FRAMEWORK FOR EFFECTIVE SAFETY MANAGEMENT IN CONSTRUCTION PROJECTS

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CIVIL AND ENVIRONMENTAL ENGINEERING

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Dissertation submitted in partial fulfillment of
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CERTIFICATION OF APPROVAL

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A project dissertation submitted to the
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Approved by,

_____

(Ir Dr Idris bin Othman)
UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK

SEPTEMBER 2016

September 2016

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

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MUHD AZMI BIN MAT YAACOB

ABSTRACT

Effective safety management is one of the serious problems in the construction industry worldwide, especially in large-scale construction projects. There have been significant reductions in the number and the rate of injury over the last 20 years. Nevertheless, construction remains as one of the high-risk industry. The purpose of this study is to examine safety management in the Malaysian construction industry, as well as to highlight the importance of construction safety management. In order to improve the safety management performance, through the identification of the key factors that cause accidents, this research develops a conceptual framework of effective safety management in construction projects. The industry has contributed significantly to the economic growth of the country. However, when construction safety management is not implemented systematically, accidents will happen and this can affect the economic growth of the country. This study has put the safety management in construction project as one of the important elements to project performance and success. The study focus on construction project in Malaysia. This research also emphasizes on awareness and the factors that lead to the safety cases in construction project. The data has been collected by doing the questionnaire and a case study. The analysis of the survey has been done by using the Relative Importance Index (RII) and Cronbach's alpha using SPSS software. The scores were then transformed to importance indices based on the formula.

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I would like to express my deepest gratitude to Allah SWT for giving me the opportunities in completing this Final Year Project Report. I also wish to express my deep sense of gratitude with love to both my parents whom have been my greatest support from the beginning of my study in Universiti Teknologi PETRONAS (UTP) until this final year period.

I take immense pleasure in thanking my FYP supervisor, Ir Dr Idris bin Othman for his valuable guidance and supports in every tasks and works assigned to me in this final year period. Also, I sincerely thank all my university lecturers for their most valuable knowledge and providing me good basics in engineering field and also in my focus project here. In addition, I would like to gratefully acknowledge Dr Carol Ng and Dr Zulaikha for their commitment to be our FYP coordinator for these 28 weeks of FYP period.

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Thank You.

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CHAPTER 1
INTRODUCTION

1.1 BACKGROUND

Construction projects are the various processes that involve during constructing a building or infrastructure. It is starts with planning, design, financing and continues with the project completion. Large scale construction like dams, bridges, refineries, highways and power generation usually requires various combination of engineering field. This includes various aspects such as design and execution of the infrastructure, the environmental impacts to the surrounding, project scheduling, construction-site safety, availability of building materials and others aspect.

According to Evelyn et al. (2004), construction sites are generally complex and sometimes unsafe to the workers and environment. It is one of the most dangerous workplaces because of high number and frequency of accidents. Therefore, construction safety is one of the serious problems in the construction industry worldwide, especially in mega construction projects. This is because of the involvement of many workers, modern methods of construction, many large and heavy plants, a great amount of materials and equipments used, complex construction operation, multi-interface, and various disciplinary aspects of its project workforce. All of this criteria that lead to the higher accident rate at the construction projects. The accidents include those that result from falling from height, collision, collapse and electric shock, amongst which falling from height and collisions are the most prevalent (Guo et al., 2012)

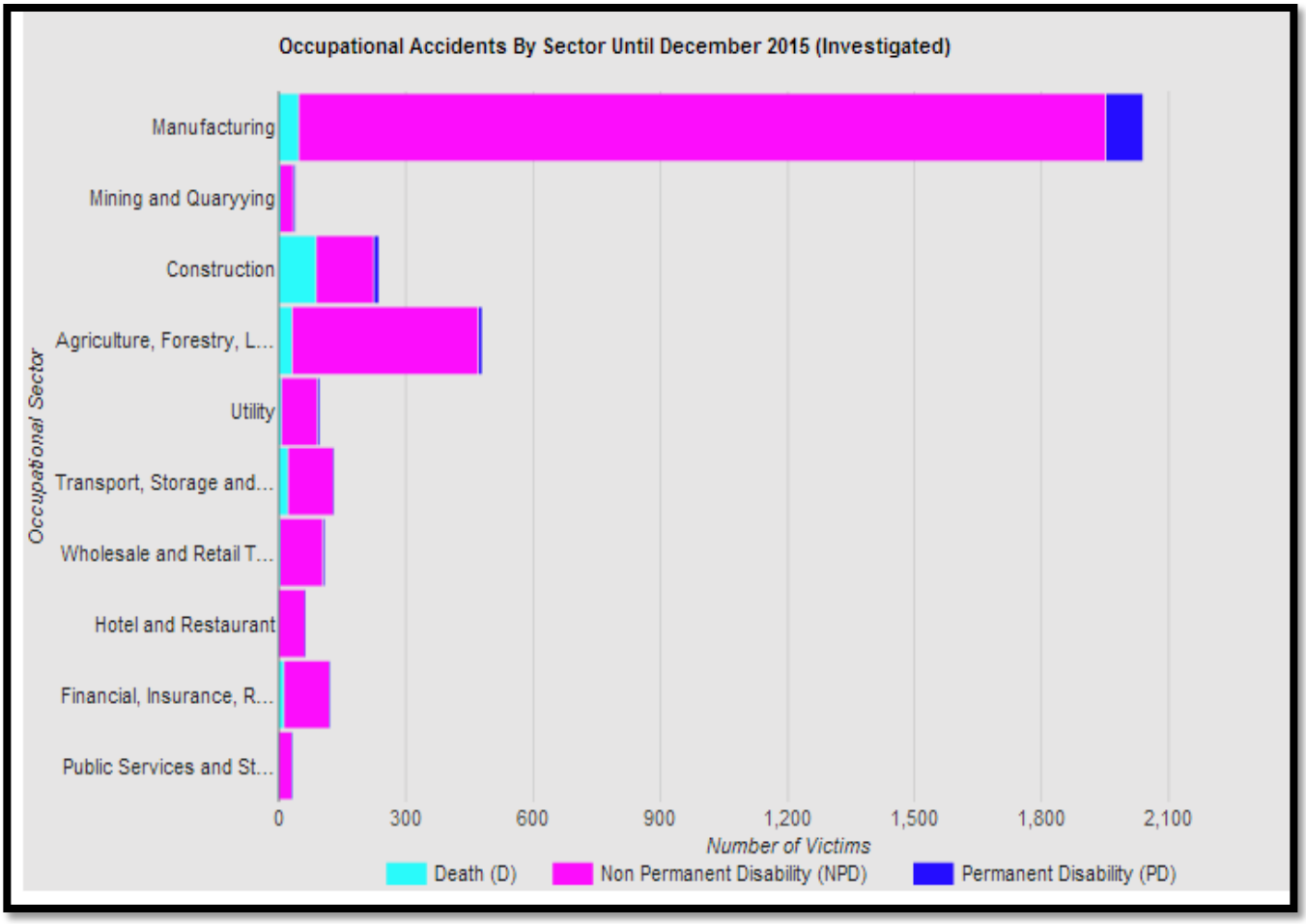

Table 1: Occupational Accidents Statistics by Sector until December 2015

Construction safety thus continues to represent a serious problem and pose a challenge for researchers and practitioners. In Malaysia, both the society and economy have suffered human and financial losses because of the poor safety performance in the construction industry. Department of Occupational Safety and Health (DOSH) in Malaysia reports that occupational accidents by sector shows that the highest number of death was in the construction industry as of for the 2015 incidents (DOSH, 2016).

Figure 1: Crane falling on 26th August 2016 (The Star)

Figure 2: Crane falling on 4th November 2016 (The Star)

On 26th August 2016, a woman died when part of a crane fell onto her car. The victim known as Chin Khoon Sing from Penang, was driving along Jalan Raja Chulan when a piece of the construction crane fell from over 20 storeys. Chin was killed instantly at that place. Two months after that, a couple were killed after a piling machine fell on the car. During the accident, they were travelling at the Jalan Meru industrial area in Klang. This is the two major fatal cases involving heavy construction equipment falling on a vehicle reported this year. It showed that there are still lacks the awareness among all the parties about the importance of safety construction at the site.

1.2 PROBLEM STATEMENT

Effective safety management on project sites is of utmost importance due to the nature of the construction industry. However, it is usually not as top priority in a market-driven society where the focus is completing projects at the specific quality with minimum time and cost. Thus, safety issues are considered only after an accident occurs at a construction site with then follow up measures to improve working environment, especially in developing countries. Therefore, proper effective safety management in construction is of utmost importance. Hence, this research aims to introduce a framework to measure construction safety through a proposed effective safety management assessment. Various factors that affecting construction safety performance were explored through a questionnaire survey that will be conducted to people that involve in construction projects. The proposed management framework will facilitate a framework process and initiatives for improving construction safety performance in construction projects. In line to improve the safety management performance, through the identification of the key factors that cause accidents, this research develops a conceptual framework in construction safety management. The aim of this paper is to investigate how management may increase the safety levels of construction sites. The proposed framework may help management to manage construction safety. When safety aspects are well managed, the frequency of accident occurrences may be reduced.

1.3 OBJECTIVE AND SCOPE OF STUDY

The objectives of this project are:

i. To study the safety issues that happen in construction projects

ii. To identify variables that significantly affects construction safety

iii. To propose a framework for project managers to use and manage construction safety.

The scopes of study in this project are:

i. Safety policy at construction projects

ii. Factors that lead to safety cases

iii. Method that applied to reduce the frequency of accidents construction sites.

CHAPTER 2
LITERATURE REVIEW

2.1 - Introduction

Effective safety management in construction projects is a core consideration for all types of organizations that are accountable for protecting and optimizing the efficiency of human resources. In regard to construction, ensuring workplace safety is not an easy test. Occupational accidents in the construction industry will give impact to economic and social issues in organizations, as well as countries. Wang et al (2016) stated that the development of construction industry has been plagued by the accidents or injuries that are frequently occurred. It is estimated that there are around 60,000 construction fatalities occurred worldwide each year, which equates to one accident happens every nine minutes. Among all industries in the world, construction has the highest rate of accidents, including deaths and disabling injuries, worldwide (Kanchana et al., 2013).

Many ways have been made to minimize this problem, but the outputs are far from satisfactory as construction accidents continue to dominate. Despite various programmes implemented by government authorities at a national level and the initiatives of private companies, the number of construction accidents remains alarmingly high. It is evident that these efforts are not sufficient to minimize the occurrence of unsafe acts and unsafe conditions at construction sites. According to Wu et al (2016), accidents at work occur either due to lack of knowledge, and supervision, lack of means to carry out a work safely, errors in judgment, carelessness in making decision, or total irresponsibility. In addition, the lack of a controlled working environment and the complexity and diversity of the sizes of organizations have give impacts on safety performance in the industry (Muiruri & Mulinge, 2014). They also found that inadequate safety precautions, non-implementation of rules, deficient knowledge and unqualified officers cause unexpected accidents in the construction project. Furthermore, according to an annual report published in 2002 by Institute of Construction Training and Development (ICTAD), the safety practices adopted at construction sites are far below acceptable standards.

Many factors that may contribute to site safety were identified. According to Evelyn et. al (2004), the safety legislation and policies have a great impact upon the safety level of a construction worksite. Legislation forms a framework in which health and safety is regulated and controlled. In this case, management have to follow the rules and regulations duly and punishments to be meted out to those who flout them. The identification of unsafe factors in the construction field mainly highlighted on the site layout, multi-interface, safety screen and scaffolding, plant operation, and construction operation (Guo et al., 2012). The identification processes are based on type of work conducted at the sites, which integrates the safety risks. By walking through the site and inspecting all the workers work, the managers can identify the potential hazard factors by themselves.

From other perspective, Wang et al (2016) stated that accidents at construction projects are caused by an unsafe act and unsafe condition. For example, an individual's behavior or activity that deviates from normal accepted safety policies or deficiency in machines, equipments and materials. In his research Wang et al (2016) also appointed out that human error is a main reason for up to 80% of all incidents and accidents in complex high risk industry such as in construction of dams, bridges, refineries, highways and nuclear power. Furthermore, Guo et al (2012) asserted that workers' unsafe acts have been recognized as the direct and common reason for construction accidents. Since the characteristics of construction work describe workers usually work on separate sites, this decentralization makes it more difficult to know and control unsafe behaviors.

The challenge is to analysis the predominant factors and develops a benchmark for measuring effective safety management in the construction industry to foster safe working culture in construction projects. The key factors that influencing safety management has not previously been the focus of research, and to date, no safety management framework has been formulated as a benchmark for construction safety management in developing countries. Therefore, the aim of this research is to develop a method for measuring effective safety management on construction sites by identifying factors that affect construction safety performance. The final objective is to provide a framework for safety management that will be acts as an effective tool for improving safety management at construction sites.

Construction sites are generally complex and sometimes unsafe to all the workers. It is complex because of extensive use of sophisticated plants, equipment, modern methods of construction, multidisciplinary and multitasked aspects of its project workforce (Guo et al., 2012). Generally, construction sites are still one of the most dangerous workplaces because of high incidence of accidents. The aim of this research is to investigate how management may increase the safety levels of construction sites. The specific objectives of this research are to identify variables that significantly affect construction safety and propose a framework for management to use and manage construction safety.

The main objective is important because the root causes of accidents have to be identified for management, so that they can take preventive and remedial actions to minimize accident occurrences. The proposed framework may help them to manage construction safety. When safety aspects are well managed, the frequency of accident occurrences may be reduced. In this research, the main focus that should be highlighted is the variables that affect the construction safety as a whole. A data analysis based on the questionnaires is follows, whereby the factors that affect construction safety significantly are identified. A framework to manage construction safety is then proposed, followed by conclusions and recommendations. From this research, many factors that may contribute to site safety were identified. These areas are now briefly reviewed.

2.2 - Factors Affecting Improper Safety Management in Construction Industry

1. Safety Inspections

Safety inspections are the usual means used to enforce safety at the jobsite. Hinze and Gambatese (2003) indicate that safety inspections are one of the means by which project managers and site supervisors can become acquainted with the nature of the safety conditions on the site. Toole (2002) argues that to effectively enforce safety on jobsite, the entity must be able to monitor the work on a frequent basis. Wong et al. (1999) argue that safety performance is affected by monitoring of safety compliance. Jaseliks et al. (1996) recommend increasing site safety inspections. Their analysis show that firms with better safety performance conducted more site safety inspections compared with firms of poor safety performance.

2. Safety Incentive and Penalties

Hinze and Wilson (2000) indicate that incentives have the objective of providing a positive reinforcement of a desired behaviour. Safety incentives are designed to influence worker actions so that safer worker performance is encouraged and rewarded. According to CII (1993), Safety incentives are among the top five high-impacts zero techniques. Hinze and Gambatese (2003) indicate that of the various types of safety initiatives that companies utilize to promote worker safety, the most widely implemented type of program involves safety incentives.

3. Safety Training and Awareness

CII (1993) study identifies safety training as one of five high-impacts zero accident technique. Hinze and Wilson (1999) indicate that there is unanimous agreement among the respondents of their study that worker training is vital to improved safety performance.

4. Workers' Attitude towards Safety

Aksorn and Hadikusumo (2008) indicate that attitude is a tendency to respond positively and/or negatively to certain persons, objects or situations. Individuals are different in their perception of risks and willingness to the risks. Successful safety programs can be achieved if the positive attitudes of employees towards safety are improved.

5. Compliance with Safety Legislation

In order to improve safety performance, a standard checklist is used to conduct the audit. This checklist included those items which are compliance to Occupational Safety and Health Act and Factories and Machinery Act and perceived to be important from the safety point of view (Shuratman Z. et al., 2007). These are the Occupational Safety and Health management, safety committee, machinery, scaffolding, working at height, public safety, workers quarters, storage facilities, formwork, excavation and shoring, personnel protective equipment, platform, floor opening, edge of open floor, access and egress, electrical safety, cleanliness, health and welfare, piling and demolition.

6. Labour Turnover Rates

To improve safety performance, Harper and Kohen (1998) recommend reducing labour turnover rates. Hinze and Gambatese (2003) examine the relationship between labour turnover rates and safety record. Hinze and Gambatese (2003) study results show that higher turnover rates are associated with higher injury rates. Consequently, construction contractors are advised to decrease their labour turnover in order to improve their safety performance.

7. Availability of Safety Equipment

Toole (2002) argues that some construction accidents results because of the absence of safety equipment necessary to perform the job safety at the location of the work. Duncan and Bennett (1991) reviewed the performance of various fall protection systems and concluded that both active measures (those that prevent workers from falling, for example guardrails) and passive measures (those that protect workers after falling, for example, safety nets) are useful in reducing fall injuries. Chi et al. (2005) analysed contributing factors to 621 occupational fatal falls. Significant linkages were found between causes of falls and accident event. Falls associated with lack of complying scaffolds, unguarded openings, and inappropriate protections, removal of protections and improper use of Personal Protective Equipment (PPE). Chi et al. (2005) suggest prevention measures to prevent falls or to mitigate the consequence of falls.

8. Organization Safety Policy

The company provides their own safety policy based on their business and works. The contents of the safety policy will be formed by the executive board for each company. Normally, different companies have different safety policy but the overall content is similar. According to Tan & Nadeera (2014), the contents of all the company's safety policy are emphasized on the responsibilities of all the key players in order to prevent accidents from happening. The objective of all construction companies is to achieve injury and incident-free workplace. The safety policy is important in order to emphasize the aim of the organization tin relation to safety matters.

9. Safety Meeting

In order to increase the safety awareness at construction site, all the construction company should provides monthly or weekly safety meeting. According to Tan & Nadeera (2014), this meeting is compulsory for all the key players such as contractor, architect, engineer, quantity surveyor, site supervisor and all safety committee to attend. The meeting usually will be led by the representative of the safety committee such as from Health, Safety and Environment (HSE) Department. During the safety meeting, they will discuss the current issues regarding safety matters such as current safety accident statistic, the implementation of safety practices at construction sites, the activities and task that will be held and others information regarding construction safety at site.

10. Emergency support and Safety Measuring Devices

The company should provide a sufficient emergency support and safety measuring devices. It comprises of first aid and medical treatment for accident for common injury. In fact, the construction company also must have provided first aid room and have also appointed a site nurse to provide further treatment after accidents especially for hard injury cases (Wu et al, 2016). Other than that, in order to increase safety awareness, the company also should provide fire prevention equipment such as fire alarm, fire poison and fire extinguisher. The fire extinguisher section must provided at the construction site, both inside and outside of the building and will be used when necessary.

2.3 – Comparison of Factors Affecting Improper Safety Management in Construction Projects

FACTOR	RESEARCH	KEY STATEMENT	GAP
Organizational Safety Policy	• Hinze and Wilson (1999); Wong et al. (1999) • Jaselisks et al. (1996)	• Organizational safety policy is a major driver for better safety performance in the construction industry. • Better safety performance involves the development of more detailed written safety programs.	• Not explain about how to make safety policy and how to improved safety policy • What are the key point need in detailed safety policy
Safety Training	• Construction Industry Institute (CII) • Hinze and Wilson (1999) • Huang and Hinze (2003)	• Safety training is one of five high-impact zero accident. techniques. • Worker training is vital to improved safety performance. • The lack of safety training is often a contributing factor to many falls.	• What type of safety training needed. • How the safety training being implemented. • How to measure the effectiveness of safety training and what is the duration.
Safety Meetings	• Jaselisks et al. (1996)	• To improve safety performance at the project level, it is recommended to increase the number of formal safety meetings with supervisors.	• How often the formal safety meeting being held
Availability of Safety Equipment	• Chi et al. (2005) • Duncan and Bennett (1991) • Toole (2002)	• Falls are associated with lack of complying scaffolds, unguarded openings, inappropriate protection and removal of protections. • Both active measures and passive measures are needed to reduce fall injuries. • Some construction accidents result because safety equipment necessary to perform the job safety is not present at the location of work.	• Why does (PPE) not been considered. • What are the passive and active measures. • What causes insufficient (PPE) in construction sites.

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CHAPTER 3
METHODOLOGY

This research was conducted to establish and develop a framework for effective safety management in construction project. It also will act as a benchmark to analysis the safety policy and the factors that lead to the safety accidents at construction sites.

The research can be divided into four phases which are from preliminary study phase, data collection phase based on the questionnaire, data analysis phase, and development phase of the framework for effective safety management. A questionnaire was designed with the objective of determining the variables that affect safety management in construction field. In the questionnaire, respondents were requested to provide information relating to safety aspects for one of the recently construction projects.

The survey questionnaire was adopted for data collection contains two main sections. The first section is designed to collect the background information of respondents while the second section consists of various factors with potential effects on workers' safety risk tolerance. The Likert scale was used to quantify these effects and was ranged as 1, 2, 3, 4 and 5, which is correspondingly represent respondents' attitude from (1) = this factor has the least effect on risk tolerance, and (5) = this factor has the strongest effect on risk tolerance (the effects grow with number increases).

Next, in the data analysis phase will indicate the relationships between the factors and potential influencing paths. Then, measurement scales for each factor were developed. Before data collection, interviews with experienced practitioners at construction sites will be conducted to ensure the accuracy and efficiency of the measurement scales and the questionnaire contents, as well as the result. Finally, the last step which is to develop a framework for effective safety management in construction projects based on the data collection and data analysis phase.

3.1 - Analytical Method

The data analysis will be done after the data collection is finished. All the data collected from the questionnaires will be analyzed and then summarized to obtain the appropriate and suitable result of the safety management in construction project. Data analysis is actually an approach to de-synthesize the data collected. It is a method of putting together facts and figures to solve problems and a systematic process of utilizing data to come up with the answer to the question.

The analysis of the survey is done by the Relative Importance Index (RII), Average Index Formula and Cronbach‟s Alpha (using SPSS Software) method. The scores were then transformed to importance indices based on the following formula.

3.2 - Relative Importance Index (RII)

The data which is collected will be processed for carrying out analysis. The collect raw data of the questionnaire survey are entered into an Excel spreadsheet and SPSS (PASW) ver.18 program to analyze the data. The relative Importance Index (RII) is calculated to get the rank of the factors and the importance of safety in construction project.

$$\textbf{Relative importance/difficulty index} = \frac{\sum w}{AN}$$

Where w is the weighting given to each factor by the respondents, ranging from 1 to 5, A is the highest weight (i.e. 5 in the study) and N is the total number of samples.

3.3 - Average Index Formula

The analysis will based on the qualitative measurement or ranking system. Rating for the questionnaire is 1 – Totally Disagree, 2 – Disagree, 3 – Moderately, 4 – Agree, 5 – Totally Agree.

The Average Index Formula:

$$\textbf{Average Index (AI)} = \sum (ß \times n)/N$$

Where,	ß	is weighing given to each factor by respondents
	N	is the frequency of the respondents
	N	is the total number of respondents

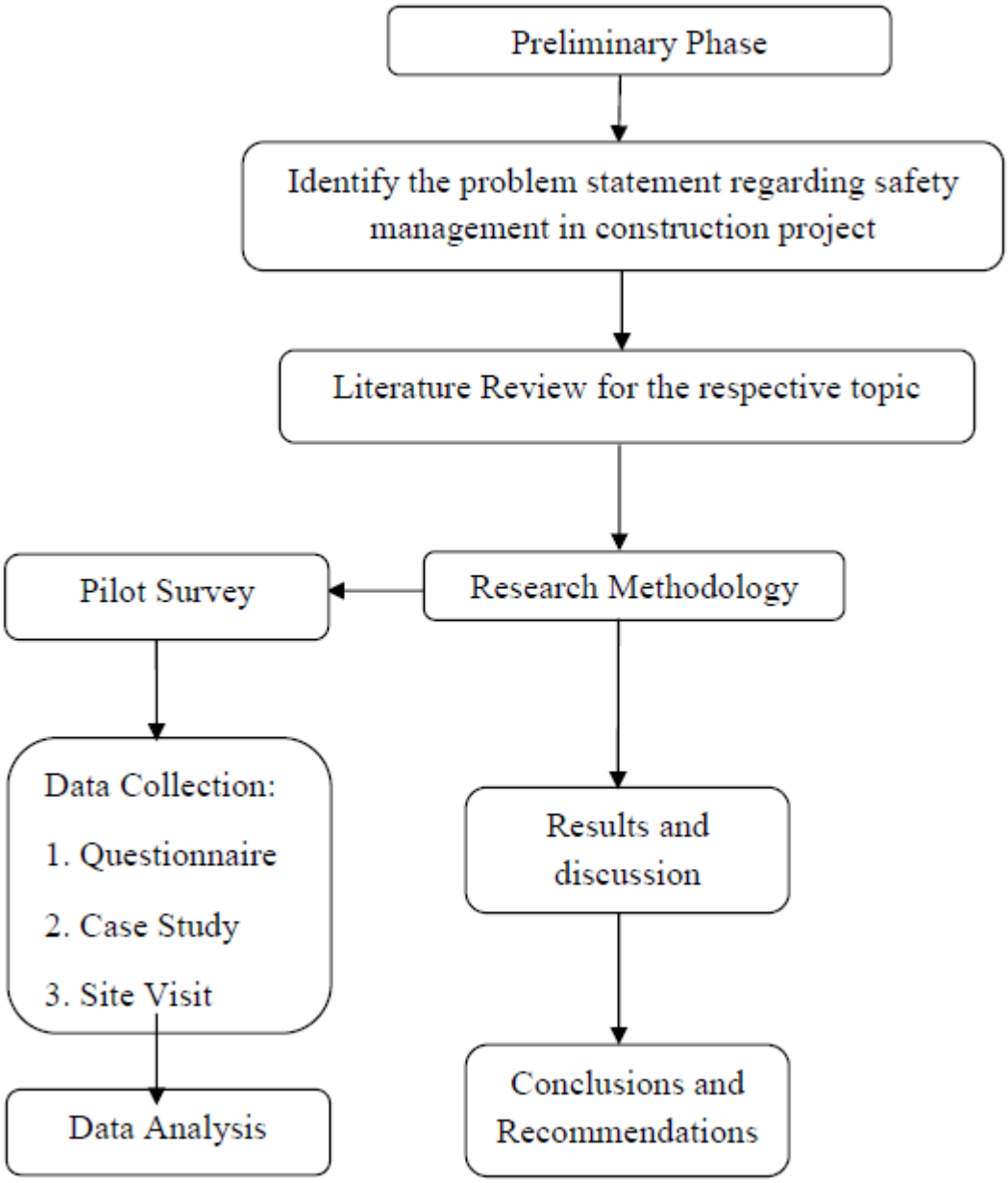
With the rating scale as below (Majid & McCaffer, 1997)

- 1 = Never/Totally disagree (1.00 < Average Index < 1.50)
- 2 = Rarely/disagree (1.50 < Average Index < 2.50)
- 3 = Sometimes/Neutral (2.50 < Average Index < 3.50)
- 4 = Often/agree (3.50 < Average Index < 4.50)
- 5 = Very often/strongly agree (4.50 < Average Index < 5.00)

3.4 - Cronbach's Alpha using SPSS Software

Cronbach's alpha is the most common measure of internal consistency ("reliability"). The Cronbach‟s alpha coefficient is an internal consistency reliability test. The Cronbach's alpha coefficient value is ranged between 0.0 and +1.0 and Cronbach's alpha value nearer to 1 show higher internal consistency.

3.5 - Project Activities Flow Diagram



3.6 - Project Timeline

Gantt Chart for FYP I and FYP II

No	Activity (FYP I)	2016															
		May				June				July				August			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.	Title selection				x												
2.	Literature review																
3.	Extended proposal								x								
4.	Acquire knowledge																
5.	Proposal Defence														x		

No	Activity (FYP II)	2016																2017		
		Sept				Oct				Nov				Dec				Jan		
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
1.	Project Work Continue			S																
2.	Submission of Progress Report									x										
3.	Pre-SEDEX																			
4.	Submission of Draft Final Report													x						
5.	Submission of Dissertation (soft bound)														x					
6.	Submission of Technical Paper														x					
7.	Viva															x				
8.	Submission of Project Dissertation (Hard Bound)																	x		

x	**= Key Milestone**
S	**= Semester Start**

CHAPTER 4
RESULT AND DISCUSSION

4.1 - Pilot Survey

The pilot survey has been done throughout all of the professional engineers either in the academic, construction or consultancy industry. After obtaining and analyzing the results of the pilot survey, logistical, technical and other issues or problems have been addressed. The questionnaire format was revised, or the type of survey had been altered into a more suitable one. After the revision of the survey being made, the large-scale of the survey is executed.

4.2 - Questionnaire Survey

The questionnaires had been distributed to the project teams which base at Bangi area. It consists of the client, consultant, contractor and companies and had received the feedbacks. Since this study is a qualitative study, 30 feedbacks are sufficient enough. The questionnaire consists of three sections, General Information, Factors Affecting Improper Safety Management in Construction Project and Current Practices of Safety Management in Construction Project.

4.3 - Background of Respondent

1. KLCC Urus Harta Holding
2. RHEA Sdn Bhd
3. NCE Sdn Bhd
4. TEKAD Sdn Bhd
5. JASABUMI Sdn Bhd

4.4 - The Construction Stakeholder Related to Safety

Introduction

All construction stakeholders like authority, client/project owner, consultant, contractor, construction worker and also insurance company who are directly and indirectly involved in the safety aspects of construction should play their important roles and responsibilities in ensuring that safety implementation, monitoring and control are carried out more effectively, so that the annual rates of accident and fatality in the construction industry continue to decline from year after another.

Authority

Authorities like DOSH, NCOSH, NIOSH, CIDB and Local Authority should emphasis more effectively on safety compliance especially by contractors and safety enforcement so that it is in accordance with provisions stipulated in current safety acts, regulations and orders available in the construction industry.

Department of Safety and Health (DOSH)

Historically, in April, 1994 the Department of Factory and Machinery (DFM) has been changed to a new name called Department of Occupational Safety and Health (DOSH) as since the newly legislated Occupational safety and Health Act, 1994 complemented the Factories and Machinery Act, 1967. This department is under the jurisdiction of the Ministry of Human Resources. It is responsible for ensuring the occupational safety, health and welfare of people at work as well as protecting other people from the safety and health hazards arising from the activities of various sectors including construction. The department is a government agency responsible for the administration and enforcement of legislations related to Occupational Safety and Health for our nation, with a vision of becoming the organisation which leads the nation in creating a safe and healthy work culture that contributes towards enhancing the quality of working life. The functions of the department are as follows:

 To study and review the policies and legislations of occupational safety and health.
 To conduct research and technical analysis on issues related to occupational safety and health at the workplace.
 To carry out promotional and publicity programs to employers, workers and the general public to foster and increase the awareness of occupational safety and health.
 To become a secretariat for the National Council regarding occupational safety and health.
 To enforce the following legislations :
 Occupational Safety and Health Act 1994 and its regulations.
 Factories and Machinery Act 1967 and its regulations.
 Part of Petroleum Act 1984 (Safety Measures) and its regulations.

Efforts to increase awareness of employers, employees and the general public on the need for a safe workplace with no health hazards require diligent efforts and the participation of numerous parties. Different approaches are required for the implementation of these efforts, and they should be carried out in an integrated, comprehensive and continuous manner in order for maximum effectiveness. This also assures all parties involved that OSH is indeed an important issue towards ensuring a quality working life as well as the survival of employers in any business transaction. As such, all allocated expenditures and efforts to ensure the success of the OSH program and its management system should be regarded as an investment.

To accomplish the assigned responsibility, the department performs three important activities: the formulation of standards, enforcement, as well as promotion and communication activities. The departmental organisation structure consists of its head office and 13 state offices. The scope of duties for the former focus on the formulation of standards, approval, accreditation and data analysis; whilst the latter concentrate more on enforcement of acts and regulations, inspection, audit, legal proceedings and investigations.

National Institute of Occupational Safety and Health (NIOSH)

The National Institute of Occupational Safety and Health (NIOSH) was officially established in December, 1992 as a Company Limited by Guarantee, under the Malaysian Companies Act, 1965. The main vision of this institute is to be the 'Leading Centre of Excellence' in Occupational Safety and Health. NIOSH's function is to provide training, consultation services, disseminate information and conduct research and development to employees, employers and those responsible, either directly or indirectly in the field of occupational safety and health. As stated in the Memorandum and Articles of Association, NIOSH aims to:-

 Contribute towards efforts in upgrading Occupational Safety and Health (OSH) through developing and providing curriculum and training programs for workers and employees, employers and those responsible for implementing OSH at the work place.
 Assist industries, commerce and others to solve problems relating to OSH.
 Assist those who are responsible for OSH with the latest information in the field of OSH, both locally and overseas.
 Conduct short term and long term research in OSH related areas that will benefit and bring advantages to the country.
 Disseminate information on research findings and to become the centre of reference in the field of OSH.
 Organize and participate in various exhibitions, seminar and conferences held nationwide as well as advises and supports industries in their safety and health campaign activities.
 As information is essential in realizing the goal of a safe and healthy workplace environment, NIOSH actively undertakes information dissemination activities to reach out to the public with the hope to inculcate safe and healthy work culture.

Information dissemination is one of the important aims of NIOSH which has become in demand by the industries. Indirectly it indicates the increasing level of awareness in OSH among employers, employees and higher learning institutions in Malaysia. The infrastructure development and the information technology software's are among the main elements of disseminating information to the industries as well as the public as whole.

Construction Industry Development Board (CIDB)

Construction Industry Development Board (CIDB) was established by Act 520 of Lembaga Pembangunan Industri Pembinaan Malaysia Act 1994 in July 1994 as a statutory body under the jurisdiction of the Ministry of Works Malaysia. Its main goal is to develop, enhance and increase the competitiveness of the Malaysian construction industry. Its objectives are to develop the construction industry to be one of the major contributing sectors to the national economy, capable of producing and delivering high quality construction works, value for money and responsive to the nation's need

Meanwhile, among its functions that are related to construction safety is to accredit and certify skilled construction workers and construction supervisors. With this particular function, the board is empowered to conduct 'Safety and Health Induction Course for Construction Workers (SICW)'. Upon successful completion of the said course, the Board shall accredit and certify skilled construction workers and construction site supervisors by issuing the so-called 'CIDB Green Cards' which then allow and qualify them to enter and work at construction sites. The green card holders are also entitled with Takaful Insurance coverage according to the coverage terms and conditions. This card shall complements with all 'NIOSH Safety Passport' issued by the National Institute of Occupational Safety and Health (NIOSH) nationwide.

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In addition to above, among the activities of the Board is to recognise outstanding players of the construction industry by staging the so-called 'Malaysian Construction Industry Excellence Awards (MCIEA)' annually. Among the new categories introduced by the Board in the year 2006 which include safety and health are:

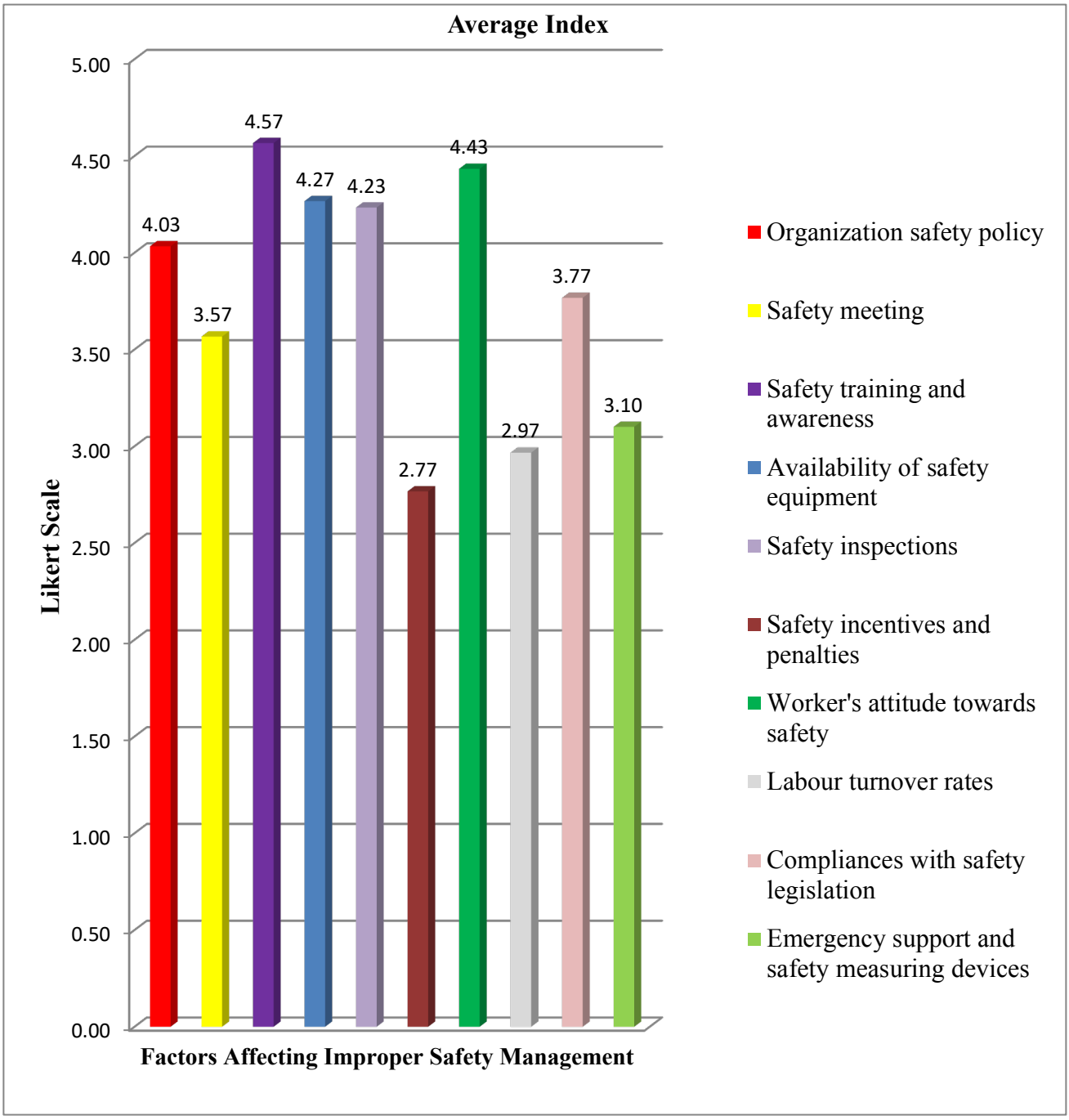
- Small Contractor Award
- Construction Professional Of The Year Award
- Safety & Health Award
- Environmental Best Practices Award
- IBS Award

4.5 - Result Study on Factors Affecting Improper Safety Management

4.5.1 - Average Index Formula using SPSS Software

Factors Affecting Improper Safety Management in Construction Projects	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
Organization safety policy	30	3	2	5	4.03	0.176	0.964	0.930
Safety meeting	30	3	2	5	3.57	0.157	0.858	0.737
Safety training and awareness	30	2	3	5	4.57	0.124	0.679	0.461
Availability of safety equipment	30	2	3	5	4.27	0.135	0.740	0.547
Safety inspections	30	3	2	5	4.23	0.164	0.898	0.806
Safety incentives and penalties	30	2	2	4	2.77	0.124	0.679	0.461
Worker's attitude towards safety	30	2	3	5	4.43	0.124	0.679	0.461
Labour turnover rates	30	3	2	5	2.97	0.155	0.850	0.723
Compliances with safety legislation	30	3	2	5	3.77	0.190	1.040	1.082
Emergency support and safety measuring devices	30	4	1	5	3.10	0.211	1.155	1.334

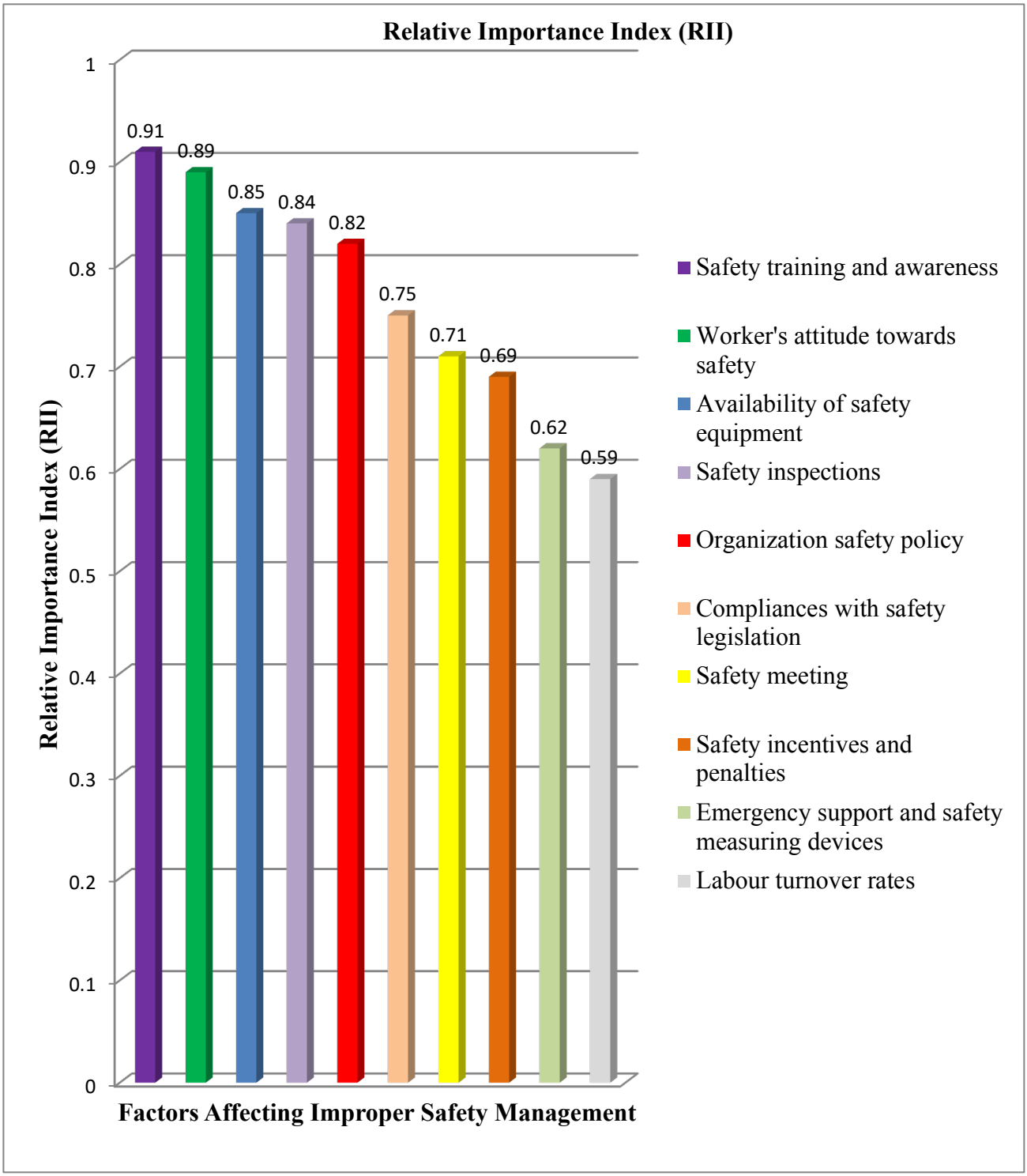
4.5.2 - Bar Chart of Average Index



4.5.3 - Relative Importance Index (RII) using SPSS Software and Microsoft Excel

No.	Factors Affecting Improper Safety Management	Relative Importance Index (RII)
1	Safety training and awareness	0.91
2	Worker's attitude towards safety	0.89
3	Availability of safety equipment	0.85
4	Safety inspections	0.84
5	Organization safety policy	0.82
6	Compliances with safety legislation	0.75
7	Safety meeting	0.71
8	Safety incentives and penalties	0.69
9	Emergency support and safety measuring devices	0.62
10	Labour turnover rates	0.59

4.5.4 - Bar Chart of Relative Importance Index (RII)



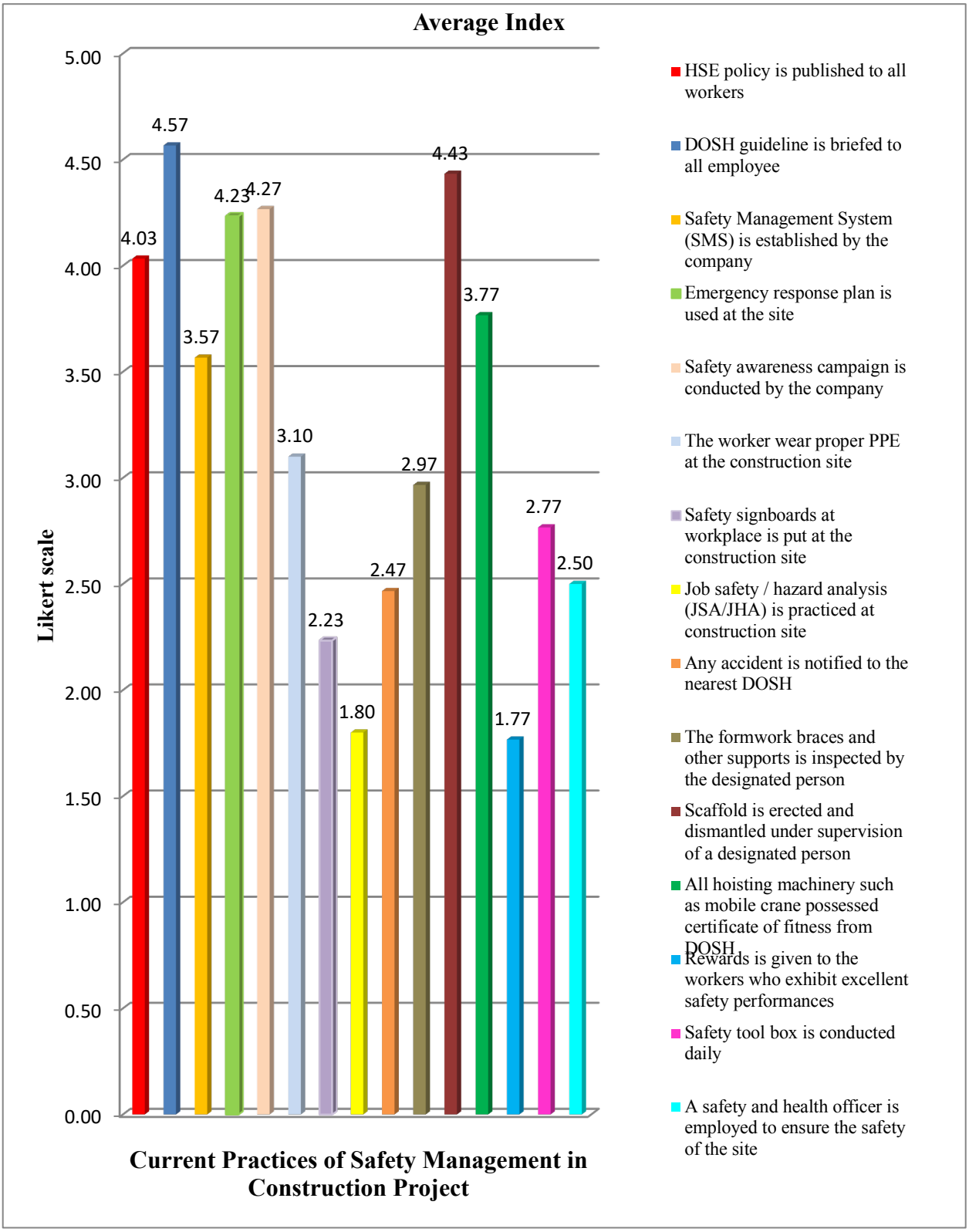
4.6 - Result Study on Current Practices of Safety Management

4.6.1 - Average Index Formula using SPSS Software

Current Practices of Safety Management in Construction Project	N	Range	Minimum	Maximum	Sum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
HSE policy is published to all workers	30	3	2	5	121	4.03	0.176	0.964	0.930
DOSH guideline is briefed to all employee	30	2	3	5	137	4.57	0.124	0.679	0.461
Safety Management System (SMS) is established by the company	30	3	2	5	107	3.57	0.157	0.858	0.737
Emergency response plan is used at the site	30	3	2	5	127	4.23	0.164	0.898	0.806
Safety awareness campaign is conducted by the company	30	2	3	5	128	4.27	0.135	0.740	0.547
The worker wear proper PPE at the construction site	30	4	1	5	93	3.10	0.211	1.155	1.334
Safety signboards at workplace is put at the construction site	30	2	1	3	67	2.23	0.124	0.679	0.461
Job safety / hazard analysis (JSA/JHA) is practiced at construction site	30	2	1	3	54	1.80	0.121	0.664	0.441
Any accident is notified to the nearest DOSH	30	3	1	4	74	2.47	0.115	0.629	0.395

The formwork braces and other supports is inspected by the designated person	30	3	2	5	89	2.97	0.155	0.850	0.723
Scaffold is erected and dismantled under supervision of a designated person	30	2	3	5	133	4.43	0.124	0.679	0.461
All hoisting machinery such as mobile crane possessed certificate of fitness from DOSH	30	3	2	5	113	3.77	.190	1.040	1.082
Rewards is given to the workers who exhibit excellent safety performances	30	2	1	3	53	1.77	.114	0.626	0.392
Safety tool box is conducted daily	30	2	2	4	83	2.77	.124	0.679	0.461
A safety and health officer is employed to ensure the safety of the site	30	3	1	4	75	2.50	.125	0.682	0.466
Valid N (listwise)	30								

4.6.2 - Bar Chart of Average Index

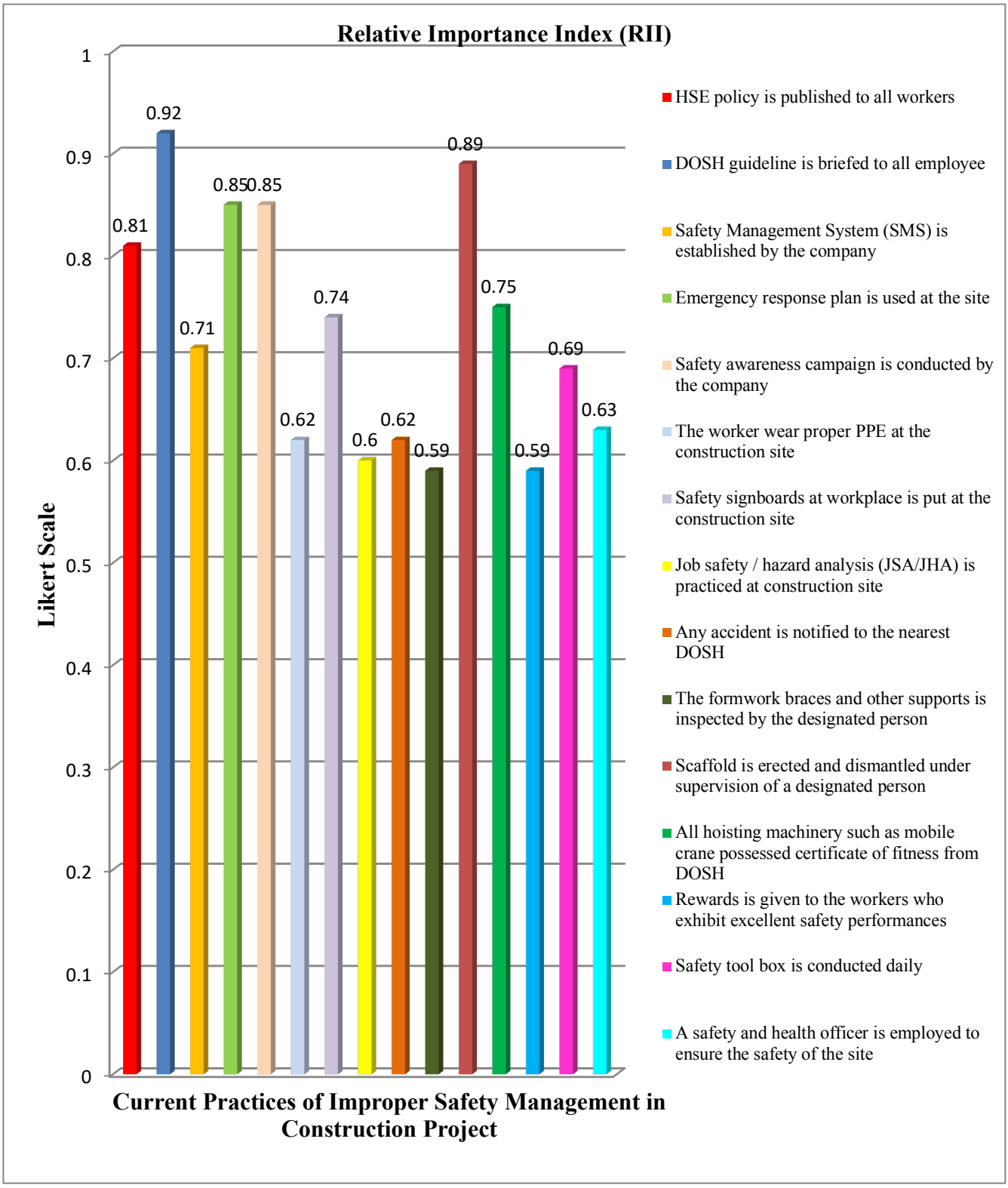


4.6.3 - Relative Importance Index (RII) using SPSS Software and Microsoft Excel

No	Current Practices of Safety Management in Construction Project	Relative Importance Index (RII)
1.	HSE policy is published to all workers	0.81
2.	DOSH guideline is briefed to all employee	0.92
3.	Safety Management System (SMS) is established by the company	0.71
4.	Emergency response plan is used at the site	0.85
5.	Safety awareness campaign is conducted by the company	0.85
6.	The worker wear proper PPE at the construction site	0.62
7.	Safety signboards at workplace is put at the construction site	0.74
8.	Job safety / hazard analysis (JSA/JHA) is practiced at construction site	0.60
9.	Any accident is notified to the nearest DOSH	0.62
10.	The formwork braces and other supports is inspected by the designated person	0.59
11.	Scaffold is erected and dismantled under supervision of a designated person	0.89
12.	All hoisting machinery such as mobile crane possessed certificate of fitness from DOSH	0.75

13.	Rewards is given to the workers who exhibit excellent safety performances	0.59
14.	Safety tool box is conducted daily	0.69
15.	A safety and health officer is employed to ensure the safety of the site	0.63

4.6.4 - Bar Chart of Relative Importance Index (RII)



4.7 - Discussion on the Result

Based on the Average Index and Relative Importance Index (RII), the respondents rank the first factor affecting of improper safety management in construction is safety training and awareness, with a relative importance index of 0.91 and average index of 4.57. It indicates that safety training and awareness play a very important role in safety management in construction projects.

"Worker's attitude towards safety" is graded the second with a relative importance index of 0.89 and average index of 4.43. The results are a clear indication of poor worker's attitude towards safety. The respondent grade availability of safety equipments, safety inspections and organization safety policy are ranked the third, fourth and fifth respectively, with a relative importance index of 0.85, 0.84 and 0.82. As for the rest of the factors it is ranked the sixth, seventh, eighth, ninth and labour turnover rates are graded as least factor which affecting of improper safety management in construction projects with a relative importance index of 0.59 and average index of 2.87.

From the case studies conducted, all involved parties have implemented safety practices. The surveys show that all five companies have safety policy for the works on site and provide education and training for workers at construction sites. In addition, they also carry out site safety inspection and safety auditing regularly. Furthermore, safety meetings are conducted at construction sites to discuss safety matters with workers and the management team. Other than that, safety organizations have been established by all companies in order to manage and control the safety management at the construction sites. However, based on the survey, majority respondents agreed that the workers are still lack of the awareness and attitude towards safety in order to minimize the safety accidents at construction site. Other than that, in order to ensure safety of workers, the companies provide personal protective equipment (PPE) to workers such as safety helmets, safety boots, gloves and others. But, some of the workers ignore the PPE when doing construction works which lastly may lead to the accidents.

Besides, based on the study also shows that all companies promote safety at construction sites to make sure the construction site is always in a safe condition. However, each company has different ways of promoting safety. Additionally, these case studies provide other safety

practices such as providing safety access and specific places for chemical materials. Thus, it can be concluded that the safety practices that have been implemented by the companies at construction sites include safety policies, training, site safety inspection, safety meeting, safety organization, personal protective equipment, emergency support and safety measuring devices, and safety promotions which are consistent with the literatures reviewed.

With regard to Occupational Safety and Health, training consist of instruction in hazard recognition and control measures, learning safe work practices and proper use of personal protective equipment, and acquiring knowledge of emergency procedures and preventive actions. Training also provide workers with ways to obtain added information about potential hazards and their control; they could gain skills to assume a more active role in implementing hazard control programs or to effect organizational changes that would enhance worksite protection. Training must also be provided if risks change, and refresher training when skills are not frequently used. This study established that the training and induction carried out in construction sites is inadequate and hence there is need to check the system and probably implement a training program on safety since it is required that all employees must be given health and safety induction training when they start work, if risks change, and refresher training when skills are not frequently used.

OSHA (2007) requires the use of personal protective equipment (PPE) to reduce employee exposure to hazards when engineering and administrative controls are not feasible or effective in reducing these exposures to acceptable levels. If PPE is to be used, a PPE program should be implemented. This program should address the hazards present; the selection, maintenance, and use of PPE; the training of employees; and monitoring of the program to ensure its ongoing effectiveness. The PPE required in the construction sites include; eye protection and face protection, hearing protection, respiratory protection, hand and arm protection, foot and leg protection, head protection and body and fall protection mechanisms. During this survey it was observed that construction workers on the sites lacked appropriate protective equipment for instance workers were noted carrying out high risk activities such as painting, excavations, concreting among others without the right protective gear such as helmets, masks, ear muffs, goggles and overalls.

4.8 - Cronbach's Alpha using SPSS Software

Generally, a questionnaire with an α of 0.8 is considered reliable (Field, 2009). Hence, this questionnaire certainly is reliable, since the α is 0.913. The resulted α should yet be interpreted with caution. Since the amount of items in a questionnaire is taken into account in the equation, a huge amount of variables can upgrade the α (Cortina, 1993; Field, 2009). For example, if the reliability analysis of just the items making up the first factor in our research, we get the same α, but the average correlation is 0.49 instead of 0.43. How huge the alpha should be for a dataset with a particular amount of items is still a point of discussion (Cortina, 1993). Cortina (1993) recommends determining the adequacy of a measure of the level of precision needed. However, since the α of this questionnaire is far higher than 0.8, we can assume that it is reliable.

4.8.1 - Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.913	0.894	30

4.9 - Framework for Effective Safety Management Based on Case Study

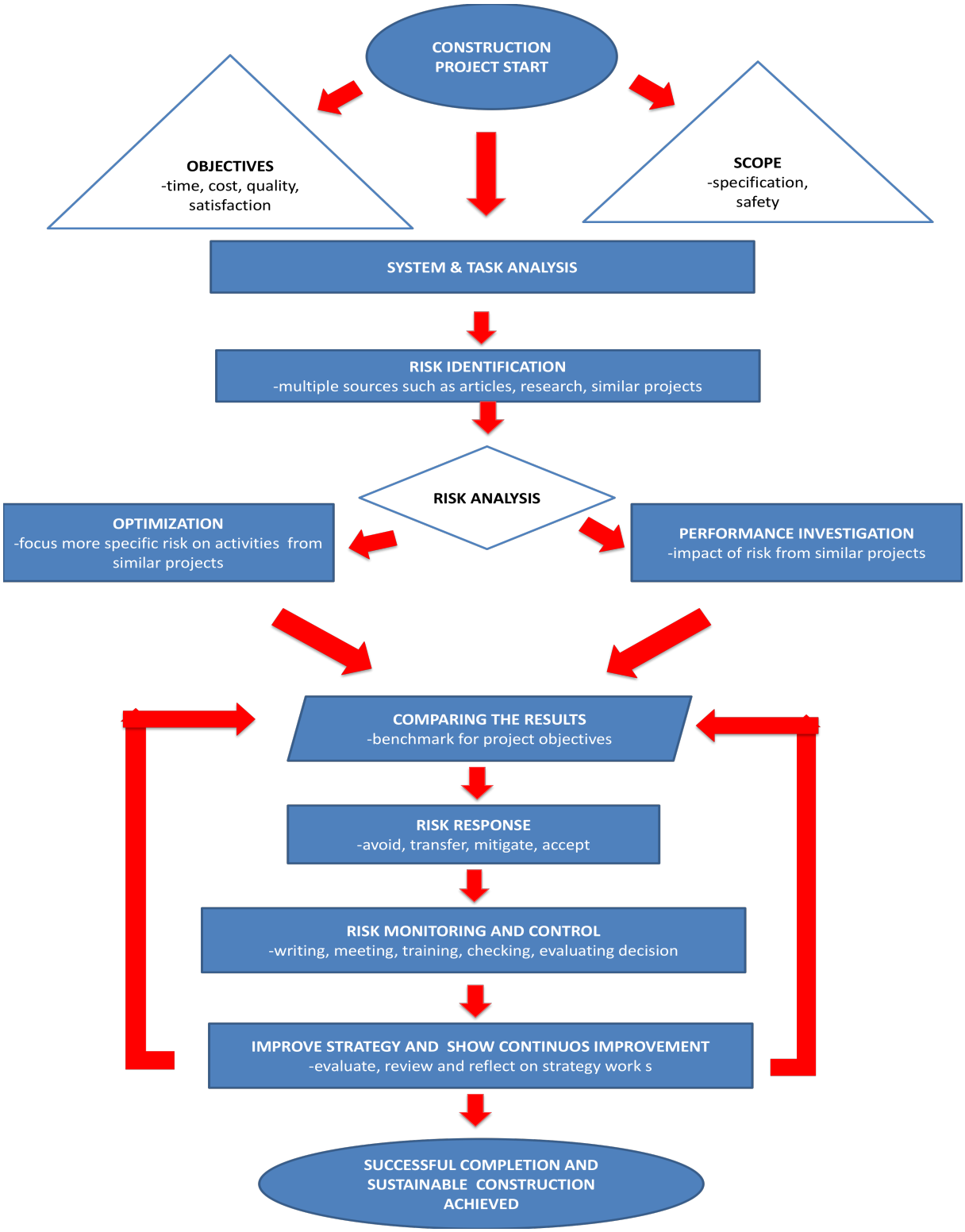


Figure 3

The proposed framework for effective safety management in construction projects as shown in figure 3. Project team and officers that involved should understand the objectives of the project undertaken by them. The objectives of the projects should be completed on time, expenses to be spent within allocated budget, fulfill the requirement of quality plans and satisfying the client expectation. Other than that, project team members also must aware about the scope of the project by following the project specification and safety requirement.

Then, the project team should make the system and task analysis. This includes type of construction works, types of material and equipments used and others analysis. After that, they shall identify risk factor which may become obstacles towards achieving the objective of successful completion. There are multiple sources of identifying risk factors such as related articles, research or observation from similar projects. Next, in the risk analysis phase, they can divide the analysis into two phases which is performance investigation and optimization.

Optimization of activities shall be checked in order to ensure that required resources are allocated sufficiently. Performance investigation shall be carried out by project team to ensure that all critical activities are completed timely. The results of optimization and performance investigation can become benchmark for the project. The application of optimization and performance investigation can alert the project team to take immediate action in order to ensure the project team achieves its objective.

After that, the project team must plan the responses to all possible risk factors by either avoidance, transfer all the risks to the third party, mitigation or acceptance. Then, the project team must carry out monitoring the risk factors by writing to the parties concerned, checking the work progress together with conducting meetings in order to control the impact of risk. Lastly, in order to increase safety management, the project team should improve strategy and continues improvement and repeated again the risk analysis phase until the project is complete and achieve the objectives.

CHAPTER 5
CONCLUSION AND RECOMMENDATION

Construction worksites are one of the most high risk places because of the high safety cases reported at construction sites. This study investigates various ways that management may take in line to make their sites safer. This study analyzed all the variables that significantly gave effect to site safety. The results of this study are very important because the factors that affecting safety have been identified. If these factors are addressed and monitored closely, safety cases at construction sites can be minimized. The implication of the findings is that the project team can use the framework which will be tested in this study, to manage construction safety with the view of reducing accidents and safety cases. This framework provides the nuts and bolts which management can rely on to manage safety on their construction sites.

As the recommendation, the management of the company has to realize the performance of the company in safety management as they play a big role in this matter. One of the ways is by restructuring the safety management team. This is to ensure that safety matters are taken cared by a responsible person. Besides that, the government should give the privilege to small construction company in order to set up a systematic construction safety management system. In addition, government should provide free Green Book Training to the workers. Thus, this will enhance the capability of the company to control safety matters in the construction site.

In conclusion, safety affects all levels of the construction organization from government, company management, supervisor, and worker. In this research, relying on site interviews and a review of the literature, various factors had been identified to assess safety management on construction projects. Questionnaires and site inspection forms were then designed to collect data from construction projects. The items and factors were quantified and relations between the factors were identified by correlation and regression analysis. This can efficiently reflect safety management performance on site. Since most of the aspects in the method were evaluated objectively, the results are reliable. In general, the effective safety management framework can be used to assess safety management performance on the construction projects.

CHAPTER 6
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APPENDICES

Safety meeting before the project starts

The worker did not wear proper PPE

QUESTIONNAIRES

CASE STUDY ON EFFECTIVE SAFETY MANAGEMENT IN CONSTRUCTION PROJECTS

Objectives:

1. To study the safety issues that happen in construction projects
2. To identify variables that significantly affects construction safety
3. To propose a framework for effective safety management in construction projects

Instructions:

1. Please fill in the space available and tick √ in the respective box
2. All information's will be treated as CONFIDENTIAL and shall be used for academic purposes only.
3. All the data information will be on aggregated basis and no individual data will be published.
4. For further information and inquiries, please contact Mr Muhd Azmi Mat Yaacob (013-3791253) or email to (azmimatyaacob13@gmail.com).

SECTION A: GENERAL INFORMATION OF THE AGENCY/ ORGANISATION

1. Name ……
2. Age ……..
3. Agency / Organization ……
4. Experience ……..
5. Current Position ……..
6. Project …….
7. Cost Estimation ……..
8. Location ……..

SECTION B: FACTORS AFFECTING IMPROPER SAFETY MANAGEMENT IN CONSTRUCTION PROJECT

For each statement below please tick √ on the appropriate number to indicate whether it is:

1 – Strongly Disagree 2 – Disagree 3 – Moderately 4 – Agree 5 – Strongly Agree

No.	Factors	1	2	3	4	5
1.	Organizational safety policy					
2.	Safety meeting					
3.	Safety training and Awareness					
4.	Availability of safety equipment					
5.	Safety inspections					
6.	Safety incentives and penalties					
7.	Worker's attitude towards safety					
8.	Labour turnover rates					
9.	Compliances with safety legislation					
10.	Emergency Support and Safety Measuring Devices					

SECTION C: CURRENT PRACTICES OF SAFETY MANAGEMENT IN CONSTRUCTION INDUSTRY

For each statement below please tick √ on the appropriate number to indicate whether it is:

1 – Strongly Disagree 2 – Disagree 3 – Moderately 4 – Agree 5 – Strongly Agree

No.	Implementations	1	2	3	4	5
1.	HSE policy is published to all workers					
2.	Safety Management System (SMS) is established by the company					
3.	DOSH guideline is briefed to all employee					
4.	Safety awareness campaign is conducted by the company					
5.	Emergency response plan is used at the site					
6.	Safety tool box is conducted daily					
7.	Scaffold is erected and dismantled under supervision of a designated person					
8.	The formwork braces and other supports is inspected by the designated person					
9.	All hoisting machinery such as mobile crane possessed certificate of fitness from DOSH					
10.	The worker wear proper PPE at the construction site					

11.	Any accident is notified to the nearest DOSH					
12.	Job safety / hazard analysis (JSA/JHA) is practiced at construction site					
13.	Safety signboards at workplace is put at the construction site					
14.	A safety and health officer is employed to ensure the safety of the site					
15.	Rewards is given to the workers who exhibit excellent safety performances					

Thank you for the feedback.