

Exploring Infrastructure Project Safety Issues in Malaysia

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Abstract:

Infrastructure plays an important role in a country’s development. However, infrastructure project has been recognized as high-risk and high complexity project. According to the latest occupational accidents statistics published by DOSH, there were 56 death cases reported due to construction projects from January 2021 until October 2021 and this fatality rate was the highest among all of Malaysia’s economic sectors. Hence, it is important to pay attention in infrastructure project safety issues. This research aims to enhance the safety management of Malaysia’s infrastructure project by studying the causes of infrastructure project safety issues, evaluating the consequences of poor safety management in infrastructure projects, and outlining the strategies for minimizing infrastructure project safety issues. Literature review related to safety issues in infrastructure projects had been conducted. Based on previous research, 10 causes of safety issues, 6 consequences, and 7 potential preventions of safety issues in infrastructure projects were discovered. A total of 198 responses were collected from contractors who specialize in highway and rail transit projects Klang Valley. Cronbach’s Alpha Reliability Test and Mean Ranking were adopted for this research study by using SPSS. The most significant cause of safety issues in Malaysia Infrastructure projects was ‘Non-use of Personal Protective Equipment’. Meanwhile, most significant consequence of poor safety management in Malaysia infrastructure projects was ‘Loss of Productivity / Lowering Workers Morale’. On the other hand, most significant prevention of safety issues in Malaysia infrastructure projects was ‘Check and Maintain Personal Protective Equipment Regularly’. This research is able to contribute the output to Malaysia’s ongoing and upcoming mega infrastructure projects. Contractors can reduce the number of accidents in infrastructure project sites by taking prevention strategies that are being studied.

Keywords —Safety, Infrastructure Projects, Construction Industry

I. INTRODUCTION

According to Budget 2022, Malaysia’s Finance Minister announced that RM3.5 billion has been allocated by government for infrastructure projects which include of Pan-Borneo Highway and Central Spine Road in order to simulate the recovering economy. In addition, another RM25 billion has been allocated for maintenance works of existing infrastructure projects (Aziz, 2022). Senior Minister of the Infrastructure Development Cluster, as known as Senior Minister of Works, Dato' Sri Fadillah Yusof mentioned that public infrastructure

project will be a key catalyst of support to dissipates Covid-19 economic crisis. The Minister of Works will focus on public infrastructure improvement by enhance connectivity, comfort and safety for Malaysia economic recovery (Malaymail, 2021). Currently, Malaysia ongoing public infrastructure projects consist of eight highway projects, five railway projects and one hydroelectric dam project (Aziz, 2022). Mass Rapid Transit Circle Line (MRT3), Light Rail Transit 3 (LRT3), Pan-Borneo Highway, and Sungai Besi-Ulu Kelang Elevated Expressway (SUKÉ) are both ongoing public infrastructure projects in Malaysia.

The development of infrastructure project is very important for a country as it brings social and economic benefits. It connects people to their jobs, creates opportunities for struggling communities, enables trade and makes a country becomes more advanced. Moreover, infrastructure provides a socioeconomic rate of return and helps to raise up Gross Domestic Product (GDP) of country according to research of McKinsey Global Institute (Aaron, et al., 2020). However, infrastructure project has been recognised as high-risk and high complexity project as it needs high-cost involvement and high technical skills (KAMAR, et al., 2019). For example, large infrastructure project involves many labours, a lot of materials, large and heavy machineries, complicated construction procedures, complex management activities and so on, hence the accident rate will be much higher than other construction projects (Guo et al., 2013). The occurrence of the accident will not only lead to higher construction costs and delay of the project, but most importantly, cause fatality and injury. Besides that, if an infrastructure project always has an accident happened, people will also lose confidence in Malaysia infrastructure project (Katherine, 2021).

In Malaysia, the government has implemented regulation and legislation regarding safety and health in the workplace such as Occupation Safety and Health Act 1994 – Act 415 (OSHA) which aims to provide a professional legal framework for construction site activities thus promoting higher safety and health awareness among construction community (Zainal, 2019). However, it is not much effective since human behaviours are hardly predicted, and bad decisions may tend to be made especially majority of infrastructure projects are large and complex. Thus, a discussion and analysing on infrastructure project safety issues must be conducted to reduce the impacts caused and to improve the safety management of Malaysia's infrastructure projects.

II. PROBLEM STATEMENT

In construction sites, there are many dangerous hazards such as collapse, working at height and falling down. Site workers are working in these

high- risk workplaces every day. Therefore, health and safety management should always be the most important thing on site. Although Department of Safety and Health Malaysia (DOSH) and Construction Industry Development Board (CIDB) have published some safety measures, rules and regulations that need to be implemented on sites, but construction industry is still one of the risky industries in Malaysia. According to the latest occupational accidents statistics published by DOSH, there were 56 death cases reported due to construction projects from January 2021 until October 2021 and this fatality rate was the highest among all of Malaysia's economic sectors (DOSH, 2021).

Another example is the Sungai Besi-Ulu Kelang Elevated Expressway (SUKE). SUKE is a 24.4km expressway running from Sri Petaling to Ulu Kelang which will complete a ring of networked highways around Klang Valley. It connects few major highways and roads in Klang Valley in order to provide more variable route for road users when travelling across cities. The connected highways include of KESAS highway, KL-Seremban highway, MRR2, Cheras-Kajang highway, DUKE expressway and so on. The completion of SUKE expressway is expected to improve Klang Valley traffic congestion issues during peak hours. However, during the construction of SUKE expressway, there were few accidents happened.

On 22nd March 2021, a construction crane fell and hit a car at SUKE project site. Three site workers were crushed to death and a motorist was injured seriously. For this fatal accident, main contractor and subcontractor were fined RM100,000 and RM200,000 respectively (Zack, 2021). Although penalties and fines were made to main contractor and subcontractor, but deaths and injuries might not be recovered.

It's only been half a year since the previous accident involving SUKE project. Public has lost confidence in Malaysia infrastructure projects, and they were scared to drive below SUKE expressway. An E-hailing driver, Sazali Mat Hassan stated that he was worried to drive or pass by an area where infrastructure construction work is going on especially elevated highway and elevated rail transit

project (Selangor Journal, 2022). Because he was worried if any objects fall down and hit his cars.

Hence, it is important to pay attention in infrastructure project safety issues. Infrastructures are built to improve the quality of our life and transportation convenience. However, if accidents happen frequently on infrastructure project sites, public will worry and lose confidence on Malaysia infrastructure projects. Therefore, it is necessary to study the causes of infrastructure project safety issues, evaluate the consequences of poor safety management in infrastructure projects, and outline the prevention strategies for minimizing infrastructure project safety issues.

III. AIM & OBJECTIVE

This research aims to enhance the safety management of Malaysia's infrastructure project. Therefore, in order to achieve the aim, the following objectives are studied in this research.

The objectives of this research are:

1. To study the causes of infrastructure project safety issues.
2. To evaluate the consequences of poor safety management in infrastructure projects.
3. (iii) To outline the prevention strategies for minimizing infrastructure project safety issues.

IV. LITERATURE REVIEW

With a critical reading for literature review, researcher is able to find out significant variables that are related to the topic, relate theoretical knowledge with problems and questions, identify the sampling method and analysis method used in previous research, get a new perspective and knowledge that relate to researcher's topic (Hart, 2018). The development of infrastructure such as highways, railway systems, airports etc. is very important as it brings benefits to a country's economic growth in both long-run and short-run (Chin, et al., 2021). Inclusive growth from faster economic growth creates job opportunities for the public and helps to reduce poverty. However, infrastructure project has been recognised as high-

risk and high complexity project as it requires large and lumpy investment, long construction period, high technical skills and divers of resources (KAMAR, et al., 2019). Based on previous research, 10 causes of safety issues in infrastructure projects were discovered, 6 consequences of poor safety management in infrastructure projects were discovered and 7 prevention strategies of safety issues in infrastructure projects were discovered

Cause 1: Poor Condition of Working Environment

According to research done, poor condition of working environment will affect the safety and health of worker and increase the risk of accident on infrastructure project sites (Williams, et al., 2017). Based on occupational accidents statistics published by DOSH, work-related injuries and death in construction industry are the highest among all of Malaysia's economic industry due to its 3D nature, which is dirty, dangerous and demeaning.

Cause 2: Poor Supervision

With appropriate supervision on construction site, workers will complete the job more accurately and efficiently as supervisors provide clear instruction and adequate technical guidance to workers. Besides that, good quality of supervision can safeguard construction site safety by ensuring workers are implementing good practices of safety rules (Durdyev, et al., 2017).

Cause 3: Financial and Schedule Challenges

Previous research has shown that financial and schedule challenges are the factors that cause infrastructure project failure (Ikediashi, et al., 2014). Zahoor et al. (2017) stated that insufficient safety budget and unrealistic project duration will increase accident and safety risks. Insufficient safety budget cannot provide a healthy and safe workplace which do not cause harm to site worker and the public (Abrey& Smallwood, 2014). Unrealistic project duration lead to heavy workload and time pressure.

Cause 4: Insufficient Communication

According to Zahoor et al. (2017), insufficient communication within construction team may affect construction site safety and cause accidents. Correct communication within a team can ensure tasks can be carried out by following to required

specifications and also ensure safety guidance has been understood by every worker on site (Rivera, et al., 2021).

Cause 5: Poor Safety Consciousness

Safety cost is usually not priced in Bills of Quantities as a project cost. Based on an interviewee of previous research, clients usually expect higher productivity with minimum cost, and they do not very care about site safety. Therefore, insufficient safety cost provided by clients might affect quality of safety management on site (Zahoor, et al., 2017). These poor safety consciousnesses include of not providing safety training and guidance to workers, insufficient promotion of safety knowledge, not being aware of potential safety risks, and not using Personal Protective Equipment (PPE) (Williams, et al., 2017).

Cause 6: Negligence & Carelessness

Williams et al. (2017) mentioned that carelessness and negligence will cause safety issues and accidents on site. In Malaysia, Occupation Safety and Health Act 1994 – Act 415 (OSHA) is regulation and legislation to ensure safety and health on construction sites. However, there are still some accidents that occur on construction sites due to negligence in complying with safety rules and regulations (Nawaz, et al., 2020). For example, drinking alcohol or taking drugs during work will increase workers' unawareness and affect their decision made.

Cause 7: Defective & Unsafe Machinery and Equipment

Previous research mentioned that defective and unsafe equipment and tools will cause a serious accident and fatal injuries on construction sites (Williams, et al., 2017). According to a fatal accident case recorded in Department of Occupational Safety and Health (DOSH), a construction worker in Perak who was a low loader driver was killed by defective mechanical low loader ramp on 13th November 2020. This accident was caused by a defective hydraulic cylinder of the mechanical low loader ramp (DOSH, 2020).

Cause 8: Lack of Training

According to Durdyev et al. (2017), lack of safety training is one of the factors affecting infrastructure construction project safety. Safety training program

for managers and workers aims to improve safety knowledge and safety skills on construction sites. Apart from general safety training, it is also very important for workers to attend specific operating training according to their workscope (Rivera, et al., 2021). Thus, workers can become more familiar with their tasks and avoid common mistakes.

Cause 9: Non-use of Personal Protective Equipment (PPE)

Personal Protective Equipment (PPE) such as safety helmet, safety vest, safety boots, safety harness and so on are used to protect workers on site and prevent work-related injuries and fatalities (Durdyev, et al., 2017). Sivanathan, one of the council members of Malaysian Trades Union Congress (MTUC) claimed that some of the foreign workers were lack of basic knowledge on occupational safety and health. They might not fully aware safety risk and not wearing personal protective equipment (PPE) during work (Thomas, 2021). According to Executive Director of North South Initiative (NSI), Adrian Pereira, he also stated that foreign construction workers had an abnormal higher death rate than Malaysian construction workers due to poor safety awareness (Thomas, 2021).

Cause 10: Unskilled / Lower Skilled Workers

Zahoor et al. (2017) mentioned that poor employment practices such as hiring unskilled or lower skilled workers may cause accidents on site. Quality of work done by unskilled or lower skilled workers will be affected as they don't have experience and don't understand the instruction given (Yap, et al., 2020). Besides that, disoperation of heavy machinery on infrastructure construction sites by unskilled or lower skilled workers is very dangerous for site workers and also the public nearby.

Consequences 1: Medical Cost and Wages for Injured Workers

According to previous research, costs needed to cover suffer and injury of affected workers include cost of hospital, medical equipment, burial cost, mental health treatment cost, wages of injured worker while working off and so on (Pillay, 2016). On 3rd March 2018, a launching gantry crane collapsed at Jalan Jinjang MRT construction site.

This accident caused one worker fell down from 40 feet high and died, two workers were suffered injuries which one worker lost a leg and another one suffered minor injury (Teoh & Mokhtar, 2018). Injured workers will not only suffer physical injury but also psychological suffering especially those who go on permanent disability due to site accident (Ikpe, et al., 2012). Moreover, if the affected worker is the breadwinner of his family, his family will encounter financial issues and his family members will lose time in order to take care of the injured workers (Abrey& Smallwood, 2014).

Consequences 2: Compensation Cost

Ikpe et al. (2012) mentioned that employer of the project may suffer compensation cost charged by government if a serious construction accident happened due to poor safety management or poor quality of workmanship. Moreover, employer also needs to provide compensation for injured workers to cover the injuries suffered by workers (Pillay, 2016). On 22nd March 2021, a construction crane collapsed and caused two dead, two injured. The main contractor and subcontractor of SUKE project were fined RM100, 000 and RM200,000 respectively (Zack, 2021).

Consequences 3: Loss of Productivity / Lowering Co-Workers' Morale

If there is an accident happened on site, productivity of workers will be decreased as new workers are hired to replace injured workers and new workers need time to get familiar with the job (Pillay, 2016). Moreover, occurrence of accident will also lower co-workers' morale and it will also lead to reduction in productivity. Co-workers will feel panic when working in such a site with poor safety management and they will start to worry about their personal safety (Ikpe, et al., 2012).

Consequences 4: Damage to Equipment, Plant, Tools etc.

As mentioned before, unskilled operating workers and defective equipment and machinery will cause serious accidents on site (Williams, et al., 2017). Thus, if there is a defective tower crane collapses, it might hit other equipment or plant and cause damage to equipment, plant, tools and so on. To cover the suffering and not delay the project,

machinery or equipment replacement cost is required (Pillay, 2016).

Consequences 5: Work Overtime

When rework is needed but the project schedule is tight, workers are required to work overtime to ensure project can be completed on time (Ikpe, et al., 2012). Moreover, overtime cost is needed for workers who work overtime, and additional overtime cost will increase the total construction cost of the project (Pillay, 2016). However, when workers work overtime, they might not have enough rest which will increase risks of human error. Then, poor quality of outcome will be carried out and rework is needed again (Yap, et al., 2020).

Consequences 6: Project Delays

As mentioned before, accident will lead to reduction in productivity and rework requires extra time to be carried out. Thus, accidents and rework may delay in completion of projects (Abrey& Smallwood, 2014). When a delay happens, contractor might need to pay for delayed penalty to clients as they cannot complete the project within the date stated in their agree

Prevention 1: Effective Safety Monitoring and Management System

According to research done by Chan et al. (2018), effective safety monitoring is one of the prevention measures that can be taken to avoid accidents in infrastructure projects. With effective safety monitoring, a site safety supervisor will be appointed to ensure workers comply with health and safety legislation. Thus, the probability of on-site accidents can be minimized. Hwang and Yang (2014) mentioned that effective management system can avoid construction rework. Effective management systems can avoid accidents and rework by paying attention to common mistakes and improving the quality of work done (Yap, et al., 2017).

Prevention 2: Establish Safe Working Procedure

Another prevention measure that can be taken to avoid safety issues in infrastructure projects is to establish task-specific safe working procedures (Chan, et al., 2018). A safe working procedure gives workers a concept of how to perform that specific tasks safely and it is recommended to apply to all hazardous tasks. According to the safe work

procedure, a task will be separated into a few steps and risk analysis for each step will be conducted to ensure workers do not make common mistakes and complete every step safely.

Prevention 3: Employ Workers with Adequate Experience

Yap et al. (2017) mentioned that good workmanship can avoid human errors in construction projects. Employing workers with adequate experience can prevent accidents happen due to human error and lower quality of work done (Chan, et al., 2018). The proper skills of workers will not only prevent safety issues but also positively increase the overall productivity of projects. An increase in overall productivity is because of the higher quality of work performed by skilled workers and thus rework is not required.

Prevention 4: Employ Workers with Relevant Safety Training Certificates

According to previous research, one of the prevention measures that can be taken to reduce safety risks in infrastructure projects is to provide adequate safety training to workers (Chan, et al., 2018). Construction Industry Development Board of Malaysia (CIDB) Construction Personnel Card ask known as CIDB Green Card is a safety programme for workers to have general construction safety knowledge and this programme aims to improve safety levels on construction sites. CIDB Green Card can prove that cardholders have registered under CIDB Malaysia, and they are eligible to enter and work on construction sites.

Prevention 5: Provide First Aid Facilities

Ikpe et al. (2012) mentioned that expenditure on costs of health and safety measures will affect the probability of accidents on site. Improvement in health and safety measures on site such as first aid facilities can provide emergency treatment to injured workers (Chan, et al., 2018). Construction sites consist of various types of hazards such as falls from height, being hit by heavy machinery or equipment and so on. Thus, it is important to create first aid facilities on site and ensure workers have general first aid training so that they can respond quickly when an injury or accident happen.

Prevention 6: Check and Maintain Personal Protective Equipment (PPE) Regularly

Personal protective equipment (PPE) is worn to minimize the exposure of workers to construction hazards which may cause serious injuries and fatalities. PPE includes of safety helmet, safety vest, safety boots, safety harness and so on (Durdyev, et al., 2017). Thus, it is important for workers to check and maintain their personal protective equipment (PPE) regularly in order to ensure good condition of PPE. Good conditions of PPE can prevent safety issues and accidents happen on sites (Chan, et al., 2018).

Prevention 7: Implementation of Internet of Things (IoT) Technologies

According to previous research done by Chong, et al. (2020), IoT technologies were tested to prevent accidents on construction sites. One of the IoT technologies was real-time heart-rate monitoring by using Photoplethysmography (PPG) sensor for construction workers. Real-time heart-rate monitoring had a high percentage in preventing accidents caused by taking alcoholic beverages or drugs and poor ventilation. This was due to these two causes of accident will directly influence heart rate of workers and are detected in real time by PPG sensor. Therefore, prevention can be taken to avoid accidents (Chong, et al., 2020).

V. METHODOLOGY

Introduction

Quantitative research method was adopted in this research to study safety issues in Malaysia infrastructure projects. The reason for using quantitative research method was due to reliable data can be collected in a short time. As quantitative research involves of a large group of respondents and the optimal sampling size is calculated, so reliable data that represent the whole population can be generated. Moreover, numerical data can be collected in shorter time by conducting questionnaire through Google Form because researcher will only need to share the Google Form link with targeted respondents and then respondents can answer the questionnaire online.

Questionnaire Design

In this research, the open and closed-ended questions were asked in the questionnaire and consists of four sections. In Section A, respondents'

demographic information such as gender, age, work position, working experience and nature of company will be collected with the use of multiple choices questions. Section B, C, and D consist of questions related to causes of safety issues, consequences of poor safety management, and prevention strategies to reduce safety issues in infrastructure projects. Respondents are required to answer the 5-Point Likert Scale questions in Sections B, C, and D based on their level of agreement from strongly disagree till strongly agree.

Sampling Size & Method

Sample size determination is the technique to predetermine the number of respondents required to carry out generalized inferences from a large population (Singh & Masuku, 2014). Solving’s Formula is used to determine the sample size required which is 165 respondents. Convenience sampling, samples are easy to obtain for researcher according to their convenient accessibility (Elfil&Negida, 2017). As mentioned before, a large number of respondents are needed when conducting quantitative research. Thus, the convenience sampling method was used in this research to collect a sufficient number of samples in a limited time.

Data Analysis Method

Data analysis was conducted after data collection. It is a process of data collecting, transforming, cleaning, and interpreting (Pickell, 2021). Data analysis provides credibility to the research as it ensures data collected are interpreted accurately without human bias (Jena, 2012). In this research, Statistical for Social Science (SPSS) program was used to analyse data collected from respondents. Moreover, three data analysis methods were conducted, which were Cronbach’s Alpha Reliability Test and Mean Ranking.

VI. RESULT AND DISCUSSIONS

During main study, questionnaire response rate was 56.3% which consists of 178 sets collected response out of 316 sets distributed questionnaires. As shown in Table 1.1 below, all the Cronbach’s Alpha values for the three categories are all above 0.80 which are considered good level of internal consistency for the research study (Cronbach, 1951). Thus, the

collected data was considered valid as it above acceptable level (Cronbach’s Alpha values = 0.70).
 Table 1.1: Cronbach’s Alpha Value

Category	Cronbach’s Alpha	Number of Items
Causes of Safety Issues	0.808	10
Consequences of Poor Safety Management	0.824	6
Prevention of Safety Issues	0.806	7

Mean Ranking on Causes of Safety Issues in Malaysia Infrastructure Project

Overall, the five most agreed causes of safety issues in Malaysia Infrastructure projects are:

- (1)Non-use of Personal Protective Equipment (Mean = 4.79, $\delta = 0.410$)
- (2)Defective and Unsafe Machinery and Equipment (Mean = 4.71, $\delta = 0.456$)
- (3)Poor Safety Consciousness (Mean = 4.70, $\delta = 0.461$)
- (4)Negligence and Carelessness (Mean = 4.67, $\delta = 0.473$)
- (5)Unskilled / Lower Skilled Worker (Mean = 4.44, $\delta = 0.498$)

Non-use of Personal Protective Equipment was observed as the top one causes of safety issues in Malaysia Infrastructure projects that ranked by respondents with overall mean value of 4.79. Personal Protective Equipment (PPE) such as safety helmet, safety vest, safety boots, safety harness and so on are used to protect workers on site and prevent work-related injuries and fatalities (Durdyev, et al., 2017). Previous research mentioned that in some projects workers had used personal protective equipment (PPE) properly, but in some projects, workers had partially used or had not used personal protective equipment (PPE) (Nawaz, et al., 2020). Workers who fail to use PPE correctly such as not wearing safety helmet, will suffer head injuries if they fall from height (Falana&Ghazaly, 2019). All four groups of respondents have ranked Non-use of Personal Protective Equipment as the top one causes of safety issues in Malaysia Infrastructure projects. Especially those contractors who is expert in construction industry which has working experience for more than fifteen years, they were strongly agree with Non-use of Personal Protective

Equipment may cause safety issues in Malaysia Infrastructure projects with a mean value of 5.00.

Defective and Unsafe Machinery and Equipment was ranked at the 2nd top causes of safety issues in Malaysia Infrastructure projects. The mean value is 4.71. Previous research mentioned that defective and unsafe equipment and tools will cause a serious accident and fatal injuries on construction sites (Williams, et al., 2017). According to a fatal accident case recorded in Department of Occupational Safety and Health (DOSH), a construction worker in Perak who was a low loader driver was killed by defective mechanical low loader ramp on 13th November 2020. This accident was caused by a defective hydraulic cylinder of the mechanical low loader ramp (DOSH, 2020). In an infrastructure project, a lot of heavy machinery such as tower crane, bulldozer, forklift etc. are included. However, some of the contractors fail to maintain their machinery regularly or repair faulty machinery. Workers are working in high safety risk and unsafe working conditions when they are using these defective and unsafe machinery and equipment (Falana&Ghazaly, 2019).

Poor Safety Consciousness was ranked by the respondent at the 3rd position with an overall of mean value 4.70. Contractor who has more than ten years working experience has ranked this as the 2nd top cause of safety issues in Malaysia Infrastructure projects. However, contractor who has less than ten years working experience has ranked this as the 3rd top cause. Safety cost is usually not priced in Bills of Quantities as a project cost. Based on an interviewee of previous research, clients usually expect higher productivity with minimum cost, and they do not very care about site safety. Therefore, insufficient safety cost provided by clients might affect quality of safety management on site (Zahoor, et al., 2017). These poor safety consciousness's include of not providing safety training and guidance to workers, insufficient promotion of safety knowledge, not being aware of potential safety risks, and not using Personal Protective Equipment (PPE) (Williams, et al., 2017).

Negligence and Carelessness was ranked at the 4th position among all causes of safety issues in Malaysia Infrastructure projects. The overall mean

value is 4.67. Williams et al. (2017) mentioned that carelessness and negligence will cause safety issues and accidents on site. On 11th August 2017, 2 construction workers died after being hit by a mobile crane collapsed in Kota Samarahan. The cause of accident was due to crane operator didn't follow safe operating procedure when using crane for lifting works (Povera, 2017). The crane operator was arrested by Kota Samarahan CID team as this accident was classified under Section 304A of the Penal Code as the crane operator was causing death by negligence (BORNEOPOST, 2017).

Mean Ranking on Consequences of Poor Safety Management in Malaysia Infrastructure Project
Overall, the top three most agreed consequences of poor safety management in Malaysia infrastructure projects are:

- (1) Loss of Productivity / Lowering Workers Morale (Mean = 4.64, $\delta = 0.481$)
- (2) Medical Cost and Wages for Injured Workers (Mean = 4.56, $\delta = 0.498$)
- (3) Compensation Cost (Mean = 4.47, $\delta = 0.500$)

Loss of Productivity / Lowering Workers Morale was observed as the top one most agreed consequences of poor safety management in Malaysia infrastructure projects that ranked by respondents with overall mean value of 4.64. If there is an accident happened on site, productivity of workers will be decreased as new workers are hired to replace injured workers and new workers need time to get familiar with the job (Pillay, 2016). Moreover, occurrence of accident will also lower co-workers' morale and it will also lead to reduction in productivity. Co-workers will feel panic when working in such a site with poor safety management and they will start to worry about their personal safety (Ikpe, et al., 2012). All four groups of respondents have ranked this consequence as the top one most agreed consequences of poor safety management in Malaysia infrastructure projects.

Medical Cost and Wages for Injured Workers was ranked at the 2nd top most agreed consequences of poor safety management in Malaysia infrastructure projects. The overall mean value is 4.56. According to Mean Ranking Table 4.6, Contractors who has working experience more than 15 years has also ranked this consequence as the top 1 consequence which has the same rank

with Loss of Productivity / Lowering Workers Morale with mean value of 4.50. On the other hand, other categories of contractor who has not more than 15 years working experience has rank this consequence as the 2nd top most agreed consequences of poor safety management in Malaysia infrastructure projects. According to previous research, costs needed to cover suffer and injury of affected workers include cost of hospital, medical equipment, burial cost, mental health treatment cost, wages of injured worker while working off and so on (Pillay, 2016).

Compensation Cost was ranked by the respondent at the 3rd position with an overall of mean value 4.47. All four groups of respondents have ranked this consequence as the 3rd most agreed consequences of poor safety management in Malaysia infrastructure projects. Ikpe et al. (2012) mentioned that employer of the project may suffer compensation cost charged by government if a serious construction accident happened due to poor safety management or poor quality of workmanship. Moreover, employer also needs to provide compensation for injured workers to cover the injuries suffered by workers (Pillay, 2016).

Mean Ranking on Prevention Strategies of Safety Issues in Malaysia Infrastructure Projects

Overall, the top three most agreed prevention of safety issues in Malaysia infrastructure projects are:
(1) Check and Maintain Personal Protective Equipment Regularly (Mean = 4.77, $\delta = 0.420$)
(2) Establish Safe Working Procedure (Mean = 4.71, $\delta = 0.454$)
(3) Provide First Aid Facilities (Mean = 4.57, $\delta = 0.497$)

Check and Maintain Personal Protective Equipment Regularly was observed as the top one most agreed prevention of safety issues in Malaysia infrastructure projects that ranked by respondents with overall mean value of 4.77. All four groups of respondents have ranked this consequence as the top one most agreed prevention of safety issues in Malaysia infrastructure projects. Personal protective equipment (PPE) is worn to minimize the exposure of workers to construction hazards which may cause serious injuries and fatalities. PPE includes of safety helmet, safety vest, safety boots, safety harness and so on (Durdyev, et al., 2017). Thus, it is

important for workers to check and maintain their personal protective equipment (PPE) regularly in order to ensure good condition of PPE. Good conditions of PPE can prevent safety issues and accidents happen on sites (Chan, et al., 2018).

Establish Safe Working Procedure was ranked at the 2nd top most agreed prevention of safety issues in Malaysia infrastructure projects. The overall mean value is 4.71. All four groups of respondents have ranked this consequence as the 2nd top most agreed prevention of safety issues in Malaysia infrastructure projects. Establish task-specific safe working procedures was identified as one of the prevention strategies that can be taken to avoid safety issues in infrastructure projects (Chan, et al., 2018). A safe working procedure gives workers a concept of how to perform that specific tasks safely and it is recommended to apply to all hazardous tasks. According to the safe work procedure, a task will be separated into a few steps and risk analysis for each step will be conducted to ensure workers do not make common mistakes and complete every step safely.

Provide First Aid Facilities was ranked by the respondent at the 3rd position with an overall of mean value 4.57. All four groups of respondents have ranked this prevention as the 3rd most agreed prevention of safety issues in Malaysia infrastructure projects. Ikpe et al. (2012) mentioned that expenditure on costs of health and safety measures will affect the probability of accidents on site. Improvement in health and safety measures on site such as first aid facilities can provide emergency treatment to injured workers (Chan, et al., 2018). Construction sites consist of various types of hazards such as falls from height, being hit by heavy machinery or equipment and so on. Thus, create first aid facilities on site and ensure workers have general first aid training are the prevention strategies of safety issues in infrastructure projects so that site workers can respond quickly when an injury or accident happen.

VII. CONCLUSIONS

The findings were carried out based on the data collected from 198 contractors who specialize in

highway and rail transit projects under the Grade 7 category within Klang Valley, Malaysia. The overall questionnaire response rate is 57.2%. The data was analysed by using SPSS with Cronbach's Alpha Reliability Test and Mean Ranking. The five most significant causes of safety issues in Malaysia Infrastructure projects were (1) Non-use of Personal Protective Equipment; (2) Defective and Unsafe Machinery and Equipment; (3) Poor Safety Consciousness; (4) Negligence and Carelessness; (5) Unskilled / Lower Skilled Worker. Meanwhile, three most significant consequences of poor safety management in Malaysia infrastructure projects were (1) Loss of Productivity / Lowering Workers Morale; (2) Medical Cost and Wages for Injured Workers; (3) Compensation Cost. On the other hand, three most significant prevention of safety issues in Malaysia infrastructure projects were (1) Check and Maintain Personal Protective Equipment Regularly; (2) Establish Safe Working Procedure; (3) Provide First Aid Facilities.

Objective 1: To study the causes of infrastructure project safety issues.

The respondents were asked to place their level of agreement towards the causes of safety issues in Malaysia Infrastructure projects. The result shows that the five most significant causes of safety issues in Malaysia Infrastructure projects were (1) Non-use of Personal Protective Equipment; (2) Defective and Unsafe Machinery and Equipment; (3) Poor Safety Consciousness; (4) Negligence and Carelessness; (5) Unskilled / Lower Skilled Worker. Meanwhile, Kruskal Wallis Test was adopted to identify whether there were any significant differences between different groups of respondents in term of working experience. The result of Kruskal-Wallis Test shows that Non-use of Personal Protective Equipment (PPE) has statistically significant difference between four respondent groups. This is due to the level of agreement of respondent groups of more than ten years working experience in construction industry in term of this cause, Non-use of Personal Protective Equipment (PPE), is higher than the other respondent groups. They were strongly agreeing with Non-use of PPE is the most

significant causes of safety issues in Malaysia infrastructure projects. It is concluded that non-use of PPE was the most significant causes of safety issues in Malaysia Infrastructure projects as PPE is the basic safety protection for construction workers when they are working with hazards. However, there were some workers who lack of safety awareness and chose to not wear PPE properly. Thus, contractor shall always improve safety conscious of workers and remind workers to wear PPE properly. All the five most significant causes of safety issues in Malaysia Infrastructure projects were from workmanship, machinery, management and human factors.

Objective 2: To evaluate the consequences of poor safety management in infrastructure projects.

The respondents were asked to place their level of agreement towards the consequences of poor safety management in Malaysia infrastructure projects. The result shows that the (1) Loss of Productivity / Lowering Workers Morale; (2) Medical Cost and Wages for Injured Workers; (3) Compensation Cost were the three most significant consequences of poor safety management in Malaysia infrastructure projects. Infrastructure project involves of many labours, materials, large and heavy machineries, complicated construction procedures, complex management activities and so on. Hence, there is undeniable that infrastructure project might have higher rate of fatality and injury if there is any accident happened. Infrastructure project shall always follow to standard operation procedures and safety regulations, not only to protect construction site workers, but also to protect public health and safety. It is concluded that the most significant consequence of poor safety management in Malaysia infrastructure projects was Loss of Productivity / Lowering Workers Morale. When accident happened especially those causing death, co-workers' morale will feel panic and start to worry about their personal safety. Apart from construction co-workers, public was also worried to pass by an area where infrastructure construction work is going on.

Objective 3: To outline the prevention strategies for minimising infrastructure project safety issues.

The respondents were asked to place their level of agreement towards the prevention strategies of safety issues in Malaysia infrastructure projects. The result shows that the (1) Check and Maintain Personal Protective Equipment Regularly; (2) Establish Safe Working Procedure; (3) Provide First Aid Facilities were the three most significant prevention strategies of safety issues in Malaysia infrastructure projects. As refer to the most significant cause of safety issues in Malaysia infrastructure projects as mentioned in objective 1, it is concluded that Check and Maintain Personal Protective Equipment (PPE) Regularly is the most significant prevention strategy of safety issues in Malaysia infrastructure projects. The respondent group who has working experience more than 10 years and considered expert in construction industry was more concerned about the prevention strategies to avoid accidents happen such as check and maintain PPE Regularly and conduct effective safety monitoring and management System. Implementation of Internet of Things (IoT) technologies was at the lowest ranking position of prevention strategy of safety issues. This might because of some respondents were unfamiliar with implementation of IoT in construction industry. However, there are more and more construction companies have start implementing these technologies in their construction projects as some of the high risk tasks can be done by IoT technologies. Also, one of the IoT technologies, real-time heart-rate monitoring by using Photoplethysmography (PPG) sensor for construction workers to avoid accidents caused by taking alcoholic beverages or drugs and poor ventilation. Hence, the implementation of IoT technologies has the potential to be a significant prevention strategies to minimise safety issues in Malaysia infrastructure in future.

VIII. RESEARCH IMPLICATION

Infrastructure plays an important role in a country's development as it provides the benefit of improving accessibility and connectivity from city to city.

Infrastructure such as railing systems and highways also help to boost economic activities along the routes (Rietveld & Bruinsma, 2012). For example, people can take MRT or LRT for work to avoid traffic jams. Infrastructure projects such as highways, LRT and MRT are recognized as high-risk projects as they are constructed in public areas (Donaldson, 2018). Contractors do not only need to complete the project with standard quality, and also need to safeguard public's health and safety and ensure minimal disruption to public. If accident or injury happens on construction site, it may cause delay in project progress, additional material cost and manpower. Therefore, this research provides a deep understanding of Malaysia's infrastructure safety issues and the prevention measures that can be taken to reduce the safety risk.

This research enhances Malaysia's infrastructure project safety management by studying causes of infrastructure project safety issues, evaluating the consequences of poor safety management in infrastructure projects, and outlining prevention strategies that can be taken to reduce fatality and injury rates in infrastructure projects. Moreover, this research is able to contribute the output to Malaysia's ongoing and upcoming mega infrastructure projects such as East Coast Rail Line, West Coast Expressway, Pan-Borneo Highway, LRT3 project etc. Contractors can reduce the number of accidents on infrastructure project sites by taking prevention measures that are being studied.

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