STRUCTURAL EQUATION MODELLING OF BUSINESS SUSTAINABILITY FOR LARGE BUILDING CONTRACTORS WITH OCCUPATIONAL SAFETY AND HEALTH MANAGEMENT SYSTEMS CERTIFICATION IN KLANG VALLEY MALAYSIA

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By

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ABSTRACT

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Sue Har

Despite many improvements in the prevention of fatalities in construction industry, the fatality rates in Malaysian construction industry continue at an unacceptable rate. Poor Safety Measure Practices, were the main cause of workers' high fatality. These practices were, lack of Safety Rules & Procedures, Unsafe Working Conditions and Unsafe Acts. The purpose of this study is to investigate the aforesaid practices that cause the incidents, simultaneously on how these practices that will influence the safety performance, financial performance and company competitiveness. The objectives are to examine the relationship among safety rules & procedure, supportive environment, safe acts, adoption of Occupational Health and Safety Management System (OHSMS), safety performance, financial performance and company competitiveness of OHSMS Certified companies. Field survey was conducted using quota sampling, a self-administrated questionnaire at 33 project sites consisting of 401 respondents within the safety management team members in the Klang Valley, Malaysia. The data analysis was carried out using Structural Equation Modelling (SEM) SPSS Amos (V21) of IBM. The findings show that Safety Rules & Procedures, Safety Acts are positively related to Adoption of OHSMS, the

adoption of OHSMS is positively related to Safety Performance, and Safety Performance are positively related to Financial Performance and Company Competitiveness. In addition, Company Competitiveness is found to mediate the effect of Safety Performance and Financial Performance. Consequently, this study proposes that an effective OHSMS assists the project to maintain an accident-free workplace and be able to negate inferior company image by the public and authorities. Top management and project managers need to re-think the current conservative approach to run the projects where safety issues are fully responsible by the safety team. Top management need to top-up resources to manage safety as like other functions of the business. Project managers need to manage safety besides the other functions of the organization such as production, maintenance, marketing, and finance to achieve business objectives.

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APPROVAL SHEET

This thesis entitled **"STRUCTURAL EQUATION MODELLING OF BUSINESS SUSTAINABILITY FOR LARGE BUILDING CONTRACTORS WITH OCCUPATIONAL SAFETY AND HEALTH MANAGEMENT SYSTEMS CERTIFICATION IN KLANG VALLEY MALAYSIA"** was prepared by SUE HAR and submitted as partial fulfillment of the requirements for the degree of Doctor of Philosophy in Science at Universiti Tunku Abdul Rahman.

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I understand that University will upload softcopy of my final thesis in pdf format into UTAR Institutional Repository, which may be made accessible to UTAR community and public.

Yours truly,

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DECLARATION

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

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TABLE OF CONTENTS

	Page
ABSTRACT	**ii**
ACKNOWLEDGEMENTS	**iv**
APPROVAL SHEET	**v**
SUBMISSION SHEET	**vi**
DECLARATION	**vii**
TABLE OF CONTENTS	**viii**
LIST OF TABLES	**xii**
LIST OF FIGURES	**xiv**
LIST OF ABBREVIATIONS	**xv**
LIST OF APPENDICES	**xvi**

CHAPTER

1.0	**INTRODUCTION**	**1**
1.1	Introduction	1
1.2	Critical Construction Issues	3
1.3	Problem Statement	6
1.4	Research Questions	13
1.5	Research Aim	13
1.6	Research Objectives	14
1.7	Significance of the Study	15
1.8	Contribution of the Study	15
1.9	Limitation of the Study	17
1.10	Scope of the Study	17
1.11	Definitions of Terms used	18
1.12	Thesis Organisation	20
1.13	Conclusion	21
2.0	**LITERATURE REVIEW**	**23**
2.1	Introduction	23
2.2	Occupational Health and Safety Management System (OHSMS)	24
2.3	Factors affecting the Occupational Health and Safety Management System	27
	2.3.1 Safety Rules and Procedures	27

2.3.2 Supportive Environment 30
2.3.3 Behavioural Involvement of Safe Act of an Individual and group interaction of Workers 34
2.3.3.1 Safe Acts 35
2.3.4 Safety Training, Management Commitment, Safety Policy, Communication between Management and Workers 36
2.3.5 Project Safety Performance 40
2.3.6 Company Competitiveness 45
2.3.7 Project Financial Performance 47
2.4 Benefits of the adoption of Occupational Health and Safety Management System (OHSMS) 48
2.5 Accredited Certification and Grade of Construction Companies in Malaysia 51
2.6 Research Gaps 53
2.7 Conclusion 56

3.0 CONCEPTUAL FRAMEWORK 57

3.1 Introduction 57
3.2 Premise of Research 57
3.3 Development of the Conceptual Framework And Hypotheses 58
3.3.1 The relationship between Safety Measure Practices and the Adoption of OHSMS 60
3.3.2 The relationship between OHSMS and Project Safety Performance 61
3.3.3 The relationship between Project Safety Performance And Project Performance 62
3.3.4 Summary of Hypotheses 66
3.4 Measurement of Variables 67
3.4.1 Safety Rules & Procedures 68
3.4.2 Supportive Environment 69
3.4.3 Safe Acts 70
3.4.4 Adoption of OSH Management System 71
3.4.5 Project Safety Performance 73
3.4.6 Company Competitiveness 75
3.4.7 Project Financial Performance 76
3.5 Conclusion 77

4.0 RESEARCH METHODOLOGY 78

4.1 Introduction 78
4.2 Research Design 78

4.2.1 Comparable Methodologies Used by Other Researchers 79
4.2.2 Research Design Process 85
4.2.3 Conditions for Causality 87
4.3 Questionnaire Development 87
4.4 Research Instruments 92
4.4.1 Pre-testing the Survey Questionnaire 92
4.4.2 Pilot Testing Sample Size 94
4.4.2.1 Reliability Test for Pilot Testing 96
4.4.3 Final Survey Questionnaire 98
4.4.4 Final Survey Sampling and Population 99
4.4.4.1 Cochran's Formula of Sample Size 100
4.4.4.2 Yamane's Formula of Sample Size 101
4.4.4.3 F Test – Statistical Sample Size 101
4.5 Data Collection 103
4.6 Data Analysis Procedure 104
4.6.1 Confirmatory Factor Analysis 105
4.6.2 Structural Equation Modelling (SEM) 106
4.6.2.1 The Importance of Carrying Out SEM 108
4.6.3 Common Method Variance 109
4.6.3.1 Harman's Single Factor Test 109
4.6.3.2 Common Latent Factor Method 110
4.6.3.3 Common Marker Variable Method 110
4.6.4 Reliability Analysis 110
4.6.5 Validity Analysis 112
4.6.6 Evaluating the Goodness of Fitness of A Measurement Model 113
4.6.7 Analysis of the Structural Equation Model 115
4.6.8 Testing the Hypotheses 116
4.6.9 The Mediation Test 117
4.7 Conclusion 121
5.0 DATA ANALYSE AND FINDINGS 122
5.1 Introduction 122
5.2 Preliminary Examination of Data 125
5.3 Missing Data 125
5.4 Normality, Outlier and Multicollinearity 126
5.5 Common Method Bias 128
5.6 Demographics of Respondents 129
5.7 Validating the Measurement Model 132
5.7.1 Convergent Validity Test 134
5.7.2 Discriminant Validity Test 140
5.8 Structural Equation Modelling 143

5.8.1 Model Fit 143
5.8.2 Path Analysis 144
5.8.3 Testing Mediating Effects 147
5.9 Outcomes of Research Objectives 150
5.10 Case Studies 151
5.10.1 Supportive of quantitative findings with case studies 151
5.10.1.1 Case Study 1 153
5.10.1.2 Case Study 2 156
5.10.1.3 Case Study 3 158
5.10.1.4 Case Study 4 161
5.10.1.5 Case Study 5 163
5.11 Summary of the 5 Case Studies 165
5.12 Conclusion 168
6.0 CONCLUSIONS AND RECOMMENDATIONS 169
6.1 Introduction 169
6.2 Recapitulation of the Study 169
6.3 Review of the Findings 170
6.3.1 The relationship between Safety Rules & Procedures and Adoption of OHSMS 170
6.3.2 The relationship between Safe Acts and Adoption of OHSMS 173
6.3.3 The relationship between Adoption of OHSMS And Project Safety Performance 175
6.3.4 The relationship between Project Safety Performance and Company Competitiveness 176
6.3.5 The relationship between Project Safety Performance and Project Financial Performance 178
6.3.6 The relationship between Company Competitiveness and Project Financial Performance 179
6.3.7 Company Competitiveness mediates the Relationship between Project Safety Performance And Project Financial Performance 180
6.4 Implications of the Study 181
6.4.1 Theoretical Implications 181
6.4.2 Practical Implications 183
6.5 Recommendations for Future Research 186
6.6 Conclusion 187

REFERENCES 189

APPENDICES 208

LIST OF TABLES

Table		Page
1.1	Occupational Accident (Death) Statistics by sectors	7
1.2	Fatality between 19/5/2014 to 18/7/2020 JKKP Malaysia	7
1.3	Accidents by State, (Selangor and WPKLP = 58 cases of fatality)	8
1.4	Comparable studies of 'Factors of Safety Practices'	11
2.1	Summary of findings of the OSHMS/OHSAS 18001 implementation	49
2.2	Accredited Certification (updated until Q2 2020)	52
2.3	Number of Registered Contractors by Grade	52
3.1	Safety Rules & Procedures Scale Items	68
3.2	Supportive Environment Scale Items	70
3.3	Safe Acts Scale Items	71
3.4	Adoption of OSH Management System Scale Items	72
3.5	Measured variables in Safety Culture, Safety Behaviour, Safety Awareness and Management Commitment	74
3.6	Measured variables in Company Competitiveness	75
3.7	Project Financial Performance Scale Items	77
4.1	Methodologies by Other Researchers	81
4.2	Research Variables, Corresponding Items and Source of Items	88
4.3	Summary of Cronbach's Alpha on Pilot Testing of 58 Variables	97

4.4	The three categories of model fit and their information	114
5.1	Tabulation of the Number of Respondents and Locations	124
5.2	Demographic Profile of Respondents	130
5.3	Means and Standard Deviations for the Variables	131
5.4	Goodness-of-fit results for the Measurement Model	134
5.5	Convergent Validity and Reliability of the Variables in Study	136
5.6	Discriminant Validity Test	142
5.7	Goodness-of-fit (GOF) results for the Structural Model	143
5.8	Results of Path Analysis	145
5.9	Bootstrap Results of Mediation Effect of Company Competitiveness between Project Safety Performance and Project Financial Performance	149
5.10	Summary of the Hypotheses Testing	151
5.11	Summary of 5 Case Studies	166

LIST OF FIGURES

Figure		Page
3.1	Conceptual Framework of Safety Measures Practices that affects Company Performance	60
3.2	Conceptual Model and Hypotheses	65
4.1	The Research Process	84
4.2	Numbers of OHSMS certification – Construction Sector	85
4.3	The Detailed Research Design Process	86
4.4	F test for sample size	102
4.5	Six stages process for Structural Equations Modelling	107
4.6	SEM – An overview	116
4.7	Testing Mediation with Regression Analysis	118
5.1	Locations of Project Sites on Google Map	123
5.2	CFA Diagram	133
5.3	Standardised Path Coefficients	146

LIST OF ABBREVIATIONS

AVE	Average Variance Extracted
CA	Cronbach’s Alpha
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CLF	Common Latent Factor
CR	Composite Reliability
GFI	Goodness Of Fit Index
RMSEA	Root-Mean Square-Error of Approximation
SEM	Structural Equation Modelling
SHASSIC	Safety and Health Assessment System in Construction
TLI	Tucker Lewis Index
TOL	Detection – Tolerance
VIF	Variance Inflation Factor
CMB	Common Method Bias
FL	Factor Loading
JKKP	Jabatan Keselamatan & Kesihatan Perkerjaan Malaysia (Department of Occupational Safety and Health, Malaysia)

LIST OF APPENDICES

Appendix		Page
A	Cover Letter for Survey	208
B	Assessment of Normality (Group number 1)	219
C	Mahalanobis Distance	220
D	Detecting Multicollinearity	221
E	Total Variance Explained	222
F	Difference of Standardized Regression Weights	223
G	Sobel Test	224
H	Kappa-squared	225
I	Semi-structural interview’s questions and case study	226
J	List of Publications	230

CHAPTER 1

INTRODUCTION

1.1 Introduction

The construction industry is considered a risky industry owing to the high incidence of accidents and fatality occurrence (Hinze, 1997). Globally, an estimate of 2.3 million deaths annually results from injuries and work-related diseases, of which 321,000 people are from occupational accidents. In addition, there are 317 million non-fatal occupational accidents per year (World Statistic - ILO).

In Australia, over the 10 years period from 2003 to 2013 (Safe Work Australia 2015), there were 401 work-related fatalities in the construction industry, making an annual average of 36.

The Health and Safety Executive UK (HSE 2020) reported that out of the absolute fatality count from 2015 to 2019, the annual average is 37 persons in the construction occupation.

The Malaysian construction industry has been the foundation of the Malaysian National Development, which has seen double-digit growth from 2010 to 2015. Currently, the industry achieves 4.6 per cent of the GDP (EPU GDP Malaysia 2016) and is anticipated to increase to 5.5 per cent by 2020. In 2016, the industry has a registered workforce of 865,044 (CIDB Malaysia 2016) which represents 5.88 per cent of the total workforce of 14.7million (DOSM 2016). The construction industry in Malaysia is a very dominate economic segment, both in fiscal growth and in enhancing the standard of living for

Malaysian citizens. Indeed, the construction industry becomes a fast growth sector with an average of 10 per cent growth. However due to the unique structure of the industry, construction site activities being physically scattered across various areas, construction workload fluctuations, project complexity, the availability of qualified workers and the high dependency on foreign unskilled workers are typical occurrences. In this respect, supervising and monitoring safety and health issues in the work place are much more challenging. These have resulted in many critical issues within the industry. In fact, negative reputation caused by substandard practices in safety and health in Malaysian construction sector was identified as one of the strategic-objectives in the Construction Industry Transformation Programme 2016-2020 (CITP).

High numbers of accidents and injuries occur mainly due to poor worksite conditions (including workers' facilities and safety and health standards), and the shortage of relevant safety officers being employed. Strategic Thrust 1 of CITP – Quality, Safety & Professionalism lays down that there is a case for change. One of the key outcomes set in motion is to reduce more than 50 per cent fatality rate at worksites by 2020.

The Malaysian construction industry accounts for one of the highest fatality rates as compared to other industries. The Department of Occupational Safety and Health (DOSH)'s record of victims in the construction industry in 2014 was 72 victims followed by manufacturing with 45 victims. Up to the end of 2015, there were 88 deaths, 138 workers suffered serious injuries and 11 with permanent disabilities. In 2016 the fatality at construction sites was 99 people killed, the highest among the occupational sectors (DOSH statistics 2016).

1.2 Critical Construction Issues

The top management, site management team, consultants, subcontractors and also the workers themselves are jointly responsible for the upkeep of safety practices at the construction site.

In a UK construction industry study by Sawacha *et al*., (1999), it was revealed that the attitudinal aspects of safety among workers comprised five main elements. These were safety talks by management, availability of safety booklets, provision of safety equipment, development of a safe working environment and engagement of a trained safety personnel at site. Most importantly, site management staff must be committed and constantly communicated on safety talks with the workers to yield better safety outcomes. Safety performance will be improved with the correct use of appropriate PPE. The workers should be trained with the correct skill or construction activities. A good housekeeping at site is always given priority in dealing with safety. Lastly, a well-organised safety personnel can promote safety performance by regular site inspection and demanding corrective actions to be taken immediately. In another case study, Ahmad et al. (2016) concurred with similar findings.

However, in China, Tam *et al*. (2004) pointed out that safety performance is fundamentally caused by low safety awareness of senior and middle management, insufficient safety training, lack of support for safety measures and reckless process of work. Presumably, most contractors did not comply with method statement of work stated in the safety handbook. The management also show insufficient priority on safety, as shown by their infrequent attendance at safety meetings.

Over in Australia work-related cuts and open wounds were extensively sustained by construction workers compared to workers in other priority industries (Safe Work Australia, 2015).

A greater proportion of injuries were also due to falls from height. The causes of injury that were perceived by the workers were not having the right equipment to carry out the work while no health and safety training was provided in the smaller construction business. In general, workers were seen to be more open towards construction risks compared to the employers. However, the conditions in the workplace may be an inhibiting factor for adherence to safety rules.

Safety is an important issue in these occupational accidents, yet safety matters are always considered as secondary. Many employers do not consider it a prerequisite for a project's success. Financial risk and expensive costs are perceived as more important than safety. Tight profit margin is another factor for the reluctance to spend money on safety. (Wadick, 2010). However, a cost-benefit analysis indicates that the benefits in averting accidents and injuries far outweigh the costs of accident prevention in a ratio of 3:1 or higher (Ikpe *et al*., 2012; Biggs *et al*. 2005).

As workplace injuries and illnesses arise from a complex set of factors, assessing safety and health performance require a careful and in-depth analysis of the occupational health and safety (OHS) management system implementation. Inadequate or the absence of an OHSMS has contributed to the high risks of injury in the work place. Another limitation stems from the lack or insufficient guidance on safety performance (Kunju, 2000). As such, an effective OHS management system integrated with a safe work-site and systems of work, can result in a safer working environment of construction. This will ultimately reduce injuries and work-related diseases. (Davies and Tomasin, 1996).

Many studies have investigated, the efficient implementation and certification of the OHS management system. These management systems generally follow the guidelines published by national and international organisations and institutions (such as BS 8800 NZS 4801 / AS, OHSAS 18001 or ILO-ISG-2001).

Occupational Health and Safety Assessment Series (OHSAS) 18001 has become an important standard to assess occupational safety and health issues. The certification of this Standard would indicate the presence of a good occupational safety and health performance within a company (Granerud and Robson, 2011).

The application of the OHSAS 18001 standard in a business is important to assist the management to achieve good OSH performance. Certification is important to show external parties that the organisation is in perfect management (Mohd *et al.*, 2013). Certification also leads to a significant increase in sales value and higher productivity (Lo *et al.*, 2014). OHSAS certification may produce advancements beyond the legal requirements, and certification is also found to support progressive improvement in health and safety performance (Granerud and Robson 2011). Likewise, Yoon *et al*. (2013) also pointed out that both work-related accidents and fatal injury rates were significantly reduced by implementing OSH management system. Also, similar findings by Bottani *et al*.

(2009); Benite and Cardoso (2003); Fernandez-Muniz *et al*. (2009); Mohammadfam *et al*. (2017) concurred on that outcome.

With the practice and certification of the OHSAS 18001 management system, many researchers have identified the main safety measures which influence the safety performance and company competitiveness performance of the organisation. These are: - (1) Management Responsibility, (2) Existence of Safety Policy, (3) Communication between management with workers, (4) Safety Training, (5) Safety Rules and Procedure, (6) Supportive Environment and (7) Behavioural Involvement of Workers.

As of the second quarter of 2020, the Department of Standards Malaysia have recorded a total of 251 construction companies practising OSHMS. The most common OSH Management Systems practised in Malaysia construction industry are ISO 45001 (9 companies), OHSAS 18001:2007 (176 companies) and MS 1722 Part 1:2005 (66 companies)- Figure 4.2.

1.3 Problem Statement

Despite all the positive findings of implementation and certification of OHS management system, the fatality rate of accidents remains high at construction sites (DOSH –DG: The contractors' lackadaisical attitude towards safety measures is the main cause of the frequent accidents notwithstanding the inspections conducted, contractors failed to comply with prescribed safety procedures (Malay Mail Online Dec 2, 2016). NIOSH chairman also pointed out that most contractors failed to follow the required site safety rules (The Star Online Nov 20, 2014).

In Malaysia, the construction and manufacturing industries are the two sectors having the top and unacceptable fatality rates as compared to other industries from 2015 to 2020 (Table 1.1).

Table 1.1- Occupational accident (Death) statistics by sectors

Year	2020	2019	2018	2017	2016	2015
Construction	66	84	118	111	91	88
Manufacturing	73	73	62	68	68	46
Agriculture, Forestry & Fishery	43	43	26	23	23	31

A detailed breakdown of 330 fatality accident cases from 19th May 2014 to 18th July 2020 published by the Department of Occupational Safety and Health Malaysia is shown in Table 1.2.

Table 1.2 – Fatality between 19/5/2014 to 18/7/2020 JKKP Malaysia

Item	Observation	Number of cases (Country)		Number of cases (Klang Valley)
		No	As %	No
1	No remarks/ No conclusive comments	75	22.73	5
2	**Lack of / no Safe Operating Procedure**	**108**	**32.73**	**14**
3	**Unsafe Working Conditions**	**77**	**23.33**	**6**
4	**Unsafe Act**	**39**	**11.82**	**12**
5	Accidents	10	3.03	2
6	No / lack of supervision from the employer	11	3.33	2

7	Lack of / insufficient training	8	2.42	2
8	Failure to communicate between workers and management	2	0.61	-
	Total	330	100	43

Table 1.3 – Accidents by State, (Selangor and WPKLP = 58 cases of fatality)

State	NPD	PD	Death	Total
Johor	285	7	32	324
Kedah	293	25	9	327
Kelantan	63	2	8	73
Melaka	224	8	8	240
NSembilan	222	8	7	237
Pahang	296	6	15	317
Perak	427	24	14	465
Perlis	20	0	1	21
PPinang	252	10	11	273
Sabah	199	12	10	221
Sarawak	320	4	30	354
Selangor	186	19	**41**	246
Terengganu	48	3	3	54
WPKLP	67	5	**17**	89
WPLabuan	5	0	0	5
Total	***2907***	***133***	***206***	***3246***

Non-Permanent Disability (NPD), Permanent Disability (PD)

Occupational Accidents by State up to October 2017 (investigated)

The review collected from the JKKP Malaysia (Table 1.2), indicated that fatality was mainly due to **'Lack of / No Safe Operating Procedure', 'Unsafe Working Conditions', and 'Unsafe Act'.**

Table 1.2 lists three major observations or causes of the 330 fatalities. 108 cases were due to the lack of or an absence of a prescribed safe operating procedures, or workers failed to implement the proper system as stated in the safety handbook. For example, safety helmets were not used and issuing of permit to perform for hazardous tasks were not carried out. Contractors should take more stringent and decisive steps to perform safety supervision and the right method or specification for the installation of a task. Safe work procedures should highlight the hazards that are harmful to a worker, the types of equipment, personal protective equipment (PPE) or other safety considerations necessary to perform the task safely. Not only that, steps to perform the task safely and training should also be given to new or returning workers and the management must ensure workers follow them.

77 cases were categorized as poor or unsafe working conditions. The Occupational Safety and Health Act 1994 (OSH Act), stipulated that employers must provide a safe workplace for every employee. Typical unsafe working environments at construction sites are unprotected open edges, torn safety net not replaced, poor or unorganized house-keeping or untidy sites, improper passage to workplace, electrical plugs not used and insufficient or the absence of lighting for works to be carried out.

39 cases of unsafe acts were linked to the attitude of the workers. The workers refrain from wearing PPE, and some feel uncomfortable wearing it. Remedial action was not taken by site management on the errant workers. This has led to the careless attitude of workers in carrying out their tasks and just disregard the safety procedure that is instructed in the rules and regulations.

Similarly, Table 1.2 shows the 43 fatalities in the Klang Valley (in the same period from 19/5/2014 to 18/07/2020). There are 14, 6 and 12 cases for Lack of

/ no Safe Operating Procedure, Unsafe Working Conditions and Unsafe Act respectively. Table 1.3 also indicated that highest fatality was Selangor.

As the literature reviews by researchers on the implementation of OHSMS will significantly reduce both work related accidents and fatality rates, yet statistical data from the above shows otherwise. Moreover, both Heras-Saizarbitoria et al. (2019) and Ghahramani and Summala (2015) pointed out that certification of OHSAS 18001 and practicing good safety measure practices (SMPs) is not completely related to better safety performance. Hence, this backdrop formulates the research gap in this study.

An analysis of 12 common factors of safety practices carried out by 19 research papers were reviewed and shown in Table 1.4. These research studies were related to safety and health management. These factors were compared with the DOSH(M) listed causes of fatalities of the 330 investigated cases. 'Safe Operating Procedure', 'Working conditions', and 'Safety Acts' were the least examined by these authors (number of authors examined these factors of 5,6,3 respectively). Further investigation into these three factors will enhance the study of the causes of accidents and fatality.

Structural equation modeling (SEM) is a multivariate data analysis method for analysing complex relationships among latent constructs and observed variables. SEM statistical approach for this study shall be able to analyse the multi-interactions between observed variables and the underlying latent constructs of safety measure practices (these are Safety rules & procedures, supportive environment, and safe acts of workers) and adoption of OHSMS. The adoption of OHSMS in turn influences the project safety performance.

Furthermore, SEM has the ability to estimate the complex relationships among project safety performance, company competitiveness, and project financial performance.

Table 1.4 – Comparable studies of 'Factors of Safety Practices'

		Factors of safety practices												
		No conclusive comments	Safe Operating Procedure	Working Conditions	Safe Act	Supervision from employer	Training	Communicate between workers and management	Management commitment	Safety policy	Legistration / compliances	Safety performance	Workers' involvement	Safety implementation system
		DOSH(M) listed causes												
	Total 330 cases investigated	75	108	77	39	11	8	2						
	Authors													
1	Buniya Mohanad Kamil et al. 2021					x	x	x	x				x	x
2	Rahlin Nor Azma et al. 2019								x		x		x	
3	Nicole SN Yiu et al. 2019		x	x				x	x		x	x	x	
4	Kassim et al. 2021						x	x	x			x		
5	Mohammadfam et al. 2016						x	x	x				x	
6	Aksorn and Hadikusumo 2008								x				x	x
7	Buniya Mohanad K et al. 2021		x	x			x		x		x		x	
8	Ghahramani Abolfazl 2016						x	x	x		x		x	x
9	Battaglia Massimo et al. 2015						x			x		x	x	
10	Fernandez-Muniz et al. 2012				x	x		x	x		x		x	x
11	Hadjimanolis and Boustras 2013						x		x	x		x		
12	Li Yadi et al 2018			x	x		x		x	x			x	x
13	Wachter and Yorio 2014		x			x	x	x					x	
14	Choudhry 2016		x			x	x		x	x			x	
15	Yanar et al. 2019			x		x			x	x		x		
16	Rajaprasad and Chalapathi 2015			x			x		x	x		x		x
17	Mahmoudi et al 2014					x	x		x	x	x		x	x
18	Yap Jeffrey et al. 2022					x	x	x						x
19	Mohammad and Hadikusumo 2017		x	x	x	x	x	x	x	x	x		x	x
	Number of authors examined the factor of safety practices		5	6	3	8	14	9	16	8	7	6	14	9

Due to these assertions, this study aims to further investigate **Safety Rules and Procedure** and its closely related factors of **Supportive Environment** and **Safe Acts of Workers** that will influence the project safety performance and project performance. In this research, 'Safety Rules and Procedure' and its closely related factors of 'Supportive Environment' and 'Safe Acts' are termed as success factors of 'Safety Measure Practices' (Sawacha et al, 1999; Sorensen et al. 2019).

From literature review presented, primarily a company is likely to implement and endorse certification of ISO 45001, OHSAS 18001, and MS 1722 Part 1 management systems. By so doing, workplace safety and health will be greatly enhanced while at the same time improve project performance. Secondly, the success factors of Safety Rules and Procedure, Supportive Environment and Safe Acts of Workers of the management system shall be re-examined. The outcome may result in the full realization of improvement on OSH measures and project performance. Simultaneously, improvement in safety performance shall in turn enhance improvement in the legal requirements of the company.

It is known that safety performance, competitiveness of company and financial performance are core elements that contribute to project success. Improvement of safety performance as a result from implementation of 'safety measure practices', will in turn improve project performance of competitiveness and financial performance of the company. Project performance has been defined as a computation of safety performance, competitiveness of company and financial performance (Chan and Chan 2004; Silva et al. 2017).

1.4 Research Questions

Based on the aforesaid contentions, the following research questions emerge: -

(a) How much influence do safety measure practices such as safety rules and procedures, a supportive environment, and safe acts have on the adoption of occupational safety and health management systems?

(b) Among project performance measures, how much influence does project safety performance through the adoption of occupational safety and health management systems have on company competitiveness and project financial performance, as well as the influence of company competitiveness on project financial performance?

(c) How do safety measure practices such as safety rules and procedures, a supportive environment, and safe acts relate to project performance measures such as project safety performance, company competitiveness, and project financial performance through the adoption of occupational safety and health management systems?

1.5 Research Aim

This research aims to develop a structural equation model that explains the relationship between safety measure practices and project performance measures through the adoption of occupational safety and health management systems for relevant large building contractors to manage project risks and achieve business sustainability.

1.6 Research Objectives

This research is targeted to address the following three objectives:

(a) To examine the influences of safety measure practices such as safety rules and procedures, a supportive environment, and safe acts on the adoption of occupational safety and health management systems.

(b) To examine, among project performance measures, the influences of project safety performance through the adoption of occupational safety and health management systems on company competitiveness and project financial performance, as well as the influence of company competitiveness on project financial performance.

(c) To develop a structural equation model to explain the relationship between safety measure practices such as safety rules and procedures, a supportive environment, and safe acts and project performance measures such as project safety performance, company competitiveness, and project financial performance through the adoption of occupational safety and health management systems.

It is essential to establish operational definitions for safety performance and project performance. The Occupational Safety and Health Administration – personal injuries, material damage and absenteeism/lost time are typical measurements of construction safety performance. Project performance is measured in term of the combination of company competitiveness and financial performance. The Competitiveness of a company is important to stakeholders of a business venture, besides product quality, productivity, customer satisfaction and status. Other typical elements of financial performance in a construction company range from increase in profitability, increase in market share and upgrading profit/sales ratios. (Ali *et al*. 2013; Shenhar *et al*. 1997).

1.7 Significance of the Study

The outcome of this study is twofold. It reveals firstly, the weaknesses and secondly, the level of understanding of the overall administration of the OSH management system within the Malaysian Construction companies. This will provide the awareness that each individual success factor is equally important for the successful implementation of OSH management system. The study indicates how top management can provide the absolute commitment to drive the management system in the organisation. By providing this impetus, all related participants such as site management, supervisors and workers themselves shall be committed, observed, obeyed and practised safety rules and procedures, with self-discipline to achieve a supportive working environment. In the long run, injuries and fatalities will be reduced, thereby improving project performance and productivity.

1.8 Contribution of the Study

The favourable, positive findings shall encourage building contractors to seek adoption of OSH management system and provide an effective safety measure practice. The pre-requisites for an effective safety and health management system, are inter alia: -

(a) Importance of Safety Rules & Procedures and Safe Acts

The study highlights the critical role of well-founded safety rules & procedures, and safety behaviour in maintaining and improving safety performance in construction sites.

(b) Impact on Safety Performance

Adoption of OHSMS which integrated with safety rules & procedures and safety behaviour is perceived as a primary determinant in reducing human injuries and property damages on project sites, particularly in the Klang Valley region.

(c) Crucial aspect for success in construction projects

Effective implementation of OHSMS is crucial for the success of construction projects. It helps maintain an accident-free workplace, enhances the company's image, and promotes productivity, quality, customer satisfaction, and financial gains in the long run.

(d) Influence on Project Budgeting

It's recommended to allocate considerable business resources for safety management. This investment should be integrated into other business management systems and strategies to ensure a comprehensive approach to safety. The study suggests that top management and project managers should emphasize the importance of OHSMS adoption, especially regarding safety rules and procedures, in project planning and budgeting. This emphasizes the importance of safety management in achieving project success and better financial performance.

In summary, this study provides valuable insights into safety management theory within the Malaysian construction industry, offering practical and theoretical advancements to enhance safety performance and promote overall project success.

1.9 Limitations of the Study

Noteworthy findings were derived from this study; however, two limitations need to be highlighted.

Firstly, the main limitation relates to sampling. It was not possible and practical to examine the entire population of construction companies in Klang valley. Non-probability sampling (quota sampling) method was adopted for data collection. Questionnaires were distributed only to familiar project sites mostly high-rise buildings in Klang valley. The issue with generalisability may arise as the findings only reflected the samples taken for the study.

The second limitation identified was that the researcher omitted qualitative inputs, such as interviews to compliment the survey approach. Quantitative approach of “closed-ended” questions would have constraint the correct response from the respondents as they did not have the choice to truly give their opinions. Respondents may select answers most similar to the true answer, even though it is different, giving rise to biased responses. Nevertheless, with interviews the researcher is able to gather responses that reflect the true feelings and perception of the respondents.

1.10 Scope of the Study

Creswell (2009) advocates that scope can assist the researcher to identify the most relevant elements and establish clarity of the research. This approach defines the scope of this study and was presented as follows:

1. The safety management team comprises project staff (manager and engineer), safety officers (site engineer, site supervisor) and those in similar position in running the project.

2. This study is confined to geographical location of project sites within the Klang Valley, Malaysia.

3. The selection of these projects will be restricted to those registered with CIDB G7 category, with ISO 45001, or OHSAS 18001or MS 1722: Part 1 certification.

Based on the delimitations discussed, the terms adopted in this study were identified with clear definitions as follows: -

1.11 Definitions of Terms used

This research is focused on the safety measure practices that influence the project performance of OSH Management System certified construction companies. The terms adopted for the constructs employed in this research are as follows:

Safety Rules & Procedures – "any rule or procedure that impinges on safety, directly or indirectly. Some rules are almost exclusively directed at safety, but many have other primary or subsidiary objectives related to quality, productivity, health, environmental control, sustainability, as well as safety" (Hale et al. 2012, p13).

Supportive Environment – "a climatic factor such as supervisory or peer support at a level of specificity that allows for the development of interventions for changing environmental characteristics and testing their effects on transfer of training" (Baldwin and Ford 1988, p64).

Safe Acts – "safe acts may happen where (a) a worker does know if he/she is acting safely, (2) he/she does know if he/she is acting safely due to different aspects, such as personality, job and managerial factors" (Aksorn and Hadikusomo, 2007).

Adoption of OHSMS - "The Occupational Health and Safety Management System enables an organisation to control its OH&S risks and improve its OH&S performance. An effective OHSMS can be integrated with other management requirements and help organisation to achieve OH&S and economic objectives" (OHSAS 18001:2007).

Project Safety Performance – "Performance findings can be either quantitative or qualitative. Measurable findings of performance can be related to the effectiveness of the prevention of physical, mental or cognitive conditions of workers and the provision of safe and healthy workplaces" (ISO 45001:2018).

Company Competitiveness – "Company employ a concept of competitiveness whereby it needs to (1) be able to meet customers' requirement – in terms of productivity, quality, reputation, price and timeliness of delivery, (2) be able to perform innovations and sustainability, and (3) constantly be connected to the latest market relevant information" (Falciola et al. 2020).

Project Financial Performance – "Project financial performance are measured as profitability, growth in market share, and improved liquidity. Cash flow, leverage and liquidity are effective performance evaluation systems for the construction project" (Omopariola,ED and Windapo, A 2019).

1.12 Thesis Organisation

This study aims to discover the influence of safety rules & procedures, supportive environment and unsafe act of the workers in OHSMS certified environment which in turn will influence the project safety performance and project performance of construction projects.

In this respect, the Behaviour-Based Safety (BBS), the Science of Applied Behaviour analysis is applied to issues of safety in the workplace. The process involves from top management and workforce, work environment, and human behaviour. A process of both management and workers to identify and determine a safe behaviour over an unsafe one formed the theoretical foundation of this research. Chapter 1 presents an overview of the construction industry in Malaysia and other developed countries, there upon providing the background for this research. From the gaps identified in the data extracted from JKKP Malaysia, the research problems form the basis of this study. This is followed by the formation of the study objectives and research aims.

Chapter 2 highlights the factors influencing the effectiveness of implementation of OHSMS at site. Success factors of safety rules and procedures, supportive environments and safe acts of workers could lead to positive improvement in operational and financial results, as well as other advantages related to the organisation. This research has classified these advantages into three categories, (project safety performance, company competitiveness and project financial performance). This application is consistent with the three categories as disclosed by Fernandez-Muniz *et al* (2009).

Chapter 3 shows the development of the conceptual model of this study, following the models proposed by Mossink 2002. Seven constructs were thus identified in their causal relationship. Eight research hypotheses were established. The causal relationships will be investigated using IBM SPSS Amos V21.0 software package.

Chapter 4 outlines the research methodologies which comprise research design, variable measurements, questionnaire development, sampling size and data collection. The developed hypotheses were empirically tested and the implemented approaches were further discussed and presented.

All data relating to respondents' profile, contextual factors of projects and preliminary data results, descriptive analysis, confirmatory factor, path analysis, mediation and moderation test analysis are coordinated in Chapter 5.

From the results obtained in Chapter 5. Chapter 6 reviews the outcomes of the significant hypotheses with conclusion, it also discusses both the theoretical and practical implications of the study. Finally, the future research is suggested and recommended.

1.13 Conclusion

Fatality rates at Malaysian construction sites are on an inclining trend (81, 91 and 111 victims were reported in 2015, 2016 and 2017 respectively). The construction sector is one of the critical components of the Malaysian economy. These statistics confirm that the current OSH practice therein requires an extensive and fast overhaul. The lack of safety practices is primarily due to the attitudes of the workers. Safety requirements were followed in a lackadaisical manner if at all. It could be assumed that the enforcement and compliance of OSH by both employers and workers are weak. Schuitz (2004) indicated that 64 per cent of employees don't think a workplace injury will happen to them. 514 (74.6%) of the 689 workers surveyed between 2013-2014 had negative attitudes toward safety. (Gharibi *et al.* 2016). Failure to wear PPE properly stems from ignorance, negligence, carelessness and over-confidence (Tanko and Anigbogu 2012). HSE (2006) reported that 44% of the 24,182 PPE-related accidents were due to failure of using PPE while at work. This indicates that workers' lack of or low level of safety awareness at the construction site is another contributing factor. Workers are reluctant to follow the safe work procedure and give low priority to safety practices. A lot of workers are unwilling to spend sufficient time for training as their focus is to complete the job quickly and get their wages.

Many studies indicated that an effective OSH management system would reduce injuries and fatality at construction sites (Ng *et al*. 2019; Sparey 2011; Yoon *et al.* 2013; Fernandez-Muniz *et al*. 2009). Besides minimizing construction costs and increasing productivity, the paramount objective is saving lives of workers. But these management standards were not followed scrupulously at the sites. Thus, the management standards have to relook into the detailed elements of the management systems such as safe rules and procedure, supportive environment and unsafe acts of the workers to enhance the management systems. It is not just on paper to show to the authority and public that the company is practising an international renowned OSH standard, but rather it is to ensure that the management standard is fully utilized to produce a safe working environment with minimum accident rate.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In recent decades, the construction industry has observed a rising trend in occupational injuries and deaths. This has prompted the formation and practice of applications such as Occupational Health and Safety Management System (OHSMS). The aim of such development is to curb the hike in fatality occurrences as well as to achieve effective management of safety and health. Davies and Tomasin (1996) pointed out that an effective OHSMS can result in a safer working environment of construction while at the same time reduce incidence of injuries and works related diseases. Yoon *et al*. (2013) indicated that the implementation of OHSMS in construction companies has resulted in the incidence of accidents reduced by 67%; while, the fatality rate of such accidents decreased by 10.3% during the period from 2006 to 2011.

Issued in 1999, the Occupational Health and Safety Assessment Series (OHSAS) 18001 is a voluntary OSHMS recognised globally. Following the publication of this standard, a sizeable number of organisations worldwide have implemented it (OHSAS Project Group). Surveys conducted in 2004, 2009 and 2011, revealed that there were 11091 certificates, 54357 certificates, 90,000 certificates based on the (equivalent) OHSAS specification documents in 82, 116 and 127 countries respectively.

There is no guarantee that the implementation of OHSMSs will improve safety performance. The effectiveness and success of the performance of OSHMSs in an organisation will depend on several safety factors. These safety factors include the top management's responsibility to safety, involvement and safety acts of the workers, communication between workers and management, safety training, safety policy, the implementation of safe operating procedure or guideline by the organisation and the working environment involved. External environment such as enforcement of the relevant government authorities, Department of Occupational Safety and Health (DOSH), and Construction Industry Development Board (CIDB) are other affecting factors.

2.2 Occupational Health and Safety Management System (OHSMS)

The workplace environment is the primary concern of the OHSMS. It incorporates the development, promotion and site maintenance. Its OHS objectives, policies and programs are established to ensure that employees' mental, physical, and emotional well-being are cared for. Its intent is to maintain a safe and hazard-free workplace environment. This involved hazard identification and risks control, management commitment, review and to provide continuous improvement to meet or exceed planned results.

Despite the rise in the standard of living in 1970s and early 1980s, significant workplace injuries and work-related ailments persisted. As a result of this, detailed OHS regulatory initiatives were introduced to curb with these issues, driven by 3 main principles of government intervention (Frick and Wren 2000). Firstly, there was emphasis on employers' commitment to OHS policy. Secondly, the initiatives promoted workers' participation in the OHS policy, and thirdly, these initiatives formed an initial framework towards better standards and comprehensive registration, which were still fragmented in many countries.

Nevertheless, these traditional initiatives proved unsuccessful in mitigating the rise in workplace accidents and injuries, in addition to work-related ill health. Considering that regulations solely dictate what employers need to do to reduce the incidence, the OHS policy was perceived as a passive and fragmented strategy. This policy was later replaced by the Occupational Safety and Health Management (OSHM) in the late 1980s/early 1990s. This time the focus of OSHM was in identifying workplace hazards and tackling them from a management standpoint. The guiding principle was a goal-setting philosophy, instead of prescriptive legislation. This shift in doctrine was based on the presumption that both employers and employees would be well-suited to discern and resolve work place hazards.

The new OSHM strategy encourages both employees and employers alike to adopt an active and joint responsibility for OSH quality, through a systematic management process to tackle workplace hazards. Such a systematic process is pivotal in driving the promotion of OSHM by highlighting the importance of having a better integrated OSH policy in enterprise management.

Nevertheless, there wasn't a definite system specification for the assessment and certification of occupational Safety and health Management System (OHSMS). It was only since 1999 that efforts were undertaken to address and meet this increasingly urgent demand. BSI, in collaboration with other national standard and certification organisations, and specialist advisory bodies took the task of removing confusing policies in the workplace from the proliferation of certifiable OH&S specifications. This culminated in the establishment of the Occupational Health and Safety Assessment Series (OHSAS).

The OHSAS 18001 specification was revised in July 2007. The updated Series incorporated many changes which were more closely associated with the structures of ISO 9000 and ISO 14000. This is to ensure organisation could more readily adopt OHSAS 18001 in conjunction with the existing management systems.

In March 2018, the International Organisation for Standardization published ISO 45001, replacing BS OHSAS 18001. ISO 45001 differs from OHSAS 18001 in several aspects. It focuses on identifying and controlling risks rather than hazards and is more specific in approach instead of general concepts like Risk, Workers and Workplace. This new standard is reinforced to such definitions as Monitoring, Measurement, Effectiveness, Performance and Process.

ISO 45001 itself does not make any claims, nor make any commitments or specify ‘how’ to protect the workforce. However, it does provide a yardstick for an organisation to structure its health and safety management system and assess its implementation to improve and reduce risks.

ISO 45001 was formed to emphasise effectiveness, efficiency and continual improvement. ISO 45001 details fundamental requirements based on the highly successful “plan-do-check-act” method. With regular reviews and feedback, the management system can be progressively improved with ease.

2.3 Factors affecting the Occupational Health and Safety Management System

How to manage health and safety at the workplace is one of the key challenges faced by organisations. However, in-depth knowledge about traditional work place risks, workers behaviour and involvement, top management initiative, suggests that this awareness will have a positive impact on OHSMS (Frick, 2011; Bluff, 2003).

The growth of reviewing the effectiveness of OHSMSs found sufficient evidence that these success factors should be recommended to organisations to of further improve work place safety and health.

Several key success factors are found to be effectively affecting the improvement of OHSMSs in order to mitigate workplace safety and health issues. These are (1) Safety Rules and Procedure, (2) Supportive Environment, (3) Behavioural Involvement of Workers, (4) Safety Training, (5) Management Commitment, (6) Safety Policy and (7) Communication between Management and Workers.

2.3.1 Safety Rules and Procedures

Safety rules and procedures are generally written methods that define how work tasks are performed while minimising risks to people, equipment, materials, environment, and processes. Some rules concentrate only on the safety aspect, for example, when using personal protective equipment. Others are associated with additional objectives such as quality, productivity, health, environment, and sustainability.

Literatures on safety management expound many safety rules and procedures. These literatures also identify the workforces' attitudes towards them. Work tasks performed are mainly related to human activities. Human activities give rise to human error. Human error on safety procedures are a significant cause of many work place accidents. The Health and Safety Executive (HSE 1995) Accident Prevention Advisory and others have reported that 90% of accidents are mainly caused by human error.

Studies on 200 offshore installation managers in the British North Sea were carried out by O'Den and Flin (2001). The survey indicated that 'failure to follow rules' is the third most important perceived cause of accidents, while preceding causes are 'not thinking the job through' and 'carelessness'.

A Dutch study by Directorate-General of Labour (Bellamy *et. al* 2013) reported that, 50% of the incidents of loss of containment relate to procedures. This is made up of 10% - none or unclear procedures, 12% - wrong procedures and 28% - correct procedures not followed.

Vinodkumar and Bhasi (2011) carried out the Impact of Management System Certification on Safety Management study at 8 chemical companies in Kerala, India. The project involved one thousand five hundred and sixty-six workers with a response rate of 72 %. Of this, 2 companies had OHSAS 18001 certification, 3 had ISO 9001 certification, the balance of 3 had no certification at the time of study. Six safety management practices were used to measure workers' behaviour. These approaches include management commitment, safety communication, workers' involvement, safety training, safety rules and procedures and safety promotion policies. The study revealed that the common predictor of safety attitude in all the three groups of organisations relate to the enforcement of safety and procedures.

A study of integrated safety intervention practices at construction companies by Mohammad and Hadikusumo (2017) comprised 198 randomly distributed responses. Workers' safety behaviour was reported to improve on five important aspects namely- personal protective equipment policy; safety inspection of workplace, availability of safety equipment and upkeep; safe permits and safe work programs. These outcomes will serve as a guide to construction management in identifying and formulating the appropriate programmes for workers' safety behaviour.

Chan *et al*. (2017) investigated the perceptions of safety climate of 320 ethnic minorities (mainly Nepalese and Pakistanis) from 20 companies in Hong Kong's construction industry. It was found that three safety factors influence the ethnic minorities performance of safety at the workplace. These elements are - safety management commitment, safety resources, and safety communication; employee's involvement and worker's influence; and perception of safety rules, procedures and risks. These findings serve as a benchmark in the design and development of appropriate safety management practices among ethnic minorities.

Ample studies on the safety climate in the construction industry abound. One such study was conducted by Li et al. (2017) at construction sites in Nanjing, China. This study explored the safety climate dimensions (SCDs) and identify critical safety climate indicators (SCIs) of the construction team. This was assessed from three perspectives- (1) the safety work environment, (2) construction team workers, and (3) safety management and supervision. As a result, 6 SCDs (workers' self-perception, workers' involvement, co-workers' interaction, safety environment, management involvement and safety personnel support) were identified as significantly important to the safety climate. This was further evaluated. Among all twenty safety climate indicators, the following three areas showed prominent influence on the construction team. (a) safety management involvement and safety personnel support have greater influence than the other dimensions, (b) working pressure, as opposed to safety awareness, is more useful for workers' self-perception of safety (c) safety procedure and policy was the most important measure of safety climate.

Choudhry *et al*. (2009) also reported that safety procedures must be regularly reviewed and feedback obtained from the workers to sustain progressive safety performance at the workplace.

2.3.2 Supportive Environment

Every employee desire and expects to work in a safe and protected environment. Hence, workplace safety is paramount in every industry, more so in the hazardous and accident-prone construction sector.

All industries have inherent safety risks but the management has the responsibility and commitment by devoting time and resources to this aspect of safety management.

Part IV of the Occupational Safety and Health Act (Act514, 1994) and Regulation sets out the general obligations for each employer to provide and maintain a safe and healthy workplace. Section 15 provides for employers and self-employed persons to their employees; Section 17 to persons other than employees and Section 18 provides for an occupier of a place of work to persons other than his employees. Prior to 1994, the safety and health of workers were regulated by the Factories and Machinery Act (FMA) 1967. When the Occupational Safety and Health Act (OSHA) was introduced in 1994, the limitations of FMA 1967 were resolved. Since then, DOSH has been responsible for monitoring OSHA performance and compliance in industries. This ensures that the health, safety and welfare of workers are provided at the workplace.

A field research by Mosly (2015) explored the safety performance of 100 random construction sites in Saudi Arabia. Due to many hazards and occurrence of accidents, these work sites tend to have little safety performance. Five groups of safety aspects with 33 sub-safety aspects were developed for the study of safety performance in these 100 construction sites. It was found that six of the sub-safety aspects were not abided in any of the 100 sites studied. These six sub-safety aspects were mainly implicated in a conducive working environment. These were: (1) Conspicuous emergency evacuation plan; (2) Availability of fire extinguishers ;(3) Wearing safety glasses; (4) Wearing hearing protection; (5) Safety harness for workers' fall protection; and (6) Availability of flag persons for machinery. In view of the absence of a favourable working environment, the number of safety aspects had limited presence in the study. The lack of safety features is revealed as follows: safety signs and emergency contacts were not displayed on boards at the workplace. Good housekeeping was not practised in a relevant manner, resulting in issues and risks at site. Insufficient working areas, inappropriate material storage areas and unsecured electric cables were other hazards.

The findings of this study suggested that there is an urgent need to improve and sustain a safe working environment by the owners and contractors in the industry in Saudi Arabia.

A well-recognised and proper implementation of OSHMS would greatly enhance the health and safety performance of a company. Tan *et al*. (2015), investigated the determinants for the adoption of OHSAS 18001 in Malaysia.

The industries being studied comprised manufacturing (42.12%), construction (16.48%), and servicing (15.30%). The remaining 26.02% were from other industries. Respondents from multi-national companies totalled 82.03%, public listed companies 7.03%, small and medium enterprises 2.30% and others 8.59%. The influence of four determinants, management commitment, work involvement, incentive and recognition, and conducive environment were examined.

The study concluded that the main influence in the adoption of OHSAS 18001 is dependent on management commitment and supportive environment, whereas work involvement, incentive and recognition have little or no impact. Two main practical implications emerged from their findings. Firstly, top management is the principal decision maker, and driving force for the adoption of OHSAS 18001. A committed management portrays a good role model and this positive attitude and aspirations ought to be communicated to all employees. Secondly, in order to fully and effectively execute the OHSAS 18001 management system, the steering committee needs to have access to a supportive work environment, good work practices and safety culture of the organisation. It was established that immediate improvement in conducive environment and employee involvement contributes the highest level of safety behaviour at the workplace.

Rajaprasad and Chalapathi (2015) conducted a study in chemical plants in Kerala, India. It was revealed that safety performance and supportive working environment are the linkage variables between safety culture and management commitment and safety policy. The results from this study guide top management to focus on the critical factors to successfully implement OHSAS 18001.

A study to explore the safety and health performance of contractors at construction sites was undertaken by Yakubu and Bakri (2013), using the Safety and Health Assessment System in Construction (SHASSIC).

SHASSIC is an independent method aimed at assessing and evaluating a contractor’s safety and health performance in construction works/projects. The methodology of SHASSIC is divided into three different components, namely: - document check, work site inspection and employee interview. Thereafter, it is followed by corrective action to implement improvements.

Their analysis asserts the importance of a safety program in construction site. Its successful implementation must satisfy, at least three conditions: - (1) top management commitment in the form of leadership, vision statement and company goals and objectives. (2) Safe work condition such as proper housekeeping, appropriate site layout and adequate facilities and space for performing tasks. (3) Safe work habit which includes safety culture and awareness, good communication practice, and personal attitude and competency.

2.3.3 Behavioural Involvement of Safe Acts of an individual and group interaction of Workers

Workers' commitment comprises an awareness of belonging a social group and a sense of involvement within the group. Workers' involvement consists of positive group norms and continuous participation within the group, as well as personal attitudes and motivation. Workers' safety attitudes can be formed following norms of peer groups and can be directed by workmate's influence which is closely related to team environment and work ((Neha and Nishat (2013), Gunu and Oladepo (2014)). The level of involvement in safety-related activities greatly elevated workers perception of safety programmes. Such efforts include participation in safety committees and taking initiative in reporting and correcting pitfalls within their operations.

Vance (2006) reported that employees who are highly motivated and committed in their work contribute extra competitive advantages to their company– including higher productivity, lower employee turnover and improve safety performance. For example, during 2002, beverage giant Molson Coors discovered that committed employees were five times less likely than non-committed employees to have an adverse safety incident and seven times less likely to have a lost-time safety incident.

Studies by Wachter and Yorio (2014), indicated that the behaviour and consequential actions of the workers' themselves have a direct influence on the safety management performance. This is more so for highly committed employees who interact closely with the safety system and its procedures. Hence their analyses concluded that the level of workers' cognitive and emotional engagement in a safety system immensely contribute to reduction in accident rates. Similarly, Quan *et al*, (2008) pointed out that safety management is more sensitive to safety climate factors such as management commitments and workmate's influences and less susceptive to work and education experience.

Mohammadfam *et al.* (2016) ranked the effectiveness of OHSAS 18001 as management commitment, workers involvement, financial resources budget, objectives and activities of OSH programme, and risk assessment.

Ghahramani (2016) conducted a research on companies in Iran to discover potential areas for progress in the adoption of OHSAS 18001. The results concurred with the criteria previously found by Mohammadfam *et al.* (2016), whereby senior managers' commitment and employees' participation greatly accelerate the improvement of OHSAS 18001 in the company. In fact, greater control of potential risks and reduction in staff injuries is chiefly affected by the certification of OHSAS 18001 which is considered a prerequisite in all cases (Bevilacqua et al, 2016).

2.3.3.1 Safe Acts

Normally workplace accidents occur as a result of unsafe working conditions or unsafe acts of workers (Mohammad and Hadikusumo 2017). In the construction industry, studies by Sawacha et al 1999; Abdelhamid and Everett, 2000; have revealed that the most significant factor in the cause of site accidents relate to unsafe acts. There is no universal definition of an unsafe act. However, it has been defined as an unaccepted practice which has the potential to cause future accidents and injuries. It has also been described as any act that deviates from the norm and accepted method of performing a task, resulting in increased risk of accidents. There must also be an element of unaccepted behaviour prior to initiating the event. Aksorn and Hadikusumo (2007) have identified unsafe acts that can be caused by personal behaviour and workgroup interaction behaviour. Personal behaviours are laziness, past experience, being in a hurry, showing off, being angry and overconfidence to carry out a particular task. Workgroup interaction behaviours are group pressure and group norms where an individual worker may follow the group's way of doing things. For example, even though it is a risky method, a worker may nevertheless respond with "everyone else does it that way". The main factor behind unsafe act is the human attitude and their behaviour towards their job at their respective workplace. In this study, unsafe act has been identified and caused by an individual and group interaction.

2.3.4 Safety Training, Management Commitment, Safety Policy, Communication between Management and Workers

Effective implementation of a safety and health program requires management leadership and vision as well as resources. Workers' safety and health is management's primary duty whereby further improvements can be achieved through workforce participation and feedback.

Commitment from management plays an important role in making and enforcing policy. Staff including senior leaders, managers and supervisors are the 'visible' promoters of safety in the workplace. Management must be fully committed to eradicate hazards, protect workers and continually improve workplace safety and health. This responsibility must be demonstrated and conveyed to all employees.

Resources such as capital, equipment, staff times, training, access to information and tools are needed to implement the safety and health program. These can be integrated into the planning and budgeting processes and aligning budgets with program needs. Shortcomings must be addressed when they are identified.

For the manufacturing sector to remain competitive, the certification of management systems is a mandatory requirement. In major industrial accidents in the chemical industry, Vinodkumar and Bhasi (2001) studied the impact of safety management certification and safety performance. 6 important safety management practices and safety behaviour are focused to gauge employees' perception in 8 chemical companies in Kerala in India. There was a response rate of 72% from 1566 participants. The 6 safety management practices comprise management commitment, workers' involvement, safety training, communication & feedback, safety rules and procedures and safety promotion policy & behaviour.

Of the 6 factors, empirical investigation revealed that management commitment, safety training, communication and rules & procedures were found to have a major impact on safety behaviour in OHSAS 18001 certified companies.

For OHSAS 18001 certification, management commitment, work involvement, incentive and recognition, and supportive environment are followed. Tan *et al.* (2015) examined these determinants on 128 OHSAS 18001 certified companies from various industries in Malaysia. The survey disclosed that only supportive environment and management commitment positively influence OHSAS 18001 management system adoption.

Adudayyeh et al. (2006) examined the correlation between management commitment to safety and the frequency of construction related injuries and illnesses. Data from the Bureau of Labour Statistics (BLS) on injury and illness were analysed with a thorough literature review. The study covers the top 500 U.S. companies. Research findings revealed that management commitment is closely related to worker incident experience. Companies with OSHA regulation and some form of management system in place fare better in overall safety performance with lower adverse incidents.

Bukowski’s (2014) study on Du Pont and safety are intertwined and have been synonymous for over 200 years. Du Pont have come a long way in serious injury and fatality prevention, but they are always working toward improving safety and health at the workplace and risk reduction. Du Pont is an excellent case study on how Safety and Health management can positively affect an organisation’s bottom line. For example, in 2012, the total recordable injury rate was reduced by 13% compared to 2011. During the same period, Du Pont experienced a 3% growth in revenue. Notwithstanding many other contributing factors to the success of Safety and Health management, 5 key elements emerge as prominent factors, the most critical element is a committed and active leadership participation to safety and health practices within the organisation. The other key elements are, personal accountability for workplace safety, skills and training, understanding of work processes together for improvement when needed, and auditing the process both internally and externally.

Mohammadfam *et al*. (2016), examined and developed an integrating decision-making approach to assess and promote the effectiveness of OHSMS. The process merges both the techniques of Analytical Network Process (ANP) and Order Preference by Similarity to Ideal Solution (TOPSIS). The case study was carried out in a combined cycle power plant construction projects in Iran. The project is an OHSAS 18001 certified construction company. The research results showed that for effective OHSAS 18001 implementation, the most influential factors involve management commitment, workers' involvement and evaluating and updating OSH policies.

Meanwhile to measure construction safety, Kanchana *et al*. (2013) introduced a benchmark for the evaluation with a study in Sri Lanka. Six elements were considered, namely, management commitment, management procedures, application, project types, individual involvement and economic investment. Likewise, management commitment was deemed to exert the most prominent influence on construction safety.

An organisation's clear policy is a written statement by management that defines its pledge to provide and maintain a safety and health program within all works. A program contains the health and safety elements and objectives of the organisation which make it possible to achieve its goal in the protection of its workers at the workplace. This objective ought to be communicated to all employees and related parties such as contractors, subcontractors, suppliers and vendors, customers and even temporary workers. The safety and health program should be visible in operations in the organisation. For workers to comply with the set procedures, management needs to lead by example. Furthermore, there must be continual review of safety and health indicators and outstanding issues resolved during work meetings.

In a study by Shahram *et al*. (2014) 75 respondents involved in construction activities were asked to assess the importance of safety and health management practices and its related factors. These respondents consist of employers, contractors and safety and health experts. From seven established management practices (leaderships & commitment, strategic objectives, resources & documentation, risk assessment & management, performance measurement, auditing and regular reviewing), good leadership & commitment is found to be the prime impetus in reducing and preventing workforce fatalities.

In a health and safety survey on teachers in a secondary school at Mbooni West District, Jonathan (2016) disclosed that school administrators do not regard teaching staff's involvement as relevant in safety procedures. Teachers were not involved in safety training, skills and policies in the workplace. This scenario has impacted teachers' response to safety matters and health hazards. It concluded that the workers are merely policy implementers and implementation cannot be complete without the full understanding of the policies involved.

2.3.5 Project Safety Performance

Safety performance has been identified as the tangible outcomes from an organisation's management of its OSH risks (DOSH's Guidelines). This includes measuring the organisation's OHS controls against its OHS policy, objectives and related performance requirements.

Subject to an organisation's prerequisites, OSH management system requirement MS 1722:2011 stipulated that performance measurement can be both qualitative and quantitative.

The traditional approach for measuring safety performance is normally quoted as injury statistics. It often comes down to one negative measure, injury, ill health, and fatality rate. Presently, researchers and safety organisations have developed a variety of measurement methods. These are frequency rate (FR), severity rate (SR) (Venkataman , 2008), lost time injury frequency rates (LTIFR) (Hopkins,2002), work days lost (HSE), accident rate and fatality rate (DOSH Malaysia).

It needs to be recognised that there is no single reliable measurement method for health and safety performance, however these measurements provide information on a range of health and safety activities. Organisations can rely on this evaluation to benchmark its OHS performance for their related field of business

The purpose of the present study is to identify elements that will improve safety performance and not to measure safety implementation.

The primary cause of workplace accidents has been identified by Mohd Nawi *et al.* (2016) as poor safety management of the workers. Hence, factors that will improve safety performance would include workers' awareness and knowledge of the procedures, apart from their negligence and carelessness. These workers were not well educated and lacked theoretical knowledge in applications of the tasks.

Choudhry *at el*. (2007) researched 22 construction sites in Hong Kong to identify the factors that positively influence safety performance. 1120 valid hard-copy questionnaires were analysed. Multiple regression analysis was used to examine 7 safety climate factors namely (1) management commitment and employee involvement, (2) satisfaction with resources and training, (3) competence, (4) inappropriate safety procedure and work pressure, (5) personal risk appreciation, (6) appraisal of hazard and reporting, and (7) co-workers' influence. The results indicated that 'management commitment and employee involvement' constitutes the most noteworthy factor in safety performance. Additionally, the provision of safety resources and staff training form the second most important contributor to an effective safety climate at construction sites. The findings also showed that safety performance and 'ill-suited safety procedure and work pressure' is inversely correlated.

Hinze *et al*. (2013) researched the correlation between the most effective safety practices and safety performance of 57 projects in United States. Out of the identified 96 safety practices, 22 practices were accepted as the basis of a solid safety program. These 22 practices include safety and health manuals, training, site-safety plans, safety inspection, PPE policy, job hazard analysis, worker's involvement, regular safety meeting, subcontractor's obligation in general contractor's orientation and training, safety goals development and communication, safety behaviour reward and recognition, foremen involvement in hazard assessment. The study concluded that as more safety practices are incorporated, the safety performance is simultaneously improved.

Workplace accident rates at 142 Spanish business from 2006 to 2009 were analysed by Abad *et al*. (2013). These businesses were OHSAS 18001 certified companies. The data obtained were-: rate of work accidents, minor accidents, injuries, fatality and the quantity of lost work days. These businesses composed 31.54% with less than 50 employees (small firms), 41.11% between 51 and 250 employees (medium-sized firm), and 27.35% are large firms.

The binary logistic regression analyses method was used to determine the benefits and effectiveness on safety performance and labour productivity with the adoption of OHSAS 18001.

The results indicated that the adoption of the OHSAS 18001 in a business is not size related. Moreover, businesses with higher fatal accidents rates are more likely to adopt the OHSAS 18001. The adoption of the OHSAS 18001 will further influence the organisation's safety performance and labour productivity. It concurred with O Paas et al (2015) that certification of OHSAS 18001 represents a critical factor for improving safety performance. As to labour productivity, the analysis shows OHSAS 18001 to be significantly positive. The average rate of sales per employee and labour productivity was increased by 5.93 and 4.21 percentage points respectively.

Wachter and Yorio (2014) conducted surveys in 2011 and 2012 to establish the interrelation between ten safety management practices, employee engagement levels and performance outcomes. The ten safety practices relate to (1) Employee involvement/influence, (2) pre-and post-task safety reviews, (3) Safe work procedures, (4) Hiring, (5) Cooperation, (6) Training, (7) Communication and information sharing, (8) Accident investigation, (9) Detection and monitoring and (10) Safe task assignment (task-employee matching). The survey comprises two separate large-scale studies. In the first study involving 342 safety managers, the relationship between the system and safety performance statistics was observed. In the second study, first line supervisors and their workers were targeted from 60 work groups of 650 employees. The relationship between the system, employee reported levels on injuries and illnesses was examined.

The first study on safety managers indicated that all ten safety practices together with workers' participation are significant in reducing workplace incidents. The second study on supervisors and their workers revealed that workers' participation offers a benchmark for the existence of a system of safety practices. The engagement composite and cognitive engagement predictors primarily predict the recordable and lost time incidents. Those flaws may be resolved by workers' participation.

Sparey (2011) outlines his findings that an effective OSH management system can benefit any organisation, irrespective of its size.

From his research the increasing advantages include:

(1) Helping the organisation create a safe work culture/environment by 81%.
(2) Reducing injuries by 51.8% and lowering injury related cost – such as saving on medical and insurance claims, avoid labour replacement and increase in insurance premiums.
(3) Providing measurable systems that can verify OSH performance. Improvement in performance monitoring by 75.5%.
(4) Demonstrating that the organisation meets legal requirements. 38% of the organisation surveyed showed significant improvement.

(5) Communication improved by 61% between management and workers. Organisational goals and efforts are therefore understood at all levels to achieve the desired result.

2.3.6 Company Competitiveness

There is no clear definition of competitiveness. It can be determined at national, industrial and firm level, depending on the expectations of the stakeholders. Competitiveness is influenced by changing factors and context. Additionally, its measurement varies. Traditionally, competitiveness is measured in finance or marketing terms, notably more superior to competitors in sales, profit margins, market share etc.

However, the changing business environment characterised by tense competitiveness required business organisations to establish an effective and efficient inter-functional collaboration management system. These operations cover (1) Better quality (reliability, performance), (2) Better customer service (after sales service), (3) Customer loyalty (the most profitable customers), (4) Motivated and dedicated employees. The key concept of competitiveness will affect the business as a whole, not just in better marketing and profits.

Whatever the true meaning of competitiveness, improvement in performance is tantamount to enhancing competitiveness In construction management, the two key areas which impact the performance of construction projects are business environment and human behaviour. Human behaviour involved the areas of safety and healthy workforce, a safe work environment, higher productivity resulted from reduction in accidents.

Chen *et al*. (2009) investigated the performance indicators for eleven Taiwan printed circuit board (PCB) companies. These are OHSAS 18001 certified companies from January 2004 to December 2005. A reference group of 26 OSHMS academic specialists in the PCB industry was simultaneously surveyed. Factors used for performance appraisal were identified as: -

(1) External motivation factors affecting the implementation of OHSAS 18001,

(2) Internal motivation factors affecting the implementation of OHSAS 18001,

(3) Crucial factors for successful implementation of OHSAS 18001,

(4) Key factors influencing the failure of implementation of OHSAS 18001, and

(5) The selected performance criteria by professionals and manufacturers.

The findings indicated that PCB manufacturers' decision to implement OHSAS 18001 is particularly affected by both internal and external factors. Internal elements comprise company image and management requirements while external aspects focussed on domestic and foreign customer requirements.

A survey was conducted by Fernandez-Muniz *et al*. (2009) to identify how adoption of OSHMS influences safety management, competitiveness and economic-financial performance in Spanish firms.

A total of 3820 firms were randomly selected. The population of firms was divided into sizes of small (less than 50 workers), medium (50-249) and large (more than 250). From these, 455 valid responses were received.

It was concluded that a good safety management practice generates a beneficial impact on: -

(1) Safety management as working environment is improved with less accidents and personal injuries, inevitably boosting employees' motivation with less absenteeism.

(2) Competitiveness performance, the firm's status in elevated by the enhanced image, prestige, productivity and innovation.

(3) Economic-financial performance, with productive efforts in sales and profitability, leading to superior economic and financial benefits.

Another study on Danish workplace environment by Buhai et al (2008), similarly concurred that any improvement in the physical elements of the work, health and safety environment will significantly influence the company's productivity.

Kabir et al (2018) selected a sample of 227 companies on workplace safety and evidence concluded that negative announcements produce a more conspicuous negative effect on shareholder value. Operational managers need to play a leading role to ensure a safe working environment. This is to prevent heavy penalties from regulatory agencies for non-compliance and avert a negative impact on company's competitiveness.

2.3.7 Project Financial Performance

The financial achievement of a company is measured by the effective use of funds over a period of time. Several factors such as capital adequacy ratio, liquidity, leverage, solvency and profitability are used to evaluate this key indicator.

Construction companies are constantly pressured by slow economic growth, high competition and soaring capital outlay for advance technology to continually improve their productivity and financial performance for survival.

The demand for better financial performance evaluation has increased both at project and company level. The financial performance appraisals being carried out usually include net profit, improved in profitability, growth in market share, and increase in work volume. Fernandez-Muniz et al (2009) pointed out that effective OSH management practices generate a favourable influence on financial performance, such as company's sales and profitability.

2.4 Benefits of the adoption of Occupational Health and Safety Management System (OHSMS)

The adoption and implementation of OHSMS and OHSAS 18001 show positive improvement in safety performance of the companies.

The following were findings/outcomes of researchers on the effects of implementation of OHSMSs (Table 2.1). There were 16 studies which indicated that certification/practising some form of OHSMS have resulted in positive effects on safety performance of the companies, with the exception of one study where OHSMS is not related to better safety performance.

Table 2.1 – Summary of findings of the OHSMS/OHSAS 18001 implementation

Item	Researchers	Subject Description	Outcomes/findings
1	Mohammadfam *et al.* 2017	Evaluation of the quality of OSHMS in certified organisations.	OSHMS certified companies performed significantly better than non-certified corporations.
2	Bottani *et al.* 2009	Performance variances between adopters and non-adopters in safety management systems (SMS).	Companies adopting SMS exhibit significantly higher performance against the non-adopters.
3	Lafuente and Abad 2018	Analysis of the relationship between the adoption of the OHSAS 18001 and business performance	In the short term, work accidents rates decrease after the adoption of the OHSAS 18001, but in the long term, safety and operational performance is improved.
4	Ng *et al.* 2019	Safety climate and successful implementation of safety management system.	Safety management systems have a positive effect on safety performance.
5	Abad *et al.* 2013	Assessment of the OHSAS 18001 certification process	Accident rates and labour productivity improve after implementation OHSAS 18001. The OHSAS 18001 is a strategic tool that helps to achieve safety and operating outcomes.
6	Yiu *et al.* 2019	Implementation of safety management system in construction projects.	The top four benefits include safer work environment, reduce workers' injuries, prioritise safety management and better supervision.

7	O Paas *et al.* 2015	Assess the contributory extent of OHSAS 18001 to real and formal safety elements in manufacturing companies.	OHSAS 18001 is perceived as a strategic unit for improving safety performance
8	Zubar *et al.* 2014	Analysing the occupational health and safety management system of manufacturing industries.	There is an immediate need in implementing and maintaining a good health and safety management system to improve the safety standards in the manufacturing sectors.
9	Yoon *et al.* 2013	Effect of OSHMS on work-related accident rate in South Korea's construction industry.	The implementation of OSHMS among the top 100 construction companies shows 67% reduction in common accidents and 10.3% decrease in fatal accidents.
10	Benite and Cardoso 2003	Implementation of OSHMS in one construction company in Brazil.	It is clear that the implementation of an OSHMS is extremely positive for construction companies.
11	Omran *et al.* 2008	Implementation of OHSAS 18001 in Construction Industry in Malaysia.	OHSAS 18001 application can help to reduce the accident rate, especially fatal accidents.
12	Sparey 2011	Benefits of an effective OSH system	Reduction of injuries, and improvement in OHS performance.
13	Heras-Saizarbitoria *et al.* 2019	OHSAS 18001 certification and work accidents	OHSAS 18001 certification is not related to better safety performance.
14	Chen et al. 2009	Implementation of OHSAS 18001 at eleven Taiwan companies.	Improvement of company image both locally and globally.

15	Buhai et al. 2008	Studies at Denmark work place environment.	An improvement in health and safety environment and increase company productivity.
16	Fernandez-Muniz et al. 2009	Practising good OSH management system	Positive effect on financial performance, such as sales and profits.
17	Ghahramani and Summala 2015	OHSAS 18001 certification and occupational injury	Implementation of OHSAS 18001 not linked to safety improvement

2.5 Accredited Certification and Grade of Construction Companies in Malaysia

In Table 2.2 Accredited Certification, the number of certified organisations of OHSAS 18001:2007 and MS 1722 Part 1:2005 are a maximum of 176 and 66 respectively. However, there were 1,477 construction companies certified with ISO 9001. The combined OHSAS 18001 and MS 1722 amount to 237 companies which is only 16 per cent of the certified ISO 9001 companies. There is still a lot more effort required to persuade these companies to register and certify with OSHMS.

Table 2.3 Number of Contractors by Grade, value of work undertake by G7 is unlimited. The research data are intended to collect information from these 7,402 companies which are certified with OSHMS only.

Table 2.2: Accredited Certification (updated until Q2 2020)

Sector	QMS	EMS	OSH		
	ISO 9001	ISO 14001	ISO 45001	OHSAS 18001:2007	MS 1722:2011
Construction	1,544	119	9	176	66
Total OHS management systems: -			251		

Source: Department of Standards Malaysia, Ministry of International Trade & Industry

Table 2.3: Number of Registered Contractors by Grade

Grade	Value of Work	Year		
		2015	2016	2017
G1	Not exceeding RM200,000.00	33,744	35,149	35,347
G2	Not exceeding RM500,000.00	12,097	16,253	17,402
G3	Not exceeding RM1,000,000.00	9,246	10,628	12,510
G4	Not exceeding RM3,000,000.00	3,341	3,896	4,112
G5	Not exceeding RM5,000,000.00	4,656	5,101	5,455
G6	Not exceeding RM10,00,000.00	1,557	1,703	1,803
G7	No Limit	6,066	7,084	7,402
Total		70,707	79,814	84,031

Source: 2017 ANNUAL REPORT, CIDB MALAYSIA

2.6 Research Gaps

Workplace injuries are the norm in the construction business as it is labour intensive. Workforce safety is a complex issue. The construction sector is always risky due to the nature of its outdoor and altitude operations, unique site conditions and complicated equipment operations. The rapidly changing landscape of construction conditions and work hazards further aggravated the situation. Construction sites normally involved the main contractors, multiple subcontractors either nominated or direct, and a high proportion of foreign workers from different countries who speak different languages.

Construction works are being performed by subcontractors and the main contractor takes on the role as project management. The workplace involves multiple subcontractors, resulting in obscure and overlapping responsibilities. Subcontractors are only accountable for their own workload. The progressively complex workplace scenario greatly impede enforcement by OSH inspectors. Historically, safety has always been an integral part of the subcontractors' key business activities. Safety knowledge is acquired through on-the-job learning which requires constant appraisal about the hazards and risks. Ultimately, construction workers have established this process for themselves, making it difficult to differentiate what risks are acceptable and which are not.

Subcontractors placed great confidence and trust on practical safety knowledge and experience gained through years of practice over safety courses and book knowledge. The working attitude based on "done that in the past and no harm has occurred" has been found to be a significant contributor to worksite accidents (Johnson et al. 1988). Although risks and workplace hazards are mostly predictable, nevertheless many subcontractors admit that the interrelationship between the jobs is a cause for safety concerns,

Most workers are mainly foreigners from various countries such as Indonesia, Bangladesh, Myanmar, India and others, whether they are employed by subcontractors or main contractor. These workers are not-highly educated (Mohd Nawi *et al*. 2016) or some posed language barrier (Trajkovski and Loosemore 2006). Moreover, their main purpose to work is to earn more money in the shortest possible time. Any additional requirement by safety rules and procedure will be viewed as a hindrance to their earning. They feel that there is no tangible reward for making safety efforts since it is difficult to appreciate an accident that has been avoided.

In the past, the primary concern of management pertains to technical and design issues. However, non-technical matters such as leadership, communication and worker participation need to be heeded. In construction, the leadership style is authoritarian where the manager has complete control. The worker merely follows the instructions as it is assumed that the employee does not contribute to decision making due to a lack of knowledge, motivation or language barrier. This type of leadership needs to be changed in order to incorporate workers' involvement in decision making. Participation in the job activity builds open and trusting relationship where communication, suggestions and feedback are noted. Managers require the flexibility of the type of leadership in order to enhance effective corporate management.

A safe construction site is under the purview of the main contractor whose central role is to organise, plan and communicates effectively with all parties concerned. Hence, safety rules and procedures, conducive environment and workers participation are vital internal controls of an organisation. The appropriate use and enhancement of these internal controls shall ensure owners and workers do not injure themselves or customers during business operations.

Publications on safety management rate safety rules and procedures as one of the foundations of the risk control system. The safety policy sets out the top management's commitment to its implementation at the workplace. The important of the safety guidelines is obvious, yet it is often considered trivial and undisputed (Hale et al., 2012).

Both direct and indirect beneficiaries benefit from the implementation of a conducive and supportive working environment. Directly affected are the workers themselves and the organisation. Indirect recipients are the insurers, contractors, consumers, families and society in general. However, developing and maintaining a conducive working environment is difficult to achieve. The major difficulty is getting workers responsibility of safety, motivation and creating effective deterrents against carelessness. Worker involvement, motivation, communication and responsibility are the most common cited behaviour to improve working conditions and enhance safety performance. Research papers have presented many approaches of safety improvement at work sites, with the ultimate goals to mitigate accidents or reduce fatality. However, official records of the numbers of accidents and fatalities are unacceptable, not to mention cases are not reported to the relevant authorities. This study is to address the main issues that cause these fatalities, and to highlight these issues and possible solutions to the industrial practitioners.

2.7 Conclusion

Top management's priority, both morally and mandatory, is to protect workers from injury. Establishing an OSHMS acts as a proactive control to enhance workplace performance. There are many successful factors affecting the implementation of OSHMS. All safety rules and procedures should be formulated upon consultative interaction with the workers involved. Procedures should be simple to understand and acceptable by workers in multi languages. The program should provide workers with clear expectations on jobsite safety rules of themselves and others. Workers should be educated about personal responsibility for their own as well as co-workers' safety. Additionally, an effective communication route between management and workers needs to be established for better compliance.

Managers should enforce good safety practices to establish supportive working environment, such as proper use of PPE, protection of falling from height, prevention of trenching collapse, sound installation of scaffolding by competent person, and protection of electric shock and arc flash.

Unsatisfactory safety performance resulting in alarming statistics of fatal injuries at construction sites has frequently been highlighted. Although many organisations are showing increasing interest in the concept of OHSMS, more proactive procedures need to be adopted. This has prompted the authorities to take drastic measures and impose heavy penalties on defaulters. Hence it is time for the construction management to take effective approaches to reduce fatal workplace deaths and injuries.

CHAPTER 3

CONCEPTUAL FRAMEWORK

3.1 Introduction

Subsequent to the theoretical and literature review in Chapter 2, this chapter outlines the formation of the conceptual model for this study. The existing potential relationships among the applied constructs are also examined. The hypotheses are developed in accordance with the justifications from the reviewed literatures. The framework is based on the concept that all behaviour results from antecedents and consequences (Skinner). Data are obtained from participants who are working and practising within OHSMS environment.

3.2 Premise of Research

The Behaviour-Based Safety (BBS), which is the application of the Science of Applied behaviour analysis to issues of safety in the workplace is the theoretical foundation of this research. The process includes all workforce from the front-line to top management and involves person, work environment and workers' behaviour. Person includes knowledge, skills, abilities, intelligence, personality, attitudes, and values. Work environment comprises equipment, tools, machines, housekeeping, engineering, management systems, work processes, safety rules, standards, and operating procedures. Workers' behaviour involves complying, coaching, recognizing, communicating, and actively caring. BBS is a process of both management and workers to identify and determine a safe behaviour over an unsafe one. The goal of BBS is to change the behaviour of workers from 'at risk' behaviour to 'safe' behaviour (Pardy and Andrews, 2010). The BBS principles were founded on Herbert William

Heinrich's research, which disclosed that 88 percent of accidents result from workers' unsafe acts rather than unsafe conditions (Choudhry 2014).

Behaviour safety efforts are based on the theory of Skinner B F, that all behaviour are a result of antecedents and consequences (Jasiulewicz-Kaczmarek *et al*. 2015; Geller, 2005), These antecedents serve as activators to observable behaviours. Consequences can either reinforce or deter repetition of the behaviours. It is believed that workers can be motivated to behave safely by encouraging these safe behaviours and promoting them. Similarly, those antecedents that discourage safe behaviours can be identified and removed. Positive reinforcement enforces safe behaviour and negative reinforcement deters unsafe behaviour. BBS programs remove the notion that safety is solely the safety manager's duty. Rather, safety responsibility ought to be assigned to everyone at all levels in the organisation.

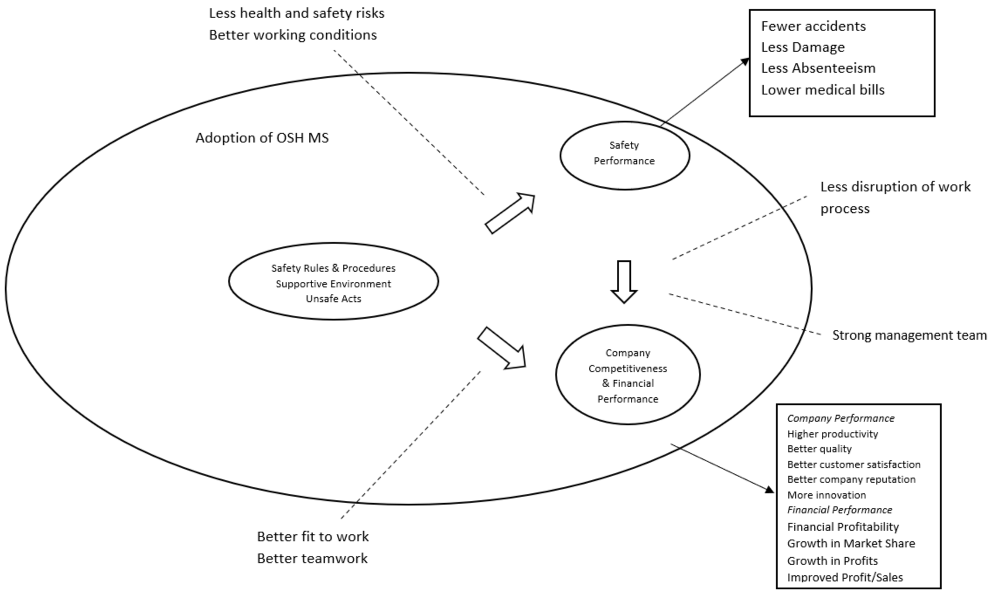
Based on these revelations, a questionnaire was developed to measure safety performance and project performance and gauge the causal effect of safety measure practices influencing safety and project performances. The questionnaire was designed on the basis of work place conditions covering safety rules and operating procedures, supportive working conditions, workers' behaviour and attitudes, management system etc.

3.3 Development of the Conceptual Framework and Hypotheses

By ascertaining the problem and research objectives, the connection between safety measure practices and project performance is expounded.

This is achieved by examining the implementation of safety rules & procedures, practising supportive environment, analysing safe acts of the workers, adoption of OHSMS in the project sites, safety performance, company competitiveness and financial performance in Malaysia construction industry.

Safety rules and procedures, supportive environment and behaviour of the workers are some of the prerequisite activities within the scope, OH&S management requirements and implementation & operation for a certified OHSMS company. The management shall take ultimate responsibility to ensure that OH&S policy is established, identified and implemented. To enhance a better working environment, hazard identification procedures, risk assessment, controls and appropriate training and awareness are essential requirements. The ultimate purpose of practising safety rules & procedure, better supportive environment at workplace and improve workers' safety awareness behaviour shall affect the safety performance at the project site, which in turn effect the project performance. The relationship between the studied constructs is defined and illustrated as follows: Figure 3.1 outlines the conceptual model by Mossink (2002), that focuses on Safety Measure Practices, which affect the Safety and Health Performance and Company Performance.



NOTE:

1. *Safety Measure Practices is a composition of Safety Rules & Procedures, Supportive Environment and Safe Acts*
2. *Project Performance is measured as project safety performance, company competitiveness and project financial performance.*

Figure 3.1- Conceptual Framework of Safety Measure Practices that affects the Company Performance.

3.3.1 The relationship between Safety Measures Practices and the Adoption of OHSMS

Past studies confirmed that OHSMS and safety measures practices are increasingly correlated with both administration and adoption of OHSMS. A safe work environment positively predicts the workers' behaviours at workplace (Mohammad and Hadikusumo, 2017). Other studies also link safety measures practices to numerous factors that causes accidents, lower productivity, unsafe acts and safety awareness of workers. The perceived causes of accidents include- failure to follow rules; cases of accidents related to safety rules & procedures; workers involvement, as well as safe work practices. (O'Dea and Flin, 2001; Bellamy et al., 2013; Vinodkumar and Bhasi, 2011; Mohammad and

Hadikusumo, 2017; Chan et al., 2017; Sawacha et al., 1999). An organisation's safety measures practices can be evaluated as a significant internal mechanism to revitalize work safety programme through the adoption of OHSMS. Against these backdrops, this study argues that to improve work safety performance, an organisation's top priority ought to focus on safety attitudes of workers and establishing a conducive work environment. Hence, it is hypothesized that: -

Hypothesis 1 (H1). *Safety Rules & Procedures have a positive and significant effect on Adoption of OHSMS*

This hypothesis is expanded as: -

Hypothesis 2 (H2). *Supportive Environment have a positive and significant effect on Adoption of OHSMS*

Hypothesis 3 (H3). *Safe Acts have a positive and significant effect on Adoption of OHSMS*

3.3.2 The relationship between OHSMS and Project Safety Performance

Throughout the years, the adoption of OHSMS was long considered as a dominant predictor of safety performance (Bottani et al., 2009; O Paas et al., 2015; Yoon et al., 2013). According to Benite and Cardoso (2003), it is clear that the implementation of an OHSMS is extremely beneficial for construction companies. The implementation of OHSMS is a key approach that facilitates safety and effective operating outcomes where accident rates were down and labour productivity was improved (Abad et al., 2013). Lafuente and Abad (2018) also pointed out that in the interim period, work accident rates reduced after OHSMS implementation, while in the long term, OHSMS improved safety performance. The outcomes of these studies clearly indicated that implementation of OHSMS will effectively improve safety performance at the workplace. Based on these empirical assumptions, the study further hypothesized that: -

Hypothesis 4 (H4). *Adoption of OHSMS have a positive and significant effect on Project Safety Performance*

3.3.3 The relationship between Project Safety Performance and Project Performance

Increasing evidence indicated that providing an effective safety management and a good safety performance workplace has the potential to increase productivity, better quality of product leading to increase in project profitability (Lamm et al. 2007). According to Lakhal and Pasin (2008), product quality is not directly linked to financial performance. However, it is shown that product quality does affect financial performance through two intermediate variables, namely customer satisfaction and internal processes. A case study on food industry by Katsuro et al. (2010), found that bad OHS practices reduce the workers' performance, leading to a drop in productivity.

However, Sousa et al., (2021), in their mapping review of the relationship between firms investing in worker safety and financial performance, reported that evidence shows a positive association between OHS and better financial gain. Another study by Fernandez-Muniz et al. (2009) concluded that safety performance reduces accident rate, improves desired working conditions, which in turn raises workers' motivation. Productivity, firm's image, sales, profit and profitability all went up. It was reported that the absence of effective safety performance may cause workers' job-related stress, burnout and health issues.

These factors remain a barrier to productivity and quality of product diminishes. From these empirical assumptions, this study anticipates that: -

Hypothesis 5 (H5). *Project Safety Performance have a positive and significant effect on Company Competitiveness*

This hypothesis is expanded as: -

Hypothesis 6 (H6). *Project Safety Performance have a positive and significant effect on Project Financial Performance*

Hypothesis 7 (H7). *Company Competitiveness have a positive and significant effect on Project Financial Performance*

In order to gain competitiveness advantages and superior business financial performance, in a challenging market, construction companies have to spend lots of tangible and intangible resources into safety and health management system and practices. Prior studies have discussed several determinants of competitiveness advantages and financial efforts (Fernandez-Muniz et al., 2009; Yang et al., 2018). As much as an entrepreneur, the researcher also wishes to explore what are the factors that will directly and indirectly influence the financial gain in safety performance and project performance. In keeping with these assumptions, this study further hypothesized that: -

Hypothesis 8 (H8). *Company Competitiveness mediates the relationship between Project Safety Performance and Project Financial Performance*

From the developed hypotheses, the conceptual framework was formed with the principles that all behaviour are a result of antecedents and consequences, combined with the adaption of Mossink (2002), Yiu et al. (2019), Rahlin NZ et al. (2019) theoretical models. The resultant proposed framework can be regarded as an integrated channel to explore the relationship between Safety Measure Practices (comprises of Safety Rules & Procedures, Supportive Environment and Unsafe Acts of workers) and Adoption of OHSMS, Safety Performance, Company Competitiveness and Financial Performance. This is to demonstrate how workers need to adopt practices which can trigger better project performance through safety performance. The resultant proposed conceptual framework for the present study is depicted in Figure 3.2.

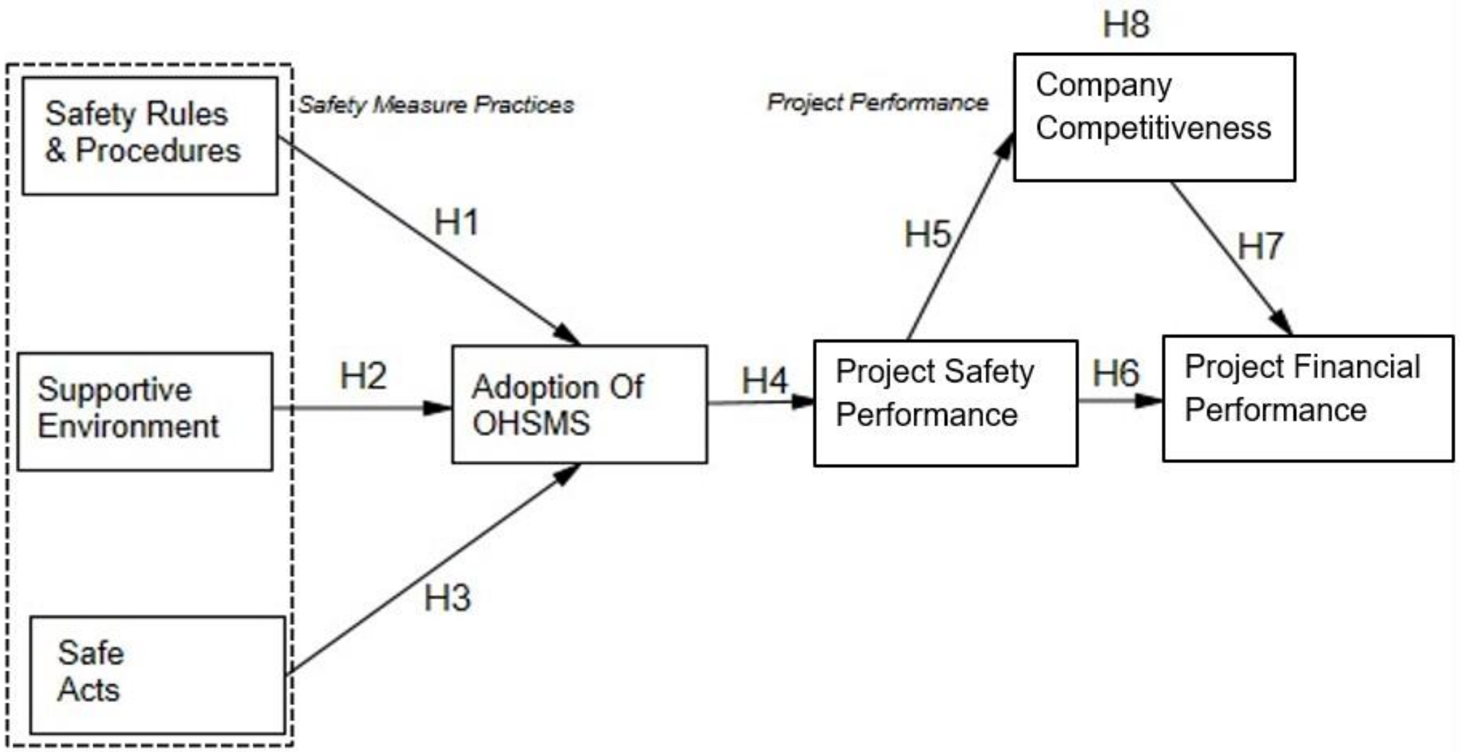


Figure 3.2 – Conceptual Model and Hypotheses

3.3.4 Summary of Hypotheses

This section presents the resultant hypotheses from the previously reviewed study. The hypotheses are as follows:

H1	Safety Rules & Procedures have a positive and significant effect on Adoption of OHSMS.
H2	Supportive Environment have a positive and significant effect on Adoption of OHSMS.
H3	Safe Acts have a positive and significant effect on Adoption of OHSMS.
H4	Adoption of OHSMS have a positive and significant effect on Project Safety Performance.
H5	Project Safety Performance have a positive and significant effect on Company Competitiveness.
H6	Project Safety Performance have a positive and significant effect on Project Financial Performance.
H7	Company Competitiveness have a positive and significant effect on Project Financial Performance.
H8	Company Competitiveness mediates the relationship between Project Safety Performance and Project Financial Performance.

3.4 Measurement of Variables

Operationalisation is a primary and essential quality of any measurement model.

Hair et al. (2010) postulates that, operationalisation determines the measurement items for any specific construct and defines the mode of measurement. In addition, Hair and team maintains that it is necessary for any researcher to develop his/her own measurement construct should there be insufficient support from prior researches, or if results from prior researches are not credible. Likewise, if previous and existing literatures provided adequate support, then it would be highly recommended for the researcher to adopt those results to operationalise a specific construct as this will further improve the validity and reliability of the construct measurements.

Two levels of consideration have been employed in this study.

Firstly, an in-depth review of prior literatures on health and safety issues in the construction industry have been conducted by the researcher. These features comprise safety rules and procedures, supportive environment, unsafe acts of the workers, adoption of OHSMS in practising companies, safety performance, company competitiveness and financial performance of construction companies. Secondly, the researcher also ensured that the measurement constructs that were adopted were well defined and consistent with the objective of this study.

The succeeding sections explain the operationalisation of the constructs in this research.

3.4.1 Safety Rules & Procedures

Safety Rules and Procedures are prominently emphasized in health and safety, but do not receive much attention and care needed to make the most of their contribution to risk assessment and control. This results in some organisations taking risk assessment and control as nothing more than complying with rules and procedures thought up by experts and consultants (Hale and Borys 2013). Organisations see the need for obeying safety rules and procedures as a foregone conclusion, leading them to impose safety rules and procedures without much thought. Managers treat deviations from safety rules as violations and apportion blame accordingly.

Therefore, the four manifest variables (failure to follow, enforcement, self-perception and safety facilities availability) are, essential but not least, selected to assess Safety Rules and Procedures (Vinodkumar and Bhasi 2011). Items for the respective measured variables are provided in Table 3.1 – Measured Variables for Safety Rules & Procedures were used in this study. Moreover, the minimum requirement for reliability and confirmatory factor analysis test (CFI = 0.99, CA = 0.81, BBI = 0.99), of the constructs have been adequately fulfilled.

Table 3.1: Safety Rules & Procedures Scale Items

No	Scale Items
1	The safety rules and procedures followed in my company are sufficient to prevent incidents occurring.
2	The facilities in the safety department are not adequate to meet the needs of my organisation.

3	My supervisors and managers always try to enforce safe working procedures.
4	Safety inspections are carried out regularly.
5	The safety procedures and practices in this organisation are useful and effective.

3.4.2 Supportive Environment

A supportive work environment is crucial to create a productive organisation and increases employee well-being. Furthermore, it helps reduce staff turnover and increases employee satisfaction (Raziq and Maulabakhsh 2015; Josefsson et al. 2018). They are four key areas for initiating a supportive environment.

Supportive Environment is measured by the following four indicators: Maintaining a safe and healthy workplace, identifying hazardous and unsafe to work situation (Thobaben 1996), keeping a positive attitude work behaviour and provide a conducive working environment. The measurement scale of supportive environments developed and verified using the factor analysis (CA = 0.918, loading range from 0.782-0.911, AVE = 0.712, CR = 0.937 by Tan *et al*. 2015) were appropriate for this study. The seven items of variables are shown in Table 3.2 – Measured Variables for Supportive Environment.

Table 3.2 – Supportive Environment Scale Items

No	Scale Items
1	My organisation's employee adopts a no blame approach to highlight unsafe work behaviour.
2	My organisation's employee often reminded each other on how to work safely.
3	My organisation's employee believes that it is our business to maintain a safer and healthier workplace.
4	My organisation's employee always offers help when needed to perform the job safely.
5	My organisation's employee endeavours that individuals do not work alone under risky or hazardous condition.
6	My organisation's employee always maintains a good working relationship.
7	The workload is reasonably balanced among my organisation's employees.

3.4.3 Safe Acts

Workplace accidents are primarily prompted by unsafe acts. These include incorrect use and abuse of plant and equipment (Zahoor et al. 2016), failure to use PPE (Jaselskis and Suazo 1994) and ignoring safety signs/warning devices.

Among the identified critical factors chosen to measure 'Safe Act' are: team engagement/work group interaction, highly involved and committed in their work, necessary involvement in the safety system, and workers participation in

OSH practices. Items for the respective measured variables were chosen from Mohammad and Hadikusumo (2017) which consists of individual and group interaction behaviour. The factor loading for the selected six items range from 0.83 to 0.91are deemed appropriate. These elements are displayed in Table 3.3.

Table 3.3 – Safe Acts Scale Items

No	Scale Items
1	Voluntarily conducting tasks or activities that help to improve workplace safety.
2	Ensure the highest levels of safety when they conduct the job.
3	Use the correct safety procedures for conducting the job and know safety issues.
4	Help their co-workers when they are working under risky conditions.
5	Helping co-workers in safety learning and implementation.
6	Nobody ever works alone in construction industry, should work together safely.

3.4.4 Adoption of OSH Management System

With the introduction of OHSMS to industries, companies adopting this concept exhibit significantly higher performance against the non-adopters (Bottani et al. 2009; Mohammadfam et al. 2017). The implementation of OHSMS show improvement in health and safety performance in organisations (Ng et al. 2019; Abad et al. 2013; O Paas et al. 2015; Sparey 2011; Yoon et al. 2013). The implementation of OHSMS mainly include safety and health policy, objectives, plans, procedures, training, communication, control and organisation responsibilities.

The observable variables consisting of (OSH policy, objectives, acceptable risks, hazard identification and control, management commitment and review, and OSH performance) are chosen to assess 'the adoption of OSH management system' (Bakri et al 2006; Rajaprasad and Chalapathi 2015). Items for the respective measured variables were chosen from Tan *et al.* 2015, the ten measurement items have loading range 0.717 – 0.863, CA = 0.934, AVE = 0.631 and CR = 0.944. The measured items that were used in this study are listed in Table 3.4.

Table 3.4 – Adoption of OSH Management System Scale items

No	Scale Items
1	My organisation has written, detailed occupational safety and health policy.
2	My organisation has proactive occupational safety and health policy beyond the compliances of legislative requirement.
3	My organisation has established quantifiable occupational safety and health objectives
4	My organisation monitors occupational safety and health cost and benefits
5	My organisation has established the role and responsibilities with respect to occupational safety and health programs.
6	My organisation has documented procedures for occupational safety and health.
7	My organisation provides appropriate training for its employees.
8	My organisation conducts occupational safety and health audit on a regular basis.

9	My organisation conducts reassessment on occupational safety and health on a regular basis.
10	My organisation's employee remuneration and promotion are based on occupational safety and health objectives.

3.4.5 Project Safety Performance

Safety performance is measured by four first-order constructs, namely: -

(a) Safety Culture construct, (b) Safety Behaviour construct, **(c) Safety Awareness construct, and (d) Management Commitment construct**.

Safety culture, representing the shared values, cognition, commitment, beliefs, communication and attitudes and norms of the employees will affect their safety behaviour. Safety habits is found to have certain predictive ability and significance on safety performance (Chen *et al.* 2018). Wang and Zhou (2019) established that safety climate moderated between safety intention and safety behaviour giving rise to positive outcomes on safety performance.

Analytical results support the assumption that the safety management system and work group processes are determined by management commitment and workers' involvement. The ensuring effect on workers' safety awareness and bahaviours will boost safety performance (Tsao *et al*. 2017). Mohd Nawi et al. (2016) concluded that by determining the root causes of accidents, effective prevention measures will minimise the frequency of accidents occurrence resulting in progress on safety performance.

The measured variables for each aforesaid constructs (Mohd Nawi et al. 2016) used in this study are recorded in Table 3.5.

Table 3.5 - Measured variables in Safety Culture, Safety Behaviour, Safety Awareness and Management Commitment

1st Order Construct	No	Scale Items
Safety Culture	1	No regular supervision at least once a week.
	2	Difficulties in communication towards foreign workers.
	3	Risk assessment is not practicable at workplace
	4	Workers are not likely to report incidents/accidents.
	5	Decision making does not involve all organisation.
Safety Behaviour	1	Workers under influence of drugs and alcohol.
	2	Discipline issues.
	3	Irresponsible attitude of the workers during working or handling machines.
	4	Fatigue caused by working overtime.
	5	Working for incentives
Safety Awareness	1	Disparities in age, with different level of awareness.
	2	Lack of accident records and official safety data.
	3	Not well educated.
	4	No safety briefing/toolbox meeting.
	5	Lack of safety signage board.
Management Commitment	1	Absence of Safety and Health Committee.
	2	Fail to nominate SHO (Safety and Health Officer) that comply with OSHA regulations
	3	Lack of communication between manager and Safety and Health Committee
	4	Lack of commitment to OSHA 1994.
	5	Lack of communication between manager and worker.
	6	Inadequate PPE at Work Regulations 1992 (FMA 1967).

3.4.6 Company Competitiveness

These five apparent variables, better quality (reliability and performance of product) productivity, customer satisfaction (include after sales service), reputation and innovation were identified to assess a firm's competitiveness. In their study of construction companies by Lielgaidina and Geipele (2011), they concluded that customer satisfaction ranked the best measures of quality, followed by skilled work force and management commitment. Similarly, in El-Diraby *et al*. (2006) study of some Toronto contractors, customer satisfaction was one of the prevailing factors used to measure company competitiveness and market attractiveness. Sustainable profitability was the highest impart factor on market attractiveness. To maintain a successful competitive edge, companies need to be innovative Pellicer *et al.* (2010). Enforcing an occupational safety management system with good management practices, has resulted not only in improved safety performance. It also developed an optimistic outcome competitiveness performance as a consequence of the beneficial impact on the company's image, reputation, productivity and innovation, Fernandez-Munix *et al*. 2009. The measurement scale of company competitiveness developed by Fernandez-Munix et al. 2009, (CA = 0.853, CR = 0.857, t-Values >13.00) were appropriate for this study. The five items of variables as shown in Table 3.6 – Measured Variables for company competitiveness.

Table 3.6 – Measured variables in Company Competitiveness

No	Scale items
1	Product quality
2	Productivity

3	Customer satisfaction
4	Reputation
5	Innovation

3.4.7 Project Financial Performance

They are many ways to measure financial performance. Two main measures often used to compute a project's financial performance are profit and market share. As highlighted by Mohamad et al. (2014), annual workload, net profit and working capital are paramount factors that impact the construction companies' financial performance. Feng et al (2021) carried out their study on food safety management and product quality. They suggested that financial performance of the company is measured by a firm's profitability, improved sales growth, increased asset turnover and reduction in production costs. Early adopters of OHSMS shall realise additional financial performance and improvement of labour productivity (Yang et al 2021).

Besides improvement of company competitiveness with an effective safety management system, Fernandez-Munix et al. (2009), also pointed out that it has a favourable outcome on the company's sales, profits and profitability. The measurement scale of finance performance developed by Fernandez-Munix et al. 2009, (CA = 0.929, CR = 0.930, t-Values >20.00) were adopted for this study. The four items of variables as shown in Table 3.7. -measured variables for financial performance.

Table 3.7 – Project Financial Performance Scale items

No	Scale items
1	Financial profitability
2	Growth in market share
3	Growth in profit
4	Improved profit/sales

3.5 Conclusion

This chapter discussed the rationales for the formation of the conceptual framework for this study. Furthermore, the interrelationships amongst the seven constructs were well founded based on the principle that all human behaviour are a result of antecedents and consequences. Additionally, the study has analysed eight hypotheses, where the testing of these hypotheses is theorized to provide solutions to the research objectives. The next chapter will discuss the research method adopted.

CHAPTER 4

RESEARCH METHODOLOGY

4.1 Introduction

This chapter discusses how the research was carried out to meet the research's aims together with the options of methodology. It comprises the overall review of the research design, conceptual model, instrumentation used, the preliminary study on literature reviews and the explanatory survey questionnaire. The questionnaire involved pre-pilot testing with semi-structured interviews with experts, sampling, population and data preparation. The latter includes data cleaning, analysis, reliability, validity and finally the equitable procedures undertaken. The foregoing aspects aim to create a clearer understanding of the research approach selected for a satisfactory justification of the research question.

4.2 Research Design

Considered as the 'backbone' of the research structure, the research design describes each of the elements and their interconnection. Jahoda *et al.,* (1951) defined it as "the arrangement of conditions for the collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy and procedure". Research evidence gathered should include criteria from past researchers such as unambiguity (David 2001), conformance to purpose of research (Kothari 2004) and type of research approach. Saunders *et al.* (2009) and Robson (2002), identified the criteria for deductive and inductive research approaches. In the deductive approach the researcher develops a theory and hypothesis (or hypotheses), followed by a research strategy to test the hypothesis.

On the contrary, in the inductive approach the researcher collects data and develops a theory as a result of the data analysis.

Saunders *et al.* (2009) pointed out that the research purpose could be either exploratory, descriptive or explanatory or their combination where the research project has more than one purpose. Exploratory studies aim to further examine causal relationships between variables from a wide spectrum of perspectives, such as different context or population. On the other hand, descriptive studies depict on the accurate representation of persons, events or situations.

The fundamental study in this research, adapts the deductive approach, as hypotheses were formulated to show the causal relationships between variables from existing literature review theories. As such, this research is explanatory in nature.

4.2.1 Comparable Methodologies Used by Other Researchers

An analysis of methodology used by other researchers are reviewed and shown in Table 4.1. These reviewed research studies are related to safety and health management. A breakdown of the research methods showed that: – 9 out of 13 were quantitative; 3 out of 13 were a combination of qualitative and quantitative; and 1 out of 13 was qualitative. Also, four research papers have carried out pilot surveys to test the feasibility of the final questionnaire survey. Moreover, most of the researchers use SPSS as data analysis method.

Most researchers have used Likert Scale to obtain respondents' answers on their degree of agreement or disagreement with the questionnaire questions. The response rate could be maximised by distribution of the questionnaire through hand-delivery (Durdyev et al 2017; Wang and Zhou 2019; Choudhry et al. 2007).

From the analysis of their research methodology, the most common modules adopted are quantitative research method, collection data using questionnaire survey, pilot survey and analysis of data using structural equation modelling (SPSS). In this study, the adaptation of this similar approach is well justified.

Table 4.1: Methodologies by Other Researches

Researcher	Ikpe Elias et al (2012)	Tam et al (2004)	Sawacha et al (1999)	Chen et al (2009)	Omran et al (2008)
Research Objective	Cost-benefit analysis for accident prevention in construction projects	Identify factors of poor construction safety management	Factor affecting safety performance on construction site	Factors affecting the implementation of OHSAS in manufacturing	OHSAS 18001 may reduce accident rate
Research Method	Quantitative	Quantitative	Qualitive and Quantitative	Quantitative	Quantitative
Instrument	Questionnaire survey	Questionnaire survey	Interviews and questionnaire survey	Questionnaire survey	Questionnaire survey
Pre-Test (if any)	-	-	Pilot survey	-	-
Sampling	Health & Safety managers and similar positions	Safety Inspectors, managers and directors representatives	Operatives, site managers and safety officer	Certified OHSAS 18001 companies	CIDB G7 registered construction companies
No of questionnaire being distributed (if quantitative are the instrument for collecting data	500	200 construction firms	200	11 Taiwan PCB manufacturers	300
Data Collection Procedure	Mailed out with self-address envelope	Not stated	Sent to site managers then pass to operatives	Not stated	By post
Rate of Responses	15.8% (79/500)	30% (60/200)	60% (120/200)	Not stated	68/300
Data Analysis Method	Ratio Analysis	RII, 5- point Likert scale	5-point Likert scale, (SPSS)	5-point Likert scale (SPSS V11.0)	SPSS

Researcher	O Paas et al (2015)	Zubar et al (2014)	Yoon et al (2013)	Fernandez-Muniz et al (2009)
Research Objective	Benefit and estimate safety performance of OHSAS 18001	Analysing the occupational health and safety management in manufacturing industries	Work-related accident rate and awareness of OHSAS	Relationship between occupational safety management and firm performance
Research Method	Qualitative study	quantitative	Qualitative and quantitative	quantitative
Instrument	Interview	Questionnaire survey	Quantitative survey	Questionnaire survey
Pre-Test (if any)	-	-	-	Safety officers from eight companies
Sampling	OHSAS certified and non-certified companies	Safety related personnel	Site managers and OHS manager	Safety officer and safety coordinators
No of questionnaire being distributed (if quantitative are the instrument for collecting data	8 certified and 8 non-certified companies	Not stated	60 OHSMS certified construction workplaces of 17 companies. (n=72)	455 valid from 3820
Data Collection Procedure	Interview	Mailed and walk-through survey	Email and phone	Phone and sent questionnaire
Rate of Responses	Not stated	Not stated	Not stated	12%
Data Analysis Method	MISHA calculation	Analysed by using means and percentages, D&S method	SPSS V19.0	5-point Likert scale (CFA – SEM)

Researcher	Iraj Mohammadfam et ai (2017)	Bottani et al (2009)	Ng et al (2019)	Yiu et al (2019)
Research Objective	Evaluate the performance of OHSAS 18001	Performance of safety management system – adopting and not adopting statistically difference	Role of safety climate in the successful implementation of safety management system	Benefits and obstacles of safety management system adoption in construction projects.
Research Method	Quantitative	Quantitative	Quantitative	Qualitative and quantitative
Instrument	Questionnaire survey	Questionnaire survey	Questionnaire survey	Structural interview and questionnaire survey
Pre-Test (if any)	-	By email survey	Safety officers as sample test	-
Sampling	OHS managers	Mainly safety managers	Randomly selected construction company	Safety practitioners
No of questionnaire being distributed (if quantitative are the instrument for collecting data	3 OHSAS 18001 certified and 3 non-certified companies	500 companies	1695 companies	18 experts with minimum 8 years of working experiences
Data Collection Procedure	Not stated	Mailed to selected companies	Contacted by telephone and sent by post	Not stated
Rate of Responses	Not stated	23.2% (116/500)	20.6% (349/1695)	-
Data Analysis Method	SPSS 16.0 ; Mann Whitney U test	4-point Likert scale (SPSS V14)	5-point Likert scale (Smart PLS)	5-point Likert scale

The outline research process incorporated in this study is shown in Figure 4.1 (Bryman and Cramer, 2001) below: -

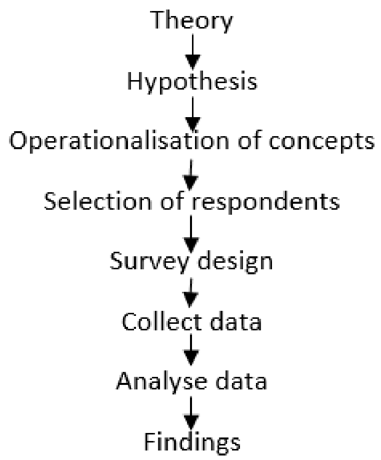
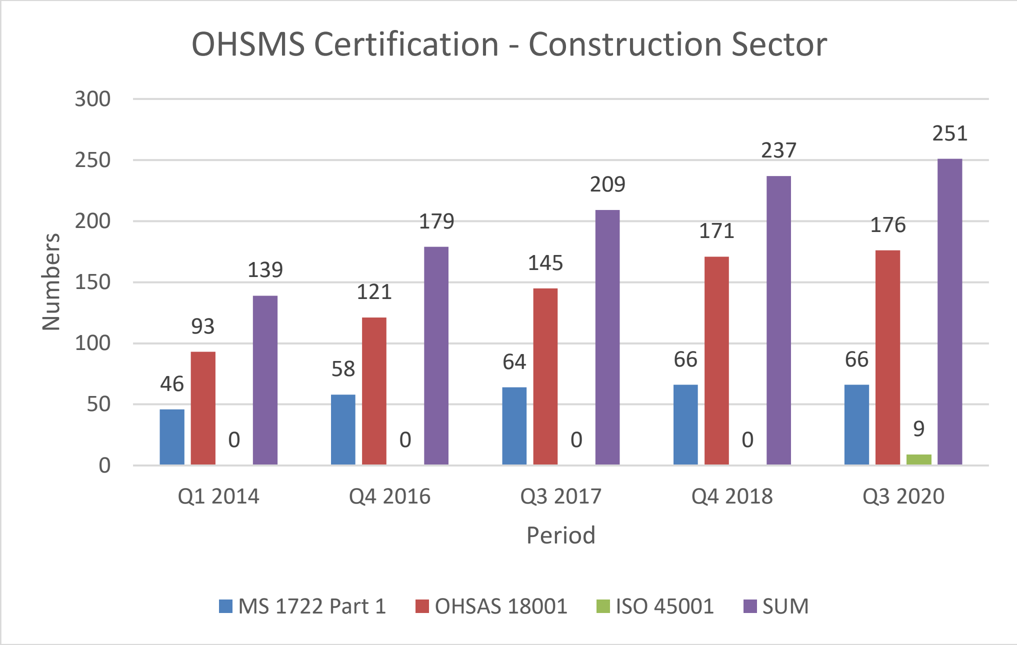


Figure 4.1: The Research Process

This research reflects the objective to explain and further understand the success factors influencing project performance in ISO 45001, OHSAS 18001 and MS1722 Part1 environment among Malaysian contractors as the OSHMS certification has been gradually increased as indicated in Figure 4.2- Numbers of OSH certification. The increase in OHSAS 18001 certification among the contractors should have reduce the number of incidence of accidents and fatality occurrence but the statistic shows otherwise.



Source: - Department of Standards Malaysia

Figure 4.2 – Numbers of OHSMS certification – Construction Sector

4.2.2 Research Design Process

The detailed research design process adapted in this study is illustrated in Figure 4.3

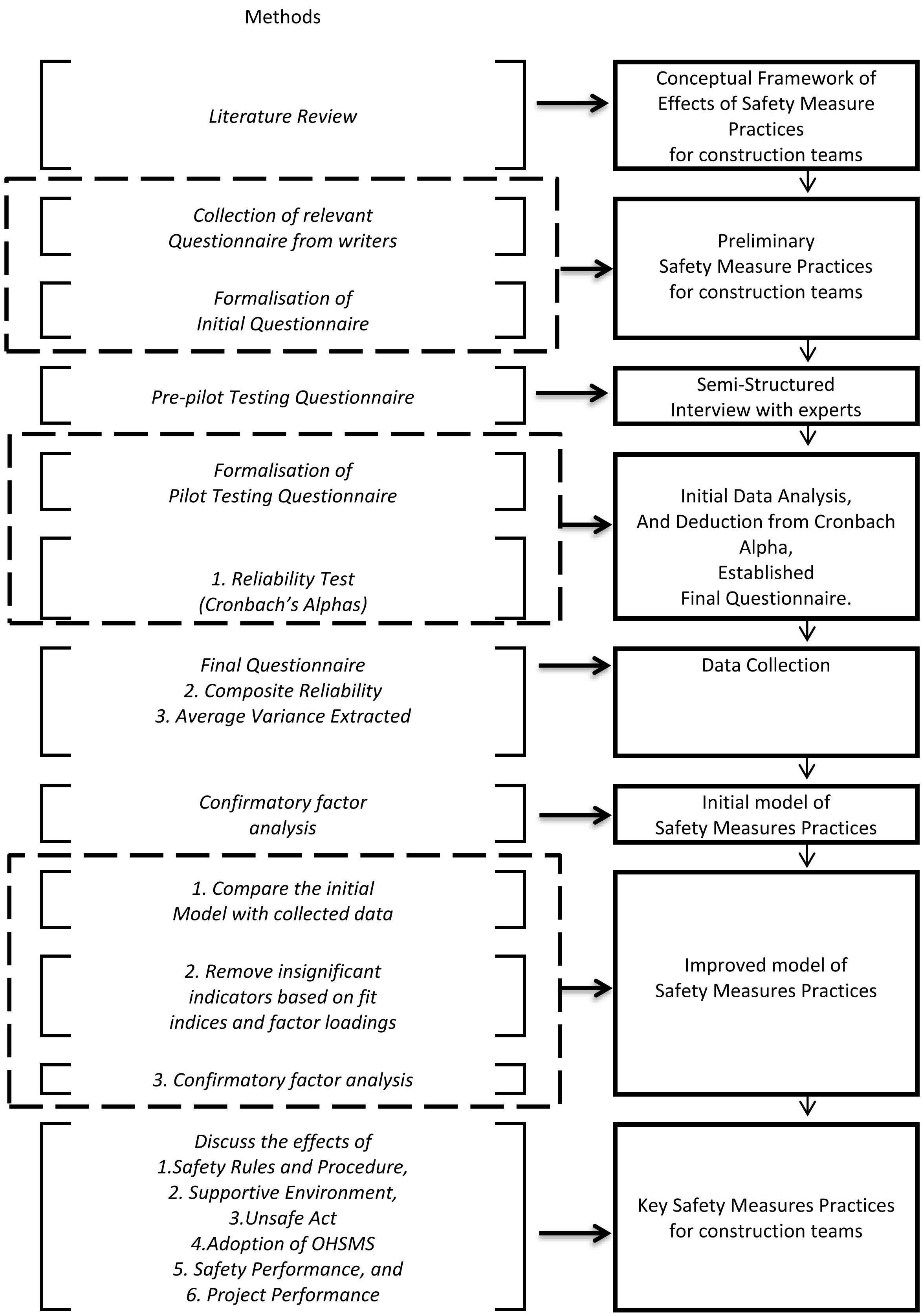


Figure 4.3 The Detailed Research Design Process

4.2.3 Conditions for Causality

The causal effect of constructs measurement through Structural Equation Modelling (SEM), is determined with four types of confirmations. These are required for the questionnaire survey quantitative data (Hair *et al*, 2014, p555-556), Schumacker and Lomax (2010)). These are: -

(a) co-variation: there must be an indication of a causal relationship between both the constructs,

(b) non-spurious relationship: the relationship must be ‘true’, i.e., the relationship between the constructs will be unaffected with the addition of new predictors,

(c) temporal sequence effect: the occurrence of a particular construct (B), following the occurrence of another construct (A), is an indication of A being the cause of B, and

(d) theoretical support: which should justify the cause-and-effect relationship.

4.3 Questionnaire Development

Ng (2006) pointed out that the design of the questionnaire is imperative to ensure accurate responses to the stated research objectives. Likewise, a bad questionnaire renders the results unadaptable, or worse, may lead to erroneous conclusion. Thus, the design and the selection of questionnaire must be fashioned based on the research objective, upheld by past relevant literatures, hypotheses developed, and be functionable for each of the constructs adopted.

To achieve these aims, the first important consideration is sequencing as this will increase the positive response rate and respondents’ manner of answering questions (Marshall 2005). Therefore, the questionnaire was designed and arranged sequentially. This allows respondents to complete a section before moving to a subsequent section. The questions will start with easy, non-threatening and non-sensitive nature. Sensitive questions are placed towards the end of the survey form as once the respondent has spent some time in answering the questionnaire, they are less likely to stop.

Furthermore, Saunder's closed-ended questions and Likert scale-response questions were incorporated into the initial and subsequent sections respectively. Close-ended questions which depict social-demographic profile and project details require less skill and quicker to answer (Saunders et al. 2009, p 375).

The questions were comprised of seven sections as follows: Safety rules & procedures (5 items), supportive environment (7 items), safe acts (6 items), adoption of OHSAS 18001 / ISO45001 (10 items), safety performance (21 items), company competitiveness (5 items) and financial performance (4 items). Table 4.9 represents all the seven research variables together with 58 corresponding items and its source. The questionnaire conducted in this study is presented in Appendix 1

Table 4.2 Research Variables, Corresponding Items and Source of Items

Research Variable		Corresponding Items	Items Source
Safety Rules & Procedures	1	The safety rules and procedures followed in my company are sufficient to prevent incidents occurring.	Vinodkumar and Bhasi (2011)
	2	The facilities in the safety department are not adequate to meet the needs of my organisation.	
	3	My supervisors and managers always try to enforce safe working procedures.	

	4	Safety inspections are carried out regularly.	
	5	The safety procedures and practices in this organisation are useful and effective.	

Supportive Environment	1	My organisation's employee adopts a no blame approach to highlight unsafe work behaviour.	Tan *et al*. (2015)
	2	My organisation's employee often reminded each other on how to work safely.	
	3	My organisation's employee believes that it is our business to maintain a safer and healthier workplace.	
	4	My organisation's employee always offers help when needed to perform the job safely.	
	5	My organisation's employee endeavours that individuals do not work alone under risky or hazardous condition.	
	6	My organisation's employee always maintains a good working relationship.	
	7	The workload is reasonably balanced among my organisation's employees.	

Safe Acts	1	Voluntarily conducting tasks or activities that help to improve workplace safety.	Mohammad and Hadikusumo (2017)
	2	Ensure the highest levels of safety when they conduct the job.	
	3	Use the correct safety procedures for conducting the job and know safety issues.	
	4	Help their co-workers when they are working under risky conditions.	
	5	Helping co-workers in safety learning and implementation.	
	6	Nobody ever works alone in construction industry, should work together safely.	

Continue

Table 4.2 Research Variables, Corresponding Items and Source of Items (Cont.)

Research Variable		Corresponding Items	Items Source
Adoption of OSHMS	1	My organisation has written, detailed occupational safety and health policy.	Tan *et al*. (2015)
	2	My organisation has proactive occupational safety and health policy beyond the compliances of legislative requirement.	
	3	My organisation has established quantifiable occupational safety and health objectives	
	4	My organisation monitors occupational safety and health cost and benefits	
	5	My organisation has established the role and responsibilities with respect to occupational safety and health programs.	
	6	My organisation has documented procedures for occupational safety and health.	
	7	My organisation provides appropriate training for its employees.	
	8	My organisation conducts occupational safety and health audit on a regular basis.	
	9	My organisation conducts reassessment on occupational safety and health on a regular basis.	
	10	My organisation's employee remuneration and promotion are based on occupational safety and health objectives.	

continue

Table 4.2 Research Variables, Corresponding Items and Source of Items (Cont.)

Research Variable		Corresponding Items	Items Source
Project Safety Performance			
Safety Culture	1	No regular supervision at least once a week.	Mohd Nawi *et al*. 2016
	2	Difficulties in communication towards foreign workers.	
	3	Risk assessment is not practicable at workplace	
	4	Workers are not likely to report incidents/accidents.	
	5	Decision making does not involve all organisation.	
Safety Behaviour	1	Workers under influence of drugs and alcohol.	
	2	Discipline issues.	
	3	Irresponsible attitude of the workers during working or handling machines.	
	4	Fatigue caused by working overtime.	
	5	Working for incentives	
Safety Awareness	1	Differences in age, with different level of awareness.	
	2	Lack of accident records and official safety data.	
	3	Not well educated.	
	4	No safety briefing/toolbox meeting.	
	5	Lack of safety signage board.	
Management Commitment	1	Absence of Safety and Health Committee.	
	2	Fail to nominate SHO (Safety and Health Officer) that comply with OSHA regulations	
	3	Lack of communication between manager and Safety and Health Committee	
	4	Lack of commitment to OSHA 1994.	
	5	Lack of communication between manager and worker.	
	6	Inadequate PPE at Work Regulations 1992 (FMA 1967).	

Continue

Table 4.2 Research Variables, Corresponding Items and Source of Items (Cont.)

Research Variable		Corresponding Items	Items Source
Company Competitiveness	1	Product quality	Fernandez-Muniz et al. (2009)
	2	Productivity	
	3	Customer satisfaction	
	4	Reputation	
	5	Innovation	
Project Financial performance	1	Financial profitability	
	2	Growth in market share	
	3	Growth in profit	
	4	Improved profit/sales	

4.4 Research Instruments

4.4.1 Pre-testing the Survey Questionnaire

Pre-testing the survey questionnaire is carried out to verify reliability and validity of the questions. This ensures that double-barrelled, ambiguous statements or improper flow sequence will not mar the authenticity and intention of the researcher.

These 58 content items were pre-tested through expert evaluation. Expert evaluation can identify and diagnose a large number of problems through diversity of expertise and interaction during the group meeting. The advantage is that the expert panel is normally relatively inexpensive. The expert panel usually consists of a small group of people (3 to 8) who critically review and scrutinise the questions from multiple perspectives (Czaja 1998). The expert evaluation involved 5 SHO from the construction industry (with working experience of at least six years), two DOSH officers and two university lecturers. The items were discussed, analysed to ensure the questionnaire works as intended, accurately reflect on the information in this study which represents current practices and site conditions applicable to the Malaysian construction industry, and ensures that the respondents comprehend and are likely to respond to them.

Finally, all 58 survey questionnaires were accepted and established. Safety rules and procedures (5 practices), supportive environment (7 practices), safe acts (6 practices), adoption of OHSAS MS (10 practices), safety performance (21 practices), company competitiveness (5 practices) and financial performance (4 practices).

At the advice of the experts, these questionnaires need to be written both in English and Bahasa Malaysia, to enable the respondents to fully understand the research questions. In a multi-lingual society like Malaysia, translating the questionnaire into different languages has become a norm, as self-administered questionnaires involved the general working population in the construction industry. Inaccurate translation of the questions will affect different answers for the same question, resulting in erroneous outcomes and conclusions.

To avoid this issue, a "translate-back-translate" method is used. The English text was translated into Bahasa Malaysia by two competent SHO with at least 8 years of site experience who are familiar with safety and health practices. Both are university graduates in safety course, one of whom holds a master degree in the same field. Thereafter, the questionnaire is back-translated into English language. The back-translation was performed by two Malay project engineers, who are university graduates with full time employment in construction company. The main purpose is to ensure there are no changes or deviation in meaning between the two translations. The final translated questionnaire is then incorporated as dual languages questionnaire.

4.4.2 Pilot Testing Sample Size

Prior to the ground analysis a pilot study test was conducted to confirm the reliability of the questionnaire units. This is carried out to identify prior potential problem areas and deficiencies, such as ambiguous inclusion, exclusion criteria or misinterpretations of questionnaire items in the research instruments. It often furnishes the researcher with ideas, approaches and guides initially unforeseen prior to conducting the final survey. It allows a thorough check of the planned statistical and analytical procedures, and usefulness of the data collected, so that more efficient adjustments can be made in the data collection methods. This will accurately be answering the research question. However, attention should be considered not only on the main survey but also the pilot test sample size. There are several general guidelines for the size of a pilot test. Julious (2004) recommended a pilot trial sample size of 12 per group of 2, Kieser and Wassmer (1996) suggested 20 to 40 sample size when main trials are between 80 and 250. Sim and Lewis (2012) proposed 50 for small to medium effect sizes., while Teare *et al.* (2014) favour 70 based on an extensive simulation study. Whitehead *et al.* (2016) formulated the stepped rules of thumb technique whereby the pilot study is established as a function of the target effect size and power of the main trial.

Viechtbauer *et al* (2015) has devised a simple formula for the calculation of sample size in pilot studies. The formula is based on a combination of a chosen level of confidence, and a given probability. The formula for n, number of pilot sample desired,

$N = \ln (1-\gamma)/ \ln(1-\pi)$

Where π denotes probability,

γ denotes the threshold of confidence.

Where $\gamma = 0.95$, and $\pi = 0.05$,

$N = 58.4$

For the pilot testing, Viechtbauer's formula is adopted to ascertain the number of sample size with a probability level of 0.05 and 95% confidence level. Hence, 59 participants shall be the minimum number for the tabulations of reliability test of Cronbach's Alpha coefficient (Cronbach 1951).

A total of 59 participants were recorded for pilot testing from four project sites in Klang Valley, namely, Millerz Square Old Klang Road KL (14 participants), Mizumi Residences Kepong KL (14 participants), Empire Damansara Petaling Jaya Selangor (13 participants), and Maxim Residences Cheras KL (18 participants). A five-point Likert type scale was used to compute the responses. Participants' perception on each project item was recorded from 1=strongly disagree to 5=strongly agree, 1=extremely poor to 5=extremely good, or 1=extremely dissatisfied to 5=strongly satisfied.

4.4.2.1 Reliability Test for Pilot Testing

Internal consistency between multiple variables was determined by the content reliability test. For maximum reliability Cronbach's alpha coefficient (Cronbach 1951) was calculated for each factor/content. Cronbach's alpha coefficient greater than 0.7, was considered sufficiently reliable to examine the causal relations. The statistical analyses were conducted using IBM SPSS Statistics (Windows version 21). Summary of Cronbach's Alpha coefficient were listed in Table 4.3

Table 4.3 – Summary of Cronbach's Alpha on Pilot Testing of 58 Variables

Item No	Content Description	Variables/Items	No of Variables	Cronbach's Alpha	Remark
1(a)	Safety Rules and Procedures	R1, R2, R3, R4, R5	5	0.36	Not Acceptable
1(b)	Safety Rules and Procedures	R1, R3, R4, R5	4	**0.788**	Acceptable upon deduction of Variable R2
2	Supportive Environment	E1, E2, E3, E4, E5, E6, E7	7	**0.768**	Acceptable
3	Safe Acts	UA1, UA2, UA3, UA4, UA5, UA6	6	**0.850**	Acceptable
4	Adoption of OHSAS 18001	A1, A2, A3, A4, A5, A6, A7, A8, A9, A10	10	**0.922**	Acceptable
5	Project Safety Performance - Culture	C1, C2, C3, C4, C5	5	**0.841**	Acceptable
6	Project Safety Performance – Behaviour	B1, B2, B3, B4, B5	5	**0.833**	Acceptable
7	Project Safety Performance – Awareness	Aw1, Aw2, Aw3, Aw4, Aw5	5	**0.776**	Acceptable
8	Project Safety Performance – Management	M1, M2, M3, M4, M5, M6	6	**0.968**	Acceptable
9	Company Competitiveness	CC1, CC2, CC3, CC4, CC5	5	**0.939**	Acceptable
10	Project Financial Profitability	FP1, FP2, FP3, FP4	4	**0.965**	Acceptable
	Total of variables		58		
	Total of variables accepted		57		

4.4.3 Final Survey Questionnaire

Out of the 58 variables tested for Cronbach's Alpha coefficient, one of the variables from Rules and Procedures needs to be dropped as Cronbach's alpha coefficient requirement above 0.7 was not achieved. The final survey questionnaire becomes 57 variables, namely Safety rules and procedures (4 practices), supportive environment (7 practices), safe act (6 practices), adoption of OSHMS (10 practices), safety performance (21 practices), company competitiveness (5 practices) and financial performance (4 practices).

The questionnaire was composed of two segments. The first section investigates the demographics of the respondents (including job experience, job position, gender, education level, age), and relates to the contextual factors, (numbers of workers employed at site, ISO certifications, location of project, types of construction, and method of construction). The second section includes the items to measure workers' safe management practices perception and safety behaviours criteria as per Appendix A. The questionnaire will be self-administered, "deliver and collect" from the respondents. Prior to collection of data, the writer contacted the Person In-charge (PIC) of the project site (normally a project manager or senior project manager). The locations of the project sites were selected to represent different sections of the Klang Valley. The objective of the study will be briefed to the PIC and members of his project team. Those who agreed to participate will be given the questionnaire and the completed forms returned within the day to the PIC. From there the completed forms will be collected by the writer from the respective PIC. This "deliver and collect" survey is very similar to postal survey. In this case, the writer is able to control and identify the origin of the survey locations.

4.4.4 Final Survey Sampling and Population

In this section, the study examines the question of the main survey sample size. Sample size is a decisive element where objective inferences are sought about a population. If a sample does not truly portray the target population, inaccurate outcomes may arise. Sample selection is determined in such a way that they represent the total population 'as good as' possible. What sample/observation quantities are necessary for representative of the study is contentions. Some potential SEM users are also reluctant to use the software, feeling that the sample sizes must be very large. For sample size, 'bigger is always better' when subtle effects exist, measures are not especially accurate/reliable or the structural model is indistinguishable among constructs etc. However, where there are reliable variables, substantial effects and a simple model, then smaller samples will be adequate (Bollen 1990).

Where each factor has three or more indicators, 150 samples will suffice for a convergent and proper finding (Iacobucci 2010).

Israel (1992) reviewed the three criteria in determining the appropriate sample size. Based on the sampling error (indicative of precision level), the true population range is estimated. This range is often expressed as a percentage, (such as ±5 percent). Secondly, the confidence or risk level, which is based on the Central Limit Theorem is determined. In a normal distribution, the desired confidence level is specified by the Z value. This is a point along the abscissa of the standard normal distribution. For 95% of the area below the normal curve, Z value is 1.96. For a Z value of 2.58, 99% of the cases is specified under the normal curve. The last criterion, refers to the distribution of attributes in the population. The more heterogeneous a population, a larger sample size is required to achieve a given level of precision. Whereas a measure of 50% denotes the maximum population variability, it is often accepted for a more conservative sample size.

4.4.4.1 Cochran's Formula of Sample Size

Cochran (1977) has developed formulae for calculating sample size in infinite and finite populations. The formulae are $n_0 = \frac{z^2 pq}{e^2}$, and $\mathrm{n} = \frac{n_0}{1+\frac{(n_0-1)}{N}}$ respectively.

- where, n_0 is the sample size of infinite population,
- *z* is the selected critical value of desired confidence level
- *p* is the estimated proportion of an attribute that is present in the population,
- *q* = 1-*p* and *e* is the desired level of precision
- n is the sample size of finite population
- N is the targeted population size.

There were 78,334 and 67,963 site supervisors and project managers respectively registered in 2017, out of the total construction personnel of 701,661 (CIDB Annual Report 2018). JKKP reported that there were 4723 and 5705 of SHO and SSS respectively (JKKP Annual Report 2018). The aforesaid construction personnel (supervisors, project managers, SHO and SSS) make up a total population of 156,725 and are members of the project safety management team at project sites. They are the eligible survey participants of this study.

Cochran's formula with infinite population, taking maximum variability of p=0.5, the desired confidence level of 95% and 5% level of precision is applied to indicate sample size.

$$n_o = \frac{z^2pq}{e^2} = \frac{1.96^2 \times (0.5)(0.5)}{0.05^2} = 384.16 \quad \text{say 385 respondents.}$$

For finite population of N=156,725 eligible respondents,

$$n = \frac{n_0}{1+\frac{(n_0-1)}{N}} = \frac{385}{1+\frac{(385-1)}{156725}} = 384.06 \qquad \text{say 384 respondents}$$

4.4.4.2 Yamane's Formula of Sample Size

Yamane (1967) has provided a basic formula to calculate sample size with known population density. The formula is: -

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

- where n is the sample size of finite population
- N is the targeted population size
- This formula also assumed a 95% confidence level and p (maximum variability of 0.5)
- e is the level of precision

Yamane's formula for finite population.

$$n = \frac{N}{1+N(e)^2} = \frac{156725}{1+156725(0.05)(0.05)} = 398.98 \quad \text{say 399 respondents}$$

4.4.4.3 F Test – Statistical Sample Size

Another determinant of sample size is Power Analysis using Linear Multiple Regression: Fixed Model, R2 deviation from zero procedure (Faul *et al* 2009)

Given three predictor variables, the results of a prior analysis revealed the total sample size of 119 to achieve a power of .95 in a test based on α = .05 Figure 4.4 is the statistical Test output of the 3 predictors.

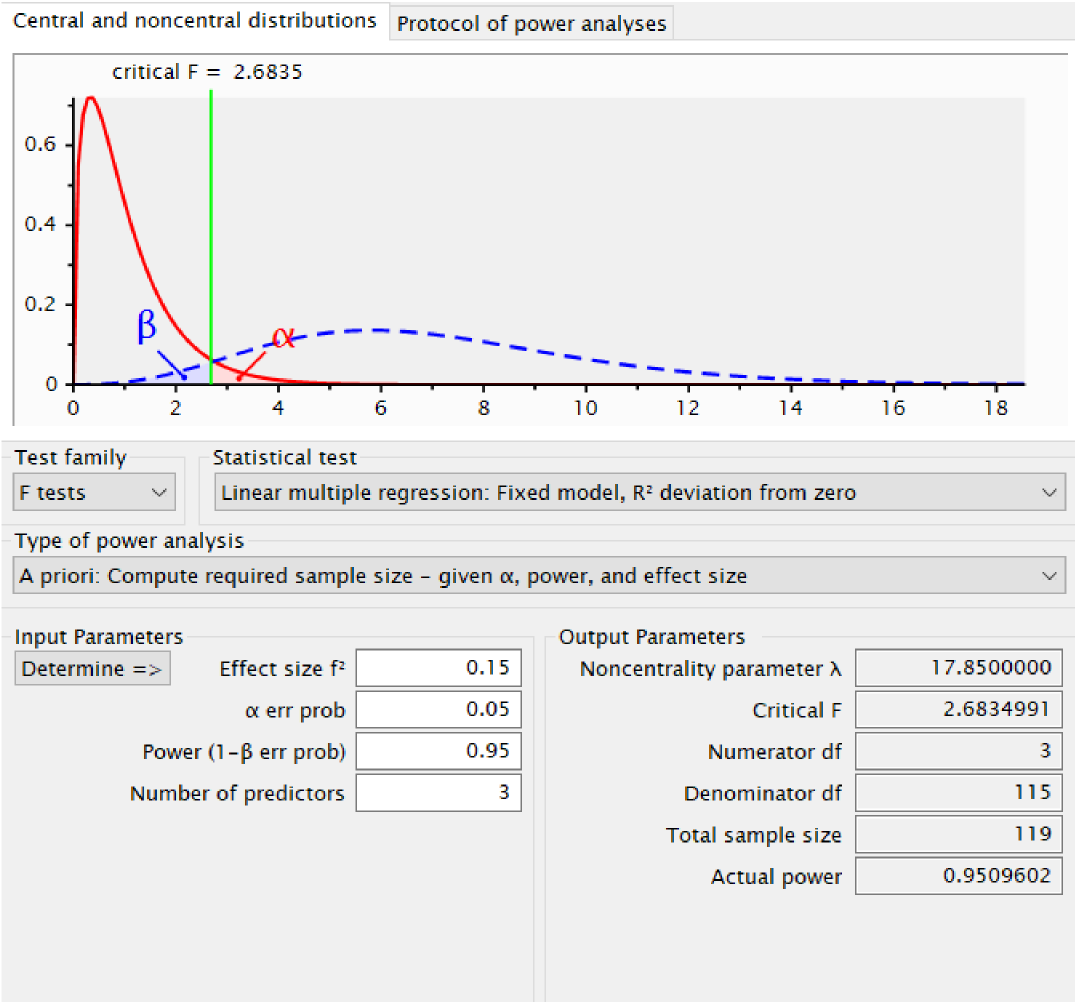


Figure 4.4 – F test for sample size

Taking into consideration of the four outputs of 385, 384, 399 and 119 from the formulae and chart, the minimum respondents for the survey in this study is set to be 399 respondents. It also fulfilled the suggestion of the ration of 5 to 1 sample size of 285 by Bentler & Chou (1987).

4.5 Data Collection

This research is focused on construction companies in Malaysia. It was shown that the primary cause of workplace accidents was a consequence of the non-management of unsafe acts, unsupportive working environments/conditions and lack of safety rules and procedure.

Construction companies registered under CIDB in Malaysia at G7 were targeted. This grade of companies is permitted to undertake projects costing more than ten million ringgit. For projects above twenty million ringgit Section 29 of the OSH Act 1994 stipulates that a safety and health officer must be employed. G7 contractor companies with ISO 45001/OHSAS 18001/MS1722 Part 1 certification must comply with safety capabilities. The management team of these selected group of companies forms the main group of respondents for this study. The members comprise the project manager, safety manager, safety officer, project engineer, site engineer, site safety supervisor, site supervisor, and those in similar positions.

The state of Selangor was selected as the study site due to its status as the most developed and progressive area in Malaysia (State Socioeconomic Report 2019 DSM). Moreover, up to October 2017, DOSH (M) reported that Selangor has the highest fatality (Table 1.3).

Survey questionnaires were hand-delivered. The project managers agreed to distribute the questionnaire at their sites with the help of their safety supervisors to enhance the rate of responses. Should the completed questionnaire contain any missing value or answered by unclassified respondents, these replies would be considered void and discarded. This is to ensure there is no misinterpretation of results from the data set.

When survey questionnaires were ready to be carried out at the appropriate project sites, the Movement Control Order (MCO) was imposed across the country. The survey was compelled to defer till MCO was lifted. In order to avoid non-response and duplication of the survey, questionnaires were distributed to a small group of respondents (a group of 20). The best time to get them in is immediately after projects site meeting. Pre-arrangement have to be made with the project manager with regards to the time and venue of their regular project site meeting. Although a lot of time is wasted in waiting, the outcome is self-satisfaction.

4.6 Data Analysis Procedure

The key element for any research lies in the data analysis as it is capable to determine the results and findings of the study (Trochim et al., 2014). Several steps are undertaken by this researcher to achieve the most reliable and justifiable results. Steps include data cleaning, (the process of ensuring all collected data is correct, consistent and usable), common method variance, outlier, multicollinearity and normality of the data, followed by confirmatory factor analysis (CFA).

Problems were encountered during the data analysis of the SPSS Amos software, especially during the testing of the pilot survey. Due to the existence of MCO, the researcher was unable to attend SPSS Amos application courses as many short courses had been postponed between early 2020 to late 2021. Lecturers who were familiar with SPSS Amos were also unavailable at the university.

Through the research supervisor, pre-recorded SEM short courses were used to further understand the mechanism of data analyses. Also, through the supervisors' networking, visits and consultation with SEM familiar lecturers in other local university (such as UCSI) helped to overcome the problem of data analyses.

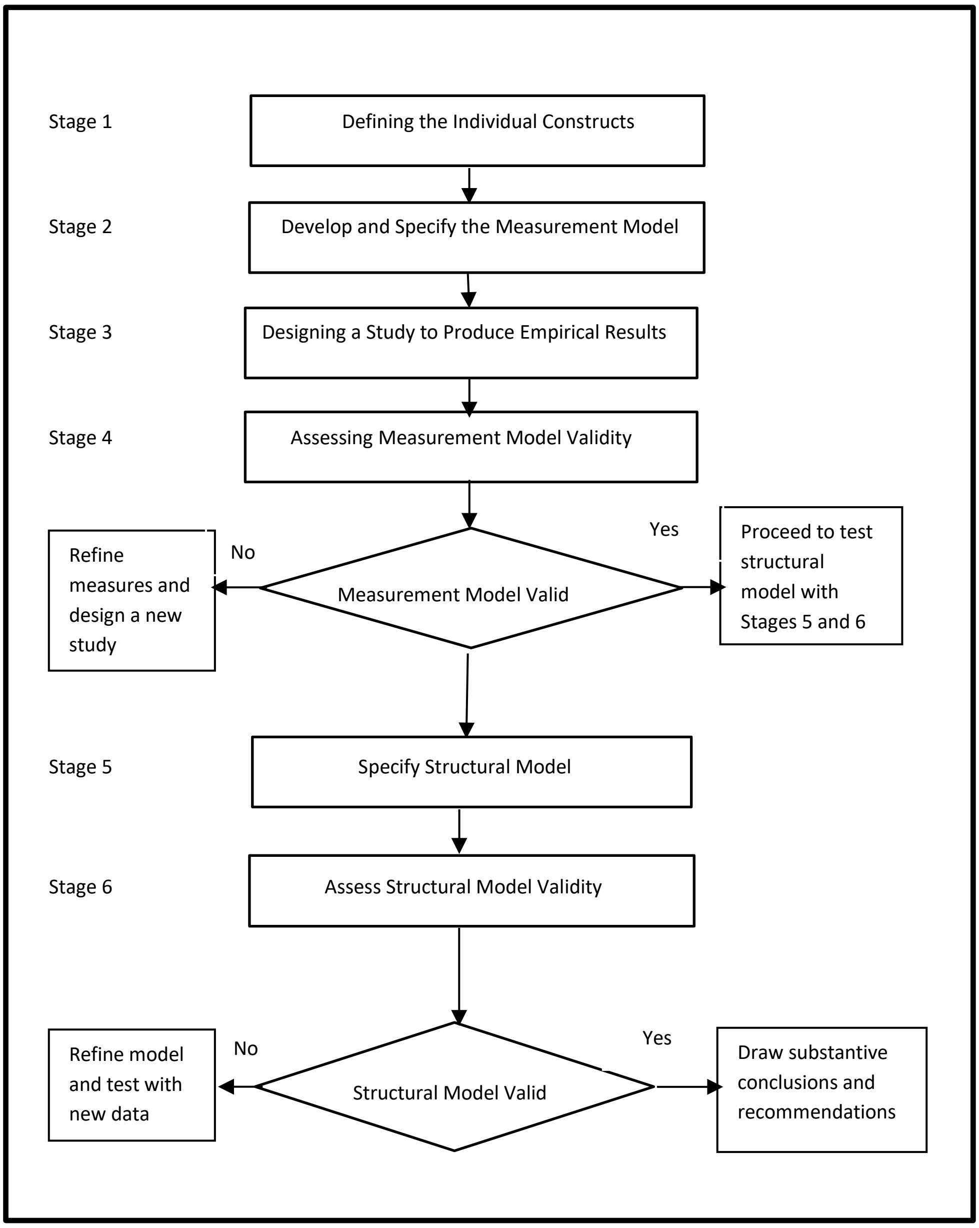
4.6.1 Confirmatory Factor Analysis

The Conceptual Model and Hypotheses in Figure 3.2 depicts the causal effects of Safety Measure Practices and Project Performance in an OSHMS certified working environment. These processes were investigated by structural equation modelling (SEM), a multivariance technique for analysing structural relationships between measured variables and latent constructs. The technique combines factor analysis and multiple regression analysis. According to Hair *et al*. (2014, p549-550), a model is a representation of a theory. "Structural equation modelling can perhaps best be defined as a class of methodologies that seeks to represent hypotheses about the means, variances and covariances of observed data in terms of a smaller number of 'structural' parameters defined by a hypothesized underlying model". Therefore, SEM provides a conceptually convincing process to fit theory to reality. CFA is a confirmatory method for formulating a hypothesized model to estimate population covariance, so as to obtain the least difference between the assessed and observed matrices (Schreiber *et al*. 2006). It is used to test several hypothesised model fitness data. These include unidimensionality, and authenticity of the measurement model. The assessed indices and their criteria should meet the stated requirement prior to proceeding with the structural model.

4.6.2 Structural Equation Modelling (SEM)

The conceptual model in this research was achieved according to the six stages (Figure 4.5) recommended by Hair et al (2014, p566). The first-order measurement models comprise (i) Safety Rules & Procedures – measured by 4 observed variables, (ii) Supportive Environment – 7 observed variables, (iii) Safe Acts – 6 observed variables, (iv) – Adoption of OHSMS – 10 observed variables, (v) Company Competitiveness – 5 observed variables and (vi) Financial Performance – 4 observed variables. However, the safety performance construct was a second-order measurement model initiated by four first-order factors which were evaluated by 21 observed variables. To test the eight hypotheses using SEM, the measurement models for the seven latent constructs as per Figure 3.2 have to be included. SEM used the AMOS (v21) of SPSS software (Statistical Package for the Social Science) of IBM.

IBM SPSS AMOS is a covariance-based structural equation modelling (CB-SEM). To use CB-SEM certain criteria must be present, (a) it is aimed at theory testing, theory confirmation, or comparing alternative theories, (b) error terms require covariation, (c) the structural model has circular relationships and (d) the study requires a universal goodness-of-fit criterion (Hair *et al*. 2011).



(Multivariate Data Analysis – Joseph F Hair, Jr, William c Black, Barry J Babin, Rolph E Anderson (2014) page 566)

Figure 4.5 Six stages process for Structural Equations Modelling

4.6.2.1 The Importance of Carrying Out SEM

SEM is a statistical method that combines both multiple regressions and factor analysis. Hair et al. (2010) claimed that SEM is a method that allows researchers to simultaneously test the interrelated relationships between latent constructs and its indicators and between numerous latent constructs at one time. It is a powerful tool that delve deep into complex relationships among variables within a model. It not only allows for the examination of direct and indirect effects, accept an assortment of variable types but also provide insights into the underlying structure of the data. By employing SEM, researchers can validate theoretical frameworks, test hypotheses rigorously, and uncover hidden patterns that might otherwise remain undetected (Kline 2005). Thus, embracing SEM in research endeavours empowers scholars to achieve a more comprehensive understanding of the phenomena under investigation, ultimately enhancing the quality and depth of their findings.

While numerous statistical packages offer SEM (eg Lisrel, Mplus, Amos, EQS, PLS etc). SPSS AMOS (V21) was selected for its user-friendly interface and its capacity to furnish a comprehensive and visually appealing model depiction.

Anderson and Gerbing (1988) delineated two primary approaches to SEM, the one-stage and two-stage methods. In the one-stage approach, both the measurement and structural models are analysed concurrently, serving to validate the measurement model. Conversely, the two-stage approach, as expounded by Kline (2005) comprises distinctly two steps. Step 1 focuses on confirming the measurement model, while step 2 is dedicated to scrutinising the structural model. The rationale behind the two-stage approach lies in its ability to mitigate potential interactions among the adopted constructs during the structural model testing phase.

Given the above considerations, SEM emerges as an indispensable statistical tool and its incorporation is justified in this study. The adoption of the two-stage approach is imperative to ensure robust testing of hypotheses and the hypothesised conceptual model.

4.6.3 Common Method Variance

Common method variance (CMV) as the deviation inferable to the measurement method instead of the constructs per se (Florian Kock et al. 2021)

In other words, the survey instruments introduce a bias, a serious and problematic issue that can jeopardise the validity of the research findings. Therefore, this drawback needs to be analysed. The Common Method Bias (CMB) generated by CMV, occurs when one construct's relationship with another might be inflated.

The objective of testing for CMB is to verify the magnitude to which the data may be influenced by biases arising from the survey method used. This estimate is carried out using statistical technique. There are three frequently used techniques (Eichhorn 2014) to estimate this phenomenon.

4.6.3.1 Harman's Single Factor Test

In the Harman's single factor test (Podsakoff et al 2003), all the constructs' variables are loaded onto a newly introduced common latent factor analysis. This gauges whether the common factor can account for most of the variance, if this new common latent factor explains CMB is deemed present more than 50%

of the variance. However, this method conveys multiple weaknesses. This test is no longer widely accepted and is considered an outdated and inferior approach on its own.

4.6.3.2 Common Latent Factor Method

The second technique is called Common Latent Factor (CLF) method. The common factor was introduced to pick the common variance from all the model's variables including the latent factors. The standardised regression weights is compared between the models with and without the CLF. If the difference between the estimates exceed 0.2 (Gaskin, 2012), then the issue of CMB exists.

4.6.3.3 Common Marker Variable Method

The third method, Common Marker Variable, is simply an extension of the Common Latent Factor method. For this method, another latent factor is added to the model, followed by the common factor. Often, Marker variables are used to indicate some other features which are not directly observable.

There are no definite solutions to which method to employ in order to control CMB. It is recommended to use multiple methods to alleviate the various concerns about CMB (Chang et al., 2010). A combination of Harman's single factor and Common Latent Factor techniques are employed in this research to determine if any bias exists in the data.

4.6.4 Reliability Analysis

The internal compatibility between the multiple scale variables is measured by the reliability analysis which involves Cronbach's alpha coefficient

(Cronbach 1951) and the Composite Reliability Index. An alpha coefficient greater than 0.7 in Cronbach's analysis was deemed to be satisfactory to examine the causal relations. The thresholds for Composite Reliability Index 0.6 and above were considered acceptable (Bagozzi and Yi 1988). However, in 2004, Cronbach acknowledged his unease about references to Cronbach's alpha. He concluded that the alpha formula is no longer viewed as the most relevant method to examine most data. He also pointed out that it provides for only a limited viewpoint of the measurement uses for which require reliability information. Alpha has very strict assumptions: - unidimensional, uncorrelated errors, and all covariances between all items should be identical. In most cases the assumptions are violated. Cronbach's alpha formula shows:

$$\alpha = \frac{N \cdot \bar{c}}{\bar{V} + (N-1) \cdot \bar{c}}$$

where N = the number of items

$\bar{c}$ = average covariance between item-pairs

$\bar{V}$ = average variance

The value is thus a function of the number of test items, the average covariance between pairs of items and the variance of the total score.

So, a high alpha coefficient isn't indicative of a 'good' or reliable set of items, as the alpha coefficient can be inflated with an increase of items in the analysis.

To measure reliability in this research, the Composite Reliability Index is used together with Cronbach's alpha.

4.6.5 Validity Analysis

Validity describes the extent to which study findings or conclusions actually measure the elements as claimed. This measurement is verified by considering the accuracy from three aspects, namely: - the content, convergent and discriminant constructs.

Content validity relates to the level in which a study or test fulfilled the requirements of all the elements of a construct. Considering that the suggested questionnaire was designed after an exhaustive review of the literatures and revision involving semi-structured interview with the ten safety experts, this measure can be evaluated.

Convergent validity refers to the correlation between the tested constructs. (Hair et al. 2014, p618-619). Convergent validity is analysed by each variable's standardised factorial regression coefficient with the latent one (Anderson and Gerbing 1988), using lambda parameters. A strong convergent validity is where the individual standard factor loadings (regression weights) should be over 0.5, preferably 0.7 and significant at confident level of 95%. and the squared multiple correlation R^2 >0.4. Moreover, average variance extracted (AVE) measures should equal or exceed 50 percent.

Discriminant validity describes the degree to which the tested constructs which don't have a relationship indeed are not related.

There are two common methods of assessing discriminant validity. First, a more conservative method by Hair et al. (2014, p619-620) compares the variance extracted value against the squared inter-construct correlations associated with that construct. If the results exceed its squared correlation with other variables (Fornell and Larcker's 1981), then the discriminant validity for the CFA model is not a concern. A second method to evaluate the discriminant validity is to compare the Chi-square difference between two measurement models, namely, the unconstrained and the constrained model. If the $\chi 2$ difference between the two models is significant, the two constructs are claimed as having good discriminant validity.

4.6.6 Evaluating the Goodness of Fitness of a Measurement Model

In SEM, several Goodness of Fitness Indices reflect how fit the measurement model is in relation to the sufficient data collected. However, no single fit index adequately provides an assessment of fit. Hair *et al.* (2014, p583) recommended at least one fitness index from three model fit categories namely, Absolute Fit, Incremental Fit, and Parsimonious Fit for evaluation.

Absolute fit gauges the 'badness-of-fit' of a model and measure the extent to which the model-implied covariance matrix corresponds with the observed covariance matrix. The smaller the number, the better the model fit. A zero value indicates an optimal fit, whereas increasing values denote higher divergence from the observed matrix. In contrast, incremental fit indices, also known as comparative fit indices judge the tested model's 'goodness of fit' and evaluates its degree of dominance over an alternative model. Hence the bigger the values, the greater the model fit over the alternative model. It is assumed that the observed variables are independent of each other. A Parsimonious fit index provides the best model among a set of competing models despite its fit complexity. Parsimony-corrected fit indices are adjustments that rectify models that are impartial, so that simpler theoretical processes are favoured over more complex ones. The more complex the model, the lower the fit index.

The option of which index to adopt depends on the referent literature. The information relating to the model fit category, the level of acceptance and literature are listed in TABLE 4.11.

Table 4.4: The three categories of model fit and their information

Name of category	Name of index	Acceptance level	Literature
1 Absolute fit	Chi-Square	P-value>0.05	Wheaton et al. (1977)
	RMSEA	RMSEA<0.08	Browne and Cudeck (1993)
	GFI	GFI>0.90	Joreskog and Sorbom (1984)
2 Incremental fit	AGFI	AGFI>0.90	Tanaka and Huba (1985)
	CFI	CFI>0.90	Bentler (1990)
	TLI	TLI>0.90	Bentler and Bonett (1980)
	NFI	NFI>0.90	Bollen (1989)
3 Parsimonious fit	Chisq/df	Chisq/df<5.0	Marsh and Hocevar (1985)

Note: Extract from SEM Made Simple – Zainudin Awang 2015

4.6.7 Analysis of the Structural Equation Model

To achieve the required model fitness, a pooled Confirmatory Factor Analysis (CFA) runs all the latent variables in the structural equation model simultaneously while an Individual CFA runs the latent variables singly. CFA is a significant part for the measurement model in SEM in order to attain an acceptable model fit for the structural model (Bollen 1990).

The structural program SSPS Amos (Malkanthie 2015) was used to conduct the CFA analysis for goodness-of-fit between research data and the hypothesised model.

The structural equation model (SEM) was developed on successful completion of CFA stage. SEM comprises a measurement model, MM (exogenous measuring against latent variables) and a structural model, SM (latent variables relationship). There are 3 levels in SEM analysis, in the order of (1) CFA (2) MM and (3) SM.

The competency of the measurement model is evaluated by: -

(a) The reliability and validity of each construct evaluated by the Composite Reliability, AVE, Discriminant validity and the indicator loadings statistical significance.

(b) Normality of the data and potential outlier, and

(c) Overall fit of the model with the data.

4.6.8 Testing the Hypotheses

Structural Equation Modelling (SEM) offers a technique to specify a path analysis model, investigate link between endogenous and exogenous variables, and produce a comprehensive analysis of the input data. In addition, SEM can measure any complex relationships both direct and mediate effects.

The aforesaid technique was used to test the hypotheses. Standardised Regression Weight, T-ratio (C.R.) and their significant level were also applied to verify the hypotheses. Figure 4.6 indicates the overall testing of Structural Equation modelling with their acceptable criteria.

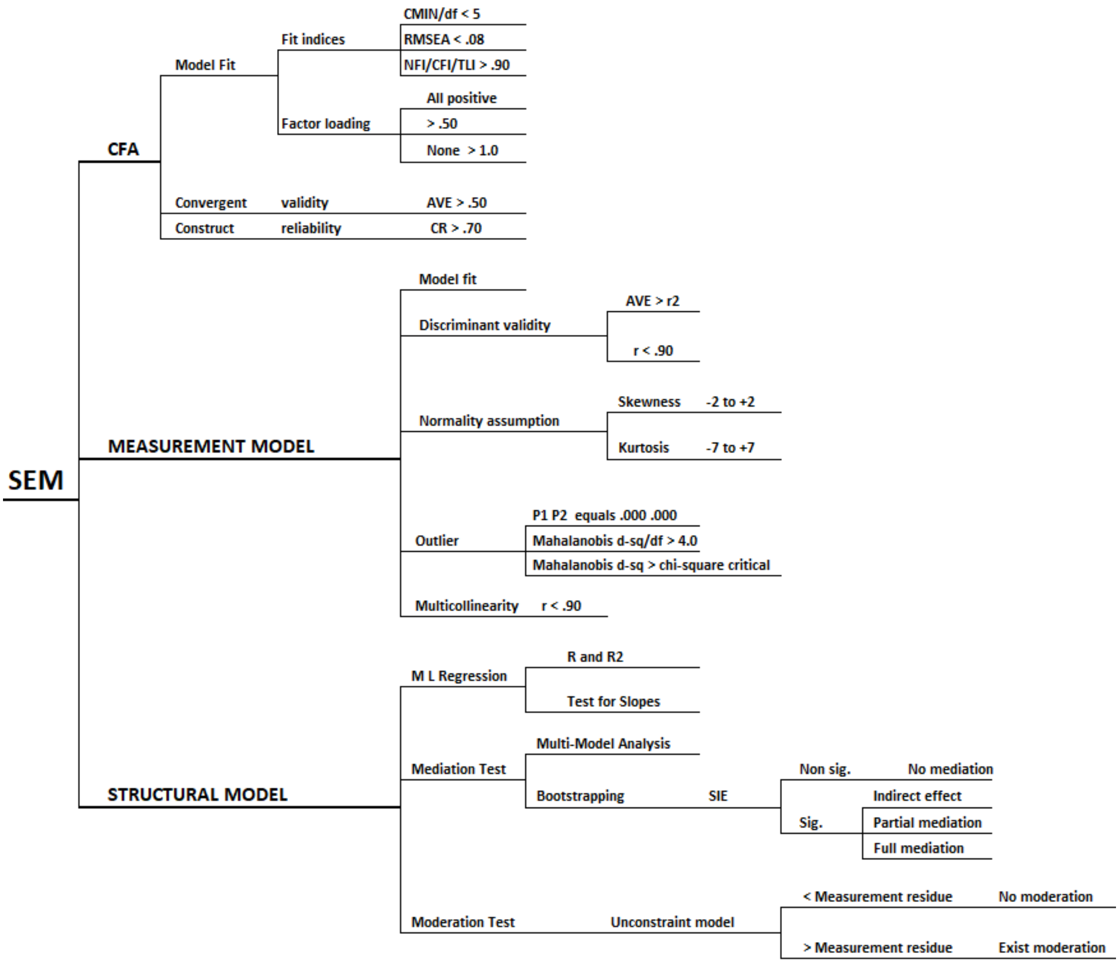


Figure 4.6: SEM - An overview

4.6.9 The Mediation Test

Where one variable affects another variable in succession, mediation analysis is used to test this hypothetical causal chain (Boran and Kenny 1986, page 1176). To test the mediating effect of Safety Performance between the exogenous variables and the hypothesised Project Performance, this study follows the recommendations of Wood et al. (2008). Exogenous variables (Adoption of OSHMS, Safety Rules & Procedures, Supportive Environment, and Unsafe Act) and Project Performance. Moreover, Baron and Kenny (1986) have also identified four causal steps to examine the mediation effect. Sobel test and bootstrap estimation method are significant checks (Shrout and Bolger, 2002), Bootstrap 5000 was used as recommended by Hayes (2009).

Baron and Kenny’s (1986) suggested analysis is carried out in 3 statistical processes of regression analysis. X – represents an independent variable, Y – the dependent variable and ‘III’ – the path. Figure 4.7(a) shows the direct effect without M. While in Figure 4.7(b), paths ‘I and II’ are called the indirect effect which is mediated by M (the mediator).

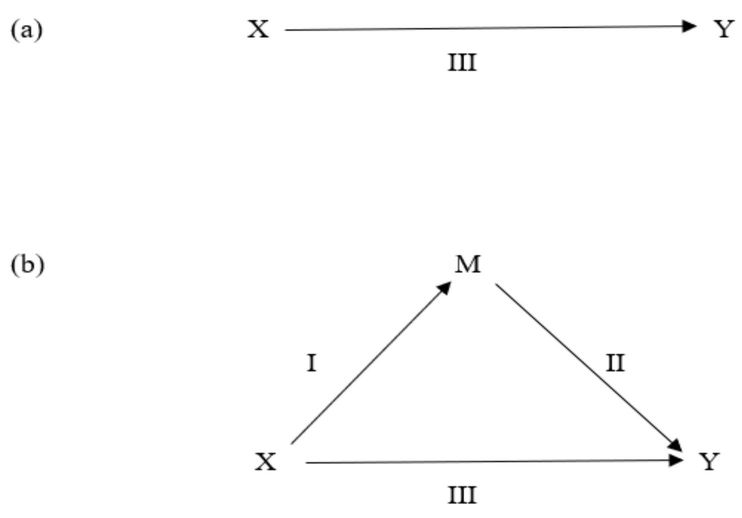


Figure 4.7: Testing Mediation with Regression Analysis

Baron and Kenny's (1986) mediation is tested through three regressions. To determine a mediation effect occurred, four conditions must be satisfied. (1) The independent variable (X) is shown to significantly influence the dependent variable (Y), (2) (X) is shown to significantly influence the mediator (M), (3) (M) must significantly influence (Y). and (4) the test of mediation is dependent on the regression outcomes after the addition of M. Full mediation is present when (X) no longer influences (Y)without M's dominance. Partial mediation occurs when (X)'s influence on (Y) is reduced after (M) is controlled.

Although Baron and Kenny's (1986) causal steps have been widely acceptable, there are some reservations to their approach. Some empirical studies (examples, MacKinnon and Fairchild, 2009; Preacher and Hayes, 2004) have criticised the aforementioned approach's failure to assess the implication of the mediation effect as well as having low statistical power. To overcome these drawbacks, Sobel's test (1982) was used to examine the indirect influence of the mediator by providing an estimate of its impact, the standard error, the z-value for that effect, and the p-value for the estimate. However, Sobel's test is hinged upon the indirect effect being normally distributed with an inclination to have adequate power only with large sample sizes. Therefore, this study also includes the use of mediation bootstrapping method of estimate to enhance the outcome. The bootstrapping method provides some advantages primarily to an increase in power. In bootstrapping, sample observations are randomly and repeatedly replaced from the data set to compute their desired results. The statistical analysis is calculated using the software package SPSS. The system generates point estimates and confidence intervals so that the significance or otherwise of a mediation effect can be determined. This study utilised Preacher and Hayes's (2004) statistical macro script to examine mediation test and to reach a definitive discussion on the topic.

SEM enables a researcher to examine a combination of factors analysis, regression equation or path analysis (the relationship between sets of data) simultaneously. Its purpose is to determine a set of relationship amongst one or more exogenous (independent) variables and one or more endogenous (dependent) variables. Its objective is twofold. First, it seeks to obtain estimates of the model's parameters, the factor loadings, the factors' variance and covariance, and the residual error variances. The second objective focuses on the model fit. The regression or path coefficient between factors indicates the constructs' relationship.

In summary, the application of SEM can identify the interdependent and causal relationship between the observed and latent variables.

There are several SEM software programmes available in the market. These programmes include SPSS Amos, SAS PROC CALIS, R packages sem, lavaan, OpenMX, LISREL, EQS, and Mplus (Narayanan 2012). For linear SEM analysis, these software packages have the capabilities for handling single or multiple group studies, non-normal variables and missing data texts. All packages produce closely accurate results. The decisive choice is user interface, SPSS Amos, LISREL, EQS are feasible in programming mode and graphical interface. While other packages are applicable solely in a programme environment. R packages SEM and OpenMix are viable in developing a path blueprint through other third-party application. Currently SAS PROC CALIS and lavaan do not generate path diagram output. Each package possesses its own strength and special features in terms of output.

El-Sheikh et al. (2017) also concluded that the selection of the software packages is dependent on the researcher's need and user-friendly consideration. Three packages, lavaan, SPSS Amos, and LISREL produce almost identical results when the same estimation method is used. SPSS-Amos was selected for this study based on its excellent graphical interface, well organised and rapidly accessible output format. Moreover, the researcher is familiar with the software.

With the SPSS Amos (v21) application in this study the independent or interdependent impact of observed variables on a project's safety rules and procedure, supportive environment, unsafe acts of workers, safety performance and project performance can be identified. The three safety measures practices were taken as latent variables since any one of them cannot be 'directly' or 'explicitly' observed.

4.7 Conclusion

The present chapter provides an in-depth outline of the research design process adopted in this study, including the development of the theoretical conceptual model of Safety Measure Practices and Project Performance. It also identifies the types and sources of data which it was designed to collect. Both the pilot test questionnaire and its data were analysed to ensure that the scale was reliable and validated prior to setting and collection of final survey sampling and population. Final survey data were evaluated through a systematic analysis of SPSS Amos (v21) of path analysis and CFA. Cronbach's alpha coefficient was adopted to verify the content reliability of each questionnaire. A total of 57 survey questions were established.

The hypotheses will be validated through the evaluation of Goodness-of-Fit and application of modification indices. The next chapter will highlight testing of the mediating effect of safety performance between the exogenous variables and project performance.

CHAPTER 5

DATA ANALYSES AND FINDINGS

5.1 Introduction

This chapter examines the results obtained from the data analyse and the tests of hypotheses. The first section details the preliminary study of the obtained data. In the second subsection, a breakdown of the demographic profiles of the safety management team respondents, types and natures of the construction projects are presented. Descriptive analysis of the variables follows in the third subsection. The fourth area summarises the Confirmatory Factor Analysis (CFA) for all the studied concepts, with reliability and validity testing. The fifth part shows the outcomes of structural equation modelling (SEM), together with mediation tests. Finally, comprehensive hypotheses analyses are disclosed.

A total of 600 questionnaire survey forms were sent to 33 ISO 45001/OHSAS 18001/MS 1722 Part 1 certified project sites within the vicinity of Klang Valley. These 33 project sites were undertaken by 16 G7 construction companies, of which 10 are listed public companies. There were 442 sets of survey forms returned. However, 36 forms were rejected due to incomplete or missing information and five rejected due to outlier, making a total of 401 valid forms. This makes up to a response rate of 67% achieved. Figure 5.1 shows the locations of project sites on Google Map. Table 5.1 indicates the tabulation of the numbers of respondents with respect to the locations of the project sites.

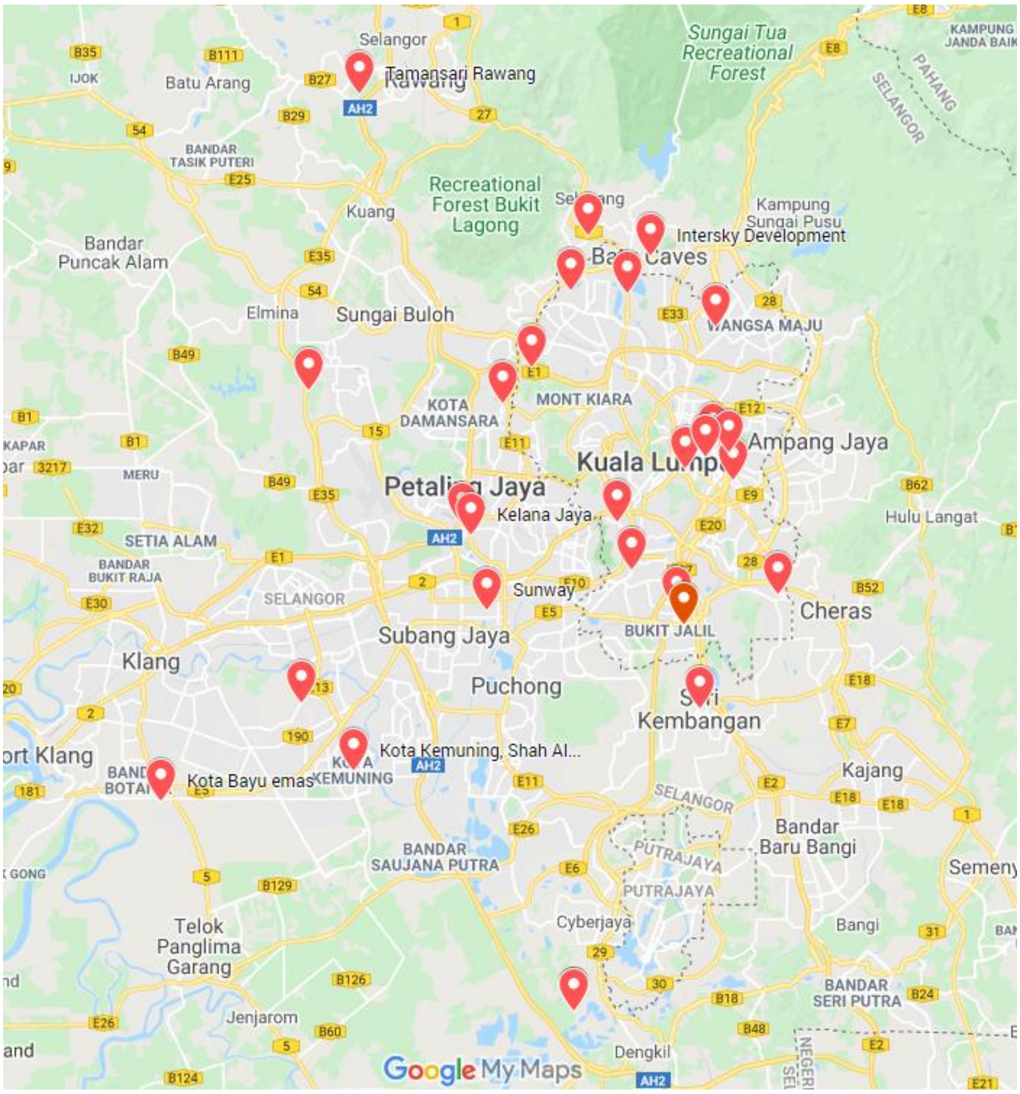


Figure 5.1- Locations of Project Sites on Google Map

Table 5.1 Tabulation of the Number of Respondents and Locations

Target: - 399 respondents / 28 locations.   Achieved: - 401 respondents / 33 locations

Item	No of Respondents	Type of Properties	Location
1	8	Highrise Residential	PV18, Jalan Langkawi, Setapak
2	8	Highrise Residential	Millerz, Old Klang Road
3	13	Highrise Residential	Mizumi, Jalan Metro Perdana Barat
4	12	Empire Damansara	Empire Damansara, Damansara Perdana
5	17	Majestic Maxim	Majestic Maxim, Taman Len Seng KL
6	5	MRT Infrastructure	Seri Kembangan
7	6	Highrise Residential	Arcuz, Kelena Jaya
8	32	Shopping mall	Merdeka, KLCC
9	18	Highrise Residential	Bangsar South
10	17	Highrise Commercial	Jalan Bukit Bintang BBCC
11	16	Highrise Commercial	TRX (HSBC)
12	17	Highrise Residential	Taman Wahyu JL99
13	17	Highrise Commercial	Kelana Jaya SS7
14	4	Landed Property	Kota Bayuemas, Klang
15	11	Landed Property	Tamansari Rawang
16	3	Landed Property	Emerald Selayang
17	4	Landed Property	Elima, Shah alam
18	4	Landed Property	Kota Kemuning
19	11	Highrise Commercial	Peel Road Cheras
20	9	Highrise Commercial	SIS Sunway
21	14	Highrise	Kita Cybersouth
22	5	Landed	Kita Cybersouth
23	9	Highrise Commercial	Merdeka 118
24	7	Infrastructure Tunnel	Belfield Tunnel PMV
25	7	Landed	MBSA Impian
26	7	Highrise	South Brooke, Desa Park
27	31	Highrise	TRX Resi Jln Utara / Imbi
28	11	Highrise	Jalan Harapan PJ
29	16	Highrise	M Arisa Setapak
30	9	Highrise	Platinum Arena, OKR
31	10	Highrise	Ryan & Miho, S13 PJ
32	25	Highrise	BBCC
33	18	Infrastructure	SUKE
Total	401 Respondents		33 Locations

5.2 Preliminary Examination of Data

Data cleaning is the process to remove incorrect, corrupted, duplicate or incomplete data within the dataset. Coding of the individual survey forms will ensure easy identification, cross referencing during data entry into the software package. Undoubtedly, the quality of analysis and research outcomes depend mainly on how effectively research data was compiled, transferred and input into the analysis. Thus, the returned survey forms were scrutinised to assess for any missing information, incomplete forms and the specified qualified respondents. Data was also examined and disparities excluded, such as outliers, normality and multicollinearity, prior to carrying out analysis for hypotheses testing.

5.3 Missing Data

Missing data due to unanswered survey questions occur invariably in all research, even in well controlled ones. Lost input can significantly influence the statistical efficacy of a study and can result in biased estimates. There are ways to deal with missing data but there is no optimal solution. The maximum likelihood estimation is one of the methods recommended (Kang 2013). But, for SEM analysis, missing data is not an issue, and no solution is required (SPSS Amos). In the present study, the missing data were identified and screened through the frequency distributions and descriptive statistics of SPSS software. To minimise missing data, the original plan was to deliver the survey forms to the project person in charge. The survey will be carried out after the weekly meeting of the project team and collected on the same day. However, due to

Movement Control Order (MCO) restrictions, the forms were delivered and returned after a few days, resulting in some incomplete survey forms being retuned.

5.4 Normality, Outlier and Multicollinearity

Outlier are suspicious observations or measures that depart from the norm because they are much smaller or much larger than the vast majority of the observations. In other words, they are unusual values in a data set. The presence of these observations is problematic, as it can lead to inflated error rates enough to distort the real results or miss significant findings. Outliers can be univariate or multivariate. A univariate outlier is a data point with exceptional values on a single variable, whereas a multivariate outlier arises on two or more variables. A univariate outlier can be cleaned using normality testing which includes skewness and kurtosis. High regression levels of skewness (symmetry) and kurtosis (peakedness), are not desirable and can undermine these analyses.

For the current research, the IBM SPSS statistical software was used to determine the skewness and kurtosis as recommended by Kline (2015). There are no official rules to determine the cut-off criteria for skewness or kurtosis values to indicate non-normality of the data. Hence any values falling within the skewness values (-2 to +2), and kurtosis values of (-7 to +7), can be considered normal. The normality results (Appendix B) for all the measured variables items revealed that, the absolute degree of skewness and kurtosis fall within the acceptable range of ±2 and ±7 respectively.

Outliers are identified by using Mahalanobis distance (Filzmoser *et al.* 2005), which is the length of the line segment from a data point to the centroid of the means of the remaining predictor variables. To detect multivariate outlier, the calculated Mahalanobis distance (D) is compared against a chi-square (x^2) distribution with degrees of freedom equal to the number of dependent variables. A value of D^2 with a low p value <0.001 in the appropriate centre chi-square-distribution may determine the presence of outlier. IBM SPSS prints Mahalanobis distances in the output copy. In this study, Mahalanobis D^2 test is assessed based on the suggestion by Kline (2015). As established by Mahalanobis distance output from the software (Appendix C) where p1 and p2 values are <0.001, 5 extreme outliers were detected. The final sample size of 401 are left for further analysis. As to another test of outlier identified through D2/degree of freedom, the biggest value obtained was less than 4 (sample size > 200), so there is no further potential of outlier from Mahalanobis distance in the data set.

In combined variables in the data set, multicollinearity is ascertained by values of detection-tolerance (TOL) and the variance inflation factor (VIF) (Allison 2003). Multicollinearity is deemed to exist if the values of TOL and VIF are <0.2 and >5.0 respectively. O'Brien (2007) also concurred that if any correlations > 0.8 amongst the variables, a source of multicollinearity is considered present. For the data set in this study, multicollinearity was conducted using SPSS. Verification of all variables is by acceptable values of TOL (>0.20) and VIF (<5.0) Furthermore, the correlations between the variables were found to be less than 0.8 (Appendix D). Hence, the outliers, normality and multicollinearity reviews satisfy the basic criteria of SEM and therefore can proceed with further analysis.

5.5 Common Method Bias

When relationships between two or more constructs are measured with the same method, common method bias (CMB) occurs (Podsakoff et al., 2012). This serious methodological issue might compromise the reliability and validity of the measures. There are no explicit methods to solve or control CMB. For this research, a combination of Harman's single factor and common latent factors approaches are employed to determine if any bias is present in the data.

After data collection, Herman's single factor test examines whether variance in the set is caused by a single factor (Chang et al 2010). The largest variance explained was 33.602 % (<40 %) (Hair et al.,2017) – Appendix E.

In addition, pretesting by expert panel that critically review, scrutinise and pilot test the questionnaire ensures that it was concise and simple without double-meaning items.

Furthermore, CMB can be determined by assessing the difference between the standardised regression weight with/without Common Latent Factor (Appendix 6). The highest value difference between the two estimates of standardised regression weight was 0.191 (<0.2) (0.2 is a small effect sizes between two variables, Cohen 1988; Sawilowsky 2009). Appendix F is the CFA models with and without Common Latent Factor respectively. The acceptable results of Harman's single factor and common latent factor tests confirms that CMB was not present in this study (Hair et al.,2014).

5.6 Demographics of Respondents

Following the prior data assessment in the previous segment, this section features the respondents' profiles and contextual factors of the projects involved. The background of the projects taking part in the survey were regarded as imperative information owing to the hazards and risks involved during the implementation of the works.

Table 5.2 presents a complete overview of the 401 respondents' demographic profiles and project features. It was discovered that the makeup of the respondents are 81.3 % male, and 18.7 % female. It is a norm that the construction industry is dominated by male (Lim 2019). 86.3 % of the respondents were over 25 years old, so the data can be considered mutually acceptable. In terms of education level, 62.6 % were with bachelor and master degree. The statistics also revealed that 58.6 % have at least 6 years work experience. Job position comprises project manager (16.2 %), engineer (26.9 %), supervising staff (34.7 %) and Safety and Health Staff (12.0 %).

The projects involved were strata property ≥ 20 storey (65.1 %); mall construction (13.7 %); landed property (8.7 %); infrastructure (7.5 %), and strata property < 20 storey (5 %). High rise strata property is considered high risk project as working at height, open edges, being struck by falling objects or moving objects by cranes, scaffolding not being assembled or used properly, falls protection etc are common hazards. A mixture of conventional and system formwork at 64.6 % was the main method of construction. The Industrialised Building System (IBS) method of construction at only 4.5 %, needs to be promoted to reduce manpower employed at site, which in turn will minimise the health issues for workers staying at the project site. 49.1 % of the project sites employed 100 to 499 workers while 32.9 % had over 500 workers. With these high figures, health issues need to be addressed as most of the workers stay at site under unsuitable conditions.

Table 5.2 - Demographic Profile of Respondents

Variable	Classification	Frequency	Percentage (%)
Gender	Male	326	81.3
	Female	75	18.7
	Total	401	
Age	25 years old and below	55	13.7
	26-35 years old	208	51.9
	36-45 years old	83	20.8
	46-55 years old	37	9.2
	Above 56 years old	18	4.4
	Total	401	
Education	High Schools and Below	12	3.0
	Certificate and Diploma	129	32.2
	Professional Certificate	9	2.2
	Bachelor Degree	216	53.9
	Master Degree	35	8.7
	Total	401	
Experience	5 years & below	166	41.4
	6 to 10 years	113	28.2
	11 to 15 years	52	12.9
	16 to 20 years	30	7.5
	Over 21 years	40	10.0
	Total	401	
Position	Project Manager/Sr Manager	65	16.2
	Engineer	108	26.9
	Supervisor/Coordinator	139	34.7
	SHO/SSS/Safety Profession	48	12.0
	QS	9	2.2
	Others	32	8.0
	Total	401	
Project Details			
No. of workers employed per site	Less than 100	72	18.0
	100 to 499	197	49.1
	500 and above	132	32.9
	Total	401	
Type of Project	Landed Property	35	8.7
	Strata Property < 20 Storey	20	5.0
	Strata Property ≥ 20 Storey	261	65.1
	Infrastructure	30	7.5
	Mall	55	13.7

	Total	401	
Method of Construction	IBS	18	4.5
	System Formwork	93	23.2
	Conventional	31	7.7
	Mix of System and Conventional	259	64.6
	Total	401	
ISO Certification	OSH	144	35.9
	OSH + QMS	75	18.7
	OSH + EMS	15	3.7
	OSH + QMS + EMS	167	41.7
	Total	401	

The studied variables, namely safety rules and procedures, supportive environment, safe acts, adoption of OHSMS, safety performance, company competitiveness and financial performance were presented with descriptive analyses of its mean and standard deviation. These provide a representative value of the entire data set. It measures the central tendency of a probability distribution. However, a standard deviation is used to measure the dispersion of a dataset relative to its mean. Specifically, it measures the typical distance between each data point and the mean. As it measures the absolute variability of a distribution, the higher the dispersion the greater is the standard deviation.

Table 5.3 presents both the means and standard deviation of all the variables employed in this study.

Table 5.3 - Means and Standard Deviations for the Variables

Variables	Mean*	Standard Deviation
Safety Rules & Procedures	4.3099	0.5557
Supportive Environment	4.2951	0.5565
Safe Acts	4.2519	0.5523
Adoption of OHSMS	4.2896	0.5662
Project Safety Performance	4.0559	0.8714
Company Competitiveness	4.1032	0.6356
Project Financial Performance	3.9563	0.6835

Note. * Five-points scale: 1= Strongly disagree; 5 = Strongly agree

5.7 Validating the Measurement Model

In this research, CFA was used to retrieve model fit and examine the convergent and discriminant validity. As illustrated in Table 4.11, the criteria for model fit include RMSEA < 0.08, GFI > 0.9, CFI > 0.9, TLI > 0.9, NFI > 0.9, Chisq/df < 5.0. Hair et al. (2014, p583) recommended that at least one fitness index from each category must be complied, for the model to be deemed fit. Also, all items must have factor loading > 0.5 and no greater than 1.0 and positive.

CFA was performed to determine the interrelationship between safety rules & procedure, supportive environment, safe acts, adoption of OHSMS, safety performance, company competitiveness and financial performance of project sites in Klang valley.

Figure 5.2 shows the interactions among the constructs, scale items and the goodness-of-fit results.

Table 5.4 indicates that all the CFA indices satisfied the threshold values. All measured items have a factor loading above 0.5 (the range from 0.617 to 0.983, all positive – Appendix F). All values (e.g., RMSEA = 0.049; CFI = 0.936; TLI = 0.928; Normed Chi-Square (χ^2 / df) = 1.961) have achieved the recommended threshold value. It also fulfilled the suggestion by Hair et al. (2014), that at least one fitness index from each category exists. Based on the above justification, it confirms that the measurement model for the study is reasonably fit. Once the criteria and acceptance of model fit have been determined, the next step is to establish the reliability and validity (convergent and discriminant) tests.

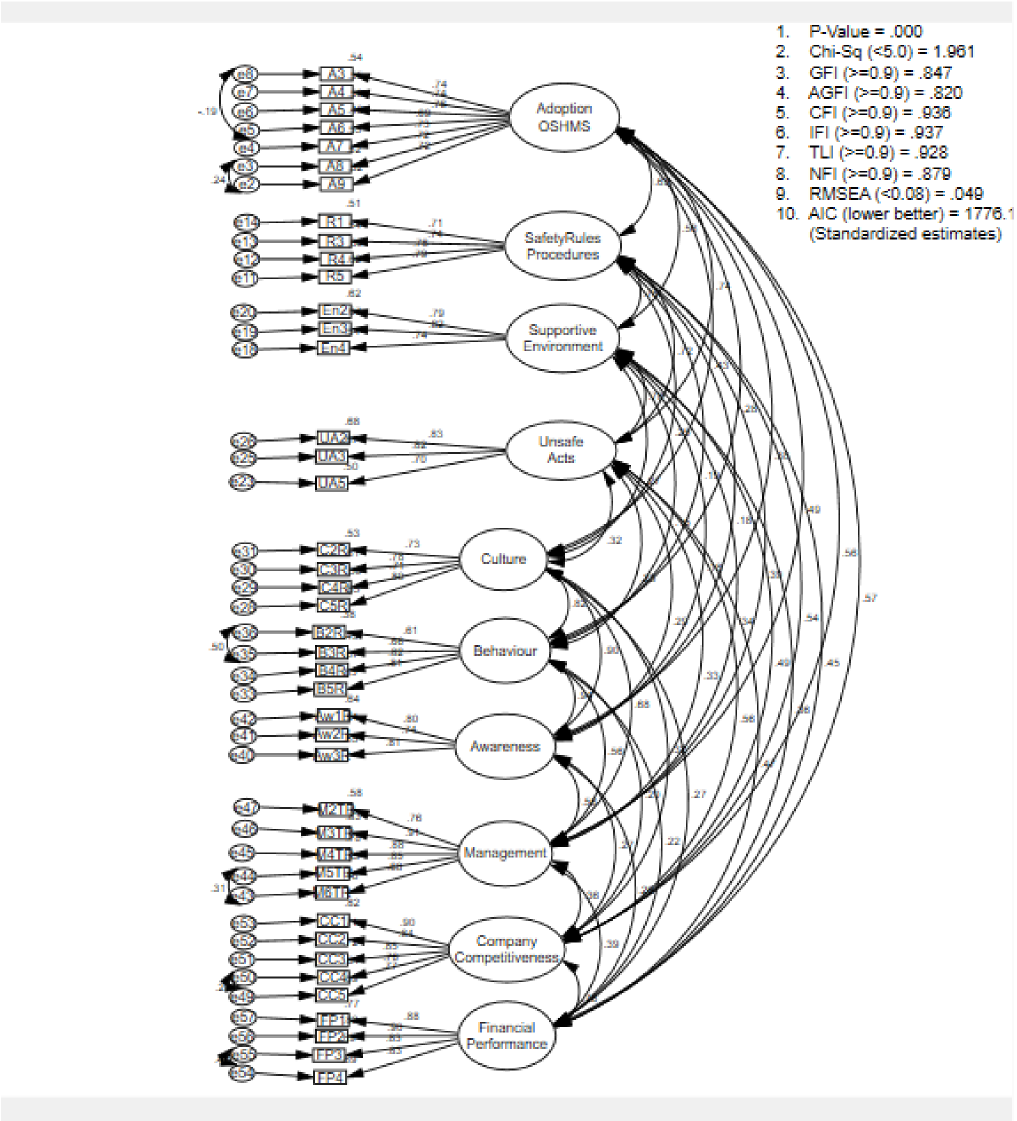


Figure 5.2- CFA Diagram

Table 5.4 - Goodness-of-fit results for the Measurement Model

Goodness of Fit Statistics	Desired Range of values for a good fit	Values
Root-Mean Square-Error of Approximation (RMSEA)	≤ 0.08	0.049
Comparative-Fit-Index (CFI)	> 0.90	0.936
Tucker Lewis Index (TLI)	> 0.90	0.928
Normed Chi-Square (χ^2 / df)	< 5.0	1.961
Chi-Square		1617.622
Degree of Freedom		788

5.7.1 Convergent Validity Test

Standardised loading estimates are used to determine how strongly items are related to their associated constructs. Hair et al. (2014, p605) recommended that loadings of these scales should be 0.5 or highly, ideally 0.7 or higher to indicate construct validity. However, the cut-off points of 0.6 is still acceptable, due to fact that the squared multiple correlation of less than 0.4 is deleted to improve Average Variance Extracted (AVE). Thus, for the propose of this study, variable items with loading less than 0.60 are discarded. Table 5.4 present the factor loading estimates of all the variables in this study. Safety rules & procedures (0.710 to 0.789), supportive environment (0.741 to 0.817), safe acts (0.702 to 0.826), adoption of OHSMS (0.686 to 0.759), company competitiveness (0.766 to 0.851), financial performance (0.828 to 0.905) and safety performance (0.649 to 0.983). As the factor loading (>0.60) for the entire observed variables exceeded the cut-off values, all the items fulfilled the requirements of convergent validity as recommended by Hair et al. (2014). As stated in Table 5.4, the values of AVE are Safety rules & procedures (0.567), supportive environment (0.612), safe acts (0.617), adoption of OHSMS (0.532), company competitiveness (0.688), financial performance (0.741) and safety performance (0.771).

Cronbach's alpha (CA) and composite reliability (CR) are two scales that measure the reliability of each variable in this study. If both the above values exceed or equal to the recommended level of 0.70 (Hair et al., 2014), a variable is deemed reliable. However, Cronbach's alpha is sensitive to the quantity of tested items, as a larger number will give rise to a larger alpha. It was argued by some scholars that this phenomenon underestimates the issue of reliability of the variables. Based on these contentions, both Cronbach's alpha and composite reliability values are included in this study.

Table 5.5 shows the Cronbach's alpha and composite reliability values for each variable. Safety rules & procedures (CA=0.838; CR=0.839), supportive environment (CA=0.823; CR=0.825), safe acts (CA=0.824; CR=0.828), adoption of OHSMS (CA=0.887; CR=0.888), company competitiveness (CA=0.918; CR=0.916), financial performance (CA=0.928; CR=0.920) and safety performance (CA=0.933; CR=0.929). Overall, the values of Cronbach's alpha and composite reliability values exceed the threshold of 0.70, confirming that all the items fulfilled the requirements of construct reliability.

Table 5.5 - Convergent Validity and Reliability of the Variables in Study

Variables	F.L.	C.A.	C.R.	AVE
First Order Variables				
Safety Rules & Procedures				
1) The safety rules and procedures followed in my company are sufficient to prevent incidents occurring.	0.710	0.838	0.839	0.567
2) My supervisors and managers always try to enforce safe working procedures.	0.735			
3) Safety inspections are carried out regularly.	0.775			
4) The safety procedures and practices in this organisation are useful and effective.	0.789			
Supportive Environment				
1) My organisation's employee often reminded each other on how to work safely.	0.787	0.823	0.825	0.612
2) My organisation's employee believes that it is our business to maintain a safer and healthier workplace.	0.817			
3) My organisation's employee always offers help when needed to perform the job safely.	0.741			
Safe Acts				

Notes. Recommended thresholds: Factor Loading (F.L). > 0.60; Cronbach's Alpha (C.A.) > 0.7; Composite Reliability (C.R.) > 0.7; Average Variance Extracted (AVE) > 0.5, (Hair et al., 2014).

1) Ensure the highest levels of safety when they conduct the job.	0.823	0.824	0.828	0.617
2) Use the correct safety procedures for conducting the job and know safety issues.	0.826			
3) Helping co-workers in safety learning and implementation.	0.702			

Variables	**F.L.**	**C.A.**	**C.R.**	**AVE**
First Order Variables				
Adoption of OHSMS				
1) My organisation has established quantifiable occupational safety and health objectives	0.734	0.887	0.888	0.532
2) My organisation monitors occupational safety and health cost and benefits	0.745			
3) My organisation has established the role and responsibilities with respect to occupational safety and health programs.	0.759			
4) My organisation has documented procedures for occupational safety and health.	0.686			
5) My organisation provides appropriate training for its employees.	0.731			
6) My organisation conducts occupational safety and health audit on a regular basis.	0.726			

7) My organisation conducts reassessment on occupational safety and health on a regular basis.	0.721			

Company Competitiveness				
1) Product quality.	0.902	0.918	0.916	0.688
2) Productivity.	0.842			
3) Customer Satisfaction.	0.851			
4) Reputation.	0.778			
5) Innovation.	0.766			

Project Financial Performance				
1) Financial profitability	0.876	0.928	0.920	0.741
2) Growth in market share	0.905			
3) Growth in profit	0.833			
4) Improved profit/sales	0.828			

Variables	**F.L.**	**C.A.**	**C.R.**	**AVE**
Second Order Variables				
Project Safety Performance				
Safety Culture	0.929	0.933	0.929	0.771
Safety Behaviour	0.912			
Safety Awareness	0.983			
Management Commitment	0.649			
First Order Variables				
Safety Culture				
1) Difficulties in communication towards foreign workers.	0.738	0.824	0.617	0.828

2) Risk assessment is not practicable at workplace	0.770			
3) Workers are not likely to report incidents/accidents.	0.709			
4) Decision making does not involve all organisation.	0.805			
Safety Behaviour				
1) Discipline issues.	0.617	0.831	0.819	0.535
2) Irresponsible attitude of the workers during working or handling machines.	0.658			
3) Fatigue caused by working overtime.	0.834			
4) Working for incentives	0.793			
Safety Awareness				
1) Differences in age, with different level of awareness.	0.770	0.821	0.826	0.612
2) Lack of accident records and official safety data.	0.757			
3) Not well educated.	0.819			

Variables	**F.L.**	**C.A.**	**C.R.**	**AVE**
First Order Variables				
Management Commitment				
1) Fail to nominate SHO (Safety and Health Officer) that comply with OSHA regulations	0.757	0.913	0.910	0.672
2) Lack of communication between manager and Safety and Health Committee	0.909			

3) Lack of commitment to OSHA 1994.	0.881
4) Lack of communication between manager and worker.	0.857
5) Inadequate PPE at Work Regulations 1992 (FMA 1967).	0.672

Notes. Recommended thresholds: Factor Loading (F.L). > 0.60; Cronbach's Alpha (C.A.) > 0.7; Composite Reliability (C.R.) > 0.7; Average Variance Extracted (AVE) > 0.5, (Hair et al., 2014).

The research findings for factor loadings, Cronbach's alpha, composite reliability and AVE were above the recommended threshold, indicating that the convergent validity and construct reliability for the model were considered as adequate and satisfactory. The next step for further assessment of the model is to perform discriminant validity test as follows.

5.7.2 Discriminant Validity Test

Discriminant validity testing demonstrates the existence or non-existence of a relationship between measures of constructs. Its objective is to discriminate between dissimilar measures of constructs. In other words, the construct measures what it is intended to measure. One method to evaluate the existence of discriminant validity is to compare the AVE for any two constructs with the square of the correlation estimate between the two constructs. The AVE should be higher than the square correlation estimate (Fornell and Larcker 1981). Another method is by examining the cross loadings of the indicators. The loading of each indicator should be higher than all of its cross-loadings (Henseler et al. 2009).

For this study, the discriminant validity testing adopts the Fornell and Lacker (1981) recommendation. In this respect, Table 5.6 shows that the square root of AVE (bold italic) exceed the correlations between variables (off-diagonal in corresponding rows and columns). Hence the measured variable is deemed fit and closely relate to its latent construct. In subsequent SEM analysis, the variables verified convergent and discriminant validity will be adopted.

Table 5.6 - Discriminant Validity Test

	AVE	CR	Adoption 0f OHSMS	Safety Rules & Procedures	Supportive Environment	Unsafe Acts	Project Safety Performance	Company Competitiveness	Project Financial Performance
Adoption 0f OHSMS	0.532	0.888	***0.729***						
Safety Rules & Procedures	0.567	0.839	*0.555*	***0.753***					
Supportive Environment	0.612	0.825	0.472	*0.718*	***0.782***				
Safe Acts	0.617	0.828	0.716	0.697	*0.761*	***0.785***			
Project Safety Performance	0.771	0.929	0.401	0.206	0.203	*0.289*	***0.878***		
Company Competitiveness	0.688	0.916	0.512	0.487	0.440	0.524	*0.273*	***0.829***	
Project Financial Performance	0.741	0.920	0.523	0.383	0.289	0.429	0.266	*0.737*	***0.861***

Note: The diagonal entries (in Bold and Italics) represent the squared roots average variance.

The off-diagonal entries (in italics) represent the variance shared between constructs

5.8 Structural Equation Modelling

Structural equation modelling (SEM) is designed to establish a theoretical causal relationship model consisting of a set of predicted covariances between variables and whether it is valid when compared to the observed data. This technique tests the interrelationships of safety rules and procedures, supportive environment, safe acts, adoption of OHSMS, safety performance, company competitiveness and financial performance for OHSAS 18001 / ISO 45001 certified projects in Klang valley. The resultant structural model was to determine whether it is fit and valid prior to proceeding with analysis of structural links.

5.8.1 Model Fit

Prior statistical evidence as summarised in Table 5.7 has confirmed that the structural model for this study is deemed fit. Moreover, it also satisfied the recommendation by Hair et al. (2014). Thereafter the path analysis for the hypothesised relationship will proceed to the succeeding sections.

Table 5.7 - Goodness-of-fit (GOF) results for the Structural Model

Goodness of Fit Statistics	Desired Range of values for a good fit	Values
Root-Mean Square-Error of Approximation (RMSEA)	≤ 0.08	0.055
Comparative-Fit-Index (CFI)	> 0.90	0.916
Tucker Lewis Index (TLI)	> 0.90	0.909
Normed Chi-Square (χ^2 / df)	< 5.0	2.219
Chi-Square		1773.077
Degree of Freedom		799

5.8.2 Path Analysis

The goodness-of-fit indices (Table 5.7) indicated that the research model meet the stipulated criteria. This shows that the developed conceptual model represents workplace practices at the project sites (Jabareen, 2009). Table 5.8 describes the path significance and standardised path coefficients of the structural model. In addition, it was indicated that safety rules & procedures ($\beta = 0.249$, $p < 0.05$), and safe acts ($\beta = 0.596$, $p < 0.001$) had positive and significant effect on adoption of OHSMS. In comparison, safe acts had more significant impact on adoption of OHSMS in construction project in Klang Valley.

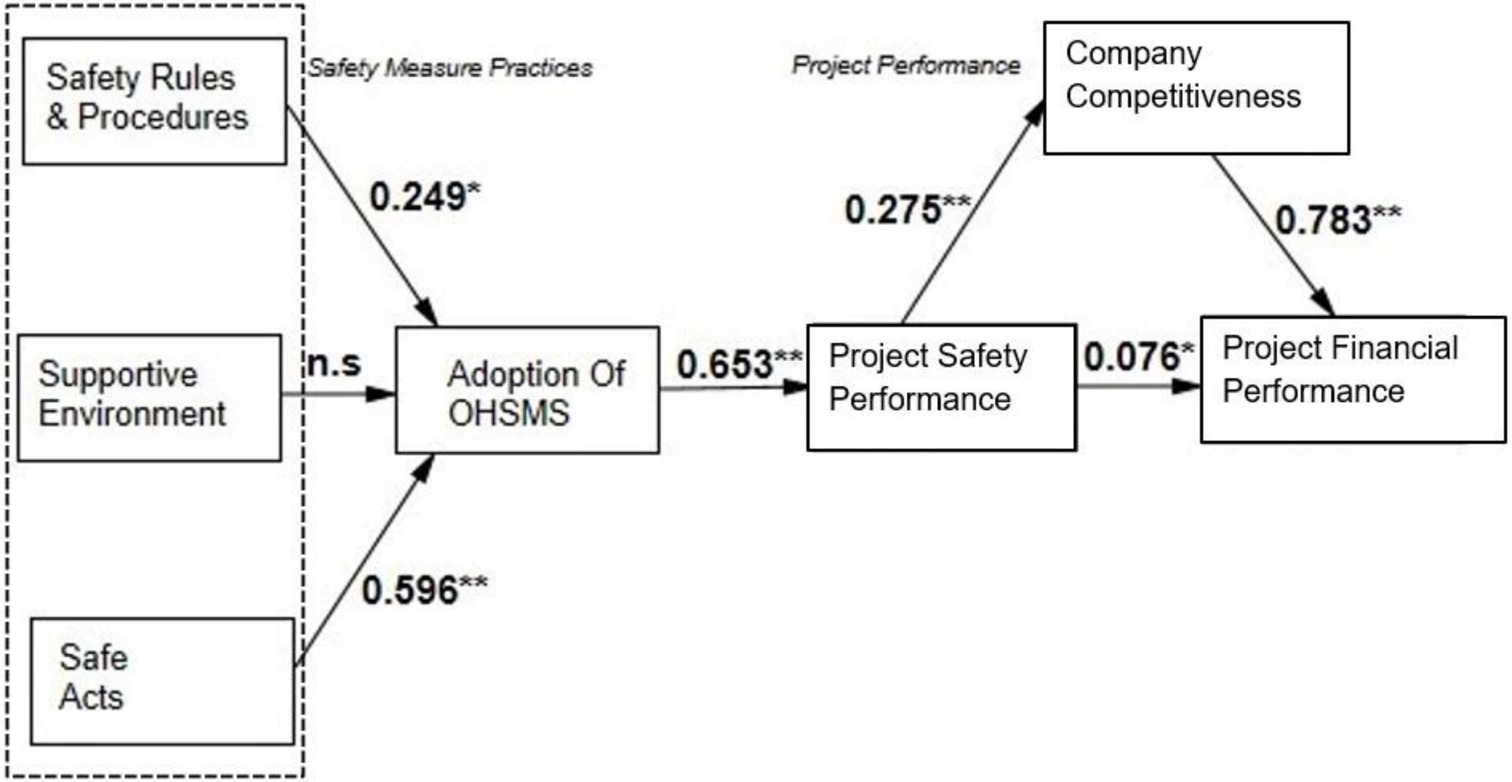
The adoption of OHSMS has a positive and prominent effect on safety performance ($\beta = 0.653$, $p < 0.001$), financial performance ($\beta = 0.076$, $p < 0.05$), and company competitiveness ($\beta = 0.275$, $p < 0.001$). Furthermore, financial performance ($\beta = 0.783$, $p < 0.001$) is positively influenced by company competitiveness.

The results of path analysis shown in Table 5.8 and Figure 5.3, disclosed that only six hypothesised paths in the research model were significant, with the exception of supportive environment (H2) Whilst company competitiveness (H8) mediates the relationship between safety performance and financial performance is the focus of discussion in the subsequent sections.

Table 5.8 Results of Path Analysis

Paths	β	SE	Beta	CR	P value
H1: Safety Rules & Procedures → Adoption OHSMS	0.249	0.078	0.277	3.189	0.001
H2: Supportive Environment → Adoption OHSMS	-0.169	0.098	-.178	-1.72	0.085
H3: Safe Acts → Adoption OHSMS	0.596	0.092	0.675	6.483	0.000
H4: Adoption OHSMS → Project Safety Performance	0.653	0.087	0.441	7.525	0.000
H5: Project Safety Performance → Company Competitiveness	0.275	0.047	0.324	5.804	0.000
H6: Project Safety Performance → Project Financial Performance	0.076	0.038	0.083	1.968	0.049
H7: Company Competitiveness → Project Financial Performance	0.783	0.061	0.729	12.739	0.000

Note. SE: Standardised Error; CR: Critical Ratio



Note. ** p-value < 0.001; * p-value < 0.05; n.s. = not significant

Figure 5.3 – Standardised Path Coefficients

5.8.3 Testing Mediating Effects

Figure 3.2 shows the proposed research model with one hypothesised mediation effect (company competitiveness) between project safety performance and project financial performance. The present research has adopted three different methods to address the mediating effect. These are Baron and Kenny's causal steps tests, bootstrapping (analysed with the use of SPSS pertaining to mediation model and direct model), and Sobel's Z test.

To infer mediation, Baron and Kenny's (1986) causal steps highlighted four prerequisites The data analysis for the study are presented as follows:

Legend: Independent variable/Project Safety Performance – (X)

Dependent variable/Project Financial Performance – (Y)

The mediator/Company Competitiveness – (M)

Criterion 1:

(X) was a key predictor of (Y). Hence project safety performance was significant and positively influence project financial performance ($b=0.317$, $CR=5.719$, $p<0.001$). Thus, criterion 1 is met.

Criterion 2:

(X) was a significant predictor of (M). The results showed that project safety performance was essential and positively affect company competitiveness ($b=0.083$, $CR=5.804$, $p<0.001$). As such, criterion 2 is satisfied.

Criterion 3:

(M) was an important determinant of the (Y). The result indicated that Company Competitiveness significantly and positively affect project financial performance ($b=0.237$, $CR=12.739$, $p<0.001$). Therefore, criterion 3 is achieved.

Criterion 4:

The effects of project safety performance (X) on project financial performance (Y) were decreased when company competitiveness (M) was included. The unstandardised coefficient (b) decreased from 0.317 to 0,083, but remained statistically significant at $p < 0.05$. Thus, criterion 4 was also fulfilled in that M partially mediated between X and Y.

Besides the four criteria, the Sobel's test ($Z = 5.324$, $p < 0.001$) – Appendix G also concurred that company competitiveness has an indirect effect of 0.237 between project safety performance and project financial performance.

Based on 5000 samples bootstrapping estimation indicated the two tailed significance $p < 0.001$ with lower bounds of 0.153, and upper bounds of 0.328. The Kappa Squared (K^2) – Appendix H, measures the effect size equal to 0.303, which indicates a large effect (Cohen, 1988). These results indicated that company competitiveness only partially mediated with large effect between project safety performance and project financial performance. Thus, hypothesis H8 of this study is affirmed.

Table 5.9 provides the statistical findings of bootstrap results of the mediation effect.

Table 5.9: Bootstrap Results of Mediation Effect of Company Competitiveness between Project Safety Performance and Project Financial Performance

Model			95% CI BC		
Hypothesised Paths	Beta	p	LB	UB	K2
Direct Model					
Proj Safety Perf → Proj Financial Perform	0.317	0.000			0.303
Mediation Model	Decreasing				
Proj Safety Perf → Proj Financial Perform	0.083	0.049			
Standardised Indirect Effect (SIE)	0.237	0.000	0.153	0.328	
Result – PARTIAL MEDIATION with large effect					

5.9 Outcomes of Research Objectives

(a) Safety Rules & Procedures and Safe Acts of safety measure practices have a positive impact on the Adoption of Occupational Safety and Health Management Systems.

(b) The Adoption of Occupational Safety and Health Management Systems have significant effect on Project Safety Performance, which in turn positively improve both Company Competitiveness and Project Financial Performance. Ultimately, Company Competitiveness have a positive impact on Project Financial Performance.

(c) The research structural equation model was formulated in figure 3.2. Table 5.8 showed the outcome of the path analysis amongst the constructs, while Table 5.10 presented the summary of hypotheses testing. The results affirmed that all the developed hypotheses have been supported with the exception of hypothesis H2. Another noticeable finding of this study revealed that Company Competitiveness served as partial mediator with large effect in the link between Project Safety Performance and Project Financial Performance in Malaysian construction industries.

Table 5.10: Summary of the Hypotheses Testing

	Hypotheses	Supported by Data
H1	Safety Rules & Procedures have a positive and significant effect on Adoption of OHSMS.	Yes
H2	Supportive Environment have a positive and significant effect on Adoption of OHSMS.	No
H3	Safe Acts have a positive and significant effect on Adoption of OHSMS.	Yes
H4	Adoption of OHSMS have a positive and significant effect on Project Safety Performance.	Yes
H5	Project Safety Performance have a positive and significant effect on Company Competitiveness.	Yes
H6	Project Safety Performance have a positive and significant effect on Project Financial Performance.	Yes
H7	Company Competitiveness have a positive and significant effect on Project Financial Performance.	Yes
H8	Company Competitiveness mediates the relationship between Project Safety Performance and Project Financial Performance.	Yes

5.10 Case Studies

5.10.1 Supportive of quantitative findings with case studies

Case studies are empirical investigations that delves into a phenomenon within a real-life context. It involves examining one or more cases to gain a comprehensive understanding, often aiming to illustrate specific issues and their impacts. Typically, case studies emphasize qualitative data collection methods such as observations, interviews, and analysis of primary or secondary sources.

Qualitative research, including interviews, can yield data that are nuanced, rich, and more valid compared to quantitative approaches. However, qualitative methods are not designed to generate statistically generalizable inferences, and they require significant time and effort, making large-scale studies impractical.

In some cases, alongside qualitative data, a case study may also incorporate quantitative data, exemplifying a mixed-method approach. Mixed-methods research involves integrating both qualitative and quantitative methods either simultaneously or sequentially to leverage the strengths of each. For instance, in sequential mixing, a researcher might begin with a survey questionnaire to gather quantitative data and then follow up with interviews to delve deeper into participants' experiences and perspectives.

By combining qualitative and quantitative approaches, mixed-methods research has the potential to produce higher-quality insights, as noted by Ruark and Fielding (2016). It allows for complementary and synergistic interactions between different research methodologies, enriching the depth and breadth of the findings.

In the present research, the case study involved interviews of site safety management staff with the homogenous questionnaire in the earlier field surveys. The analysis and outcomes of the case study with qualitative and quantitative data may enhance and further validate the SEM quantitative findings.

The contexts of the interviewee of the case study were designed to simulate the intended objectives of the survey questionnaire carried out at the 33 project sites. The contexts of the questionnaire are based on the constructs of the said conceptual framework, which include ways to improve project safety performance, potential difficulties in implementing Safety Measure Practices (SMPs).

Case studies were conducted through interviews with the 4 project managers and one Safety and Health Officer at 5 of the 33 sites where survey data were gathered. These semi-structured interviews conducted supplement and validate the findings of the survey data analysis.

5.10.1.1 Case Study 1

Project brief

Proposed and completion of 2 blocks of service apartments consisting of 2 blocks of 36 storey, 1066 units (454 and 612) and 8 levels of carpark @ Jalan PJU 8/8, Damansara Perdana, Mukim Sungai Buloh, Daerah Petaling Selangor Darul Ehsan. (D'Vervain)

Contract Sum-RM205,410,000.00

Elevation

Top View

Rating was set at the following manner-

Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	2	3	4	5

The following information was communicated with interviews with the project manager at site who is fully in charge of the project.

Outcome of the interview

The response from project manager

(a) Does practising an effective safety measure practices (Safety rules and procedures, Workers' working behaviour and supportive working environment) at site improve safety performance of the site.

The project manager agreed with the statement. (Rated with a 4)

(b) Does the improvement of safety performance affect the following descriptions. The project manager rated the following statements.

No	Description	Rated	Remarks
1	Reduces rates of injuries	5	Strongly agree
2	Reduces fatal accidents	5	Strongly agree
3	Enhance safer working conditions	4	Agree
4	Improve productivities	3	The project manager perceived that productivities will only improve through innovation; safety performance will not significantly increase productivity.
5	Improve company image	5	Strongly agree
6	Positive effect on financial performance	2	The project manager perceived more money will be spent on safety. The project is yet to complete, there is no costing available for analysis.

(c) The project manager is fully agreed that practising OHSMS will improve safety performance.

Method or process to improve Project Safety Performance

(1) The project manager suggested that improving workers' competency and provide regular training.

(2) Implementing new or better method of construction (such as self-climbing platform) will improve safety performance, however the costs will be higher.

Potential Difficulties in implementing SMPs

(1) The project manager pointed out that the potential difficulties of implementing effective safety measure practices are due to language barrier to communicate with foreign workers. The project is highly dependent on foreign workers, as nearly 80% of the work force are foreigners.

(2) The project manager highlighted that workers do not follow safety instruction. They always take the easy way to complete the tasks.

Evidence of safety and health improvement

(1) No incident reported at site (NADOPOD),

(2) Client satisfaction with no complaint on safety and health, and

(3) The staff turnover is low.

5.10.1.2 Case Study 2

Project brief

Proposed and completion of 45 storey Block C (453 units), 38 storey Block D (307 units) and 45 storey Block E (502 units) at Lot 20, Lot 7573, Lot 7574 Jalan Kelang Lama, Mukim Petaling, Wilayah Persekutuan Kuala Lumpur (Millerz Square).

Contract sums-RM478,000,000.00

Elevation View

Top View

The following information was communicated through interviews with the safety and health manager who is full time at site.

Outcome of the interview

The response from the safety and health manager

(a) Does practising an effective safety measure practices (Safety rules and procedures, Workers' working behaviour and supportive working environment) at site improve safety performance of the site.

The SHO manager agreed with the statement. (Rated with a 4)

(b) Does the improvement of safety performance affect the following descriptions. The project manager rated the following statements.

No	Description	Rated	Remarks
1	Reduces rates of injuries	5	Strongly agree
2	Reduces fatal accidents	5	Strongly agree
3	Enhance safer working conditions	4	Agree
4	Improve productivities	3	Neither agree nor disagree
5	Improve company image	4	Agree
6	Positive effect on financial performance	3	Neither agree nor disagree

(c) The SHO manager is fully agreed that practising OHSMS will improve safety performance.

Method or process to improve Project Safety Performance

(1) The SHO manager suggested that upgrade workers' competency through CIDB training.

(2) During tool box meeting or training, ensure the new foreign workers understand the work procedure/instruction through translator.

(3) Additional site safety supervisor from the subcontractor shall improve overall safety performance of the project.

Potential Difficulties in implementing SMPs

(1) The SHO Manager pointed out the potential difficulties of implementing effective safety measure practices are: - very difficult to influence/command over the subcontractors' management due to the long-term relationship with them.

(2) More allocation to replace older equipment.

Evidence of safety and health improvement

(1) No incident reported at site.

(2) Client satisfaction with safety and health implementation at site.

5.10.1.3 Case Study 3

Project brief

Proposed and completion of 43 storey Block A (339 units) and 44 storey Block B (339 units) at Lot 1136 and Lot 45637 Jalan Kelang Lama, Mukim Petaling, Wilayah Persekutuan Kuala Lumpur (Millerz Square)

Contract sum- RM200,000,000.00

Elevation Level 8

The following information was communicated through interviews with the senior project manager at site who is full time at site.

Outcome of the interview

The response from the senior project manager,

(a) Does practising an effective safety measure practices (Safety rules and procedures, Workers' working behaviour and supportive working environment) at site improve safety performance of the site.

The senior project manager agreed with the statement. (Rated with a 5)

(b) Does the improvement of safety performance affect the following descriptions. The project manager rated the following statements.

No	Description	Rated	Remarks
1	Reduces rates of injuries	5	Strongly agree
2	Reduces fatal accidents	5	Strongly agree
3	Enhance safer working conditions	5	Strongly agree
4	Improve productivities	5	Strongly agree
5	Improve company image	5	Strongly agree
6	Positive effect on financial performance	5	Strongly agree

(c) The senior manager manager is fully agreed that practising OHSMS will improve safety performance.

Method or process to improve Project Safety Performance

(1) The senior project manager suggested that additional and frequent safety and health training needed as reminders to the workers.

(2) Observation and feedback on training to ensure the workers understand the trainings.

Potential Difficulties in implementing SMPs

(1) Workers' stubbornness for a easy way out.

(2) Language barrier for foreign workers, over 80% are foreign workers.

(3) Insufficient budget for safety and health programme.

Evidence of safety and health improvement

(1) No incident reported at site.

(2) Client satisfaction from customer feedback forms.

5.10.1.4 Case Study 4

Project brief

Proposed and completion of 3 blocks of apartments (1512 units) consisting of Block D – 42 storey (460 units), Block E – 42 storey (460 units), Block F – 42 storey (592 units) and 8 storey of carpark levels at Lot PT 26890, Jalan Metro Perdana Barat, Kepong, Mukim Batu, Daerah Kuala Lumpur, Wilayah Persekutuan. (Mizumi)

Contract Sum-RM 311,838,029.00

The following information was communicated with interviews with the project manager at site who is fully in charge of the project.

Outcome of the interview

The response from project manager

(a) Does practising an effective safety measure practices (Safety rules and procedures, Workers' working behaviour and supportive working environment) at site improve safety performance of the site.

The project manager agreed with the statement. (Rated with a 4)

(b) Does the improvement of safety performance affect the following descriptions. The project manager rated the following statements.

No	Description	Rated	Remarks
1	Reduces rates of injuries	4	Agree
2	Reduces fatal accidents	4	Agree
3	Enhance safer working conditions	4	Agree
4	Improve productivities	4	Agree
5	Improve company image	4	Agree
6	Positive effect on financial performance	3	The project manager perceived more money will be spent during early stage of implementation.

(c) The project manager is fully agreed that practising OHSMS will improve safety performance.

Method or process to improve Project Safety Performance

(1) Safety policy / plan must be communicated well to all parties concerned.

(2) HIRARC must be done with the project team members (include subcontractor) and reviewed regularly.

(3) Increase safety awareness through on-site training.

(4) Regular inspection to be carried out regularly at site by the project team members and include DSC and NSC. Appropriate correction action must be taken against those who breach the safety policy/plan.

Potential Difficulties in implementing SMPs

(1) Some project stakeholders are stubborn and resist new changes to what they are practicing now.

(2) Inadequate manpower and resources to implement SMP.

(3) Language barrier for foreign workers to understand SMP during safety toolbox meeting and safety training.

(4) SMP must be continuously implemented, controlled and monitored throughout project lifecycle.

Evidence of safety and health improvement

(1) There is reduced accident rate and zero fatal accident at site.

(2) Lesser complaints received from project stakeholders and Authorities.

5.10.1.5 Case Study 5

Project brief

Proposed and completion of 4 blocks of service apartment (2136 units) at Lot 43436, 43437 (PT9257), 43438 (PT9258), 43439 and Plot 1, Mukim Petaling, Kuala Lumpur (Majestic Maxim).

Contract Sum-RM398,746,356.00

The following information was communicated through interviews with the senior project manager at site who is full time at site.

Outcome of the interview

The response from the senior project manager,

(a) Does practising an effective safety measure practices (Safety rules and procedures, Workers' working behaviour and supportive working environment) at site improve safety performance of the site.

The senior project manager agreed with the statement. (Rated with a 5)

(b) Does the improvement of safety performance affect the following descriptions. The project manager rated the following statements.

No	Description	Rated	Remarks
1	Reduces rates of injuries	4	Agree
2	Reduces fatal accidents	4	Agree

3	Enhance safer working conditions	4	Agree
4	Improve productivities	3	Neither agree nor disagree
5	Improve company image	4	Agree
6	Positive effect on financial performance	4	Agree

(c) The senior project manager is fully agreed that practising OHSMS will improve safety performance.

Method or process to improve Project Safety Performance

(1) Conduct regular training

(2) Provide CIDB competency training

(3) Encourage workers to participate actively and feedback.

Potential Difficulties in implementing SMPs

(1) Language barrier for foreign workers.

Evidence of safety and health improvement

(1) Reduction of injury.

(2) Client satisfaction with safety practices.

5.11 Summary of the 5 Case Studies

As per the tabulations of the ratings and comments given by the project managers and Safety & Health Officer as at Table 5.11.

Table 5.11: Summary of 5 Case Studies

Description	Case 1	Case 2	Case 3	Case 4	Case 5	Mean
Does practising an effective safety measure practices (Safety rules and procedures, Workers' working behaviour and supportive working environment) at site improve safety performance of the site.	4	4	5	4	5	4.4
Does the improvement of safety performance affect the following descriptions. The interviewee rated the following statements						
(a) Reduces rates of injuries	5	5	5	4	4	4.6
(b) Reduces fatal accidents	5	5	5	4	4	4.6
(c) Enhance safer working conditions	4	4	5	4	4	4,2
(d) Improve productivities	3	3	5	4	3	3.6
(e) Improve company image	5	4	5	4	4	4.4
(f) Positive effect on financial performance	2	3	5	3	4	3.4
The interviewee is fully agreed that practising OHSMS will improve safety performance.	yes	yes	yes	yes	yes	

The following statements and conclusions have emerged: -

(a) Practising an effective safety measure practices will improve safety performance of the site.

(b) The improvement of safety performance will result in reducing rates of accidents, fatal casualties, enhance working conditions and improves company image. However, there is no significant effect on both the productivities and financial performance.

(c) Practising OHS Management System will improve safety performance.

The common main methods of improvement in safety performance suggested by the interviewees were providing training and upgrade of workers' competency.

The potential difficulties in implementing safety measure practices were language barrier with the foreign workers and their stubborn attitude to accept new ideas but stick to the old method as an easy way out.

The semi-structured interview questions of 5 cases of study were listed in Appendix I.

The outcomes of the interviews are closely aligned with the findings of objective 1 and 2 of the data analyses that practising an effective safety measure practices and OHSMS will have a direct impact and improvement of safety management at site.

5.12 Conclusion

This chapter summarises the results of the questionnaire survey. These include characteristic descriptive statistics of the sample, contextual factors of the projects, and confirmatory factor analysis (factor loading, convergent validity and construct reliability). This was followed by inferential statistical analysis using SEM, Baran and Kenny's causal steps test, and bootstrapping estimates to address and justify the hypotheses developed in this study. It also analysis the outcome of the 5 cases of study through semi-structured interviews with project manager and Safety and Health Officer.

Following these findings, the subsequent chapter will discuss major disclosures from past researches, providing new insights to the Malaysian construction industry.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

Chapters 1 to 5 have outlined the aims of this research, literature review and research methodology, together with analyses of the data collected. The first section of this chapter discusses the synopsis and reviews of earlier findings. Subsequently, the implications of theoretical perspective and practical approach are noted, and limitations of the study are also highlighted. The final section concludes with a discourse on the contributions of the study in the Malaysian construction industry, together with recommendations for future studies.

6.2 Recapitulation of the Study

This research was developed on the premise of safety and health management in construction projects. It was revealed that the practices of safety measure can be implemented via safety rules & procedures, together with supportive environment and influence on the workers' safety awareness behaviour. In addition to this, implementation of safety measures practices within an OHSMS certified workplace shall improve safety performance and enhance project performance.

It also disclosed that safety performance, company competitiveness and financial performance were interrelated and were essential in developing a safe workplace of a project. Project performance was improved in terms of better quality, customer satisfaction, reputation, innovation, profit and market share. Moreover, this study also found that company competitiveness partially mediates with large effect between safety performance and financial performance.

The following noteworthy outcomes were observed from the study data gathered:

- Safety rules & procedures and workers' behavioural actions produce a positive influence on the OHS management system.
- Adoption of OHS management system has a notable impact on a project safety performance.
- Project safety performance is substantially related to company competitiveness and project financial performance.
- Company competitiveness is significantly related to project financial performance.
- Company competitiveness is the mediating factor between project safety performance and project financial performance.

6.3 Review of the Findings

The results from the testing of research objectives and hypotheses are discussed as follows:

6.3.1 *The relationship between Safety Rules & Procedures and Adoption of OHS management system*

The ultimate aim of OHS management system is centred on the wellbeing of workers at their work site. Its implementation incorporates procedures and processes that serve to enhance positive workplace, protecting, preserving and promoting health and safety. In the current trend, practising OHS management system is no more a privilege of a construction company, rather it is an essential part of the business activity. As such, more and more companies are taking up registration and certification of OSH management system. Over the years, JKKP and Niosh Malaysia have been promoting the OHSMS to the industries. JKKP also initiated the implementing of SHASSIC evaluation at project sites by providing incentives to obtain free CCD points for contractor to renew CIDB annual license. SHASSIC evaluation involved high loading on the documentation of standard operating procedure (SOP) and on workers' involvement and understanding of these SOP.

Past studies have reported that safety rules & procedures played an essential and significant role in reducing accidents (Vinodkumar and Bhasi 2011). The design of safety rules & procedures in this study was based on the research by Vinodkumar and Bhasi (2011), hence highlighting their results and reviews is necessary. Their study compared three groups of organisations, namely - certified with non-certified organisations; only OHSAS 18001 certified organisations; and only OHSAS 18001 certified and ISO 9001 certified firms. It concluded that OHSAS 18001 certified firms possess more superior safety management system (including safety rules and procedures) and safety behaviour compared with other organisations. In these three categories of companies, enforcement of safety rules and procedures was found to be the common predictor of safety behaviour in an organisation. This revelation provides strong empirical support that the theoretical model of antecedent and consequent components of safety performance are closely related.

Statistical results of this study indicated that safety rules & procedures ($\beta = 0.249$, $p<0.05$) positively influence the safety management system. The vital relationship between safety rules & procedures and safety management system is also supported and consistent with previous studies (Tan and Nadeera, 2014: O'Dea and Flin, 2001; Bellamy et al., 2013; Li et al. 2017). Thus, the findings evidently indicate that the implementation of OHSMS is positively enhanced by proper and effective safety rules & procedures.

However, the Malaysia construction industry has recorded high and rising accident rates. The Malaysian construction sector employed a high volume of foreign workers from Indonesia, Myanmar, Bangladesh and others. Safety rules & procedures form the key elements to avoid occupational injuries and accidents. Compared to local workers, foreign workers are more susceptible to injuries due to their different perception of safety rules & procedures. Additionally, foreign workers may lack construction related experience or are unfamiliar with local safety rules & procedures. They are often ignorant of the safety rules and procedures given to them, or understanding it as a result of the language barrier. Between April 2014 and September 2017, data analysed from JKKP Malaysia reviewed that 57 fatalities out of 200 cases reported were due to inadequate or nil safe operating procedures (highest amongst the known cause of fatality, Table 1.1). Based on the detail breakdown of the surveyed questionnaire, the systematic approach of safety rules & procedures are mostly in place. However, the most likely shortcoming to its implementation and understanding by both local and foreign workers is insufficient awareness and deficiency of the existing system,

6.3.2 *The relationship between Safe Acts and Adoption of OHSMS*

In this research, the relationship between workers' behavioural actions and adoption of OHS management system has also been explored. Most of the accidents happened due to unsafe acts and hazardous conditions. It was reported that as many as 88% of workplace injuries are a result of unsafe acts committed by the workers (Heinrich H W, 1931). Unsafe acts in workplace are behavioural in nature, such as taking short cuts, being complacent, over-confidence, ignoring rules and procedures or poor attitudes including improper or failure to use PPE, or operate defective equipment. As mentioned, workers behave recklessly because they wanted to show others that they are tough guys, more experienced, as well as due to co-worker encouragement (peer pressure) to undertake risky tasks, to exhibit their work skills, or to become notable in the eyes of the boss.

It was earlier affirmed that a significant positive relationship exists between adoption of OHSMS and unsafe acts in construction projects located in the Klang valley. In other words, any unexpected event which results in injury or illness in a workplace, occurs most likely due to workers' unsafe acts in performing a task.

Aksorn and Hadikusumo (2008), described worker involvement as building favourable safety attitudes and motivation within the constructive norms of the work group and the extent of their involvement in safety activities. Workers' participation affects their attitudes to work and subsequently reduced accident rate. Their study concluded that in the work groups with the lowest accident rate, majority of workers are aware of safety, such as conforming to safety rules, performing jobs safely, and caring for co-workers' well-being. Mature workers guided and directed their co-workers to perform tasks safely. The safety standard is occasionally violated by a few young and seasonal workers. According to Abdelhamid and Everett (2000), unsafe behaviour is one of the chief courses of construction site accidents, whilst workers are a key factor influencing its occurrence (Haslam et al., 2005). So, in order to reduce accidents at site, managing workers' safety attitude and safety knowledge is utmost important (Iraj Mohammadfam et al, 2017).

Due to the fact that Malaysia construction industry employed a high volume of foreign workers, of different cultural backgrounds, management through systematic interaction is more effective. This can be achieved by executing PPE programmes, safety permits, workplace safety inspections, safe work practices, and routine hazardous condition inspection. A safety system is feasible not only on paper (written policies, plans, rules and procedures) but through the workers' behaviours and consequential actions. For the higher-grade workers, who interact necessarily with the safety system and its practices, they need to be upskilled in the area of construction safety.

Furthermore, data and implications from this research are consistent with the study by Wang et al., (2018), that improvement in individual safety awareness and organisational safety climate will contribute to effective safety management by reducing unsafe acts.

6.3.3 *The relationship between Adoption of OHSMS and Project Safety Performance*

Considering the growth in population and higher demand of housing, urbanisation entails higher strata housing to be built in Klang valley. Currently, the norm is to build over 40 storeys in height. Also, purchasers' expectation and marketing strategies, sky gardens and swimming pools at roof level with fancy over-hang structures are the norm. These posed the method of construction to be more hazardous and required better building skills. Falling objects and stability of temporary structures due to higher wind load have become a serious risk. The construction industry has increasingly experienced unprecedented changes and new challenges to all the contractors, subcontractors and workers. Due to these additional threats, adoption of OHSMS is critical for a non-certified OHSMS company and a constant review of the OHSMS for an existing certified company to achieve better safety performance of the project. Improving professional competence will successfully enhance the safety performance of high-rise projects. In practice, the person in charge of the project should appoint professionals or experienced candidates to form a safety management system. Safety measures such as safety training, safety meetings to upgrade workers' safety awareness and encourage correct safety behaviour should be undertaken by the safety manager to ensure effective implementation. The above findings should be deemed appropriate to this study as the survey is made up of 65.1 percent strata properties over 20 storeys in height.

Similar to the finding by Ng et al. (2019) (t-value = 2.068, $p < 0.05$), this study's statistical result of ($CR = 3.189$, $p < 0.05$) revealed that adoption of OHSMS and safety performance were positively associated. Therefore, this result validates that construction projects in Malaysia needed to intensify effectiveness of OHSMS implementation through safety behaviour and attitudes interaction amongst employees and workers, which will significantly impact on safety performance of the projects.

In addition, similar findings from construction projects from other countries such as South Korea, Brazil, Hong Kong, were carried out by Yoon et al. (2013), Benite and Cardoso (2003) and Yiu et al. (2019) respectively.

Past empirical studies from other diverse industries, likewise attest that an effective OHSMS improves safety performance of an organisation (Bottani et al. 2009; Zubar et al. 2014; O'Paas et al. 2015). Therefore, it is indisputable that safety performance rely on an effective implementation of OHSMS at workplace.

Based on the above findings and uphold by existing literature, this study acknowledges that adoption of OHSMS imparts a direct positive influence on safety performance in the Malaysian construction industry.

6.3.4 *The relationship between Project Safety Performance and Company Competitiveness*

Company competitiveness is being defined as customer satisfaction, product quality, reputation and innovation in this study. The result of the statistical analysis indicated that safety performance and company competitiveness ($b = 0.275$, $p < 0.001$) are closely and positively associated. It is evidenced that when projects in the present study implement good safety performance, it reaps superior benefits such as improved customer satisfaction, better product quality and gained higher reputation within the industry. This disclosure is also consistent with well documented past research that safety performance plays a significant role in determining positive company competitiveness (Fernandez-Muniz et al. 2009; Morgado et al. 2019; Chen et al. 2009; Rechenthin 2004; Buhai et al. 2008; Omran et al. 2008).

In a competitive business environment, delivering high quality products is an ongoing concern for many services organisation. Customer requirement is the primary external motivating factor for maintaining a high safety performance. Therefore, it is explicit that safety performance is the precursor of 'customer requirement'.

It was also reported that an efficient safety management system reduces both personal injuries and material damages. With efforts to reduce absenteeism, enhance motivation and maintain workers' loyalty the company can retain skillful workers with specific job knowledge who otherwise are irreplaceable. As a result, higher and better quality in terms of projects' products and services, expanded productivity, elevated consumer satisfaction and distinguished company reputation and image can be achieved. All these advantages shall provide company with a sustainable competitiveness edge over a period of time.

Omran et al. (2008) also pointed out that the effect of good safety management resulted in 68 respondent companies' success in respect of the following; - enhanced the image – 46 companies (67.6%); increase business opportunity – 34 companies (50%). If all the aspects of good safety management, reduce accidents, retain specific knowledge workers, preserve high quality product, up keep customer satisfaction, it implies that the level of company competitiveness can be enhanced. Consequently, the aforesaid confirms that a significant relationship prevails between safety performance and company competitiveness in Malaysia construction industry.

6.3.5 *The relationship between Project Safety Performance and Project Financial Performance*

Workplace safety does not only improve workers' lives. The costs invested in OHSMS will create a better safety performance, less disruptions due to injuries and illnesses, a harmonious workplace and higher productivity, all of which will generate financial gain, directly or indirectly (Yang and Maresova 2020). Therefore, a positive gain is achieved by the company to invest into OHSMS. This study finds that a significant association exists between safety performance and financial achievement ($b = 0.076$, $p < 0.05$). This implies that safety performance was considered to be a determinant factor that influence the profit and profitability of the project.

This aspect is also supported from previous studies by (Fernandez-Muniz et al. 2009; Ikpe et al. 2012; Sousa et al. 2021). In the wake of increasing competition amongst contractors and higher complexity in construction, financial return is an important component of sustainability and long-term benefits of stakeholders. Hence, this positive finding will represent a key catalyst for business enterprises to implement an effective OHS management system to improve safety performance in the project sites.

6.3.6 *The relationship between Company Competitiveness and Project Financial Performance*

Foregoing statistics on company competitiveness and financial performance have revealed a positive relationship between them ($b = 0.783$, $p < 0.001$). This asserts that as company competitiveness (comprising product quality, productivity, customer satisfaction, reputation and innovation) increased, the financial performance (such as profitability, market share and profits) will also improve.

From a business perspective, delivering quality product to meet customer satisfaction is an ongoing concern for many construction projects. It is argued that reputation is created during the handing over of the completed project. Moreover, Lakhal and Pasin (2008) affirmed that improving product quality will increase customer satisfaction. In their review of empirical studies of the relationship between profitability, growth, market value and quality, the highest significant relations were found between quality and profitability (Pignanelli and Csillg, 2008). Another important determinant for the success of company competitiveness is reputation. It was pointed out that reputation reflects a corporation’s public image, which also boost profitability and enhance shareholders’ value (Sanchez and Sotorrio, 2007; Jao et al. 2020). In other words, a higher productivity due to a safe workplace, producing quality product to meet customer satisfaction resulted in enhanced reputation and amplify superior yields and growth in market share (Fernandez-Muniz et al., 2009).

6.3.7 *Company Competitiveness mediates the relationship between Project Safety Performance and Project Financial Performance*

Many past literatures on the construction industry have disclosed that safety performance holds a potential influence on the financial performance of a project (Sousa et al. 2021; Fernandez-Muniz et al. 2009). On the contrary, other researchers are against the idea that a sole relationship between safety performance and financial performance is adequate. It was argued that the roles of other concepts such as company competitiveness (quality, productivity, customer satisfaction etc) were virtually neglected (Mohammadi et al. 2018; Cheng et al., 2012; Lamm et al., 2007;). Hajmohammad and Vachon (2013), pointed out that the actual scope of implemented safety practices mediate the association between safety culture and safety performance. Hence, company competitiveness is included in this study as it plays an imperative role in explaining financial performance.

Previously tested statistics have validated the direct positive relationship between safety performance on financial performance and company competitiveness. Moreover, a company which practices OHSMS accomplished better performance in company competitiveness leading to additional financial gain. A mediation test on the hypothesised relationship indicated that safety performance had an indirect association on financial performance through company competitiveness. Therefore, projects which practice OHSMS should not base financial performance only on safety performance but also consider company competitiveness. A sustainable company competitiveness advantage maximises a business' financial gains through superior value in productivity, quality and cost efficiency (Maudgalya et al. 2008; Wanberg et al., 2013). By offering high quality products and first-rate services at lower cost, a higher level of customer satisfaction is achieved (Lakhal and Pasin, 2008) thereby meeting the company's goals.

Feng et al., (2018) discovered that supply chain management indirectly influenced financial performance through operational performance; Similarly, enterprise risk management practices and financial performance is affected by competitiveness (Yang et al., 2018); Reputation and competitive advantage mediate between corporate social responsibility and firm performance (Saeidi et al., 2015). Supported by all the mentioned evidence, this study provides a validation that safety performance had an indirect and non-linear effect on financial performance and partially mediated by company competitiveness.

6.4 Implications of the Study

Several useful implications were discovered from this study. These implications, both from a theoretical as well as managerial prospective, are presented in the following section.

6.4.1 Theoretical Implications

This study has contributed significant insights to the existing literature on several contexts. From an organisational viewpoint, it was found that well founded safety rules & procedures and safety behaviour play critical roles in maintaining and improving safety performance, consequently safety rules and procedures and safety behaviour of workers are imperative in a construction project. As most site workers' working behaviour and attitudes depend on safety rules & procedures, safety culture, safety behaviour, as well as safety awareness, input from the site safety management team is essential. Also, the evidence revealed that both of these success factors are integrated in the OHS management system, which ultimately has a positive impact on safety performance. Therefore, the relationship between both success factors affirms that adoption of OHSMS should be emphasised as the precedent to safety management when reviewing or updating the safety manual.

Previous studies have revealed that adoption of OHSMS plays a significant role in creating a safe workplace to attain excellent safety performance. Therefore, adoption of OHSMS is perceived as the main determinant in helping the project site to reduce human injuries and property damages. This verification further contributed and reinforced the understanding that adoption of OHSMS by the site safety management team is crucial in relation to the perception of safety performance.

In developing a research framework for the adoption of OHSMS several theoretical implications are unveiled from this study. This is accomplished by incorporating the impacts of safety rules & procedures and safe behaviour in relation to the safety performance model. In addition, the interrelationships between safety performance, company competitiveness and financial performance were further examined. It was found that there was limited studies on the relationship between company competitiveness and financial performance. To fill this lack, the researcher hopes to provide empirical evidence on this subject. A review on construction industry literature also shows scarce information on the mediating effect of company competitiveness.

In summary, this study serves to provide a substantial understanding of the components and relationship of safety management theory in Malaysia construction industry.

6.4.2 Practical Implications

The measured variables in this study give rise to several important practical implications and are worthy of mention.

From a managerial viewpoint it was anticipated that implementation of OHSMS in construction company is a crucial factor for the success of construction projects in Klang valley. This is because an effective OHSMS assists the project to maintain an accident-free workplace and avoids the existence of an inferior company image by the public and authorities. Additionally, an effective OHS management system was found to dominate and enhance superior safety performance, which in turn promote productivity, quality, customer satisfaction and higher financial gains for the company in the long run.

Bearing in mind the importance of adoption of OHSMS, the project PIC including the site safety management team ought to fully comprehend the essence of OHSMS compliances and the principle of Plan-Do-Check-Act cycle. This is to establish OHS objectives by identifying hazards and determining legal and other requirements. Implementation plans should also be created to achieve continuous improvement in the OHS management system. It also involves safety hazards identification, gauging level of risk severity, monitoring, analysis and evaluation to improve safety performance. A considerable business resource is recommended to be allocated for safety management and integrated into other business management systems and strategies. These strategies can allow the decision maker to propel the organisation in a common direction.

The Occupational Safety and Health Act and Regulations and Factories and Machinery Act, sets out mandatory requirement to employ a full time competent SHO with 15 hours per week competent SSS at the project site for project value of RM 20 million and above. Together with the safety management members, this credible team will ensure the safety management processes can be conducted efficiently in order to promote safety awareness amongst the workers at site.

The findings from this study have verified that safety performance of a project was a very effective means to uphold and improve company competitiveness and financial gains. Owing to the importance of safety performance, the project manager or PIC are recommended to recognise the needs for upkeep and upgrade product quality (by a systematic, cohesive workforce) through progressive productivity via innovation of work processes. The project manager needs to oversee safety besides managing other functions of the organisation such as production, maintenance, marketing and finance. They should also focus on providing up to date technology and review method statements to carry out works rather than just routine tasks by the workers. For instance, in relation to high rise building, Self-climbing platforms which protect falling objects at the perimeter façade of the building under construction should be used instead of conventional scaffolding. More industrialised building systems should be used in lieu of conventional method of construction. These systems are able to control consistency in quality and at the same time reduce safety hazard. With these new technologies, the level of risk is reduced and better controlled, which have already proven in other countries.

In terms of compliance, the above practices shall provide a good perception to authorities such as JKKP and CIDB that the construction methods executed by the contractor are beyond the OHSA acts and regulations. It is suggested that the safety management team members should demonstrate excellent efficacy in safety issues especially safety rules & procedures technical skills and professionalism in relation to the construction methods employed in the project. This would minimise disruptions of project due to unwanted conditions imposed by the authorities.

Likewise, this research model should provide a useful guide for project managers to develop and plan project budgeting. It is reiterated that project managers should be aware of the importance of company competitiveness (quality, productivity, customer satisfaction, reputation and innovation) arising from its mediating effects and influence on financial gains. However, increasing company competitiveness is not an easy task due to the influence of many factors, such as time frame to complete the project and changes to the workers' behaviour and attitude although these factors are not new in project and safety management.

As a result, in ensuring that a project manager is able to plan an effective project budgeting, this study recommends that top management together with project manager should emphasise on the importance of adoption of OHSMS with special referencing to safety rules & procedures related to a particular project. At project level, the safety management team needs to ensure improvement of safety behaviour of the individual worker and interrelationship within the group through safety induction courses, tool box meeting and specified training for unstandardised method of construction. This is to ensure the workers appreciate the purpose of providing them training rather than a feeling of routine safety requirements. Special training allows the management team to judge the workers' understanding of the risks and severity involved from the method of construction through immediate feedback from the workers.

6.5 Recommendations for Future Research

Since this study only covered Klang valley, this finding may develop an issue with generalisability due to its coverage element. Therefore, it is proposed that future studies should consider other ideal approaches, such as wider geographical coverage of all the states in Malaysia. A balance of diversified construction projects is suggested, such as low rise landed dwellings, high-rise strata properties, shopping malls, institutional buildings, factories, and various infrastructure construction such as roads, railways, highways, bridges and the like. This suggested approach is expected to enhance reliability and validity of the findings, while concurrently ensure that the research is applicable to different settings.

For the present research, the survey questionnaire provides the only means of gathering responses from the participants. Although this method is commonly used in quantitative studies, the answers to the questions are somehow being 'predetermined'. It was also noted that qualitative methodology such as in-depth interviews would be useful to determine the respondents' true feelings. Thus, future research ought to consider the triangulation method (combination of the quantitative and qualitative approaches) in data collection. This will increase the reliability and produce conclusive findings that are applicable to construction industry as a whole.

6.6 Conclusion

The main objective guiding this study was to examine the roles of good safety measures practices in OHSMS company and its effects on project performance. The roles of OHSMS safety systems is upheld as a process to enhance safety conditions at the workplace which ultimately impact different dimensions of business performance. An accident-free workplace environment, not only minimises risks of production delays but also demonstrates commitment to meet legal obligations, achieve competitive advantages and acquire financial benefits in the project. The objective was demonstrated by the findings as mentioned in the previous chapters.

This research significantly acknowledges that both safety rules & procedures and workers' safe behavioural acts are crucial strategic components that enhance safe workplace, which eventually creates better safety performance, company competitive advantages and sound business operation. Specifically, the implementation of effective safety rules & procedures as a function of work safety objective metrics cultivate workers' safety behaviour as the ultimate achievable goal.

Significant findings for the construction industry were derived from this study, specially concerning the improvement of company image and reputation and ultimately the business goal of financial gains. It is proposed that project managers adopt this framework as a benchmark to formulate and implement effective safety strategies at the project site. Most importantly, the ultimate aim is to achieve a more superior business operation to reap sustainable benefits. It is aimed to boost project profit margin, to better handle the excessive authority compliances, amidst the intense competitive environment in the construction industry. Overall, this study provides a practical and tangible safety framework to achieve business goals over and above safety outcomes. Ultimately, there is a need for top management to embrace changes in the perception of safety and health for maintainable sustainability.

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Appendix A

COVER LETTER FOR SURVEY

Dear All,

Please be informed that you are invited to take part in a research study titled "**Causal effects of safety measure practices influencing project performance of OHSAS 18001/ISO45001/MS 1722 Part 1 certified companies in Malaysian Construction Industry using SEM**".

Kindly be informed that your answers to this survey will be treated with confidentially.

Your frank opinions in this survey are sought and the information obtained will be strictly used for academic purposes only.

Would appreciate if you could take a few minutes of your time to complete this survey.

Thank you.

Best Regards,

H.Sue (Mr)
Lee Kong Chian Faculty of Engineering & Science
Universiti Tunku Abdul Rahman
Sungai Long Campus

Participants

The safety management team: - the project manager, the safety manager, the safety officer, the project engineer, the site engineer, the site safety supervisor, the site supervisor, and those in similar positions.

APPENDIX A: PART 1 (Demographic Information) & PART 2 (Contextual Factors)

Part 1 - Demographic Information

(A) Date: ____________________________

(B) Gender: **[1]** Male **/** **[2]** Female **Please underline your answer**

(C) Age: _______________________________

(D) Position: **[1]** Project Manager **/** **[2]** Engineer **/** **[3]** Supervisor **/**

[4] Others (pls specify)_________________________________

(E) Education: **[1]** Diploma **/** **[2]** Degree **/** **[3]** Master **/**

[4] others (pls specify)____________________________

(F) Years of experience at construction site:
____

Part 2 -Project Details

(G) No of workers employed at site: **/** **[1]** less than 100 **/** **[2]** 100-499 **/** **[3]** ≥500 **/**

(H) ISO certification: -(You may select 1 or more answer) **[1]** OHSAS 18001/ISO 45001 /

. **[2]** ISO 9001 / **[3]** ISO 14001 **/** **[4]** Others (pls specify) _____________

(I) Project location (name of local authority):
____

(J) Types of construction: **/** **[1]** Landed Property **/** **[2]** Strata Property: - Below 20 storey **/**

[3] Strata Property:- ≥ 20 storeys **/** **[4]** Infrastructure (Transportation, Highway etc) **/**

[5] others (pls specify) _______________________________ **/**

(K) Method of Construction: **/** **[1]** IBS / **[2]** System Formwork **/** **[3]** Conventional /

/ **[4]** Mix of Conventional and System Formwork **/**

APPENDIX A – Part 3

Survey Feedback on Safety Measure Practices, Adoption of OHSAS 18001/ ISO 45001 MS, Safety Performance, Company Competitiveness and Financial Profitability

Please answer the following 57 questions from a Likert scale of 1 to 5

Safety measure practices questionnaire

(a) Safety rules and procedures

Please circle the appropriate number to show your level of agreement with each of the following statements (1 – Strongly disagree, 5 – Strongly agree) *Sila lingkarkan nombor yang sesuai untuk menunjukkan tahap perjanjian anda dengan setiap pernyataan berikut (1 - Sangat tidak setuju, 5 - Sangat setuju)*		Item Node	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	The safety rules and procedures followed in my company are sufficient to prevent incidents occurring. *Peraturan keselamatan dan prosedur yang diikuti di syarikat saya adalah mencukupi untuk mencegah insiden yang berlaku.*	R1	1	2	3	4	5
2	My supervisors and managers always try to enforce safe working procedures. *Penyelia dan pengurus saya sentiasa berusaha untuk menguatkuasakan prosedur kerja yang selamat .*	R3	1	2	3	4	5
3	Safety inspections are carried out regularly. *Pemeriksaan keselamatan dijalankan dengan kerap.*	R4	1	2	3	4	5
4	The safety procedures and practices in this organization are useful and effective. *Prosedur dan amalan keselamatan dalam organisasi ini berguna dan berkesan .*	R5	1	2	3	4	5

Note – Item Node is not in the survey forms, it is added for easy reference

Safety measure practices questionnaire

(b) Supportive environment

Please circle the appropriate number to show your level of agreement with each of the following statements (1 – Strongly disagree, 5 – Strongly agree) *Sila lingkarkan nombor yang sesuai untuk menunjukkan tahap perjanjian anda dengan setiap pernyataan berikut (1 - Sangat tidak setuju, 5 - Sangat setuju)*		Item Node	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	My organization's employee adopts a no blame approach to highlight unsafe work behaviour. *Pekerja organisasi saya mengamalkan pendekatan tidak menyalahkan untuk menyerlahkan tingkah laku kerja yang tidak selamat.*	En1	1	2	3	4	5
2	My organization's employee often reminded each other on how to work safely. *Pekerja organisasi saya sering mengingatkan antara satu sama lain tentang cara bekerja dengan selamat.*	En2	1	2	3	4	5
3	My organization's employee believes that it is our business to maintain a safer and healthier workplace. *Pekerja organisasi saya percaya bahawa ia adalah perniagaan kami untuk mengekalkan tempat kerja yang lebih selamat dan sihat.*	En3	1	2	3	4	5
4	My organization's employee always offers help when needed to perform the job safely. *Pekerja organisasi saya sentiasa menawarkan bantuan apabila diperlukan untuk melaksanakan tugas dengan selamat.*	En4	1	2	3	4	5
5	My organization's employee endeavours that individuals do not work alone under risky or hazardous condition. *Pekerja organisasi saya berusaha bahawa individu tidak berfungsi sendiri di bawah keadaan berisiko atau berbahaya .*	En5	1	2	3	4	5

6	My organization's employee always maintains a good working relationship. *Pekerja organisasi saya sentiasa mengekalkan hubungan kerja yang baik.*	En6	1	2	3	4	5
7	The workload is reasonably balanced among my organization's employees. *Beban kerja agak seimbang di kalangan pekerja organisasi saya.*	En7	1	2	3	4	5

Safety measure practices questionnaire

(c) Unsafe acts questionnaire

	Please circle the appropriate scale accordingly how would you rate the quality level of the following behavioural safety performance of worker based on your experience in the project according to the following statements about level of workers' safety behaviour performance (1- Extremely poor, 5- Extremely good). *Sila lingkarkan skala yang sesuai dengan sewajarnya bagaimana anda menilai tahap kualiti prestasi keselamatan tingkah laku berikut pekerja berdasarkan pengalaman anda dalam projek tersebut mengikut pernyataan berikut tentang tahap prestasi tingkah laku keselamatan pekerja (1- Sangat teruk, 5- Sangat baik).*	Item Node	Extremely poor	Poor	Neither poor nor good	Good	Extremely good
1	Voluntarily conducting tasks or activities that help to improve workplace safety. *Menjalankan tugas secara sukarela atau aktiviti yang membantu meningkatkan keselamatan di tempat kerja.*	UA1	1	2	3	4	5
2	Ensure the highest levels of safety when they conduct the job. *Pastikan tahap keselamatan tertinggi apabila mereka menjalankan tugas .*	UA2	1	2	3	4	5
3	Use the correct safety procedures for conducting the job and know safety issues. *Gunakan prosedur keselamatan yang betul untuk menjalankan tugas dan mengetahui isu keselamatan.*	UA3	1	2	3	4	5
4	Help their co-workers when they are working under risky conditions. *Bantu rakan sekerja mereka apabila mereka bekerja di bawah keadaan yang berisiko.*	UA4	1	2	3	4	5

5	Helping co-workers in safety learning and implementation. *Membantu rakan sekerja dalam pembelajaran dan pelaksanaan keselamatan.*	UA5	1	2	3	4	5
6	Nobody ever works alone in construction industry, should work together safely. *Tiada siapa yang pernah bekerja bersendirian dalam industri pembinaan, harus bekerjasama dengan selamat.*	UA6	1	2	3	4	5

Adoption of OHSAS 18001/ISO45001 Management System questionnaire

Please circle the appropriate number to show your level of agreement with each of the following statements (1 – Strongly disagree, 5 – Strongly agree) *Sila lingkarkan nombor yang sesuai untuk menunjukkan tahap perjanjian anda dengan setiap pernyataan berikut (1 - Sangat tidak setuju, 5 - Sangat setuju)*		Item Node	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	My organization has written, detailed occupational safety and health policy. *Organisasi saya telah menulis, dasar keselamatan dan kesihatan pekerjaan terperinci.*	A1	1	2	3	4	5
2	My organization has proactive occupational safety and health policy beyond the compliances of legislative requirement. *Organisasi saya mempunyai dasar keselamatan dan kesihatan pekerjaan yang proaktif di luar pematuhan keperluan perundangan.*	A2	1	2	3	4	5
3	My organization has established quantifiable occupational safety and health objectives. *Organisasi saya telah menubuhkan objektif keselamatan dan kesihatan pekerjaan yang boleh diukur.*	A3	1	2	3	4	5
4	My organization monitors occupational safety and health cost and benefits. *Organisasi saya memantau kos dan faedah keselamatan dan kesihatan pekerjaan.*	A4	1	2	3	4	5
5	My organization has established the role and responsibilities with respect to occupational safety and health programs. *Organisasi saya telah menubuhkan peranan dan tanggungjawab berkaitan dengan program keselamatan dan kesihatan pekerjaan.*	A5	1	2	3	4	5

6	My organization has documented procedures for occupational safety and health. *Organisasi saya telah mendokumenkan prosedur keselamatan dan kesihatan pekerjaan.*	A6	1	2	3	4	5
7	My organization provides appropriate training for its employees. *Organisasi saya menyediakan latihan yang sesuai untuk pekerjanya.*	A7	1	2	3	4	5
8	My organization conducts occupational safety and health audit on a regular basis. *Organisasi saya menjalankan audit keselamatan dan kesihatan pekerjaan secara teratur.*	A8	1	2	3	4	5
9	My organization conducts reassessment on occupational safety and health on a regular basis. *Organisasi saya menjalankan penilaian semula terhadap keselamatan dan kesihatan pekerjaan secara teratur.*	A9	1	2	3	4	5
10	My organization's employee remuneration and promotion are based on occupational safety and health objectives. *Imbuhan dan promosi pekerja organisasi saya adalah berdasarkan objektif keselamatan dan kesihatan pekerjaan.*	A10	1	2	3	4	5

Safety Performance questionnaire – Practising safety measure Practices may result the following Safety Performance

Please circle the appropriate number to show your level of agreement with each of the following statements (1 – Strongly disagree, 5 – Strongly agree) *Sila lingkarkan nombor yang sesuai untuk menunjukkan tahap perjanjian anda dengan setiap pernyataan berikut (1 - Sangat tidak setuju, 5 - Sangat setuju)*		Item Node	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	No regular supervision at least once a week. *Tiada penyeliaan biasa sekurang-kurangnya sekali seminggu.*	C1	1	2	3	4	5
2	Difficulties in communication towards foreign workers. *Kesukaran dalam komunikasi ke arah pekerja asing.*	C2	1	2	3	4	5
3	Risk assessment is not practicable at workplace. *Penilaian risiko tidak praktikal di tempat kerja.*	C3	1	2	3	4	5
4	Workers are not likely to report incidents/accidents. *Pekerja tidak mungkin melaporkan insiden / kemalangan.*	C4	1	2	3	4	5
5	Decision making does not involve all organization. *Pengambilan keputusan tidak melibatkan semua organisasi.*	C5	1	2	3	4	5

6	Workers under influence of drugs and alcohol. *Pekerja di bawah pengaruh dadah dan alcohol.*	B1	1	2	3	4	5
7	Discipline issues. *Isu disiplin.*	B2	1	2	3	4	5
8	Irresponsible attitude of the workers during working or handling machines. *Sikap pekerja yang tidak bertanggungjawab semasa bekerja atau mengendalikan mesin.*	B3	1	2	3	4	5
9	Fatigue caused by working overtime. *Keletihan yang disebabkan oleh kerja lebih masa.*	B4	1	2	3	4	5
10	Working for incentives. *Bekerja untuk insentif.*	B5	1	2	3	4	5
11	Differences in age, with different level of awareness. *Perbezaan umur, dengan tahap kesedaran yang berbeza.*	Aw1	1	2	3	4	5
12	Lack of accident records and official safety data. *Kurangnya rekod kemalangan dan data keselamatan rasmi.*	Aw2	1	2	3	4	5
13	Not well educated. *Tidak berpendidikan tinggi.*	Aw3	1	2	3	4	5
14	No safety briefing/toolbox meeting. *Tiada taklimat keselamatan / toolbox meeting.*	Aw4	1	2	3	4	5
15	Lack of safety signage board. *Kurang papan tanda keselamatan.*	Aw5	1	2	3	4	5

Safety Performance questionnaire – Practising safety measure Practices may result the following Safety Performance

Please circle the appropriate number to show your level of agreement with each of the following statements (1 – Strongly disagree, 5 – Strongly agree) *Sila lingkarkan nombor yang sesuai untuk menunjukkan tahap perjanjian anda dengan setiap pernyataan berikut (1 - Sangat tidak setuju, 5 - Sangat setuju)*		Item Node	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	Absence of Safety and Health Committee. *Ketiadaan Jawatankuasa Keselamatan dan Kesihatan.*	M1	1	2	3	4	5
2	Fail to nominate SHO (Safety and Health Officer) that comply with OSHA regulations. *Gagal menamakan SHO (Pegawai Keselamatan dan Kesihatan) yang mematuhi peraturan OSHA.Kesukaran dalam komunikasi ke arah pekerja asing.*	M2	1	2	3	4	5
3	Lack of communication between manager and Safety and Health Committee. *Kurang komunikasi antara pengurus dan Jawatankuasa Keselamatan dan Kesihatan.*	M3	1	2	3	4	5
4	Lack of commitment to OSHA 1994. *Kekurangan komitmen kepada OSHA 1994.*	M4	1	2	3	4	5
5	Lack of communication between manager and worker. *Kurang komunikasi antara pengurus dan pekerja.*	M5	1	2	3	4	5
6	Inadequate PPE at Work Regulations 1992 (FMA 1967). *PPE yang tidak mencukupi di Work Regulations 1992 (FMA 1967).*	M6	1	2	3	4	5

Company Competitiveness questionnaire – Practising Safety Measure Practices may result the following company competitiveness

Please circle the appropriate number to show your degree of satisfaction with each of the following performance indicators- in terms of company's position with respect to competitors or the sector average. *Sila lingkarkan nombor yang sesuai untuk menunjukkan tahap kepuasan anda dengan setiap indikator prestasi berikut - dari segi kedudukan syarikat berkenaan dengan pesaing atau purata sektor.*		Item Node	Extremely dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Strongly satisfied
1	Product quality. *Kualiti produk.*	CC1	1	2	3	4	5
2	Productivity. *Produktivit.i*	CC2	1	2	3	4	5
3	Customer satisfaction. *Kepuasan pelanggan.*	CC3	1	2	3	4	5
4	Reputation. *Reputasi.*	CC4	1	2	3	4	5
5	Innovation. *Inovasi.*	CC5	1	2	3	4	5

Financial Performance questionnaire – Practising Safety Measure Practices may result the following financial performance

Please circle the appropriate number to show your degree of satisfaction with each of the following performance indicators- in terms of company's position with respect to competitors or the sector average. *Sila lingkarkan nombor yang sesuai untuk menunjukkan tahap kepuasan anda dengan setiap indikator prestasi berikut - dari segi kedudukan syarikat berkenaan dengan pesaing atau purata sektor.*		Item Node	Extremely dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Strongly satisfied
1	Financial profitability. *Keuntungan kewangan.*	FP1	1	2	3	4	5
2	Growth in market share. *Pertumbuhan dalam bahagian pasaran.*	FP2	1	2	3	4	5
3	Growth in profit. *Pertumbuhan keuntungan.*	FP3	1	2	3	4	5
4	Improved profit/sales. *Bertambah baik keuntungan / jualan.*	FP4	1	2	3	4	5

Appendix B – Assessment of Normality (Group number 1)

Variable	min	max	skew	c.r.	kurtosis	c.r.
FP1	2	5	-0.269	-2.199	0.001	0.005
FP2	2	5	-0.164	-1.338	-0.338	-1.384
FP3	2	5	-0.191	-1.558	-0.242	-0.988
FP4	2	5	-0.179	-1.465	-0.127	-0.521
CC1	2	5	-0.323	-2.644	0.492	2.011
CC2	2	5	-0.167	-1.366	0.231	0.942
CC3	2	5	-0.229	-1.868	0.186	0.76
CC4	2	5	-0.225	-1.842	-0.437	-1.786
CC5	2	5	-0.237	-1.941	-0.435	-1.78
M2T	1	5	-1.129	-9.228	2.152	8.796
M3T	2	5	-0.882	-7.213	1.034	4.227
M4T	2	5	-0.8	-6.537	0.827	3.379
M5T	2	5	-0.813	-6.647	0.783	3.199
M6T	1	5	-0.964	-7.877	1.476	6.032
Aw1T	1	5	-0.388	-3.171	-0.797	-3.256
Aw2T	1	5	-0.906	-7.409	0.522	2.135
Aw3T	1	5	-0.487	-3.98	-0.521	-2.13
B2T	1	5	-0.955	-7.81	0.699	2.855
B3T	1	5	-0.832	-6.801	0.619	2.531
B4T	1	5	-0.736	-6.017	-0.08	-0.328
B5T	1	5	-0.504	-4.122	-0.594	-2.428
C2T	1	5	-0.654	-5.344	-0.152	-0.623
C3T	1	5	-0.883	-7.215	1.215	4.967
C4T	1	5	-0.688	-5.623	0.803	3.284
C5T	1	5	-0.849	-6.94	0.941	3.847
UA2	2	5	-0.168	-1.371	0.536	2.189
UA3	2	5	-0.056	-0.454	0.089	0.362
UA5	3	5	0.068	0.554	-0.408	-1.666
En2	2	5	-0.049	-0.402	0.001	0.005
En3	2	5	-0.082	-0.672	-0.233	-0.951
En4	2	5	-0.166	-1.36	-0.068	-0.278
R1	2	5	-0.19	-1.553	-0.14	-0.571
R3	2	5	-0.043	-0.35	0.588	2.405
R4	2	5	-0.154	-1.256	-0.188	-0.769
R5	2	5	-0.183	-1.493	-0.131	-0.535
A3	3	5	0.101	0.825	-0.809	-3.308
A4	2	5	-0.17	-1.392	0.489	2
A5	3	5	0.067	0.548	-0.578	-2.364
A6	3	5	0.047	0.388	-0.982	-4.015
A7	1	5	-0.826	-6.756	2.55	10.425
A8	2	5	-0.258	-2.109	0.327	1.338
A9	2	5	-0.116	-0.946	0.038	0.155
Multivariate					333.089	54.857

Appendix C: Mahalanobis Distance

Observations farthest from the centroid (Mahalanobis distance) (Group number 1)

Observation number	Mahalanobis d-squared	p1	p2
18	80.494	0	0.122
19	80.494	0	0.008
243	78.397	0.001	0.002
270	78.001	0.001	0
248	77.957	0.001	0
130	77.78	0.001	0
92	77.057	0.001	0
302	77.031	0.001	0
255	76.812	0.001	0
163	76.638	0.001	0
164	76.596	0.001	0
182	76.479	0.001	0
4	76.435	0.001	0
61	76.38	0.001	0
40	75.983	0.001	0
230	75.469	0.001	0
78	74.911	0.001	0
233	74.649	0.001	0
334	73.617	0.002	0
293	73.464	0.002	0
154	73.19	0.002	0
310	72.912	0.002	0
212	72.676	0.002	0
169	71.909	0.003	0
271	71.871	0.003	0
64	71.655	0.003	0
178	71.248	0.003	0
227	71.125	0.003	0
166	70.959	0.003	0
139	70.901	0.003	0
102	70.675	0.004	0
176	70.585	0.004	0
136	70.155	0.004	0
114	69.928	0.004	0
112	69.924	0.004	0
94	69.913	0.004	0
95	69.771	0.005	0
239	69.592	0.005	0
345	69.438	0.005	0
286	69.415	0.005	0
289	68.434	0.006	0

Appendix D – Detecting Multicollinearity

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-.006	.249		-.024	.981		
	SafetyRulesAndProcedures	.009	.067	.007	.133	.894	.489	2.044
	AdoptionofOHSMS	.316	.070	.222	4.514	.000	.487	2.052
	UnsafeAct	.016	.069	.012	.233	.816	.418	2.394
	SupportiveEnv	-.090	.065	-.069	-1.389	.166	.477	2.098
	CompanyCompetitiveness	.678	.048	.602	13.987	.000	.637	1.570
	SafetyPerformance	.026	.039	.025	.660	.509	.822	1.217

a. Dependent Variable: FinancialPerformance

Correlations

		SafetyRulesAndProcedures	AdoptionofOHSMS	UnsafeAct	SupportiveEnv	FinancialPerformance	CompanyCompetitiveness	SafetyPerformance
SafetyRulesAndProcedures	Pearson Correlation	1	.554**	.604**	.629**	.400**	.497**	.268**
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.000
	N	401	401	401	401	401	401	401
AdoptionofOHSMS	Pearson Correlation	.554**	1	.630**	.478**	.527**	.525**	.404**
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.000
	N	401	401	401	401	401	401	401
UnsafeAct	Pearson Correlation	.604**	.630**	1	.660**	.415**	.493**	.290**
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.000
	N	401	401	401	401	401	401	401
SupportiveEnv	Pearson Correlation	.629**	.478**	.660**	1	.323**	.443**	.259**
	Sig. (2-tailed)	.000	.000	.000		.000	.000	.000
	N	401	401	401	401	401	401	401
FinancialPerformance	Pearson Correlation	.400**	.527**	.415**	.323**	1	.705**	.287**
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.000
	N	401	401	401	401	401	401	401
CompanyCompetitiveness	Pearson Correlation	.497**	.525**	.493**	.443**	.705**	1	.307**
	Sig. (2-tailed)	.000	.000	.000	.000	.000		.000
	N	401	401	401	401	401	401	401
SafetyPerformance	Pearson Correlation	.268**	.404**	.290**	.259**	.287**	.307**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	
	N	401	401	401	401	401	401	401

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

Appendix E: Total Variance Explained

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	14.113	33.602	33.602	13.454	32.033	32.033
2	5.599	13.331	46.933			
3	2.837	6.754	53.687			
4	1.936	4.609	58.296			
5	1.835	4.369	62.666			
6	1.101	2.622	65.288			
7	1.012	2.410	67.698			
8	.886	2.109	69.807			
9	.817	1.946	71.753			
10	.742	1.767	73.519			
11	.689	1.641	75.160			
12	.654	1.556	76.716			
13	.599	1.425	78.141			
14	.579	1.379	79.520			
15	.539	1.282	80.803			
16	.511	1.216	82.018			
17	.490	1.168	83.186			
18	.467	1.111	84.297			
19	.446	1.061	85.358			
20	.426	1.014	86.372			
21	.402	.957	87.329			
22	.387	.921	88.250			
23	.376	.894	89.144			

Appendix F: Difference of Standardized Regression Weights

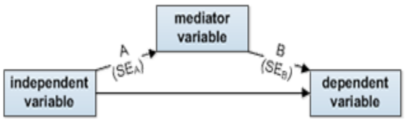
Standardized Regression Weights: (Group num					Standardized Regression Weights: (Group number 1 - De					
with CLF					Without CLF					
			Estimate					Estimate		diff
A9	<---	Adoptior	0.699		A9	<---	Adoptior	0.719		0.02
A8	<---	Adoptior	0.676		A8	<---	Adoptior	0.723		0.047
A7	<---	Adoptior	0.685		A7	<---	Adoptior	0.727		0.042
A6	<---	Adoptior	0.545		A6	<---	Adoptior	0.69		0.145
A5	<---	Adoptior	0.63		A5	<---	Adoptior	0.762		0.132
A4	<---	Adoptior	0.657		A4	<---	Adoptior	0.743		0.086
A3	<---	Adoptior	0.605		A3	<---	Adoptior	0.736		0.131
R5	<---	SafetyRu	0.772		R5	<---	SafetyRu	0.787		0.015
R4	<---	SafetyRu	0.71		R4	<---	SafetyRu	0.776		0.066
R3	<---	SafetyRu	0.699		R3	<---	SafetyRu	0.736		0.037
R1	<---	SafetyRu	0.631		R1	<---	SafetyRu	0.711		0.08
En4	<---	Supporti	0.711		En4	<---	Supporti	0.737		0.026
En3	<---	Supporti	0.774		En3	<---	Supporti	0.818		0.044
En2	<---	Supporti	0.724		En2	<---	Supporti	0.789		0.065
UA5	<---	Unsafe_	0.674		UA5	<---	Unsafe_	0.705		0.031
UA3	<---	Unsafe_	0.773		UA3	<---	Unsafe_	0.821		0.048
UA2	<---	Unsafe_	0.816		UA2	<---	Unsafe_	0.825		0.009
C5T	<---	Culture	0.712		C5T	<---	Culture	0.804		0.092
C4T	<---	Culture	0.634		C4T	<---	Culture	0.708		0.074
C3T	<---	Culture	0.655		C3T	<---	Culture	0.782		0.127
C2T	<---	Culture	0.769		C2T	<---	Culture	0.73		-0.039
B5T	<---	Behaviou	0.848		B5T	<---	Behaviou	0.807		-0.041
B4T	<---	Behaviou	0.809		B4T	<---	Behaviou	0.819		0.01
B3T	<---	Behaviou	0.631		B3T	<---	Behaviou	0.659		0.028
B2T	<---	Behaviou	0.591		B2T	<---	Behaviou	0.613		0.022
Aw3T	<---	Awarene	0.794		Aw3T	<---	Awarene	0.808		0.014
Aw2T	<---	Awarene	0.706		Aw2T	<---	Awarene	0.737		0.031
Aw1T	<---	Awarene	0.865		Aw1T	<---	Awarene	0.799		-0.066
M6T	<---	Manager	0.517		M6T	<---	Manager	0.676		0.159
M5T	<---	Manager	0.745		M5T	<---	Manager	0.855		0.11
M4T	<---	Manager	0.724		M4T	<---	Manager	0.881		0.157
M3T	<---	Manager	0.761		M3T	<---	Manager	0.909		0.148
M2T	<---	Manager	0.569		M2T	<---	Manager	0.76		0.191
CC5	<---	Company	0.73		CC5	<---	Company	0.765		0.035
CC4	<---	Company	0.735		CC4	<---	Company	0.778		0.043
CC3	<---	Company	0.836		CC3	<---	Company	0.849		0.013
CC2	<---	Company	0.839		CC2	<---	Company	0.843		0.004
CC1	<---	Company	0.884		CC1	<---	Company	0.904		0.02
FP4	<---	Financia	0.799		FP4	<---	Financia	0.828		0.029
FP3	<---	Financia	0.802		FP3	<---	Financia	0.833		0.031
FP2	<---	Financia	0.877		FP2	<---	Financia	0.905		0.028
FP1	<---	Financia	0.861		FP1	<---	Financia	0.876		0.015

Appendix G: Sobel Test

Sobel Test Calculator for the Significance of Mediation

This calculator uses the Sobel test to tell you whether a mediator variable significantly carries the influence of an independent variable to a dependent variable; i.e., whether the indirect effect of the independent variable on the dependent variable through the mediator variable is significant. This calculator returns the Sobel test statistic, and both one-tailed and two-tailed probability values.

Please enter the necessary parameter values, and then click 'Calculate'.



A: 0.275

B: 0.783

SE_A: 0.047

SE_B: 0.061

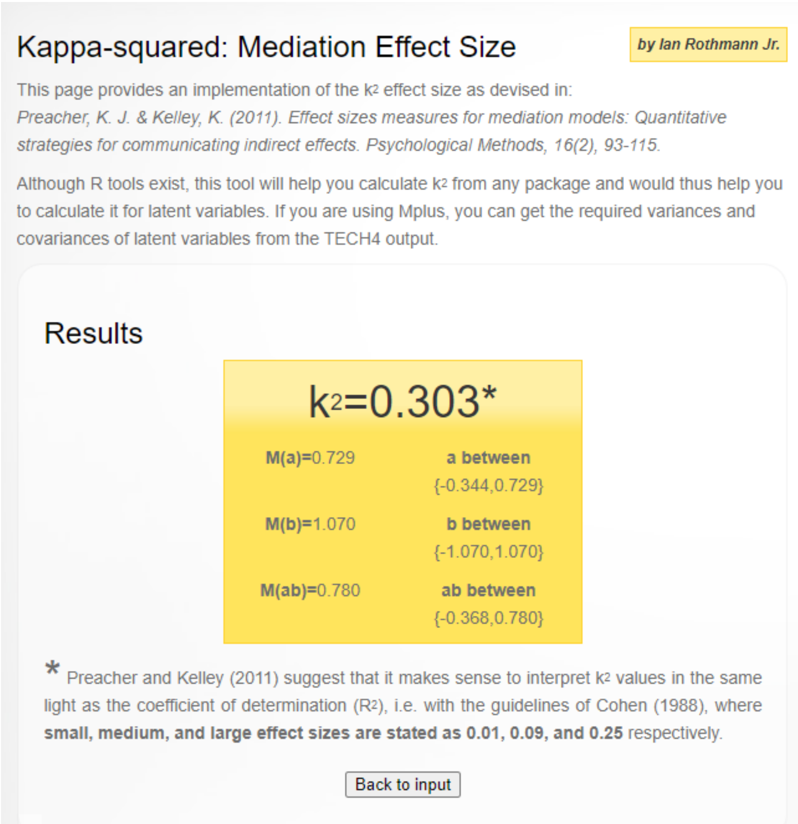
Calculate!

Sobel test statistic: 5.32403302

One-tailed probability: 0.00000005

Two-tailed probability: 0.00000010

Appendix H: Kappa-squared



Kappa-squared: Mediation Effect Size

by Ian Rothmann Jr.

This page provides an implementation of the k^2 effect size as devised in:
Preacher, K. J. & Kelley, K. (2011). Effect sizes measures for mediation models: Quantitative strategies for communicating indirect effects. Psychological Methods, 16(2), 93-115.

Although R tools exist, this tool will help you calculate k^2 from any package and would thus help you to calculate it for latent variables. If you are using Mplus, you can get the required variances and covariances of latent variables from the TECH4 output.

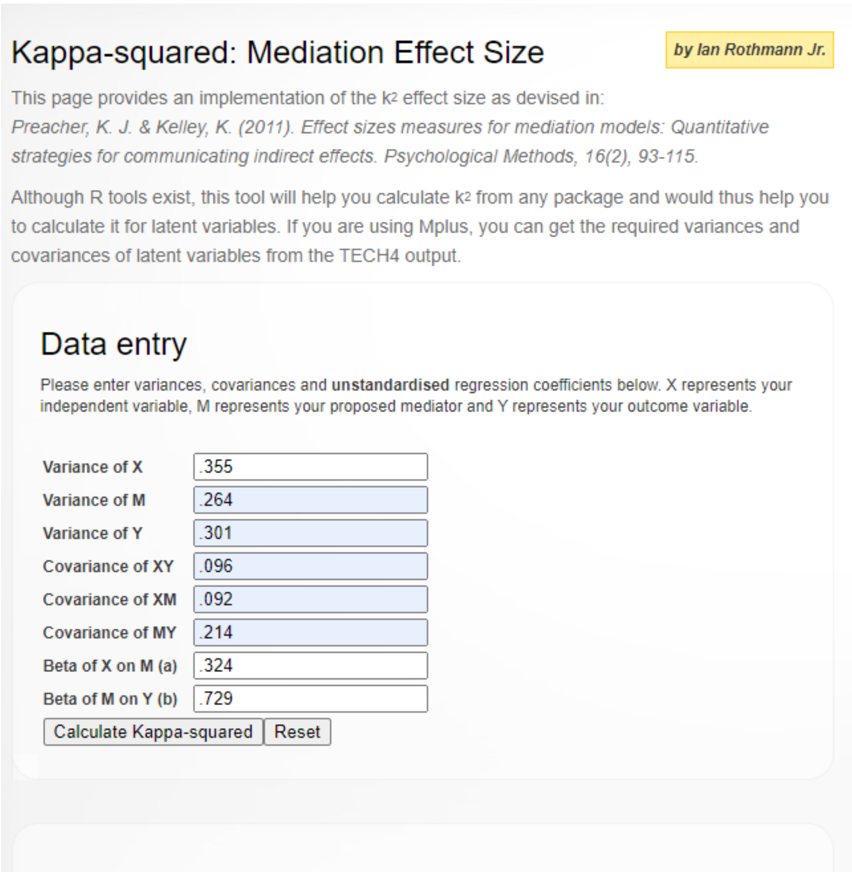
Results

k^2=0.303*

M(a)=0.729	**a between** {-0.344,0.729}
M(b)=1.070	**b between** {-1.070,1.070}
M(ab)=0.780	**ab between** {-0.368,0.780}

* Preacher and Kelley (2011) suggest that it makes sense to interpret k^2 values in the same light as the coefficient of determination (R^2), i.e. with the guidelines of Cohen (1988), where **small, medium, and large effect sizes are stated as 0.01, 0.09, and 0.25** respectively.

Back to input



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This page provides an implementation of the k^2 effect size as devised in:
Preacher, K. J. & Kelley, K. (2011). Effect sizes measures for mediation models: Quantitative strategies for communicating indirect effects. Psychological Methods, 16(2), 93-115.

Although R tools exist, this tool will help you calculate k^2 from any package and would thus help you to calculate it for latent variables. If you are using Mplus, you can get the required variances and covariances of latent variables from the TECH4 output.

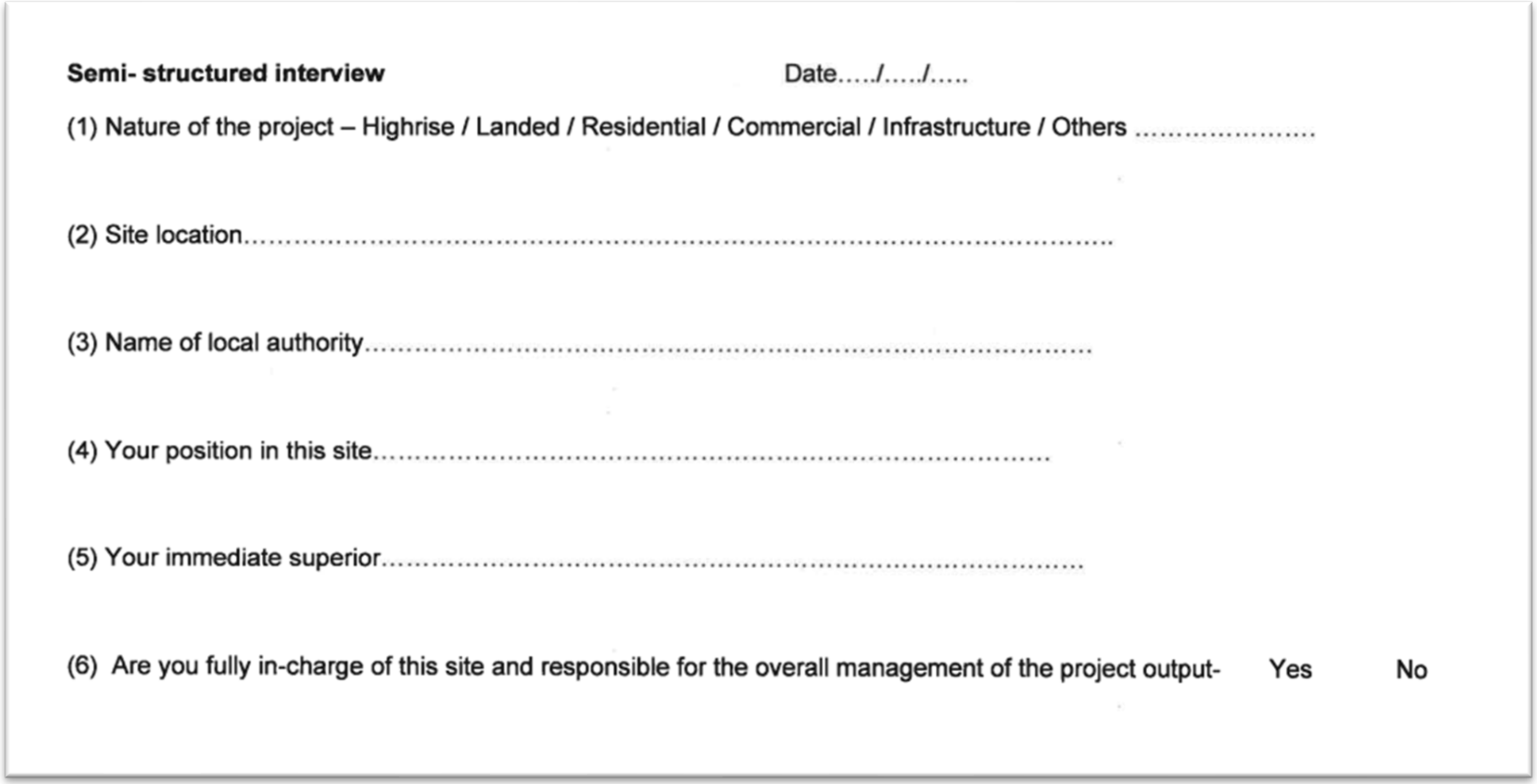
Data entry

Please enter variances, covariances and **unstandardised** regression coefficients below. X represents your independent variable, M represents your proposed mediator and Y represents your outcome variable.

Variance of X	.355
Variance of M	.264
Variance of Y	.301
Covariance of XY	.096
Covariance of XM	.092
Covariance of MY	.214
Beta of X on M (a)	.324
Beta of M on Y (b)	.729

Calculate Kappa-squared | Reset

Appendix I: Semi-structured interviews' questions and case study



Semi- structured interview Date…../…../…..

(1) Nature of the project – Highrise / Landed / Residential / Commercial / Infrastructure / Others ………………….

(2) Site location……………………………………………………………………………………..

(3) Name of local authority……………………………………………………………………….

(4) Your position in this site…………………………………………………………………….

(5) Your immediate superior………………………………………………………………………

(6) Are you fully in-charge of this site and responsible for the overall management of the project output- Yes No

(7) Does practising effective ***safety measure practices*** at site improve the safety performance?

Please circle the appropriate number to show your level of agreement with each of the following statements (1 – Strongly disagree, 5 – Strongly agree)		Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	*Improved **safety performance** of the project*	1	2	3	4	5

Safety measure practices – combination of *Safety Rules & Procedures, Workers' Working Behaviour and Supportive Working Environment.*

(8) Does improved ***safety performance***, it will improve the following perceived goals.

Please circle the appropriate number to show your level of agreement with each of the following statements (1 – Strongly disagree, 5 – Strongly agree)		Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1	Reduces rates of injuries	1	2	3	4	5
2	Reduces fatal accidents	1	2	3	4	5
3	Enhance safer working conditions	1	2	3	4	5
4	Improve productivities	1	2	3	4	5
5	Improve company image	1	2	3	4	5
6	Positive effect on financial performance	1	2	3	4	5

(9) Does practising OHSMS improve safety performance of the project - Yes No

(10) Pls suggest method / process / steps to improve overall safety performance of the project.

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(11) What are the potential difficulties of implementing effective safety measure practices?

(12) Any proof on safety and health improvement?

List of Publications

(a) Sue Har, Liang Meng Suan, Chan Yuan Eng. (2023). Causal Effects of Safety Measure Practices on Safety Performance and Project Performance. *International Journal of Business and Technology Management*. 5(3), pp.95-107. [Online]. Available at: https://doi.org/10.55057/ijbtm.2023.5.3.8 [Accessed 1 September 2023].