ADOPTION AND PRACTICES OF OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEM IN MALAYSIAN CONSTRUCTION SITES

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A project report submitted in partial fulfilment of the requirements for the award of Master of Engineering (Mechanical)

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DECLARATION

I hereby declare that this project report is based on my original work except for citations and quotations which have been duly acknowledged. I also declare that it has not been previously and concurrently submitted for any other degree or award at UTAR or other institutions.

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APPROVAL FOR SUBMISSION

I certify that this project report entitled **"ADOPTION AND PRACTICES OF OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEM IN MALAYSIAN CONSTRUCTION SITES"** was prepared by **CHEE TEIK YEE** has met the required standard for submission in partial fulfilment of the requirements for the award of Master of Engineering (Mechanical) at Universiti Tunku Abdul Rahman.

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ABSTRACT

Construction industry plays a role as an engine of economic growth since it provides job opportunities and generate revenue for both skilled and unskilled citizens. Nevertheless, the rate of occupational accident rate remained high in construction industry. The direct impacts to both the company and workers are discouraged such as loss of productivity and reputation to the company as well as loss of quality of life or premature death. Main cause to poor safety performance may due to the poor safety measure practices, supportive environment, and proper safety management system. The aims of this research are to study on the Occupational Health and Safety Management System (OHSMS) and its relationship with work-related accidents, find out the factors influencing the implementation of OHSMS and work accident at construction industry, also to test the effectiveness and reliability of the safety management system in Malaysia construction site. In this research, a field survey is conducted and 119 number of feedbacks is collected from G7 construction companies in Selangor area. The data is analyzed and evaluated using partial least square structural equation modelling (PLS-SEM) via SmartPLS software. The result revealed that all the variables have positive impact on each other from the result of path coefficient value that nearer to +1 and particularly significant on supportive environment to practices and adoption of OHSMS and importance of the safety measure practices to safety performance from the result of P value which is lower than 0.05.

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LIST OF SYMBOLS / ABBREVIATIONS

AVE	Average Variance Extracted
CA	Cronbach's Alpha
CB-SEM	Covariance-based Structural Equation Modelling
CIDB	Construction Industry Development Board
CR	Composite Reliability
CSV	Comma-separated Value
CTA-PLS	Confirmatory Tetrad Analysis
DOSH	Department of Occupational Safety and Health
HIRARC	Hazard Identification, Risk Assessment and Risk Control
HTMT	Heterotrait-monotrait
ILO	International Labour Organization
ISO	International Organization for Standardization
NFSI	National Floor Safety Institute
OHS	Occupational Health and Safety
OHSAS	Occupational Health and Safety Assessment Series
OHSMS	Occupational Health and Safety Management System
PLS	Partial Least Squares
PLS-SEM	Partial Least Squares Structural Equation Modelling
PPE	Personal Protective Equipment
SEM	Structural Equation Modelling
SHE	Safety, Health, and Environment
SOP	Standard of Procedure
VIF	Variance Inflation Factor
f^2	Effect Size
R^2	Coefficient of Determination
Q^2	Blindfolding-based Cross-validated Redundancy Measure

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CHAPTER 1

INTRODUCTION

1.1 General Introduction

According to the statistic provided by International Labour Organization (ILO), the estimated number of workers died due to industrial accident are 1000 per day and 2 million per year. Besides, an estimate of 4% of global gross domestic product implemented as the global compensated cost of industrial accident. (International Labour Organization, 1996-2023)

Construction industries is considered essential sector in contributing to global economic development. Besides, construction industry able to improve the quality of life of citizen through construct educational facilities, transport system as well as develop healthcare infrastructure. However, construction industry contributed extreme high rate of occupational accident.

Figure 1.1 demonstrates the occupational accident statistics in Malaysia from January 2023 to May 2023 which provided by Department of Occupational Safety and Health (DOSH). The construction sector is contributing to major numbers of work-related deaths among all sector where estimate of 23 die from construction sector, which is the highest among the sectors. Therefore, an attention should be put more accent on the risk of occupational accident in construction industry.

OCCUPATIONAL ACCIDENT STATISTICS BY SECTOR JANUARY- MAY 2023 (REPORTED TO DOSH ONLY)

SECTOR	NPD	PD	DEATH	TOTAL
Hotel and Restaurant	81	0	0	81
Utilities (Electricity, Gas, Water and Sanitary Service)	70	0	2	72
Finance, Insurance, Real Estate and Business Services	250	8	7	265
Construction	47	4	23	74
Transport, Storage and Communication	151	7	4	162
Manufacturing	1920	89	16	2025
Wholesale and Retail Trade	65	0	0	65
Public Services and Statutory Authorities	57	2	0	59
Mining and Quarrying	10	0	3	13
Agriculture, Forestry and Fishery	497	10	10	517
TOTAL	**3148**	**120**	**65**	**3333**

LEGEND:
PD - PERMANENT DISABILITY
NPD- NON PERMANENT DISABILITY

Source: International Policy and Research Development Division

Figure 1.1 Occupational Accident Statistics in Malaysia from January to May 2023 (DOSH, 2023)

Occurrence of occupational accident in construction industry may be because of improper practice guideline such as tiredness, improper working technique, distractions as well as messy workplace. For example, regular breaks must be taken by every worker in construction industry as majority physical work will become tiring whenever the work are conducted for a long duration. A good safety guideline is important to be implemented to reduce the occurrence of occupational accident.

A safety workplace is important because it able to avoid injury or accident, enhance productivity as well as minimize the cost of occupational accident. Safety and Health Management System should be instituted and implement in the organization. The Safety and Health program should include participation of every employee, regular monitoring, and overall wellness component (Anthony et al., 2007). The purpose of safety and health management system not only to reduce the risk of occupational accident, it also should enable workers to conduct their work efficiently and effectively (Garcia-Herrero et al., 2012). A safety workplace may affect the practice of worker to carry out their work, which in turn will improve the efficiency. As a result, employees who working in a safety workplace will perform their work in a safety way that will not cause them to injure. Safety management practices will improve the safety condition, enhance workers' behaviors which in turn minimize the occurrence of occupational accident.

1.2 Importance of the Study

Occupational injury is declared as any injury disease or death that suffered by workers from an accident in workplace. An occupational injury may lead to an occupational disease over a period. Vinodkumar and Bhasi (2010) declared that safety management commitment has positive impact on safety behaviours, employee satisfaction and competitiveness. This project is conducted to show that the implementation of safety and health management practice or occupational health and safety management system (OHSMS) able to enhance the safety performance as well as improve the reputation of the company. Besides, the influence of fundamental safety and health knowledge on the safety performance of the company. The safety and health knowledge may enhance the safety performance of the company as workers has knowledge to carry out their work in safety way. Safety motivation is significant in encourage workers to comply with safety rules and perform necessary tasks It is also related to the method that employers implemented to encourage and lead their workers with the intention of

achieving company goals. In a few words, a successful construction projects depends on the participation of all the team members to guarantee the projects are accomplished on time and minimizing the occurrence of occupational injury or accident concurrently.

1.3 Problem Statement

Department of Occupational Safety and Health (DOSH) has instituted the workplace safety rules and guidelines to maintain the prevent occupational accident in workplace, However, the construction sector still contributing to major numbers of work-related injury or deaths. It is significant to studied on the main roots that cause the occurrence of occupational accident. A few problems that can be studied such as the method of employer utilize to ensure safety of the workplace and the time interval that employer inspect their workplace to prevent the occurrence of occupational accident. It is also significant to determine any gaps in the utilization of safety act requirement and any deficiencies in examined construction sites (Arsiah et al., 2013).

Participation of employer in safety and health management implementation is important. The number of occupational accident cases due to improper safety management of the organisation increased continuously even through the incidents have been reported to the relevant authorities (International Labour Organization, 2019). This issue to be observed and more attention is required to minimise the occupational accident. All the team members of the organisation must perform their work corporately to maintain a safety workplace.

Cohen (1997), Vredenburgh (2002), and Mearns et al. (2003) stated that the ineffective communication between employers and employees and their attitude also an important factor to high accident rate. A construction project usually conducted together by a few numbers of parties such as various trade of sub-contractor and every company has their own plan to achieve the goal. To reach the goal effectively, an effective communication must be carried out among the parties to standardize all the necessary safety and health plan. A well-planned safety and health management system enable all the parties to work under a safe workplace.

There is a lot of advantages by implementing a well-planned safety and health management in the organization. Being studying journal, a proper safety practice able to minimize the cost of occupational accidents, increase productivity and increase company's reputation. Nevertheless, the journal that regarding the relationship of safety practice and construction company's competitiveness is insufficient in market.

Therefore, this project is conducted with the intention to be better acquainted on the relationship between safety practice and company's competitiveness (Bottani et al., 2009).

1.4 Aim and Objectives

This research was carried out with the purpose to have better knowledege on the relationship between safety management practice and safety performance. The objectives of this research are listed as below:

- To define the Occupational Health and Safety Management System (OHSMS) and its relationship with work related accidents
- To examine the influence of safety behavioural on implementation of Occupational Health and Safety Management System (OHSMS) and safety performance
- To examine the impact of safety management practice on the prevention of work related accidents
- To test the effectiveness and reliability of safety management system in Malaysia construction site

1.5 Scope and Limitation of the Study

In overall, the scope of this research are listed as following:

- The survey form cannot be an open-ended question.
- A personnel with site safety experience who work in the construction company are also be necessary to get incolve in this survey.
- The question in the survey form will be straightforward and clear for respondent to understand it.

However, there is also several limitation in this research. The limitation of this research are as belows:

- There is limited time frame to conducted this survey.
- The survey from this research was only collected in G7 construction company in Selangor area.

1.6 Contribution of the Study

This research focus on adoption and practices of the Occupational Health and Safety Management System (OHSMS) in construction site as its implementation play significant role to establish a safety workplace. This study indicate the effect of implement safety practices in an organization, determine the factor that influence the safety performance due to safety practices as well as the method that can be utilized by employer to drive the OHSMS. The goals of this research is to motivate all the team members of the organization involve themselves in safety and health program in order to create a safe workplace environment together and improve the competitiveness of the organization.

1.7 Outline of the Report

The ouline of the report are as belows:

Chapter 1 consists of information regarding the overview of the construction industries in Malaysia, problem statement, aim and objectives as well as the contribution of the study.

Chapter 2 contains several literature review on behavioural safety, safety manegemnt practices along with the occupational safety and management system. Also the development of hypothesis and conceptual framework.

Chapter 3 discuss the research approach such as method for data analysis, targeted population for survey, calculation of sample size as well as development of survey questionnaire including pre pilot testing and pilot test.

Chapter 4 shows the actual test result analysis from the data collected, evaluation of the model and validation of hypothesis.

Chapter 5 concludes the findings from the survey and suggest the recommendation of future works.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Construction industries is considered essential sector in contributing to economic development of the country. Construction industries improve living standard of the nations in their country. This is because construction industries able to build a sustainable environment, which in turn attract the tourists and boost economic of the country. In contrast, deficient infrastructure may lower down the quality of life of the nations along with recession in countries' economic. (Alaloul et al., 2021). Therefore, the development of construction industries is significant to every country.

However, the major drawback of construction industry is the occupational accident rate. Construction industry is considered as high-risk industry as the occupational accident rate especially on death rate in construction fields is the highest as compared to others. The Table 2.1 below show the occupational accident statistics with permanent disability, non- permanent disability, and death and Table 2.2 show the statistic of occupational accident death rate that reported to DOSH from year 2015 to year 2022.

Table 2.1 Occupational Accident Statistics (Includes permanent disability, non-permanent disability, and death) from 2015 to 2022 (Reported to DOSH only)

SECTOR	2015	2016	2017	2018	2019	2020	2021	2022
Hotel and Restaurant	62	90	81	123	235	140	126	119
Utilities (Electrical, Gas, Water and Sanitary Service)	96	74	78	173	258	220	207	189
Finance, Insurance, Real Estate and Business Services	119	126	113	217	406	327	285	373
Construction	**237**	**222**	**177**	**232**	**326**	**206**	**217**	**148**
Transport, Storage and Communication	131	127	67	137	389	311	292	248
Manufacturing	2041	2315	1691	3228	4948	4506	4269	4514
Wholesale and Retail Trade	108	111	65	73	87	128	187	119
Public Services and Statutory Authorities	32	110	47	58	99	77	74	77
Mining and Quarrying	39	24	38	41	60	39	56	37
Agriculture, Forestry and Fishery	480	467	393	749	1176	979	973	895

Table 2.2 Occupational Accident Statistic (Death Rate) from 2015 to 2022 (Reported to DOSH only)

SECTOR	2015	2016	2017	2018	2019	2020	2021	2022
Hotel and Restaurant	0	3	2	1	5	2	0	0
Utilities (Electrical, Gas, Water and Sanitary Service)	6	2	8	5	9	3	8	9
Finance, Insurance, Real Estate and Business Services	14	14	7	22	16	8	17	24
Construction	**88**	**91**	**63**	**118**	**84**	**66**	**65**	**59**
Transport, Storage and Communication	22	12	9	12	21	11	6	10
Manufacturing	46	68	46	62	73	73	48	58
Wholesale and Retail Trade	3	0	5	1	0	1	2	2
Public Services and Statutory Authorities	0	6	4	9	3	3	4	0
Mining and Quarrying	4	4	7	4	5	3	8	8
Agriculture, Forestry and Fishery	31	23	18	26	43	43	16	16

This may due to the workers does not have knowledge on the safety behaviour which will cause them to operate their work in risky way. Safety behaviour is significant in construction industry as it able to prevent or minimize the occupational accident rate. Vitharana and De Silva have stated that works in construction sites must be safe without threatening a personal life and health. Hence, construction company must ensure all their workers comply with safety practice whenever they conducted their work in construction sites.

Besides, the implementation of a well-planned safety and health management able to establish a safety workplace. Construction industry should institute a safety and health management system that suit their company as well as encourage all the team members to involved themselves in the safety and health program. This able to reduce the occurrence of occupational accident, create a safety workplace and which in turn will improve company reputation.

This chapter will concentrate on studying the factor that affecting safety performance such as safety behaviour, safety practice and health and safety management system.

2.2 Behavioural Safety

Bowander (1987) has stated that most of the occupational accidents happen due to three types of errors, which included human error, technological error and system error. Occupational accidents can be reduced by promoting behavioural safety. Behavioural safety emphasizes on at-risk human behaviour that may result in injury as well as accident prevention. Employees perform their potentially 'unsafe' practices due to not being aware that they operate their jobs in a risky way. Employees who have been routinely working in a dangerous way will perform continuously whenever the accident does not happen. As consequences, they will be involved in terrible accidents because of their at-risk working behaviour.

Behavioural safety also contributes to a culture change by challenging potentially unsafe behaviour or attitude. Besides, behavioural safety puts more accent on employees as compared to employers to improve or maintain occupational safety. This is due to the Hawthron effect where those who are aware they are being observed will change their attitude to match the observer's expectation. For instance, employees may avoid performing unsafe working behaviour whenever they notice being observed, however they will revert to dangerous working ways once they are not being observed.

2.3 Safety Management Practices

Safety management practices perform significantly in setting up the safety culture in the workplace. Safety management practices are the rules, policies, and strategies established by the management of an organisation to ensure the safety of their employees. The theory of safety management practices is to encourage employees to perform their work in a safe way to reduce the risk of occupational accidents which may influence employee's safety and health. Cohen (1997) and Smith et al. (1975) declared that organisations with lower occupational injury cases were mainly because of management involve themself in behavioural safety, carry out superior safety training and frequent training for new employees and existing employees respectively, more concern on safety issue in meeting along with post-injury administration. In short, safety culture in an organisation can be achieved if employees implement safety management practices to carry out their job.

2.3.1 Six Safety Management Practices

Zohar (1980) stated that safety management's responsibility is a significant factor in establishing successful safety programmes for the organisation. An individual will attempt to cohere with their environment. For example, individuals would implement their safety knowledge to their works if the organization has a supportive culture for safety.

2.3.1.1 Management Commitment

Vredenburgh (2002) stated that management commitment is one of the management practices to rate the items related to safety working culture. Following Vinodkumar and Bhasi (2010) declared that management commitment brings advantages on safety behaviours, employee satisfaction and competitiveness. Management commitment defined as every one of the organisations are implementing similar safety initiatives. Management of an organisation should act as a good role model for employees by enhancing their safety knowledge and be aware of the initiatives to be achieved. Leaders should always engage in themselves to a higher standard than the expectation of the workers that follow them. Every leader should understand the essential rules, guidelines, and compliance for the site. They should know how these rules influence their safety management system and be able to understand the method of the safety

team taken to solve the compliance issue. Leaders are expected to guide their employees on the road to accomplish organisation's safety initiatives.

Besides, management may take in a brief regarding safety in every morning meetings. This is because clear communication is always required. People usually only conclude the discussed item is important. Therefore, employees will assume safety is not a priority if management did not take the effort to regularly communicate regarding safety. Furthermore, management should make safety a priority. Management should exhibit their commitment by staying in line with safety rules and make sure all the employees are aware of their safety responsibility. Employees who work under an employer with priority for safety will expect such a safe working way is valued as well as will be encouraged by their employer. This will lead to employees performing their work with safety behaviour and which will then minimise the risk of accident. Several ways can accomplish this commitment such as safety training programmes together with safety communication.

2.3.1.2 Safety Training Programme

A safe working environment started with a trained employment management. The purpose of conduct a safety training program is to brief employees on the safety practices and train workers to operate their works in safety manner. A well-planned safety training programme able to educate employees on safety practices in the workplace as well as enhance employees' attitude on behavioural safety. In the absence of safety training, the common source of accident at construction sites such as malfunction of equipment, slips and falls and electrical hazards usually will be neglected and sometimes not considered as hazardous at all. Hence, safety training programme able to avoid the occurrence of occupational injury and accident as employees have been educated regarding the safety practices in the workplace. Rosfatihah Che Mat el al. (2021) stated that a systematic safety training programme should be provided to new employees instantly to make sure they can catch up the project progress rapidly.

Besides, safety training programme consists of specific rules on determine, reporting and controlling hazards in the workplace. For more elaboration, a training program able to make the risk of injury or accidents more predictable and may alert employees about a hazard quickly. Further, it also able to train employees on the

method to manage a hazard or a life-threatening situation and report this hazard to management for them to take appropriate actions to prevent the occurrence of accident. According to Health and Safety at Work Act 1974, organisations necessary to provide a free training, instruction, and supervision for all employees. An organization should organize a structural safety training programme for newly recruited employees meanwhile encourage existing employees to attend safety meeting regularly. Several types of safety training programmes can be provided, for example, in house training, external training and online training.

In house training will be organised within the organisation. This training is cost-effective as it is conducted by the team member. However, the quality of in-house training is limited since employer would not be keep up to date with new data or knowledge all the time. In contrast, external training will be organized by a professional from outside. The professional will provide their specialist knowledge and latest information to the organisation as well as offering new idea or proposal on approaching the organisation. Nevertheless, there is drawbacks to conduct external training, which included employees would be away from their work for a few days to attend the safety training programmes. Moreover, online training is an alternative method to providing safety training to employees. It is convenient for employees to attend the training programme at workplace through online platform. In accordance with Safety Representatives and Safety Committee Regulations 1977 and the Health and Safety (Consultation with Employees) Regulations 1996, it illustrated the method of employers consult their employees and their Trade Union Representatives on health and safety issues within the organisation.

In addition, safety training can be adjusted based on the operation of the organization especially with work task, work status and new employee orientations. A safety training programmes not only inherent in organization's safety rules, it also must be complied with laws of governing bodies. Over and above that, McGee (2016) stated that safety training programme will contribute to reduce the employee's accident claim and compensation insurance fees. Based on governing bodies' laws, organizations require to pay compensation to the worker who has suffered an accident. Therefore, a systematic safety training programme is significant as it able to educate employees on operate their works in safety way which in turn can lead to reduce risk of occupational accident and keep the organisation away from the compensational claims.

2.3.1.3 Employee Involvement

Rundmo (1994), Dedobbeleer and Beland (1991) have declared that employee involvement is a significant element in safety management practices. Employees involvement in safety and health program is a two-way communication process between employers and employees. It is a decision-making process by all members of the organisation, which included organizing, operating, analysing and enhancing the safety program. The amount of employee involvement can be range from no involvement to full involvement, which also means from employers make all decisions to all members of the organisation discuss together to make the decision. With the presence of employees' involvement, both employers and employees will discuss and listen to each other's ideas on safety issue for making decision on solving the safety problems happen in the organisation as well as establish a safer workplace.

Vredenburgh (2002) stated that Employers should seek for employees' opinion before they make decision, especially for those decisions that may influence employees. This is because employee is the one who carry out the assigned work and they are most aware about the potential risk related to the work so they are the qualified person to make recommendations for improvement. Employers should give chance for employees to involve in all aspects of the safety program inclusive of establish the goals of the safety program together, report dangers and make decisions together to solve the issue as well as evaluating the operation of safety program and find out suitable methods to enhance it.

Management of an organisation should listen to employee's concern or opinion. Employees will only involve themselves in safety program whenever they feel that their proposal or suggestion is welcome. In a meanwhile, participation will be hold back whenever employees' suggestion or ideas are not considered. For instance, employee may feel suppressed to involve if the evaluation concentrates on blaming individual instead of discuss on the roots that may cause occupational accident.

Several ways can be implemented to get employee involvement in safety programme. Management should make sure that all members of the organization can take part in safety program no matter their education, knowledge, experiences, or language. Besides, employers can show employees that they have acted on employee's safety opinion by providing regular feedback to employees. In addition, employers can also provide rewards to employee who reporting a potential hazard or incident.

As discussed above, all members of the organisation have the obligation to establish a safety culture. The participation of employees is important to establish an operative safety program as employees can share their concern or opinion. Hence, employers must provide opportunities to all employees to involve themselves in safety program planning and application. The participation of employees in safety program may prevent the occurrence of accident, reduce the occupational injury rate along with establishing a safety culture workplace.

2.3.1.4 Safety Communication

Safety communication is an action of communicating various potential of danger and risks to all members of the organisation. The purpose of safety communication is to prevent the happening of accident as employees aware of the potential risk related to their work. A safety communication able to make sure that all members knowledgeable about safety behavioural, safety practices and manage hazard in the workplace.

Frequent communication regarding safety must be conducted between all members of the organisation. Employers must avoid their employees to follow the rules blindly. This is because safety rules in organisation will be deeper understanding by employees if employees have been told the reason of having these safety practices. By this, employees may turn out to modify or enhance the rules with the purpose to improve workplace safety.

Cohen (1997), Vredenburgh (2002), Mearns et al. (2003) declared that the level of safety communication in an organisation may affect the safety performance. With the intention of maximize the result of safety communication, employers must adhere to a clear plan. A clear plan enables employers provide a planned goal to employees instead of sending out the safety information or instruction at random.

Communication able to enhancing the risk identification process, which will then improve safety in the workplace. Hazard identification process may reduce or avoid occupational accidents. Employers can only point out the typical risk through engaging the employees who carry out the work regularly. Solid communication regarding safety between the team member is an action to obtain employee feedback on the hazard they experienced. Employee is the one who carry out the work and most aware the potential risk related to the work so they are the qualified person to provide suggestion and make recommendations for improvement. Hazard will be unobserved or neglected with the absent of psychological safety. The hazard identification process

may enhance by combination of employers' proficiencies and employee communication. This will in turn institute a safety program as well as establish a safety working environment.

An open communication platform inspires employees to report occupational accidents on time. Organizations should analyse the source as well as the risk of occupational accident to improve safety culture of the organisation. Besides, the systems for employees to report the safety incidents must be simple and systematic to obtain the incident details. Employers should keep on open lines of communication with employees on improving the safety practices. For instance, employers may query on the reason of safety practices or safety guidelines were not followed instead of blame the occupational accident on employee action or inaction. Employers could modify the safety practices to be more appropriately implemented after they communicate with their employees.

In a nutshell, Preece and Stocking (1997) have mentioned that safety communication is a time-consuming process, however it will keep the safety culture of a workplace in a good condition. Vertical communication from employees to employers promoting the exchange of information among employees is significant for improvement in workplace safety. Therefore, management should include safety communication in their safety management practices.

2.3.1.5 Safety Procedures

Cox and Cheyne (2000) and Mearns et al. (2003) declared that safety rules and procedures is one of the factors in safety management practices as it will affect the occupational accident rates. Safety procedures in a workplace is defined as a guideline that indicated the method to conducting works with the purpose to reduce the occurrence of occupational injury or accident.

The effectiveness of an organisation's safety procedures is based on the consistency of their employee follow it. Workplace safety procedure able to enhance employee's understanding and skill regarding safety, which will then reduce the risk of accident. Risk evaluation for occupational accident must be conducted before the workplace safety procedures is instituted.

Also, several types of hazards will be taking place in a workplace such as physical hazard and safety hazard. A hazard that causes employees injured due to environmental factors like pressure, noise and heights is considered as physical hazard.

Besides, safety hazards are usually a work-related accident via contact. For example, an electrical shock by contact with a powerline or faulty electrical appliance. Next, the typical risk of occupation accident and its related safety procedure will be discussed. Based on injury facts from National Safety Council (2023), a total number of 79 occupational death and 8140 occupation injury happen due to forklift accident. Forklift accidents such as fall on workers when the across during tip-overs can be avoided if safety procedures are established. A number of safety procedures can be developed and implement in the organisation as a way to prevent forklift accidents. Employers should forbid unlicensed drivers or employees who is under 18 years old from driving the forklifts. Besides, safety operator should check and make sure the forklifts is in a good condition before workers operating it. Employers should also ensure the operators of forklifts are wearing hard helmet. Finally, workers should transmit the materials evenly to avoid the forklift from toppling over.

In accordance with National Floor Safety Institute (NFSI), occupational accidents due to accidental slips and falls is more than 1 million, including about 5 percent of injured workers experienced fractures. Based on laws of governing body, organization should pay injury compensation to employees who suffered occupational accident. This in turn lead to loss in productivity along with extra cost is required for repairs and damages. Hence, safety procedures must be established to prevent accidental slips and falls in workplace. Several safety procedures to prevent slips and falls will be analysed as following. A slip signs should be present during cleaning process, clean up the spills instantly by using proper methods as well as securely place handrails alongside stairs. On top of that, workers must always dressed-up themselves at workplace. For instance, workers should cover their arms, legs and wearing closed-toe shoes as well as dressed themselves with personal protective equipment (PPE) to reduce the risk of occupational injuries and accidents.

In summary, occupational accident can be avoided if well-planned safety procedures are implemented in the organisation. All members of the organisation should understand the safety procedures in the workplace in order to boost the productivity of the organisation and also improve the workplace safety.

2.3.1.6 Safety Promotion

Safety promotion is also considered as a safety management practices since it is closely related to the motivational level of employees. The purpose of safety promotion included motivate employees to enhance their safety practices and safety behaviour to achieved the organization's safety goals. Safety promotion allows to enhancing the safety awareness of all members of the organisation and make the employee safety as priority of the organisation.

Hagan (2001) declared that, rewards can be offered to motivate employees to carry out their work in safety ways. Wage systems is directly and indirectly related to safety issue. The presence of bonuses or gain-sharing may influence workplace safety indirectly as it will affect employee on their motivation in work and enhance their safety behaviour with the purpose to increase revenues. Besides, wage systems can be indirectly related to safety issue in the form of compensating wages that paid for worker who involve in high-risk work.

Furthermore, bonuses or gain sharing programmes can be instituted to enhance employee's performance on productivity and also safety. Employees will motivate themselves to work at high level of productivity and conduct their work in a proper way to gain the bonuses. Hartzell (2012) stated that motivation of employee is also an important factor in affecting organizational success. The organization will be working toward targeted goal more productively whenever their employees motivate themselves to work impressively. This in turn will also lead to reduction in the risk of occupational accident.

Finally, safety promotion programmes should be established by top management and must be participated by all members of the organisation. Cohen (1979) mentioned that safety promotion programmes able to add on attraction to the hazard control activity and improve employees' self-protection action when they perform their work. Safety promotion programmes is useful in establishing a safety culture through motivate employees to operate safely during work.

2.4 Definition of Occupational Health and Safety Management Systems

An occupational health and safety management system (OHSMS) establish Occupational Health and Safety (OHS) plans and guidelines to achieve safety goals of an organisation. OHSMS regulates and enhance an organizations Health and Safety achievement by ensuring incorporation into business strategic planning. It furnishes

an outline for supporting safe and healthy working environment also complying to national laws and regulations. In accordance ISO 45001, a few basic principles are listed, which included risk assessment, methods to regulate the risk, outline the goals, establish a plan to achieve the goals, monitoring process, report the results as well as evaluate the OHSMS results with the purpose to improve workplace safety. Besides, employers are encouraged to involve themselves in establishment of an OHSMS which included main elements that mentioned previously such as guideline, planning, application, evaluation, regulation, and effort for improvement as demonstrated in Figure 2.1.

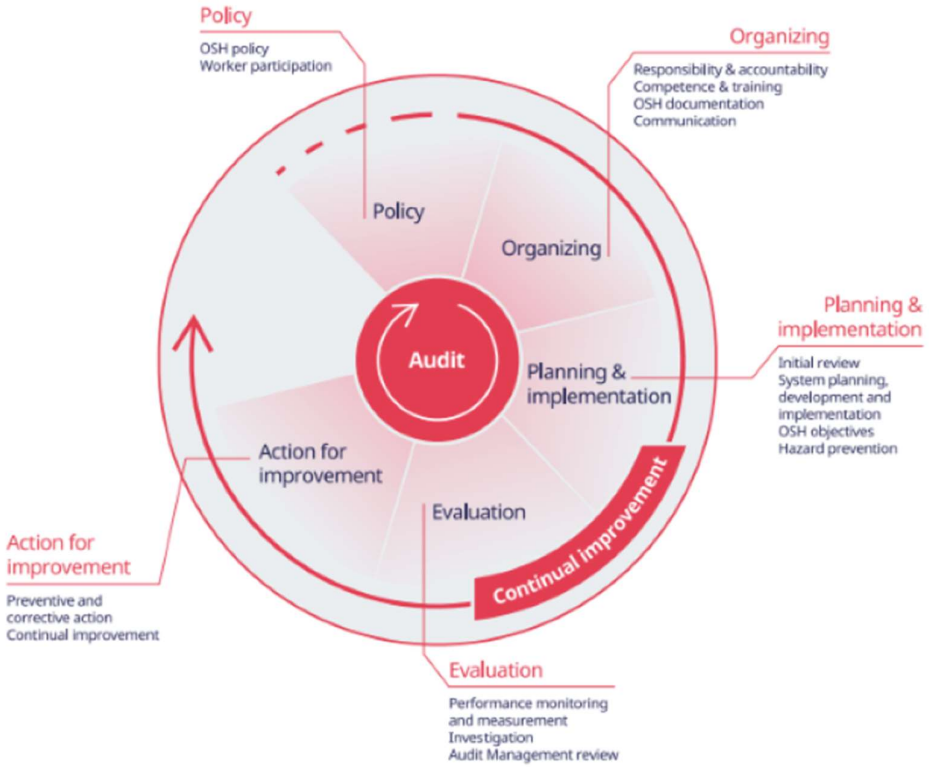

Figure 2.1 OHS Management Cycle (International Labour Organization, 2019)

2.4.1 Components of a Successful OHSMS

OHSMS should able to ensure incorporating health and safety program into business strategic planning. A successful safety management system allows employers to determine and regulate the risk in their workplace. Essential components of a successful safety management system will be explained subsequently. However, the scope and complexity of the safety management system will be differed by the risk or danger of the workplace.

2.4.1.1 Policy

Policy is the first element of a successful safety management system (International Labour Organization, 2019). Employers must show their leadership and obligation by contribute ideas, strategic planning, establish the goals and also come up with methods to guide the implementation of OHSMS. A safety and health policy defined as a strategic plan for an organization with the purpose of achieve goals to guarantee workplace safety. Hence, specific policies which comply with government laws and regulations are require to be established in the organization. Further, the programs implicated by the policy should be worthwhile, in the meantime contribute to overall business development of the organization guarantee workplace safety. This program shall be in written form, which approved by the management and the policies established must provide a clear instruction for all the team members to understand and follow. The safety and health policy of an organization should state employer's obligation on protecting their employees, declare employee's responsibility for complying organization's policy or guidelines, motivate all the team members participate themselves in safety and health event, exhibit the outstanding of the organization and explained clearly to all new employees as well as evaluate the program regularly with the purpose to improve workplace safety. A proper planning is essential in institute an appropriate policy for the organization to minimize the risk of accident or even achieving zero harm.

2.4.1.2 Planning and Implementation

Jeffrey et al. (1999) stated that planning as an essential element in developing a successful management system. The policy of the organization which discussed earlier emphasize on the goals meanwhile planning put more focus on methods to achieve the goals. During this planning stage, risk assessment and hazard investigation will be conducted. Risk assessment is defined as the entire process of hazard investigation, hazard evaluation, and the method selected to reduce the risk of accident.

Besides, OHSMS should illustrate the method to implement its health and safety policy to achieve the goals. OHSMS should also include the methods to motivate workers to operate their work in safety manner and reduce the risk of occupational accident. Further, a checklist can be implemented during this stage, which included plan the methods to keep the records of safety events such as safety training, listed the methods to do data analysis from occupational injury, prepare the

arrangement for first aid as well as outline the arrangement required to be introduced to workers or contractors with the intention of eliminate occupational accident. Planning and implementation process will assist in create a plan to accomplish its health and safety policy.

Implementation stage can only be successful if there is an effective communication between all team members. Effective communication between employers and employees can be carried out with an understandable system of work, which helps in implementation and operation of the plan as well as improve the overall performance of the organization. The implementation stage is important to be monitored as it able to create a health and safety culture in the workplace.

2.4.1.3 Evaluation

The safety and health performance are also significant to be monitored. Hence, OHSMS should outline the method to measure, control and evaluate safety performance of the organisation. OHSMS should declare the type of performance which will be measured. OHSMS should also declare the methods of monitoring that will be implemented to prevent or respond to occupational injury or accident, for instance, active self-monitors or reactive monitoring method. Several methods of evaluation could be introduced such as measuring accident, conduct data analysis, routine inspections by management, safety sampling and safety survey (International Labour Organization, 2019). An organization with successful safety and health management will evaluate their safety performance regularly and continually "fine-tuning" to enhance safety culture.

2.4.1.4 Responsibility and Accountability

Safety and Health policy of an organization can only be functioned whenever it is implemented in the organization (Makin et al., 2008). Responsibility and relationship must be established between all team members to put the safety policy into practice. For instance, employers have the responsibility on planning, application and performance of its organization safety and health policy. It is also employer's responsibility to make sure their employees involve themselves in developing and implementing the safety and health policy. Meanwhile, employees have the responsibility on take themselves comply with the organization safety and health policy. Hence, necessary resources such as training must be provided to all

the employees to make sure they can conduct their works in a safety manner and comply with organization safety and health policy (Parker et al., 2001). This able to guarantee the safety and health policy is understand or accepted by all the team members to establish a safety workplace.

2.4.1.5 Audit and Performance Improvement

International Labour Organization recommended that the fourth component of a successful OHSMS is to illustrate the method to review the health and safety management system of the organization. The health and safety management system of an organization must be evaluated by a competent person in order to determine ineffectiveness of the system and advise changes in the organization safety and health plan. The audit will also make sure that the health and safety management system of the organization is comply with nation legislation.

Besides, the safety and health performance must be reviewed by comparing the result of monitoring with the set goals. The improvement can be established for future if the goals are achieved. However, if the goals are not achieved, the organization require to determine the main root which cause for the non-achievement and adjust the safety and health policy with the intention to meet the goals. The OHSMS follow as a continuous cycle, hence it is essential to continually improving to achieve greater goals instead of remain static.

2.4.2 Benefits of OHSMS

OHSMS is a key element in developing any business profitably since it able to manage the hazard by determine hazard, analyse the hazard, provide procedures to solve the hazard, evaluate the hazard and control the hazard. OHSMS are also established to prevent or reduce the risk of occupational injury or accidents. Therefore, employer should prioritise the occupational health and safety system or safety program of their organization as there is variety of benefits of OHSMS to the organization.

2.4.2.1 Reduction in Cost of Occupational Accident

The first advantage of implementing OHSMS is reduction in cost of occupational accident. OHSMS able to maintain the machine and equipment regularly to elongate the lifespan of the equipment. OHSMS also able to enhance the workplace safety by encouraging all team members of the organization to be more aware of the risk of

accident. Bottani, Monical and Vignali (2009) declare that the implementation of OHSMS may reduce the direct and indirect costs of occupational accident. The overall costs of an occupational injury are huge and normally underestimated as some of the costs may be difficult to quantity such as compensated time, diminished work efficiency and reduced workforce participation. For instance, if a worker accidentally slips and falls in workplace, employer require to pay injury compensation to injured worker in addition to find a cover worker as the injured worker need take time off work. This in turn lead to loss in productivity along with extra cost is required for repairs and damages. Therefore, OHSMS is significantly important since it able to minimize the occurrence of occupational accident, which will then reduce the cost together with improve the overall performance of the organization.

2.4.2.2 Improvement in Worker Retention Rate

The second advantages of implementing OHSMS is improve the worker retention rate. The occurrence of occupational accident may also influence the mental health of the injured construction worker. Therefore, employer not only should manage the quality of workplace machine, they should put more accent on the physical and mental health of their workers. The implementation of OHSMS offered good safety practices in the workplace which will prevent the accident and forming a safe workplace. A safety workplace will improve the worker retention rate because worker will feel their safety is valued which in turn stay themselves with the organization (J.P. Guthrie, 2001).

2.4.2.3 Improvement in Workplace Safety

Implementation of Occupational Health and Safety System able to enhance the overall health and safety performance of the organization (Raines et al., 2011). Hence, employers of construction firms must provide regular safety training and meetings to their worker as well as their sub-contractors. Employers should also attribute responsibility to all the team members who involved in the construction project to attain experiential benefits. This is important as it enables all the team members become more concentrate on the workplace safety which in turn will reduce the occurrence of occupational accident and enhance the safety of the workplace.

2.4.2.4 Strengthen Reputation

The implementation of Occupational Health and Safety System also able to enhance the reputation of the organization (Raines et al., 2011). For instance, an organization with a particular health and safety condition which partnering with outside company will get a positive reputation from their partnering company whenever they provide professional support that required by their partnering company. Further, positive reputation of a company is also significant as it will attract employees to apply the job during the job search. Other than that, investors will also be attracted to the enhanced company reputation. Therefore, the utilization of OHSMS is important to a company as it may draw new customers, retain customers, and develop the business.

2.5 Hypothesis and Conceptual Framework

From the literature review section, the hypothesis and conceptual framework is developed as followed and Figure 2.2.

(a) Hypothesis I (H1) – Supportive environment has positive impact on safety performance.

(b) Hypothesis II (H2) - Supportive environment has positive impact on practices and adoption of OHSMS.

(c) Hypothesis III (H3) – Safety measure practices has positive impact on safety performance.

(d) Hypothesis IV (H4) – Safety measure practices has positive impact on practices and adoption of OHSMS.

(e) Hypothesis V (H5) – Practices and Adoption of OHSMS has positive impact on safety performance.

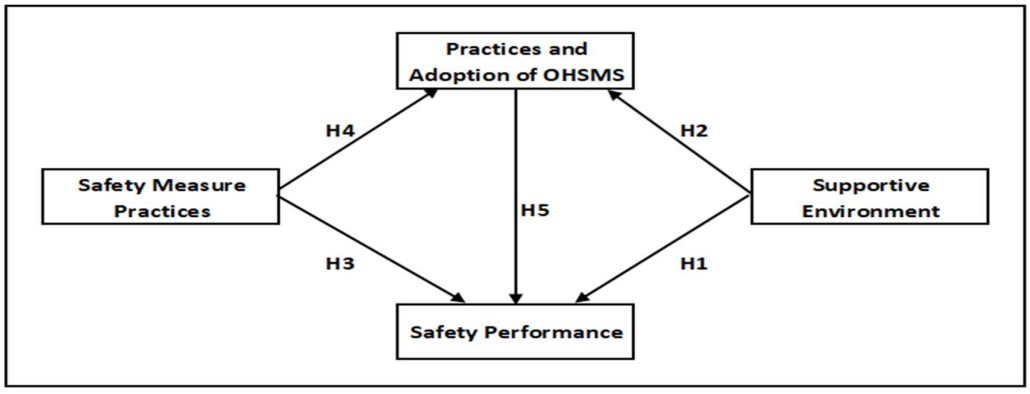

Figure 2.2 Conceptual Framework

CHAPTER 3

METHODOLOGY AND WORK PLAN

3.1 Introduction

The main objective of this chapter is to discuss on the method statement to archive the project aims and objectives. It comprises overall review of research design, development of measure variable, questionnaire development, sample size calculation, pre-pilot test, pilot test, sampling, data analysis method and validity test of the data.

3.2 Research design

Research design is the development of strategy and work plan to study the research problem thoroughly in a logical way. The purpose of research is to test the hypothesis through the data collection and analysis. In this topic, the method of research shall be exploratory type. The explanatory research can be divided into two group which is primary and secondary. The primary research requires efforts such as interview with experts, brain-storming sessions, and survey questionnaires while the secondary research mainly focus on study the present literature paper and online sources. By going through the primary and secondary research process, the hypothesis, conceptual framework, survey questionnaire shall be recognized. The survey questionnaire will be tabulated in the google form for the survey distribution and data collection purposes via quantitative collection method. Lastly, the gathered data will be analysed by using SmartPLS software to test the hypothesis. The overall research design is demonstrated as Figure 3.1.

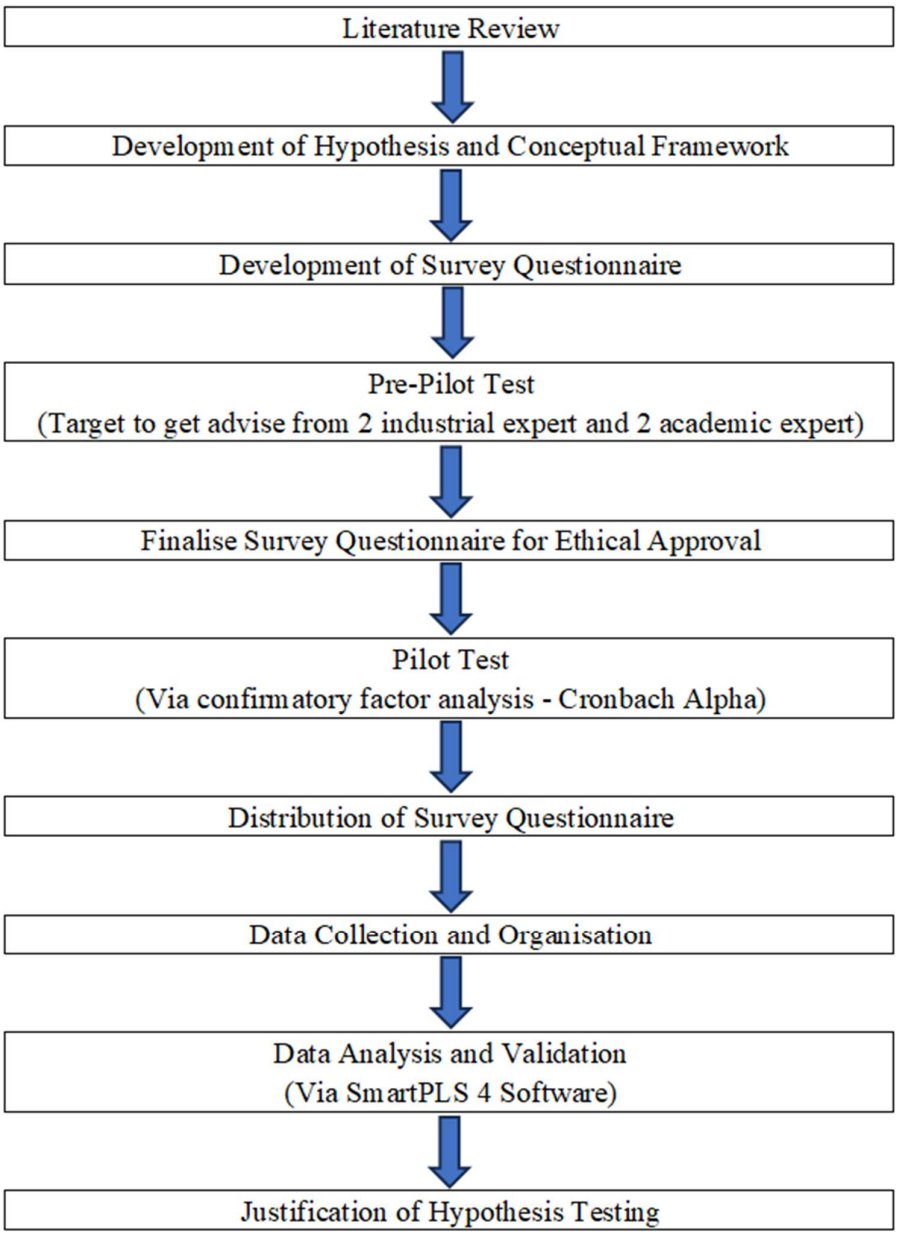

Figure 3.1 Overall Research Design

3.3 Development of Survey Questionnaire

From the literature review, the next step is the development of survey questionnaire to collect the data and validate the study. The Table 3.1 – 3.5 shows the initial proposed measurement of variables for the survey study.

Table 3.1 Measure Variable No.1 - Practices of Occupational Health & Safety Management System (OHSMS)

No	Description	Item Sources
1	The safety rules and safe work procedures implemented are adequate for accident prevention.	Vinodkumar and Bhasi (2010)
2	Top management enforces the implementation of safety rules and safe work procedures.	
3	Safety inspections are carried out regularly by competent person. (I.e. Safety and health committee member)	
4	Safety briefing/toolbox meeting is carried out regularly by competent person. (I.e. Safety and health committee member or safety and health officer)	
5	The safety rules and safe work procedures implemented are practical and effective.	

Table 3.2 Measure Variable No.2 - Adoption of Occupational Health & Safety Management System (OHSMS)

No	Description	Item Sources
1	My company has a written occupational safety and health policy.	Tan et al. (2015)
2	My company always monitors cost and benefits of implementing Occupational Health and Safety Management System.	
3	My company has established the role and responsibilities for practicing of Occupational Health and Safety Management System.	
4	My company has written standard of procedures (SOP) for Occupational Health and Safety Management System implementation.	
5	My company conducts Occupational Health and Safety Management System audit on a regular basis. (I.e. Yearly)	

Table 3.3 Measure Variable No.3 – Supportive Environment

No	Description	Item Sources
1	My company always encourages reporting of any unsafe work behavior.	Tan et al. (2015)
2	My company encourages constantly reminder on safe work procedures.	
3	My company believes that it is everyone responsibility to create a safe and healthy workplace.	
4	My company always offers assistance and resources on performing the job safely.	
5	My company prohibits working alone under risky or hazardous condition	
6	My company always ensures reasonable workload among employees	
7	My company always provides training on workplace safety and health	
8	My company has safe work procedure / manual for every job	

Table 3.4 Measure Variable No.4 – Safety Measure Practices that Resulted in Safety Performance

No	Description	Item Sources
1	Effective communication. (I.e. documented communication flow established for all levels of employee)	Mohd Nawi at al. (2017)
2	Workers take responsibility for their behavior on safety and health.	
3	There is documented records of accidents and incidents.	
4	Workers are only perform jobs under good health condition.	
5	There are regular trainings conducted for employee on workplace safety and health.	
6	Company provides sufficient safety signs and notices.	
7	Workers are well equipped with personal protective equipment (PPE).	

Table 3.5 Measure Variable No.5 - Effects of Good Safety Performance

No	Description	Item Sources
1	Reduced rate of accident / safer working environment	Fernandez et al. (2009)
2	Improved product quality	
3	Increased productivity.	
4	Improved company reputation	
5	Improved company profits and sales	

3.4 Pre-Pilot Test

To validate and improve the reliability of the survey questionnaire, the total thirty (30) number of draft questionnaires has been sent to two (2) industrial experts (Example, the safety officer that come from construction industry) and two (2) academic advisors for their advice. The evaluation to ensure the questionnaires is designed properly to reflect the current practices and condition of Malaysia construction industry. Also, the grammar and questionnaire structure to ensure the information could be convey correctly to the respondents.

Eventually, with the measure variable for practices of OHSMS and adoption of OHSMS combined into one as both are closely related, correction of grammars and enhancement of the clarity of questionnaire such as HIRARC (Hazard Identification, Risk Assessment and Risk Control) as the SOP for Occupational Health and Safety Management System implementation, the final thirty (30) number of survey questionnaire were established as Table 3.6 – 3.9.

Table 3.6 Practices and Adoption of Occupational Health & Safety Management System (OHSMS) – 10 questionnaires

No	Description	Item Node
1	The safety rules and safe work procedures implemented at construction site are adequate for accident prevention.	PA1
2	Top management enforces the implementation of safety rules and safe work procedures.	PA2
3	Safety inspections are carried out regularly by competent person. (I.e., Safety and health committee member)	PA3
4	Safety briefing/toolbox meeting is carried out regularly by competent person. (I.e., Safety and health committee member or safety and health officer)	PA4
5	The safety rules and safe work procedures implemented are practical and effective.	PA5
6	My company has a written Occupational Safety and Health Policy.	PA6
7	My company always monitors cost and benefits of implementing Occupational Health and Safety Management System.	PA7
8	My company has established the role and responsibilities for practicing of Occupational Health and Safety Management System.	PA8
9	My company has written standard of procedures (SOP) - HIRARC (Hazard Identification, Risk Assessment and Risk Control) for Occupational Health and Safety Management System implementation.	PA9
10	My company conducts Occupational Health and Safety Management System audit on a regular basis. (I.e., Yearly)	PA10

Table 3.7 Supportive Environment – 8 questionnaires

No	Description	Item Node
1	My company always encourages reporting of any unsafe act and condition.	SE1
2	My company encourages constantly reminder on safe work procedures.	SE2
3	My company believes that it is everyone responsibility to create a safe and healthy workplace.	SE3
4	My company always offers assistance and resources on performing the work safely.	SE4
5	My company prohibits working alone under risky or hazardous condition (I.e., Buddy system).	SE5
6	My company always ensures reasonable workload among employees.	SE6
7	My company always provides training on Occupational Safety and Health at work place.	SE7
8	My company has safe work procedure / manual for work process.	SE8

Table 3.8 Safety Measure Practices that Resulted in Safety Performance – 7 questionnaires

No	Description	Item Node
1	Effective communication. (I.e., documented communication flow established for all levels of employee)	SM1
2	Workers must take responsibility for their behaviour on safety and health.	SM2
3	There is documented records of accidents and incidents at workplace.	SM3
4	Workers are only work on good health condition.	SM4
5	There are regular trainings conducted for employee on Occupational Safety and Health at workplace.	SM5
6	Company provides sufficient safety signs and notices at all area.	SM6
7	Workers must wear and well equipped with personal protective equipment (PPE).	SM7

Table 3.9 Effects of Good Safety Performance – 5 questionnaires

No	Description	Item Node
1	Reduced rate of accident / safer working environment	EG1
2	Improved product quality	EG2
3	Increased productivity.	EG3
4	Improved company reputation	EG4
5	Improved company profits and sales	EG5

Then all the survey questionnaire were submitted for ethical approval before it been sent out for pilot testing.

3.4.1 Collection of Survey Data

Data collection play important role in the research as it would furnish sufficient data information to the researcher to validate their study. Therefore, the selected method of data collection must be watchful and considerate to avoid redundant data collection and resulted in inaccurate results at the end. In this study, the method used is quantitative data collection method as it allows data collection from large quantity of responds from the targeted population to test the hypothesis. The collection can be done in survey questionnaire method by sending the list of questions to the targeted respondents to get the necessary information for the research study. The questionnaire must be designed carefully to give the respondents clear idea of the purpose of question and feedback that fits their opinion. The designed questionnaire will be closed ended type of question which only allow the respondent to rate the answer from 1 to 5 to represent their thoughts.

However, there is always some limitation as such that the feedback is inflexible as it only limits to rating of 1 to 5 that represent the disagreement nor agreement of the statement, no control of the respondent as the respondent position may differ from the targeted population and answering the question without careful consideration or knowledges. With the limitation explained, some assumption has been made as such that the data collected is in identical typical feedback, the respondents are from targeted population and the respondents has fully understand the content of survey questionnaire and answer in the honest manner.

3.4.2 Targeted Population

Targeted population are the construction companies in Malaysia as they are the main population having activities on going at construction sites. In Malaysia, construction company must register under Construction Industry Development Board (CIDB) and they are categories in different grade (G1 to G7) to differentiate their capacity as Table 3.10.

Table 3.10 Contractor Grades Classification (Source from CIDB Official Website)

Contractor Grades of Registration	Tendering Capacity	Paid-Up Capital	Size of Company	Technical Qualification for Registration
G7	No Limit	RM750,000	Large	1 Diploma Holder & 1 Degree Holder in a related field one of whom has a minimum of 5 years' experience / 2 Degree Holders in a related field one of whom has a minimum of 5 years' experience.
G6	Not Exceeding RM10,000,000	RM500,000	Large	1 Diploma Holder & 1 Degree Holder in a related field one of whom has a minimum of 3 years' experience.
G5	Not Exceeding RM5,000,000	RM250,000	Medium	1 Diploma Holder & 1 Degree Holder in a related field one of whom has a minimum of 3 years' experience.
G4	Not Exceeding RM3,000,000	RM150,000	Medium	Contractor course / proof of work experience
G3	Not Exceeding RM1,000,000	RM50,000	Small	Contractor course / proof of work experience
G2	Not Exceeding RM500,000	RM25,000	Small	Contractor course / proof of work experience
G1	Not Exceeding RM200,000	RM5,000	Small	Contractor course / proof of work experience

According to Occupational Safety and Health Act 1994, the project with contract sums that more than twenty million ringgits must employ a safety and health officer. Therefore, from the classification table above, only the G7 contractor are eligible to undertake the project that require a present of safety and health officer on site. Therefore, G7 contractor shall be the targeted respondents.

Based on CIDB official website record, there are total 129,917 registered construction company in Malaysia while 9,624 of them are grade G7 construction company. Considering on the survey timeframe, the targeted population for survey are focuses on the registered G7 construction company in Selangor which is total of 3,337 companies.

3.5 Sample size

On the actual survey sample sizes calculation, there is numerous guidelines or calculation exist. According to *Gorsuch, 1983*, the sample size ratio for respondent to number of questions shall not be less than ratio 5:1 which is minimum 150 respondents in our case. According to *Krejcie and Morgan, 1970*, 384 sample sizes are appropriate for most of the behavioural and social science studies in any defined population (KMT, Krejcie & Morgan, 1970). According to *Roscie's, 1975*, he suggested generally 30 to 500 sample sizes are appropriate for most behavioural survey studies (Mumtaz Ali et al., 2020).

For the sample size calculation for PLS-SEM, a popular guideline that are accepted by PLS-SEM literature are the 10-times rule by *Barclay et al, 1995*. According to the 10-times rule, the minimum sample sizes shall be ten times of the largest number of formative indicators used to measure one construct or ten times of the largest number of structural paths directed at a particular latent construct in the inner model (Memon et al., 2020). In our case, minimum 100 sample sizes are required. Yet, this is suggested as rule of thumb as it found only works at condition where strong effect sizes and high reliability measure.

As alternative, there are few more sample sizes calculation method that considered the level of confidence and precision level, for instance Yamane's formula and Cochran's formula.

3.5.1 Yamane's Formula

Yamane's formula is developed by Taro Yamane in year 1967 which can estimate the sample size with assumption of 95% level of confidence and maximum variability of 0.5. Formula as follows.

$$n = \frac{N}{1+ N(e)^2} \tag{3.1}$$

Whereas,

n = Sample size of finite population

N = Targeted population size

e = Desired level of precision (Margin of error)

In our case, the targeted population size is 3,337 as discussed in chapter 3.4.2 with level of precision of 5%,

$$n = \frac{N}{1+ N(e)^2} = \frac{3337}{1+ 3337(0.05)^2} = 357.18$$

Hence, the 357 number of sample sizes is considered as appropriated according to Yamane's formula.

3.5.2 Cochran's Formula

For the Cochran's formula that developed by William G. Cochran in year 1977, it would able to give the appropriate numbers of sample size with a desired level of confidence level and precision level for infinite and finite populations. Formula as follows.

$$n_0 = \frac{z^2 pq}{e^2} \text{ (For infinite population)} \tag{3.2}$$

$$n = \frac{n_0}{1+ \frac{(n_0 - 1)}{N}} \text{ (For finite population)} \tag{3.3}$$

Whereas,

n_0	=	Sample size of infinite population
z	=	Desired confident level
p	=	Estimated proportion of an attribute from the population
q	=	1 – p
e	=	Desired level of precision (Margin of error)
n	=	Sample size of finite population
N	=	Targeted population size

By taking a maximum variability of P equal to 0.5, desired level of precision of 5%, desired confident level of 95% and Z value equal to 1.96 from the normal Z table (with 95% confident level).

$$n_0 = \frac{z^2 pq}{e^2} = \frac{1.96^2(0.5)(0.5)}{0.05^2} = 384.16$$

Says 384 numbers of sample size for infinite population. Then the targeted population size is 3,337 as discussed in chapter 3.4.2.

$$n = \frac{n_0}{1+\frac{(n_0-1)}{N}} = \frac{384}{1+\frac{(384-1)}{3337}} = 344.46$$

Hence, the 344 number of sample sizes is considered as appropriated according to Cochran's formula.

3.5.3 G Power Analysis

However, most of the recent researcher has suggested that the determination of sample size shall be done by power analysis as the power analysis always help them to determine the optimum sample size with the consideration of factors such as effect size, significant level, power, and number of predictors which make the outcome in more comprehensive (Suresh et al., 2012). One of the popular power analysis tools currently is G Power Analysis. G Power Analysis is the computational tool that developed by Erdfelder, Faul, & Buchner in year 1996 which is able perform the sample size calculation based on various test such as exact-test, T-test, F-test, X2-test, and z-test.

Linear Multiple Regression: Fixed model, R_2 deviation from zero from F-test family is selected as the test is good for determination of significant relationship between variables (Faul et al, 2016). The type of power analysis selected is a priori to compute the required sample size with the three given key factor that affects the sample size calculation - effect size (f^2), power (1-β error prob), and significant level (α). For the effect size, it can be separate into three categories which is small effect of correlation at value 0.02, medium effect of correlation at value 0.15 and large effect of correlation at value 0.35. The larger value mean it is easier to detect the effect or have greater effect on the construct and require less sample. On the other hand, the smaller value tell it has no effect or minimal effects on the construct and more sample is required to validate the finding. In this case, the medium size is selected.

Given the effect size (f^2) of 0.15, significant level (α) of 0.05, power (1-β error prob) of 0.95 and three number of predictor variables, the calculated sample size required is 119 as shown in Figure 3.2.

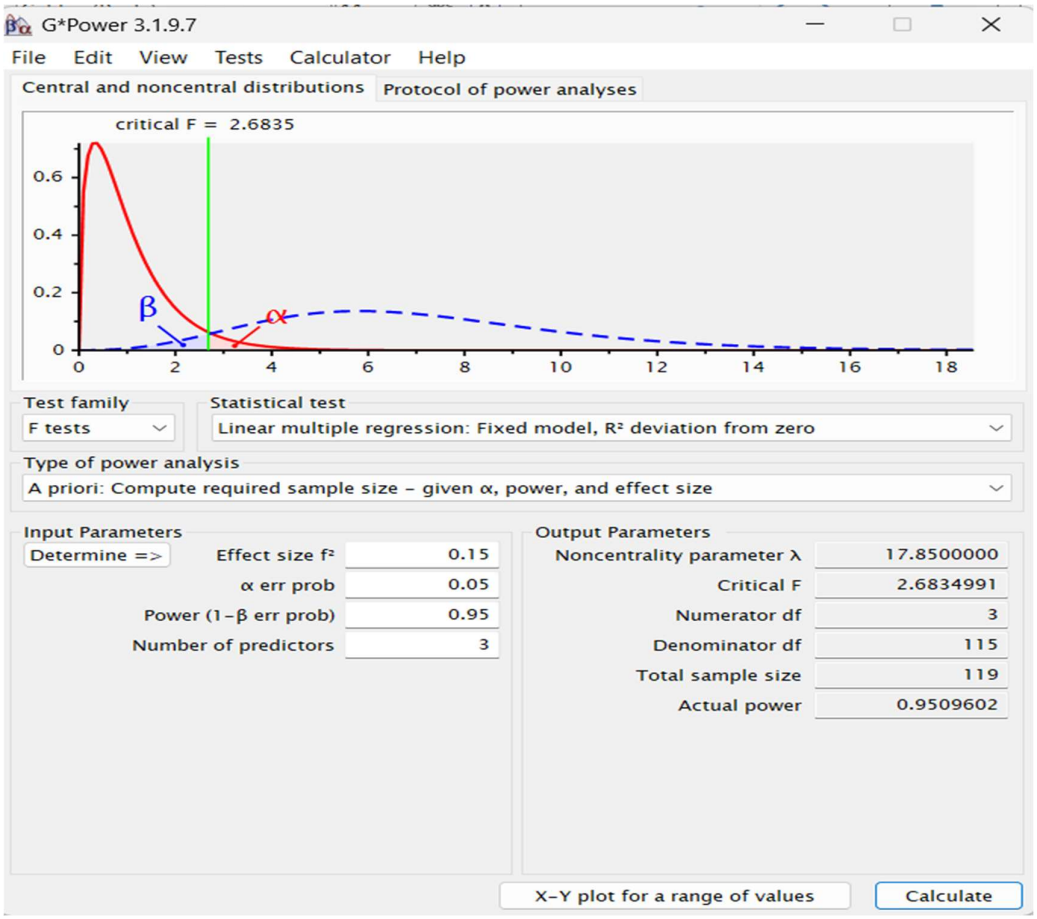

Figure 3.2 Sample Size Calculation via G Power Analysis

Table 3.11 shows sample size required via various guideline and method as discussed.

Table 3.11 Summary of Sample Size Calculation

Guideline / Method	**Sample Size Required**
Gorsuch Guide	Minimum 150
Krejcie and Morgan Table	384
Roscie's Guide	30 to 500
10-times Rule	Minimum 100
Yamane Formula	357
Cochran's Formula	344
G Power Analysis	**119**

To ensure the research is done in more efficient and effective manner, the sample sizes calculated by using G power analysis is chosen as it has been simulated in more comprehensive approach with consideration of factors such as model structure, effect size, predictor numbers, level of precision and margin of error like other methods do (Marcoulides and Chin, 2013).

3.6 Pilot Test

Prior to the actual survey, a pilot test shall be conducted to ensure the reliability and validity of the questionnaires. It also gives the initial guide to eliminate the unforeseen issues prior to the final survey. To determine the pilot test sample size, there are several guidelines in survey history. In common rule of thumbs, the sample size for pilot test shall be 10 to 20 percent of the actual survey size or at least 30 to 50 respondents (Wolfgang et al., 2015). In our case shall be 50 respondents since the actual survey size is 119. According to *Julios, 2004*, the sample sizes of 12 number per group is appropriated for pilot study. In our case shall be 48 sample sizes. Whereas according to *Kieser and Wassmer, 1996*, 20 to 40 number of sample sizes already sufficient for a pilot test. However, *Viechtbauer et al. (2015)* has established a formula for calculation of sample size for pilot test.

The formula as follows.

$$N = \ln (1-\text{ɤ})/ \ln(1-\text{ⲡ}) \quad (3.4)$$

Whereas,

ⲡ = probability

ɤ = threshold of confidence

N = sample size

For pilot test, the probability level is recommended at 0.05 and confidence level at 0.95percent.

N = ln (1 - 0.95) / ln (1 – 0.05) = 58.4

Hence, the minimum sample size for pilot test is 58 according to Viechtbauer's formula.

Table 3.12 shows sample size required for pilot test via various guideline and method as discussed.

Table 3.12 Summary of Sample Size Calculation for Pilot Test

Guideline / Method	**Sample Size Required**
Common rule of thumb	50
Julios	48
Kieser and Wassmer	40
Viechtbauer's Formula	**58**

The highest number of sample sizes is selected for pilot test which is 58 by Viechtbauer's formula to minimise the error or redundancy in actual survey.

Therefore, 58 respondents were recorded for the reliability test on pilot testing. For the purposes of maximising reliability of scales proposed, Cronbach's alpha coefficient was tested via SmartPLS 4 for each content and recorded in Table 3.13.

Table 3.13 Reliability Test for Pilot Testing

No	Content	Variables	No of Variables	Cronbach's Alpha	Remark
1	Practices and Adoption of Occupational Health & Safety Management System	PA1, PA2, PA3, PA4, PA5, PA6, PA7, PA8, PA9, PA10	10	0.907	Acceptable
2	Supportive Environment	SE1, SE2, SE3, SE4, SE5, SE6, SE7, SE8	8	0.923	Acceptable
3	Safety Measure Practices	SM1, SM2, SM3, SM4, SM5, SM6, SM7	7	0.869	Acceptable
4	Effects of Good Safety Performance	EG1, EG2, EG3, EG4, EG5	5	0.815	Acceptable
Total of Variables			30	*Criteria to accept:*	
Total of Variables Accepted			30	*0.70 < Cochran's Alpha Value < 0.95*	

From the pilot test result, it confirms the final survey questionnaires with 30 variables which is under practices and adoption of occupational health & safety management system (10), supportive environment (8), safety measurement practices (7) and effects of good safety performance (5).

The final questionnaire consists of two parts which is demographic information and survey questionnaire. For the part one, the demographic information of respondents such as genders, ages, position held in company, working experiences, education level, project site location, types of construction project, numbers of worker employed at site and ISO certifications is recorded. For the part two, survey questionnaire includes all the contents variables and all the items were measure via five-point Likert scale which ranging from 1 to 5 [1 point (Strongly disagree), 2 point (Disagree), 3 point (Neutral), 4 point (Agree), 5 point (Strongly agree)].

3.7 Structural Equation Modelling (SEM)

Structural Equation Modelling (SEM) is a powerful multivariate method to test the complex causal relationships among variables through visualization and model validation. The popularity of SEM has grown rapidly to test the theories and concepts as it allows researchers to set up and test the hypothesis relationship reliably and easily. SEM also allows the researcher to evaluate the structural model and paths when it involves multiple level of constructs, multiple dependencies between variables, latent constructs which unable to be measured directly kind of the complex model. All of these could be assessed simultaneously with minimum error probability with SEM approach. As many constructs that involved in this topic is the latent constructs, so it is chosen and applied in this research study.

There are two types of Structural Equation Modelling (SEM) approach namely Partial Least Square Structural Equation Modelling (PLS-SEM) and Covariance-based Structural Equation Modelling (CB-SEM). The CB-SEM is always recommended for the theory testing and confirmation type of research objective while PLS-SEM is good for prediction and theory development type of research objective (Ganesh Dash et al., 2021). In short, if there is existing theory to be verified, choose CB-SEM; or else PLS-SEM as it is better at theory development and prediction purposes. Hence, PLS-SEM approach is selected in this research study.

PLS-SEM have the advantages over the CB-SEM when the structural model is complicated with existence of multiples constructs and indicators, high complexity of model relationships, exploration on theory extension from existing theory, the hypothesis testing from a prediction perspective, path model with more than one number of formatively measured constructs, sample size is limited (However, PLS-SEM work-well with large sample size too), latent variables are necessary for

modelling, the non-normality data exists, the absence of distributional assumptions and used for exploratory research with secondary data (Claudia et al, 2014). PLS-SEM also has higher statistical power compared to CB-SEM which allows it to identify significant relationship when they are in the population. In this study, SmartPLS software is chosen they are easy to access and perform the PLS-SEM as required.

3.7.1 Evaluation of PLS-SEM Models

The evaluation of the model is suggested in two-step assessment which is measurement model assessment and structural model assessment (Joseph F. Hair, 2018).

There are two different constructs in measurement model which is reflective and formative constructs.

3.7.1.1 Assessment of Reflective Measurement Models

To assess the reflective measurement models, it usually involves four-step process. Firstly, is the examination of indicator loading, the loading value shall be greater than 0.708 to accept the item reliability. The loading that above the recommended value show that the constructs explain more than 50% of its indicator variance, thus the items shall be remain. Meanwhile for those below the recommended value should be removed from the scale.

The second step is to examine the internal consistency reliability which used to measure the correlation between items. There are two methods usually used to assess the internal consistency reliability which is Cronbach's alpha and Joreskog's composite reliability. Generally, the measurement thresholds for these two methods are similar which is recommended between 0.70 to 0.95. For those value of 0.95 or higher, it represents problematic exist in the model which maybe the items are redundant or possible undesirable response pattern like straight lining. However, it can be further tested with bootstrap confidence intervals using percentile method to check if the construct's reliability is significantly higher. On the other hand, the lower value which lies between 0.60 to 0.70 still be acceptable in the exploratory research works.

The third step is to check the convergent validity of each constructs measure which refers to how well the construct converges explains its item variance. The parameter to assess the convergent validity is average variance extracted (AVE). The AVE value shall be minimum 0.50 to indicate the constructs explain more than 50% of its item variance.

Lastly is assessment of discriminant validity which to ensure a construct is unique and completely different from other constructs in the structural model. It can be evaluated by cross loading, Fornell-Larker criterion and heterotrait-monotrait (HTMT) ratio of correlations. However, the recent research has showed the cross loading and Fornell-Larker criterion does not fit for discriminant validity assessment as they have limitations, example when there is only slightly different on indicator loadings to constructs. Therefore, HTMT is recommended. The threshold value for HTMT shall be lower than 0.90 or 0.85 (when the constructs are conceptually more unlike) at the 95% of confident interval.

3.7.1.2 Assessment of Formative Measurement Models

To assess the formative measurement models, it usually involves evaluation like convergent validity, collinearity assessment, indicator weights statistical significance and relevance.

Basically, convergent validity is the redundancy analysis. The assessment method and criteria for both reflective and formative measurement model is similar which the AVE value shall greater than 0.50.

The collinearity assessment mostly to prevent two indicators are highly correlated. To evaluate the collinearity of formative indicators, the variance inflation factor (VIF) is often used. It indicates a critical collinearity issue among the indicators of formative measure construct when the VIF value is equal or more than 5 and possible collinearity issue when the VIF value is between 3 to 5. The ideal VIF value shall be close the 3 and lower.

For the assessment of the statistically significant of indicators weight, bootstrapping with percentile method is often used. When the indicator weight is not significant, example loading of 0.50 and below may suggest the indicator shall be removed unless there is solid backup from the measurement theory. However, the removal of nonsignificant indicators needs to be cautious as they always a necessity to make the construct domain completed as designed in earlier conceptual stage.

Lastly is the examination of indicator's relevance with significant or nonsignificant weight. The indicator weights value usually within -1 to 1. It indicates the strong positive relationship when the value is closed to 1, weak relationship when the value is closed to zero and negative relationship when the value is closed to -1. If

the value is out of the range as mentioned, it denotes abnormal result that may cause by insufficient sample size or collinearity issue.

3.7.1.3 Assessment of Structural Model

When the assessment of measurement model is completed, the next step is the structural model assessment. The common assessment includes collinearity assessment, coefficient of determination (R^2), effect size (f^2), blindfolding-based cross-validated redundancy measure (Q^2), and path coefficient.

Firstly, the collinearity assessment needs to be carried out to evaluate the collinearity among the latent variables. The method for the assessment is the same as collinearity check in measurement models by variance inflated factor (VIF). The criteria shall be same as well.

Once the collinearity not an issue, the next is examination of coefficient of determination, R^2 of the endogenous construct. R^2 is basically measuring the variance of endogenous variable with exogenous variable. R^2 value is ranges from 0 to 1, 0.25, 0.50, and 0.75 indicating weak, moderate, and substantial in explanatory power. The higher value of R^2, the higher predicting accuracy.

Effect size (f^2) lets the researcher to observe the effects of exogenous construct on the endogenous construct. It also shows if the construct is redundant to the size of path coefficient. As general guide, the f^2 value of 0.02, 0.15, and 0.35 denotes the small, medium, and large effect size. If the value is lower than 0.02, it indicates that the exogenous construct has no effects on the endogenous construct.

For blindfolding-based cross-validated redundancy measure (Q^2), its mainly for the predictive accuracy of PLS path model. Q^2 can be estimated by replacing of single point value in the data matrix with the mean value. The smaller difference of predicted and original data gets the higher of Q^2 value. The threshold measurement value for Q^2 shall be larger than 0. As general guide, the Q^2 value of 0.50, 0.25 and 0 indicates significant, moderate, and minor predictive relevance of path model. It shows lacking of predictive relevance if the value is lower than 0 or below 0.

Lastly is to evaluate the statistically significant and relevance of the path coefficient. The criterion for path coefficient checks in structure model is like path coefficient check in measurement model. The value closer to 1 indicate strong positive relationship, weak relationship or not significant when closed to 0 and show negative

relationship when the value is closed to -1. However, the coefficient significant is available for assessment by using P value to check the significant level. The relationship is considered as significant when the P value is less than 0.05.

3.7.1.4 Robustness Check

On the measurement model, confirmatory analysis (CTA-PLS) is recommended by Gudergan et al, 2008 for validating the condition of measurement model. CTA-PLS usually subject to the concept of tetrads that define the variance of respectively covariances of product of pair.

For structural model, there is three method of robustness check which is nonlinear effects, endogeneity, and unobserved heterogeneity.

To check the nonlinear effects, Ramsey's regression equation specification error test is recommended on latent variables values in partial regressions path model. This test would show the potential nonlinear effect which indicates the unproportional between predictor and dependent variables.

Next is the checking on endogeneity that usually occurred when three main variables become violated, example, a construct that have correlation with predictor constructs and dependent constructs are removed in partial regression path model. The Park and Gupta's Gaussian copula approach is suggested to detect the endogeneity issue and then using instruments variables to clarify the source of endogeneity. But, the endogeneity assessment is not always been required unless the research is concentrating on the explanation goals.

Lastly is the assessment of unobserved heterogeneity that indicates the existence of unobserved variables which mean the observed data producing different model guess. This assessment is important as it would tell if the data set for analysis is practical and reasonable.

In the complex model studies, PLS-SEM suggested the analysis such as moderating effects and mediating effects to validate and ensure the correct setup.

Moderation happened when the effects of the exogenous construct on endogenous construct is depending on the value of third variables, that usually referred as moderator variable. The moderator variable would bring changes on the relationship of the exogenous construct and endogenous constructs, like the strength or even direction of the relationship.

Mediation happened when the mediator variables interfere the effect of the exogenous constructs on endogenous constructs in the path model. There are two types of mediation which is full mediation and partial mediation. The full mediation occurs when the exogenous constructs do not have significant effect on endogenous constructs after interruption of mediator variables. While the partial mediation shows significant effect between the two constructs when mediator variable existed. The effect also can be classified as direct and indirect effect. Direct effect referring to interference of mediator variables are affecting relationship of two construct, while the indirect effect is the combination of two or more direct effects.

3.8 Summary

This chapter has discussed on the research design, development process of questionnaire design, sample size calculation, pre-pilot test and pilot test to finalise the survey questionnaire.

The method for data analysis is also discussed which is PLS-SEM using SmartPLS software. The evaluation of PLS-SEM model mainly depends on the assessment of measurement model and structural model. Then further validate the hypothesis.

The actual survey data and result will be further analysed and discussed in next chapter

CHAPTER 4

RESULT AND DISCUSSION

4.1 Introduction

In this chapter, the key focus is to analyse and discuss on the result from the SmartPLS simulation and the testing of hypothesis.

A total of 3,337 survey questionnaire were sent via email to all the grade G7 contractor company in Selangor. There was total of 120 number survey questionnaire is collected from the respondents. However, one respondent is rejected due to the incomplete survey questionnaire, so, it made up only total of 119 number of survey questionnaire data. It then was converted into Excel CSV format and imported into SmartPLS software for further analysis.

4.2 Demographics Profile

Table 4.1 shows the overview of the demographic profile after the removal of the respondent with incomplete survey questionnaire.

Table 4.1 Demographic Profile

Item	**Classification**	**Numbers**	**Percentage (%)**
Gender	Male	87	73.11
	Female	31	26.05
	Prefer not to say	1	0.84
Age	25 – 34 years old	42	35.29
	35 – 44 years old	48	40.34
	45 – 55 years old	17	14.29
	55 – 64 years old	9	7.56
	Prefer not to say	3	2.52
Position	Director	10	8.40
	Project Manager / Site manager	37	31.09
	Engineer	33	27.73
	Supervisor / Site Executive	15	12.61
	Safety / SHE Manager / Officer	7	5.88
	Quantity Surveyor / Finance / Contract Manager	10	8.40
	Others	7	5.89
Working Experience	1 – 10 years	50	42.02
	11 – 20 years	43	36.13
	21 – 30 years	23	19.33
	30 years and above	3	2.52
Education	Master	15	12.61
	Degree	75	63.03
	Diploma	19	15.97
	SPM	6	5.04
	Others	4	3.36
Site Location	Selangor	81	68.07
	Kuala Lumpur	16	13.45
	Others	22	18.48

Table 4.1 Demographic Profile (Continued)

Item	**Classification**	**Numbers**	**Percentage (%)**
Types of Construction	Landed Building (I.e., Residential and Commercial Shops)	33	27.73
	High Rise Building (I.e., Apartment, Condominium and Commercial Office)	33	27.73
	Industrial Building (I.e., Factory and Warehouse)	26	21.85
	Infrastructure Works (I.e., Highway)	18	15.13
	Others	9	7.56
Number of Workers	Below 100	66	55.46
	100 – 199	28	23.53
	200 – 299	11	9.24
	300 and above	14	11.76
ISO Certification	OHSAS 18001 / ISO 45001	16	13.45
	ISO 14001	9	7.56
	ISO 9001	61	51.26
	All above	4	3.36
	None	29	24.37

It was found that the majority of respondent is male at 87 (73.11%), 31 females (26.05%) and there is one respondent prefer not to reveal their gender. The major group of respondents is at age of 35 – 44 years old at 40.34%, follow by 25 – 34 years old, 45 – 55 years old and 55 – 64 years old. Three of them prefer not to tell their ages. In term of position hold in the company, 8.4% is the director, 31.09% is the project manager or site manager, 27.73% is engineer, 12.61% is site supervisor or executive, 5.88% is the safety & health related position, 8.4% from the quantity survey or finance or contract background and 5.89% from others position. On the working experience, 42.02% has 1 to 10 years of working experience, 36.13% has 11 to 20 years of working experience, 19.33% has 21 to 30 years of working experience and 2.52% from the

respondent has more than 30 years working experience. In regard of education level, 12.61% of them with master degree, 63.03% of them holding bachelor degree, 15.97% holding diploma, 5.04% with SPM cert and 3.36% with other qualification. In this survey, 68.07% of their construction site is at Selangor area, 13.45% is at Kuala Lumpur area and 18.48% from others area. From there, 55.46% of their construction project is landed and high rise building which having equal numbers, 21.85% is industrial building, 15.13% is infrastructure works and 7.56% is others type of construction project such as data centre. In term of number of workers at one site, 55.46% having less than 100 workers working at site, 23.53% having 100 to 199 workers, 9.24% having 200 to 299 workers and 11.76% of them having more than 300 workers. Lastly, 13.45% of the company with OHSAS18001 / ISO45001 certificate, 7.56% of them having ISO 14001 certificate, 51.26% of them with ISO 9001 certificate, 3.36% of them having all the certificate as mentioned and 24.37% of them do not have the related ISO / OHSAS certificate.

4.3 Mean and Standard Deviation

With the data imported into SmartPLS software, the mean and standard deviation is generated. The means is the average values of the sum of all values in the data set. Then it will form the measure of centre value of probability distribution. The standard deviation is to measure the variability of distribution. Usually, the higher dispersion has greater standard deviation.

Table 4.2 shows the mean and standard deviation of each indicator.

Table 4.2 Mean and Standard Deviation

Variables	Indicators	Mean	Standard Deviation
Practices and Adoption of OHSMS	PA1	4.328	0.734
	PA2	4.277	0.697
	PA3	4.244	0.686
	PA4	4.361	0.764
	PA5	4.193	0.677
	PA6	3.908	0.970
	PA7	3.899	0.883
	PA8	3.874	0.856
	PA9	3.849	0.949
	PA10	3.655	1.024
Supportive Environment	SE1	4.151	0.729
	SE2	4.143	0.759
	SE3	4.336	0.759
	SE4	4.143	0.689
	SE5	4.252	0.758
	SE6	3.933	0.877
	SE7	3.765	0.932
	SE8	3.916	0.885
Safety Measure Practices	SM1	3.924	0.780
	SM2	4.034	0.788
	SM3	4.000	0.879
	SM4	4.126	0.794
	SM5	3.824	0.856
	SM6	4.050	0.765
	SM7	4.378	0.767
Safety Performance	EG1	4.462	0.619
	EG2	4.168	0.803
	EG3	3.958	0.929
	EG4	4.420	0.655
	EG5	3.924	0.936

4.4 Model Assessment

To start the model validation, it can be done with two-step assessment as discussed in previous chapter which is measurement model assessment and structural modal assessment.

4.4.1 Measurement Model Assessment

There are four parameters to evaluate the measurement model which is indicator loading, internal consistency reliability, convergent validity, and discriminant validity (Purwanto and Sudargini, n.d.). Before the assessment started, the path model is generated and demonstrated in Figure 4.1.

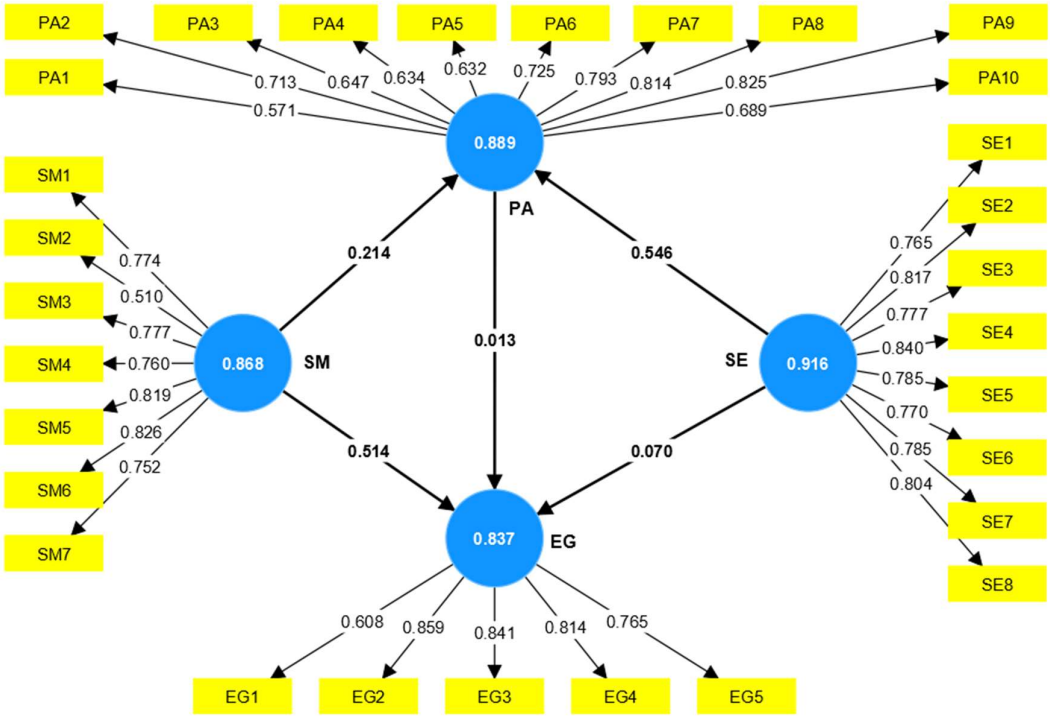

Figure 4.1 Path Model

4.4.1.1 Construct reliability and Validity

Referring to the Table 4.3, there is few indicators loading such as PA1, PA3, PA4, PA5, PA10, SM2 and EG1 is observed below the recommended value of 0.708. It has shown that the constructs may explain less than 50% of its indicator variance but some studies shows that the loading above 0.50 is still within the acceptable range. The rest of the indicators loading are greater than 0.708. Hence, the overall reliability is acceptable.

For the internal consistency reliability, there is two assessment parameter which is Cronbach's Alpha (CA) and Composite Reliability (CR). The recommendation value for these two methods is between 0.70 to 0.95 (Hair et al., 2018). All the CA and CR value is within the recommended value as observed from Table 4.3.

For the convergent validity, the assessment parameter is using average variance extracted (AVE) value which the recommended value shall be minimum 0.50 to confirm the constructs explain more than 50% of the item variance (Claudia et al., 2014). All the AVE value is within the recommended value from Table 4.3.

Table 4.3 Constructs, Indicator, Outer Loadings, Cronbach's Alpha (CA), Composite Reliability (CR), Average Variance Extracted (AVE)

Constructs	Indicators	Outer Loadings	Cronbach's Alpha (CA)	Composite Reliability (CR)	Average Variance Extracted (AVE)
Practices and Adoption of OHSMS	PA1	0.571	0.889	0.909	0.503
	PA2	0.713			
	PA3	0.647			
	PA4	0.634			
	PA5	0.632			
	PA6	0.725			
	PA7	0.793			
	PA8	0.814			
	PA9	0.825			
	PA10	0.689			
Supportive Environment	SE1	0.765	0.916	0.931	0.629
	SE2	0.817			
	SE3	0.777			
	SE4	0.840			
	SE5	0.785			
	SE6	0.770			
	SE7	0.785			
	SE8	0.804			
Safety Measure Practices	SM1	0.774	0.868	0.899	0.565
	SM2	0.510			
	SM3	0.777			
	SM4	0.760			
	SM5	0.819			
	SM6	0.826			
	SM7	0.752			
Safety Performance	EG1	0.608	0.837	0.886	0.613
	EG2	0.859			
	EG3	0.841			
	EG4	0.814			
	EG5	0.765			

Lastly is on the discriminant validity which ensure each construct is unique in the measurement model. The parameter to test the discriminant validity is heterotrait-monotrait (HTMT) ratio. The threshold value for HTMT ratio is expected be lower than 0.90 at 95% of confident interval (Henseler et al., 2016). From Table 4.4, all the HTMT ratio is observed lower than 0.90.

Table 4.4 Heterotrait-Monotrait (HTMT) Ratio

	Safety Performance	Practices and Adoption of OHSMS	Supportive Environment	Safety Measure Practices
Safety Performance				
Practices and Adoption of OHSMS	0.461			
Supportive Environment	0.558	0.768		
Safety Measure Practices	0.674	0.723	0.899	

Therefore, the overall measurement model assessment is accepted.

4.4.2 Structural Model Assessment

After the measurement model assessment is completed, the structural model assessment shall be performed. There are four parameters to evaluate the structural model assessment which is collinearity assessment, path coefficient, coefficient of determination, effect size and predictive relevance.

Firstly, the variance inflation factor (VIF) is recommended to evaluate the collinearity of indicators. The threshold value for the VIF is expected to be lower than 3 to ensure no collinearity issue (Mason and Perreault, 1991). The value between 3 to 5 is also considered as acceptable, only the collinearity issue is confirmed when the value is equal or larger than 5. From Table 4.5, most of the value is at the ideal range

and only the value of supportive environment indicator to safety performance is at 3.485 which is still at the acceptable range. Therefore, it could be concluded that there are no collinearity issues among the latent variable and all VIF value is valid.

Table 4.5 Collinearity Statistics

	Safety Performance	Practices and Adoption of OHSMS	Supportive Environment	Safety Measure Practices
Safety Performance				
Practices and Adoption of OHSMS	2.137			
Supportive Environment	3.485	2.848		
Safety Measure Practices	2.946	2.848		

For the evaluation of statistically significant and relevance of path model, path coefficient and P values is recommended. The path coefficient value shall be within -1 to +1. The value from 0 to -1 indicates the negative relationship of the constructs while the value from 0 to +1 indicates the positive relationship of constructs (Hair et al., 2014). The value nearer to +1 or -1 indicates the stronger positive or negative relationship. All the path coefficient value is observed greater than 0 from the path coefficient in Table 4.6. The practices and adoption of OHSMS on safety performances shows the weakest positive relationship, follow by supportive environment on safety performance, safety measure practices on practices and adoption of OHSMS, safety measure practices on safety performance and the supportive environment on practices and adoption of OHSMS shows the strongest positive relationship.

For the P value, the threshold value to be lower than 0.05 to show the statistically significant level (Hair et al., 2014). Only the P-value of supportive environment on practices and adoption of OHSMS and safety measure practices on

safety measurement is observed meeting the threshold value which is lower than 0.05. The rest of the value that higher than 0.05 shows that they are not statistically significant. For instance, the practices and adoption of OHSMS has no significant impact on safety performance, same to supportive environment do not have significant impact on safety performance and safety measure practices do not have significant impact on practices and adoption of OHSMS.

Table 4.6 Path Coefficient and P-Value

Description	Path Coefficient	P Values
Practices and Adoption of OHSMS -> Safety Performance	0.013	0.913
Supportive Environment -> Safety Performance	0.070	0.695
Supportive Environment -> Practices and Adoption of OHSMS	0.546	0.000
Safety Measure Practices -> Safety Performance	0.514	0.001
Safety Measure Practices -> Practices and Adoption of OHSMS	0.214	0.053

For the Coefficients of Determinations (R^2), it evaluates the prediction accuracy of the variables. The value of R^2 of 0.25, 0.50 and 0.75 indicating the weak, moderate, and substantial of prediction accuracy (Henseler et al., 2009). From the R^2 in Table 4.7, the safety performance has the R^2 value of 0.338 and practices and adoption of OHSMS has the R^2 value of 0.532. It indicates the 33.8 percent of changes in safety performance can be explained by the 3 variables while the 53.2 percent of changes in practices and adoption of OHSMS can be explained by the 2 variables as shown in the path model.

Table 4.7 Coefficients of Determinations (R^2)

Description	R^2 Value
Safety Performance	0.338
Practices and Adoption of OHSMS	0.532

For the effect size (f^2), the threshold value of f^2 of 0.02, 0.15, and 0.35 indicates the small, medium, and large effect size (Cohen, 1988). From f^2 in Table 4.8, we can observe that the effect of supportive environment on safety performance is minimal, but it is effect on the practices and adoption of OHSMS is moderate. The effect of safety measure practices to safety performance is moderate, but it effects on the practices and adoption of OHSMS is minimal. Lastly the effect of the practices and adoption of OHSMS on safety performance is minimal.

Table 4.8 Effect Size (f^2)

	Safety Performance	Practices and Adoption of OHSMS	Supportive Environment	Safety Measure Practices
Safety Performance				
Practices and Adoption of OHSMS	0.002			
Supportive Environment	0.003	0.224		
Safety Measure Practices	0.136	0.034		

For the other predictive relevance accuracy of PLS path model, the blindfolding-based cross-validated redundancy measure (Q^2) is suggested. The Q^2 value of 0, 0.25 and 0.50 indicates the minor, moderate, and significant predictive relevance of the path model (Shmueli et al, 2016). From the blindfolding and predictive relevance in Table 4.9, the Q^2 value for safety performance has the moderate predictive relevance and practices and adoption of OHSMS has significant predictive relevance of the path model.

Table 4.9 Blindfolding and Predictive Relevance (Q^2)

Description	Q^2 Value
Safety Performance	0.290
Practices and Adoption of OHSMS	0.509

4.5 Summary

This chapter has concluded all the data collected from survey questionnaire, the result has been analysed and all the hypothesis is tested.

For hypothesis H1, the supportive environment has positive impact on safety performance is supported with the path coefficient value of 0.070 but not statistically significant with the P value of 0.695. it also supported with the finding from Vinodkumar and Bhasi (2010) which stated the management commitment always brings advantages on safety performance such as reduced accident rate, employee satisfaction and competitiveness.

For hypothesis H2, the supportive environment has positive impact on practices and adoption of OHSMS is supported with the path coefficient value of 0.546 and proved statistically significant with the P value of 0.000. It also supported with the finding from Zohar (1980) which stated the management responsibility is a significant factor in establishing a successful safety programmes for an organization.

For hypothesis H3, the safety measure practices have positive impact on safety performance is supported with the path coefficient value of 0.514 and proved statistically significant with the P value of 0.001. It also supported with the finding from Cox and Cheyne (2000) which stated the safety measure practices are one of the factors that affecting the safety performance such as reduce occupational accident rate.

For hypothesis H4, the safety measure practices have positive impact on practices and adoption of OHSMS with the path coefficient value of 0.214 but not statistically significant with the P value of 0.053. As suggested by Cohen (1997), the safety measure practices such as safety communication in an organisation is important for employee to understand and adhere to the management plan.

For hypothesis H5, the practices and adoption of OHSMS has positive impact on the safety performance is supported with the path coefficient value of 0.013 but not statistically significant with the P value of 0.913. It also supported by finding from

Raines and Megan S. (2011) which stated the implementation of OHSMS able to enhance the overall health, reputation, and safety performance of the organisation.

As conclusion, all the hypothesis is generally accepted and the summary of hypothesis testing is shown in Table 4.10.

Table 4.10 Summary of Hypothesis Testing

Item	Hypothesis Testing	Supported by Data	Statistically Significant	Result
H1	Supportive environment has positive impact on safety performance	Yes	No	Accepted
H2	Supportive environment has positive impact on practices and adoption of OHSMS	Yes	Yes	Accepted
H3	Safety measure practices has positive impact on safety performance	Yes	Yes	Accepted
H4	Safety measure practices has positive impact on practices and adoption of OHSMS	Yes	No	Accepted
H5	Practices and Adoption of OHSMS has positive impact on safety performance	Yes	No	Accepted

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Further to the result and discussion in chapter 4, all the aim and objectives is tested and supported.

- To define the Occupational Health and Safety Management System (OHSMS) and its relationship with work related accidents
- To examine the influence of safety behavioural on implementation of Occupational Health and Safety Management System (OHSMS) and safety performance.
- To examine the impact of safety management practice on the prevention of work related accidents
- To test the effectiveness and reliability of safety management system in Malaysia construction site

With all the hypothesis testing from previous chapter, it shows that the implementation of Occupational Health and Safety Management System (OHSMS) has positive impact on safety performance such as reduced the rate of accident and creating the safer working environment. To make the adoption and practices of OHSMS successful, the supportive environment and safety measure practices play the important roles to ensure all party has clear direction and full commitment to archive the goal.

On the influence of safety behavioural on implementation of Occupational Health and Safety Management System (OHSMS) and safety performance, it has been tested with the hypothesis III and IV. Safety behavioral is part of the safety measure practices which highly depends on the workers attitudes, their responsibility level, willingness to participate in safety measure and capabilibities of communicate on mutual understanding and effective safer method of works. From result analysis, the safety measure practices has statiscally significant positive impact on safety performance which would bring down the rate of accident and improve company competitiveness such as productivity, reputation, financial performance and product quality.

On the impact of the safety management practices on the prevention of work-related accident, it has been proven with the all the practices such as supportive envirionment, safety measure practices and adoption and practices of OHSMS on the safety performance. Although the supportive enviroment and practices of adoption of OHSMS does not show statistically significant on safety performance, they still play important roles to ensure positive outcome of safety performance which is reducing accident rate.

The reliability and effectiveness of safety management system in Malaysia construction site is also tested. As overall, it would be considered as reliable and effective from the data collected.

In conclusion, the adoption and practices of Occupational Health and Safety Management System (OHSMS) plays the importants roles in Malaysia construction site. Whereas for the implentation of OHSMS, top management play the significant roles and the rest of the employees must hold on to their responsibility and duty for successful safer workplace. The benefits from OHSMS implementation, it definitely reduced the accidents rate and provide safer working environment to workers. Hence, it would bring the effects of productivity and quality improvement as the workers can fully focus on their assigned works without hassle. Then the reputation of the company would improved, it would help on attracting the new investor or talent hence improve the financial aspect and scale of company. Therefore, the constructions companies should adopt and practices the OHSMS when it could bring such a benefits to the company.

5.2 Implications of Study

From the findings of the study, the supportive environment has play significant roles on promoting the adoption and adoption of OHSMS. The actions like encouragement of reporting of any unsafe act and condition and constant safe work procedure reminder would bring awareness to others on the impact or consequences of being irresponsible. It also important for everyone to have responsible on safer and workplace as most of the accident happened could due to human mistake. The company must also always offer help such as training on occupational safety and health at work place, safe work procedure and manual for work process to ensure all workers have the clear direction and method of work to minimise the risk. The reasonable work load and work system like buddy system also important to make sure

the workers working in conscious and high awareness condition, also could have immediate support in case anything happened.

Besides, the safety measure practices do have significant impact on the safety performance compared to others. The study show that the effective communication flow is important to ensure the correct information or latest instruction from top management could reach to all workers in shortest time and accurate. On the other hand, the feedback from the worker could also reach top management promptly. This would enable the top management act to the problems immediately and hence minimise the losses. The worker behaviour on safety and health also an important factor, for instance the worker that do not wear proper personal protective equipment may get higher chance to face serious injuries compared to the worker with personal protective equipment. Also, worker that do cooking in construction site would possibility cause fire. The documentation of accidents and incidents at workplace could bring awareness to all workers especially to prevent the re-occurrence of incidents. The regular occupational safety and health trainings shall be conducted for all employee at construction site to constantly remind all the workers on their responsibility and acknowledge the new workers on the safety system to be adhered. At constructions site, the sufficient safety signs and notices is very important to give warning and as a reminder for workers to adhere to necessary safety and health procedure that would minimise the occurrence of accidents.

In short, the study has contributed to the understanding of strategic and relationships of management level to the adoption and practices of OHSMS and how significant of the safety measure practices impacts on the safety performance.

5.3 Limitation of Study

Although the works has revealed the relationship of the adoption and practices of OHSMS in Malaysia construction sites, there is three limitations with the research that need to be highlighted.

Firstly, its related to the data collection. It is unrealistic to collect the data from all grade construction company, as grade G1 to G7 and from whole Malaysia, according to CIDB website, there is total registered 130,342 numbers of construction company in Malaysia. The data collected was only from the grade G7 construction company from Selangor area as the Selangor is one of the most concentrated states

with construction activities and G7 construction company is mandatory to have the safety officer. Therefore, it might bring issue when come to generalisability.

Secondly, it's on the survey questionnaire. The survey questionnaire is pre-designed and it is the close-ended question. The is designed based on the study of literature review and consultation from few experts, it may not conclude all the events, while the close-ended question do not allow the respondents to express their opinion if deferred from the answer. Therefore, it might not able to get the true responses from the respondent.

Thirdly, its related to the data collection method. As the survey questionnaire only distributed via email, the survey data collected may not be exactly accurate as the personnel of respondent is uncontrolled. Example, the person who responding may not from the targeted group. Other than that, the reason of the answering is also lack clarification as the respondent do not have access to explain it.

5.4 Recommendation for Future Work

From the findings of limitation of study, the recommendation as follows.

Firstly, on the limitation of the data collection, it suggests the survey direct to all the construction company in all grade and states to obtain the more realistic and generalise data. One of the reasons to have all grade of construction company to participate is that they are also the players involves in constructions field in Malaysia. It also suggested to have balanced data of construction projects such as landed dwellings, high rise buildings, commercial buildings, factories, warehouse, and infrastructure work like roads works and bridges to enhance the generalisability of the study.

Secondly, on the limitation of survey question, it suggests the qualitative survey methodology such as interviews with respondents. It is useful to get the immediate response from the respondents and get the more concrete findings based on their site experiences.

For the limitation of data collection method, the recommendation is similar to the last approach which is conducting the interview with respondent. From there, the respondents can be assured that from the targeted group, and the clarification can be done immediately if the answer of respondents is lack of questionable.

In consideration of the resources and time limitation for the research, it may not be realistic to do qualitative approaches (Interview) with all the company. It is suggested to have hybrid approaches which is combined of quantitative and qualitative approaches via survey questionnaire and interview (online or face to face) in certain proportion hence to improve the reliability and robustness of the data.

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APPENDICES

APPENDIX A: Survey Questionnaire

FYP SURVEY QUESTIOINNAIRE

Hi, You are invited to take part in a research study title "**ADOPTION AND PRACTICES OF OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEM (OHSMS) IN MALAYSIA CONSTRUCTION SITES".**

The purposes of study:
•To determine relationship between OHSMS and work-related accidents in construction site.
•To test the effectiveness and reliability of the safety management system in construction site.

The survey questionnaire consist of 2 parts:
Part 1 - Demographic Information
Part 2 - Survey Questionnaires

Your answer in this survey shall be keep as confidential and all the information obtained will be strictly used for academic purposes only.

Thank you for the time taken to complete this survey.

Please contact the undersigned if you have any queries.

Best Regards,
Chee Teik Yee (Mr)
Universiti Tunku Abdul Rahman
Lee Kong Chian Faculty of Engineering & Science
Contact No: +6012 - 521 0199
Email: cheeteikyee@1utar.my

* Indicates required question

1. Email *

PART 1 - DEMOGRAPHIC INFORMATION

2. 1. Gender *

Mark only one oval.

- ◯ Male
- ◯ Female
- ◯ Prefer not to say

3. 2. Age *

Mark only one oval.

- ◯ 25 - 34 years old
- ◯ 35 - 44 years old
- ◯ 45 - 54 years old
- ◯ 55 - 64 years old
- ◯ Prefer not to say
- ◯ Other: _____

4. 3. Position *

Mark only one oval.

- ◯ Project Manager
- ◯ Engineer
- ◯ Supervisor
- ◯ Other: _____

5. 4. Working Experiences *

Mark only one oval.

- ◯ 1 - 10 years
- ◯ 11 - 20 years
- ◯ 21 - 30 years
- ◯ Other: _____

6. 5. Education Level *

Mark only one oval.

- ◯ Master
- ◯ Degree
- ◯ Diploma
- ◯ Other: _____

7. 6. Site Location *

Mark only one oval.

- ◯ Selangor
- ◯ Kuala Lumpur
- ◯ Other: _____

8. 7. Types of Construction *

Mark only one oval.

- ◯ Landed Property (Housing)
- ◯ High Rise Property (Less than 20 Storey)
- ◯ High Rise Property (More than 20 Storey)
- ◯ Industrial Property (I.e. Factory, Warehouse, etc)
- ◯ Infrastructure Works (I.e. Highway, etc)
- ◯ Other: _____

9. 8. Number of Workers Employed at Site *

Mark only one oval.

- ◯ 300 employees and above
- ◯ 200 - 299 employees
- ◯ 100 - 199 employees
- ◯ 100 employees and below
- ◯ Other: _____

10. 9. ISO Certification *

Mark only one oval.

- ◯ OHSAS 18001 / ISO 45001
- ◯ ISO 9001
- ◯ ISO 14001
- ◯ Other: _____

PART 2 - SURVEY QUESTIONNAIRES

The survey questionnaires consists of following section and total of 30 questionnaires.

Section A - Practices and Adoption of Occupational Health & Safety Management System (OHSMS)
Section B - Supportive Environment
Section C - Safety Measure Practices that Resulted in Safety Performance
Section D - Effects of Good Safety Performance

Please click "Next" to proceed for the survey.

Section A - Practices and Adoption of Occupational Health & Safety Management System (OHSMS)

(10 Questionnaires)

Please select one of the number below to show your agreement level with the statements.
1 - Strongly Disagree
2 - Disagree
3 - Neutral
4 - Agree
5 - Strongly Agree

11. 1. The safety rules and safe work procedures implemented at construction site are adequate for accident prevention. *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

12. 2. Top management enforces the implementation of safety rules and safe work procedures. *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

13. 3. Safety inspections are carried out regularly by competent person. (I.e. Safety and health committee member) *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

14. 4. Safety briefing/toolbox meeting is carried out regularly by competent person. (I.e. Safety and health committee member or safety and health officer) *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

15. 5. The safety rules and safe work procedures implemented are practical and effective. *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

16. 6. My company has a written Occupational Safety and Health Policy. *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

17. 7. My company always monitors cost and benefits of implementing Occupational Health and Safety Management System. *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

18. 8. My company has established the role and responsibilities for practicing of Occupational Health and Safety Management System. *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

19. 9. My company has written standard of procedures (SOP) - HIRARC (Hazard Identification, Risk Assessment and Risk Control) for Occupational Health and Safety Management System implementation. *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

20. 10. My company conducts Occupational Health and Safety Management System audit on a regular basis. (I.e. Yearly) *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

Section B - Supportive Environment

(8 Questionnaires)

Please select one of the number below to show your agreement level with the statements.
1 - Strongly Disagree
2 - Disagree
3 - Neutral
4 - Agree
5 - Strongly Agree

21. 1. My company always encourages reporting of any unsafe act and condition. *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

22. 2. My company encourages constantly reminder on safe work procedures. *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

23. 3. My company believes that it is everyone responsibility to create a safe and healthy workplace. *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

24. 4. My company always offers assistance and resources on performing the job safely. *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

25. 5. My company prohibits working alone under risky or hazardous condition. (I.e., Buddy System) *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

26. 6. My company always ensures reasonable workload among employees. *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

27. 7. My company always provides training on Occupational Safety and Health at workplace. *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

28. 8. My company has safe work procedure / manual for work process. *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

Section C - Safety Measure Practices that Resulted in Safety Performance

(7 Questionnaires)

Please select one of the number below to show your agreement level with the statements.
1 - Strongly Disagree
2 - Disagree
3 - Neutral
4 - Agree
5 - Strongly Agree

29. 1. Effective communication. (I.e., documented communication flow established for all levels of employee) *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

30. 2. Workers take responsibility for their behavior on safety and health. *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

31. 3. There is documented records of accidents and incidents at workplace. *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

32. 4. Workers are only work on good health condition. *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

33. 5. There are regular trainings conducted for employee on Occupational Safety and Health at workplace. *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

34. 6. Company provides sufficient safety signs and notices at all area. *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

35. 7. Workers must wear and well equipped with personal protective equipment (PPE). *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

Section D - Effects of Good Safety Performance

(5 Questionnaires)

Please select one of the number below to show your agreement level with the statements.
1 - Strongly Disagree
2 - Disagree
3 - Neutral
4 - Agree
5 - Strongly Agree

36. 1. Reduced rate of accident / safer working environment.

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

37. 2. Improved product quality. *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

38. 3. Increased productivity. *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

39. 4. Improved company reputation. *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

40. 5. Improved company profits and sales *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

End of Survey

Please click on the "Submit" button to complete the survey.

Thank you very much for the participation and have a nice day.