). It should be noted that due to the low numbers of respondent in grade G6 and below, these respondents were removed from the analysis of the parametric analysis that will be done later in the process. The reason this table (Table 4.14) was indicated here was to report the original frequency of respondent that contributed towards the questionnaire feedback.

Table 4: Company's Years in Operation

		Frequency	Percent	Valid Percent	Cumulative Percent
Years in Operation	5 & below	14	3.8	3.8	3.8
	6-10	60	16.2	16.2	19.9
	11-15	108	29.1	29.1	49.1
	16 & above	189	50.9	50.9	100.0
	Total	371	100.0	100.0	

Table 4 presents the company's years in operation. Half of the respondent's company had been operating for 16 years and above (50.9%). Those that have been operating between 11-15 years are second (29.1%). Thirdly are those operating 6-10 years (16.2%). Only 3.8% of the respondent's company has been operating within 5 years and below.

Perceived Leadership Practices Among Respondents

Table 5 presents the means and standard deviations for the perceived leadership practice among respondents in the Multifactor Leadership Questionnaire (MLQ). Each leadership component is presented along with the higher level construct of transformational leadership, transactional leadership and passive or avoidant leadership.

Table 5: Perceived Leadership Practises among Respondents

		Respondents	
		Manager	Staff
Idealized Influence Attribute (IA)	Mean	3.81	3.69
	Std. Deviation	.652	.729
Idealized Influence Behavior (IB)	Mean	4.14	3.82
	Std. Deviation	.505	.661
Inspirational Motivation (IM)	Mean	4.27	3.97
	Std. Deviation	.477	.691
Intellectual Stimulation (IS)	Mean	4.15	3.83
	Std. Deviation	.471	.714
Individual Consideration (IC)	Mean	3.87	3.44
	Std. Deviation	.585	.770
Contingent Reward (CR)	Mean	4.21	3.79
	Std. Deviation	.506	.756
Management by Exception Active (MBEA)	Mean	3.90	3.66
	Std. Deviation	.592	.664
Management by Exception Passive (MBEP)	Mean	1.83	2.13
	Std. Deviation	.610	.780
Laissez-faire Leadership (LFL)	Mean	1.69	1.94
	Std. Deviation	.583	.821
Transformational Leadership Style (Tforl)	Mean	4.05	3.75
	Std. Deviation	.402	.613
Transactional Leadership Style (Tsacl)	Mean	4.06	3.73
	Std. Deviation	.432	.641
Passive / Avoidant Behavior (Pal)	Mean	1.76	2.04
	Std. Deviation	.508	.738

Notes: rating scale is 1= Not at All, 2= Once in a While, 3= Sometimes, 4= Fairly Often, 5= Always.

The first five components (Idealized Influence Attribute (IA), Idealized Influence Behavior (IB), Inspirational Motivation (IM), Intellectual Stimulation (IS) and Individual Consideration(IC)) represent the five components of transformational leadership. The means show that there is a small difference between both group manager and staff perception on leadership. On the manager's side, they seem to rate higher (means range 3.81 to 4.27) on the transformational leadership components. While the staff's means ranges from 3.44 to 3.97.

Contingent Reward (CR) and Management by Exception Active (MBEA) represent the transactional leadership components. Referring to Table 4.19, the contingent reward means between managers and

staff are 4.21 and 3.79 respectively. For the management by exception active (MBEA) component, the manager's means were slightly higher compared to with the staff at 3.90 to 3.66.

Finally for the passive or avoidant leadership style, the mean for the construct are Management by Exception Passive (MBEP) and Laissez-faire Leadership (LFL). In Table 4.19, the staff's means are slightly higher than those perceived by managers. For the management by exception passive (MBEP), the staff means compared to managers is 2.13 to 1.83 respectively. Similarly, to this, the laissez-faire leadership means between staff and managers is 1.94 to 1.69.

In terms of overall results from the three-leadership style measured, the transformational leadership style has a mean range of 4.05 and 3.75 for managers and staff. While for the transactional leadership style has a mean range of 4.06 and 3.73 respectively. Lastly, for the passive or avoidant leadership style, the mean for the leadership style shows 1.76 and 2.04 respectively.

In summary, it can be concluded that according to the management level point of view, the perceived leadership style practice indicates a transactional leadership style (mean 4.06). This however shows contrast on the staffs' perceptions side. The staff perceive the leadership style practice by their managers as transformational leadership (mean 3.75). However if we compare the leadership styles based on the respondents on the management level, the mean difference between transformational leadership and transactional leadership is 4.05 and 4.06 respectively. This indicates a very small difference. While on the staff side, the mean difference between transformational leadership and transactional leadership is 3.75 and 3.73. This also shows a very small difference.

Respondent's Perception Towards Intention of Adopting The Improved Version Of ISO 9001:2000

The intention to adopt the improved innovation (ISO 9001: 2008) is argued to be dependent on the users (respondents) perceptions towards their use of the predecessor innovation (ISO 9001:2000). Table 6 presents the means and standard deviation for perception towards intention of adopting the improved version of ISO 9001:2000.

The components are broken down into four main components and they are perceived usefulness (PU), ease of use (EOU), satisfaction (Satisfy) and intention of adopting the improved version (CI).

Table 6: Respondent's Perception towards Intention of Adopting the Improved Version of ISO 9001:2000

		Workers	
		Manager	Staff
Perceived Usefulness (PU)	Mean	3.65	3.56
	Std. Deviation	.935	1.013
Ease of Use (EOU)	Mean	3.64	3.57
	Std. Deviation	.909	.932
Satisfaction (Satisfy)	Mean	3.84	3.82
	Std. Deviation	.811	.915
Intention of Adopting the Improved Version (CI)	Mean	4.08	3.79
	Std. Deviation	.849	.893

Notes: rating scale is 1= Not at All, 2= Slightly Agree, 3= Partially Agree, 4= Agree, 5= Strongly Agree.

The means show that there is very little difference among all four construct between managers and staff. From the table manager seems to have a higher mean range rating compared to their staffs. As we can see in Table 6, intention of adopting the improved version is rated the highest with a mean of 4.08, followed by satisfaction (3.84), perceived usefulness (3.65) and finally ease of use (3.64).

On the other hand, the staffs have a different mean rating with satisfaction (3.82), followed by intention of adopting the improved version (3.79), ease of use (3.57) and lastly perceived usefulness (3.56).

In summary, it can be concluded that the management level has strong intention of adopting the improved version of ISO 9001:2000 but on the staff level satisfaction of the user is important to ensure the adoption of the improved version of ISO 9001:2000.

Correlation Findings

In this section, the Pearson product-moment correlation was applied to look into the strength and direction of the relationship between perceived leadership and intention of adopting the improved version of ISO 9001:2000.

Table 7 presents the results of the Pearson product-moment correlation between Perceived Leadership Styles and intention of adopting the improved version of ISO 9001:2000 by overall. Preliminary analysis was performed to ensure no violation of the assumptions of the normality, linearity and homoscedasticity. The results show many statistically significant relationships. The correlation relationship range from a week r = -.077 to a moderate r = .347.

At the overall level of leadership styles, transformational leadership has a positive weak to moderate relationship with all perception towards adoption intention construct. The ease of use scale being the highest correlated at r = .312 followed by satisfaction (r = .305), intention of adopting the improved version (r = .270) and perceived usefulness (r = .268).

While the correlation for transactional leadership style also indicated a similar pattern of a positive weak to moderate relationship with all perception towards adoption intention construct. The ease of use scale being the highest correlated at r = .347 followed by satisfaction (r = .342), perceived usefulness (r = .331) and intention of adopting the improved version (r = .268).

On the other hand, the passive or avoidant leadership have all negatively weak relationship with all perception towards adoption intention construct. The satisfaction scale being the most negative correlated at r = -.135 followed by perceived usefulness (r = -.104), ease of use (r = -.101) and intention of adopting the improved version (r = -.077).

Table 7: Correlation between Perceived Leadership Styles and Adoption Intention construct by Overall

	Measures	1	2	3	4	5	6
1	Transformational Leadership Style (Tforl)						
2	Transactional Leadership Style (Tsacl)	.810**					
3	Passive or Avoidant Behavior (Pal)	-.332**	-.368**				
4	Perceived Usefulness (PU)	.268**	.331**	-.104*			
5	Ease of Use (EOU)	.312**	.347**	-.101	.647**		
6	Satisfaction (Satisfy)	.305**	.342**	-.135**	.784**	.706**	
7	Intention of Adopting the Improved Version (CI)	.270**	.268**	-.077	.563**	.636**	.705**

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

2. *. Correlation is significant at the 0.05 level (2-tailed).

3. N=371

CONCLUSION

The objective was to determine the influence of five factors on the intention to adopt an improved version (ISO 9001:2008) of a currently used process innovation (ISO 9001:2000) contractors in the Malaysian construction industry. The factors are the leadership style, the users' satisfaction of currently used innovation, the perceived usefulness of currently used innovation, the ease of use of currently used innovation and finally the intention of adopting the improved version of a currently used innovation.

Firstly, findings indicated at the management level point of view, the perceived leadership style practice indicates a transactional leadership style (mean 4.06). This however shows contrast on the staff's perceptions side. The staff perceived the leadership style practice by their managers as transformational leadership (mean 3.75). However if we compare the leadership styles based on the respondents, on the management level the mean difference between transformational leadership and transactional leadership is 4.05 and 4.06 respectively. While on the staff side, the mean difference between transformational leadership and transactional leadership is 3.75 and 3.73. This also shows a very small difference. The mean differences between these two leaderships are very small on both levels.

Bass (1985), Bass & Riggio (2006) and Avolio (1999) have argued that transformational leadership is more proactive and ultimately more effective than transactional leadership, corrective or avoidant leadership in terms of motivating followers to achieve higher performance. Berson & Avolio (2004) indicated that transformational leaders are more capable of sensing their environment and then forming and disseminating strategic goals that capture the attention and interest of their followers. Furthermore, followers of transformational leaders have shown to exhibit higher levels of commitment to their organisational mission, a willingness to work harder, greater levels of trust in their leader and higher levels of cohesion Avolio (1999) . Yet, according to Bass (1985) and Bass & Riggio (2006), transformational leadership is not mutually exclusive from transactional leadership. In other words, some elements of transformational leadership overlap some elements of transactional leadership.

Previous research on transformational and transactional leadership in the construction industry include (Bakar et al., 2015; Kissi et al., 2013; Krista Hoffmeistera et al., 2014). The focus of these studies range from the effect of transactional and transformative leadership styles on organisational outcomes such as workers' creativity, project success etc.; to the mediating and intervening role of role of transactional and transformational leadership on organisational outcomes. Kissi et al. (2013) also undertook case studies on construction projects and found that transformational leadership style positively influence innovation activities through fostering an innovation friendly climate.

This implies a situational usage of these two leadership styles congruent with the contingency leadership concept such as the Contingency Theory of Leadership (Fiedler, 1978) and Path Goal Theory (House, 1996). It may also imply that some aspects of transformational leadership are similar with some aspects of transactional leadership, congruent with Bass (1985). It can be argued that a person engaging strongly in transformational leadership may simultaneously engage weakly in transactional leadership, and vice versa. In other words, transformational and transactional leadership styles are on a continuum.

The premise of the innovation adoption intention is that an individual with an intention to take action will be more likely to realize the action than an individual who has no such intention (Hungerford & Volk, 1990). The findings indicate the means score on perception towards intention of adopting the improved version of ISO 9001:2000 was also high. The four main construct are perceived usefulness (PU), ease of use (EOU), satisfaction (Satisfy) and Intention of adopting the improved version (CI). The mean score show that there is very little difference among all four construct between managers and staff. The manager seems to have a higher mean range rating compared to their staff. In summary, it can be concluded that the management level has strong intention to continue improving the usage of ISO 9001:2000 but on the staff perception's level, satisfaction of the user is important to ensure continuous usage of ISO 9001:2000.

A core responsibility for organisational leaders is to direct followers towards achieving organisational purposes by expressing clearly the organisation's mission, vision, strategy and goals

(Ardi et al., 2020; Khattak et al., 2020; Lai et al., 2020; Monje Amor et al., 2020; Shafi et al., 2020). Leaders at all levels are responsible for the dissemination of strategic organisational goals, as well as for convincing their constitutes to effectively implement those goals (Berson & Avolio, 2004). This may explain the higher scores of the manager on intention of adopting the improved version of ISO 9001:2000 compared to the scores of the workers.

Adopting innovations also helps improve the productivity of business processes (Alrowwad et al., 2020; Branstad & Solem, 2020; Watson et al., 2020; Zach et al., 2020; Zhao et al., 2021). However, innovation technology push is insufficient for improved efficiency and effectiveness of the working environment unless there is clear consideration of the business process and the human issues.

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