MODELLING CAPABILITY-BASED RISK ASSESSMENT FOR INTERNATIONAL CONSTRUCTION PROJECT VENTURES

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ABSTRACT

Globalization has created more opportunities for contractors to enter international construction markets. Despite the financial markets meltdown in the autumn of 2008, international contractors are still finding opportunities in the international marketplace. International projects are exposed to more diverse and complex risks, thus higher possibility of loss, than domestic projects. Similarly, the vast uncertainties and complexities in international construction would render project selection decisions to be intricate as compared to domestic construction. As a result, copious risk assessment tools and methods have been proposed to assist this decision making, most of them based on Probability-Impact (P-I) risk model. Although P-I risk model is useful to assess risks, firm's capabilities are missing in the early assessment to provide accurate risk picture to decision makers for project selection decision in the international construction. This study aims to develop a risk assessment model, through the determination of the extent to which firm's capabilities impact on international construction project risk significance values, for improved productivity and performance. The international construction firm's capabilities are explored using resource-based view, dynamic capabilities, and Porter's generic value chain theories. The conceptual framework postulated that international construction firms could lower the exposure to risks in the international construction foray by a combination of firm's capabilities. A total of 252 survey questionnaires were sent out in 2013 to 2014 to 155 international construction firms and 65 firms responded via either structured interview or questionnaire survey. The respondents are project selection decision makers in their firms and thus are approached through face-to-face interviews if they are based in Malaysia or contacted via email if they are based in their home countries. The data collected were analyzed using SPSS and PLS-SEM software. The results from structural model evaluation found that only 53 out of 110 hypothesized relationships were significantly important. It was discovered that four firm's capabilities have less influence on the risks studied; they are financial, innovation, physical, and procurement capabilities. This suggests that human resource, organizational, business management, organizational learning, construction, and project management capabilities are more influential towards international construction risk significances. A novel Capability-Risk Assessment (CapRA) model was developed and validated using the PLS-SEM technique. The model was then formulated into modified P-I risk model equations and computerized into a CapRA calculator to facilitate construction firms in selecting international construction projects. The Mean Absolute Percentage Error found that CapRA is able to improve prediction accuracy by 16% to 21%. International contractors are recommended to use CapRA to conduct preliminary assessment on their firm's capabilities and risks of potential projects. This study contributes to the knowledge of risk assessment by enhancing the P-I risk model with firm's capability component. The model developed enables firms to be informed of the combination of firm's capabilities needed to lower the exposure to certain risks. Thus, a proper assessment of firm's capabilities and project risks before coming into any decision can be achieved. Future study could incorporate other influencing variables such as various contract clauses to refine CapRA.

ABSTRAK

Ledakan globalisasi telah mencetuskan lebih banyak peluang kepada kontraktor antarabangsa untuk memasuki pasaran pembinaan antarabangsa. Kontraktor-kontraktor antarabangsa masih tidak berputus asa terhadap pasaran antarabangsa walaupun berlakunya krisis kewangan pasaran pada musim luruh tahun 2008. Berbanding dengan projek dalam negara, projek antarabangsa lebih terdedah kepada pelbagai risiko yang kompleks dan berkemungkinan mengalami kerugian yang parah. Justeru, keputusan pemilihan projek dalam pasaran pembinaan antarabangsa adalah lebih sukar and kompleks berbanding dengan pemilihan projek dalam negara. Oleh itu, berbagai-bagai alat dan kaedah penilaian risiko telah dicadangkan untuk membantu keputusan pemilihan. Kebanyakan daripada alat-alat dan kaedah-kaedah penilaian risiko tersebut adalah berasaskan model risiko Kebarangkalian-Kesan (P-I). Walaupun model risiko P-I adalah berguna dalam penilaian risiko tetapi komponen 'keupayaan firma' tidak dititikberatkan dalam penilaian, komponen ini boleh memberikan gambaran risiko yang lebih tepat bagi membuat keputusan pemilihan projek pasaran antarabangsa. Kajian ini bertujuan untuk membangunkan suatu model penilaian risiko yang ditentukan oleh impak keupayaan firma terhadap nilai signifikasi risiko projek pembinaan antarabangsa bagi meningkatkan produktiviti dan prestasi projek. Keupayaan firma pembinaan antarabangsa diterokai melalui tiga teori iaitu 'resource-based view', 'dynamic capabilities', dan 'Porter's generic value chain'. Rangka kerja konseptual pula mengandaikan bahawa firma pembinaan antarabangsa dapat mengurangkan pendedahan kepada risiko dengan suatu kombinasi keupayaan firma. Sejumlah 252 kajian soal selidik telah dihantar kepada 155 firma pembinaan antarabangsa pada tahun 2013 sampai ke tahun 2014. Terdapat 65 firma yang membalas melalui temu bual berstruktur ataupun soal selidik. Responden-responden adalah terdiri daripada orang-orang penting yang membuat keputusan dalam firma mereka dan mereka akan ditemubual sekiranya berada di dalam Malaysia atau dihubungi melalui emel bagi yang berada di negara asal firma. Data dianalisis dengan menggunakan perisian SPSS dan PLS-SEM. Penilaian model struktur mendapati bahawa hanya 53 daripada 110 hipotesis adalah penting. Kajian ini juga mendapati bahawa empat jenis keupayaan firma kurang berpengaruh kepada risiko yang dikaji iaitu keupayaan firma dari segi kewangan, inovasi, fizikal, dan perolehan. Keupayaan firma dari segi sumber manusia, organisasi, pengurusan perniagaan, pembelajaran organisasi, pembinaan, dan pengurusan projek pula lebih berpengaruh kepada nilai signifikasi risiko. Sebuah model penilaian keupayaan-risiko (CapRA) telah dibangunkan dan disahkan menggunakan teknik PLS-SEM. Model ini kemudiannya mengubahsuaikan rumusan model risiko P-I dengan penemuan daripada CapRA dan mendigitalkan rumusan baru daripada CapRA kepada kalkulator CapRA yang memudahkan firma-firma pembinaan dalam menganalisis pemilihan projek pembinaan antarabangsa. Peratusan Ralat Min Mutlak (MAPE) juga mendapati CapRA dapat meningkatkan ketepatan ramalan sebanyak 16% ke 21%. Kontraktor antarabangsa digalakkan untuk menggunakan CapRA dalam penilaian awal atas keupayaan firma mereka dan risiko projek. Kajian ini juga menyumbang kepada literatur analisis risiko dengan meningkatkan ketepatan model risiko P-I dengan komponen keupayaan firma. Model CapRA memberi kombinasi keupayaan firma yang diperlukan untuk mengurangkan pendedahan kepada sesuatu risiko. Lantas, penilaian keupayaan firma dan risiko projek yang menyeluruh dapat dilakukan sebelum membuat keputusan pemilihan projek. Kajian ini juga menyimpulkan bahawa parameter lain seperti klausa kontrak boleh ditambah untuk penambahbaikan CapRA.

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ABBREVIATION	DEFINITION
AHP	Analytical Hierarchy Process
ANOVA	Analysis of Variance
ANP	Analytic Network Process
AVE	Average Variance Extracted
BSMG	Business Management capability construct
CapRA	Capability-Risk Assessment
CCA	Canonical Correlation Analysis
CFA	Confirmatory Factor Analysis
CIDB	Construction Industry Development Board Malaysia
CNST	Construction capability construct
ECUL	External Cultural risk construct
EFA	Exploratory Factor Analysis
ELGT	External Logistics risk construct
ENAE	External Natural Environmental risk construct
ENR	Engineering News Record
EPOE	External Political and Economic risk construct
ETRP	External Third Party risk construct
EVM	Earned Value Management
FNCL	Financial capability construct
FST	Fuzzy Sets Theory
GUI	Graphical User Interface
HMRS	Human Resource capability construct
IBS	Industrialized Building System
ICNS	Internal Construction risk construct
ICRAM-1	International Construction Risk Assessment Model
IFNC	Internal Financial risk construct
ILAB	Internal Labour risk construct
IMEQ	Internal Material and Equipment risk construct
IMGR	Internal Managerial risk construct
INNV	Innovation capability construct

IODS	Internal Owner, Design consultant, Supervisor risk construct
JV	Joint Venture
MANOVA	Multivariate Analysis of Variance
MAPE	Mean Absolute Percentage Error
MCS	Monte Carlo Simulation
MDA	Multigroup Discriminate Analysis
MPE	Mean Percentage Error
ORGL	Organizational Learning capability construct
ORGZ	Organizational capability construct
PCRM	Procurement capability construct
PE	Percentage Error
PERT	Program Evaluation and Review Technique
PHYS	Physical capability construct
P-I	Probability-Impact
PLS-SEM	Partial Least Square-Structural Equation Modeling
PRMG	Project Management capability construct
RBV	Resource-Based View
ROI	Return On Investment
SEM	Structural Equation Modeling
SPSS	Statistical Package for the Social Sciences
SWOT	Strengths Weaknesses Opportunities Threats
VIF	Variance Inflation Factor

CHAPTER 1
INTRODUCTION

1.1 Introduction

Within Chapter 1, an overall introduction to the study is presented to set out the intentions of the research. Firstly, relevant background information that documents the relevance and significance of the study is provided. Subsequently, the problem statement, and the defined aim and objectives are presented. The research methods applied and the outline of the remaining chapters are also delineated in this chapter. Chapter 1 then concludes with a summary of information provided.

1.2 Research Background

Construction industry is one of the most dynamic, risky and challenging businesses no matter what size of a project (Hayes, Perry, Thompson, & Willmer, 1986; Thompson & Perry, 1992). As highlighted by Hayes et al. (1986), this industry has a poor reputation in managing risks and consequently, many major projects fail to achieve the deadlines and cost targets. For example, complexity of the project, location, speed of construction, variations in weather, productivity of labour and plant, quality of material and familiarity with the type of work are the other factors carrying risks (Hayes, et al., 1986; Thompson & Perry, 1992). Thompson and Perry (1992) noted that size can be one of the major causes of risk, as well as changes in political or commercial planning..

Mills (2001) found that risks and uncertainty can result in damaging consequences for some projects such as affecting the productivity, performance, quality, and the budget of a project. Hayes et al. (1986) also added that construction risks are either ignored or dealt in a completely arbitrary way; hence, it is a typical situation where 10 percent of contingency is added onto the estimated cost of project. However, this approach is often inadequate for a complex construction as expensive delays, litigation, and even bankruptcy are the common consequences. Risk can only be minimized, transferred or retained but cannot be eliminated (Burchett, Tummala, & Leung, 1999). For these reasons, risk management ensures risks are managed in the most efficient manner to provide the best balance of cost, time and quality and performance for the parties involved in attaining the best value for money.

Risk is a combination of chance of an adverse event occurring and the consequences it will have if it occurs. Risk may in result the positive and negative impacts to the project and party involved. Opportunity is positive risk and can be identified and managed in a similar way (AbouRizk, 2003). The opportunity is also defined as the possibility of realizing a favorable outcome and the impact of the outcome has on the involved party. Various researchers (Baloi & Price, 2003; Barber, 2005; Project Management Institute, 2004; Ward & Chapman, 2003) noted that project risks are uncertain events or conditions which may have an impact on the project objectives. Risk management, on the other hand, is a systematic process of identifying, assessing and responding to project risk (Del Cano & de la Cruz, 2002; Flanagan & Norman, 1993; Project Management Institute, 2004; Uher & Toakley, 1999). Osipova (2008) mentioned that risk management has an overall goal to maximize the opportunities and minimize the consequences of a risk event.

To further illustrate, risk identification determines the potential risks, which are those that may affect the project. There are several methods in classifying project risks and risk sources (Bing, Akintoye, Edwards, & Hardcastle, 2005; Leung, Tummala, & Chuah, 1998; Tah & Carr, 2000). Generally, the risks in a construction projects may be derived from two risk sources. The first risk source stems from environmental impacts, which are called external risks (e.g. financial, economic, political, legal and environmental). The second risk source results from uncertainties in the project itself, which are known as internal risks (e.g. design, construction, management and relationships) (Zhi, 1995). During the risk assessment, which goal is to prioritize risks for management, the identified risks are evaluated and ranked (Osipova, 2008). Baccarini and Archer (2001) described a methodology for ranking the risks of projects, which enables an effective and efficient allocation of the resources for managing the project risks. After the risk assessment process, the risk response process is initiated to identify a way of handling the project risks and it consists of three main techniques- risk reduction, risk transfer and risk retention (Smith, Merna, & Jobling, 2013). Within the construction industry in the United Kingdom, Baker, Ponniah, and Smith (1999) found that risk reduction is the most frequently used technique.

Globalization created more opportunities for contractors to enter international construction markets. Nevertheless, international projects are exposed to more diverse and complex risks than domestic projects, which make international projects have a high possibility of loss. For instance, international construction is more susceptible to country-specific conditions like currency devaluation, currency exchange restrictions, cultural differences, or unstable laws or regulations (Han & Diekmann, 2001a). For this reason, risk management should be emphasized and systemized in international or overseas projects in order to improve the quality of the difficult decisions.

The next section presents the research gaps and problems in detail. It will be followed by a description of the research aim and objectives, research questions, and scope. A brief discussion of the research methodology and significance of the study is presented as well, followed by an outline of the thesis structure.

1.3 Problem Statement

Despite the financial markets meltdown in the autumn of 2008, international contractors are still finding opportunities in the international marketplace. The global construction market is lucrative and has led to an increase in international construction projects. Engineering News Record (ENR) compiled the list of top 250 International Contractors yearly and these firms are ranked based on contracting revenue from projects outside of their home countries, which measure their presence in international business. It is noteworthy that Lu (2014), who studied the reliability of ENR international construction data, revealed that some studies that use ENR data are dismissed because ENR data are thought to be inherently and seriously problematic. However, his study has found otherwise, that ENR data can be confidently used for international construction research. Figure 1.1 illustrates the contracting revenue of construction firms in the international market from year 2006 to 2013- the domestics contracting revenue, the international contracting revenue, and the total contracting revenue. It should be noted that the domestic contracting revenues are not available for year 2008 and 2011, thus the same for the total contracting revenues. Since the focus of this study is concerning the international context, the missing values shall not be a problem.

Figure 1.1 shows that international contractors had US$543.97 billion in contracting revenue in 2013 from projects outside their home countries, an increase of 6.4% from US$511.05 billion in 2012. The top 250 international contractors also had US$871.50 billion in revenue from domestic projects in 2013, increasing from US$813.55 billion (7.1%) in 2012. The market boom is seen in early 2008 in the revenue figures for the top 225 international contractors, generating US$390.01 billion in revenue in 2008 from projects outside their home countries, up 25.7% from US$310.25 billion in 2007. The 2008's recession has halted much financing needed to launch projects and caused many

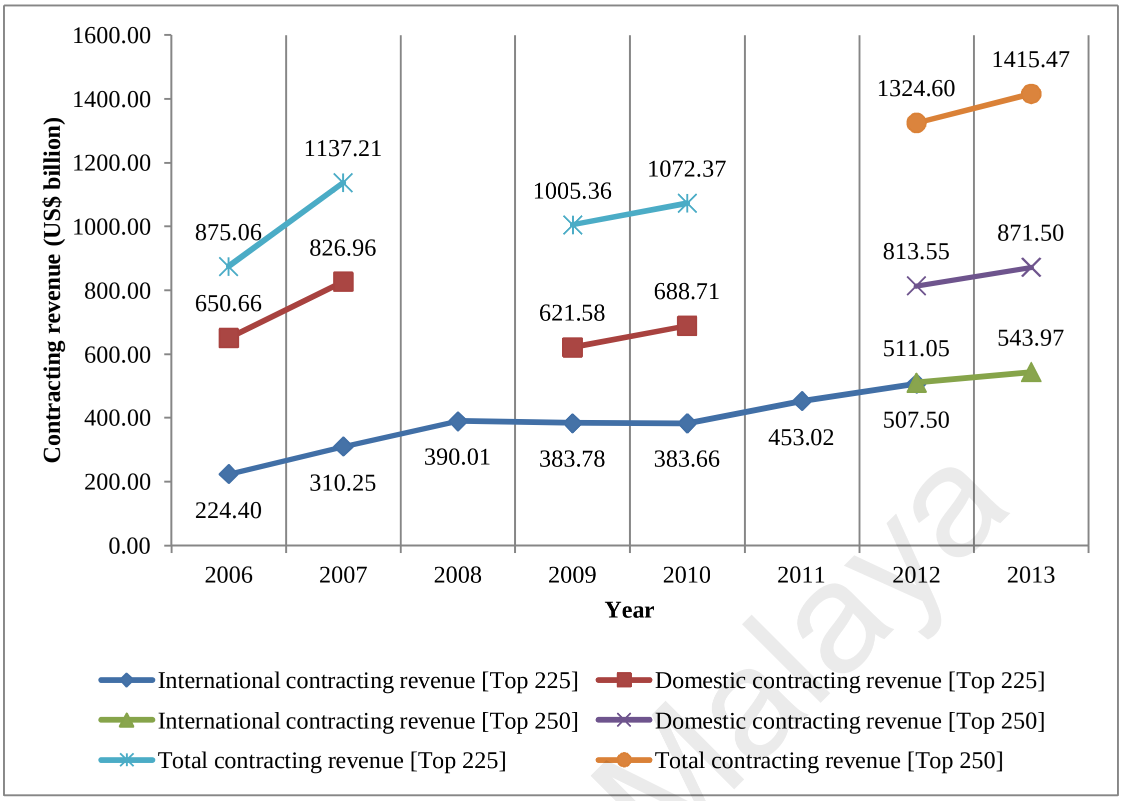


Figure 1.1: Contracting revenue of construction firms in the international market (2006-2013) (Source: ENR, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014)

international contractors to scramble. Most of the projects in this market were terminated or postponed after the credit crunch (ENR, 2009). It took years for the international contractors to recover from the financial turmoil, the global shift can be seen in 2010 where top 225 international contractors as a group generated US$383.66 billion in contracting revenue from projects outside their home countries, down by a mere US$0.12 billion from 2009. Contractors are finding opportunities outside their home countries amidst stagnant domestic markets especially in Europe and United States and fertile markets are available in the developing countries (ENR, 2010). Contractors are holding their own domestic markets and at the same time foraying abroad, this means more contractors are testing new waters in the international marketplace (ENR, 2013). The increased international contracts fuelled growth of construction firms' bottom lines by mitigating the impact of cyclical domestic markets (You & Zi, 2007). These are the challenges for novice construction firms that trying to venture oversea, having to sustain their companies' growth and to adjust to the unfamiliar environment in the international marketplace.

A growing number of contractors is finding success in the global markets, this intensified competition to capitalize on global opportunities often leads to excessive burdens for bid participation (Han, Kim, Jang, & Choi, 2010). In some overseas construction jobs, countries or clients of these global markets mainly in developing countries require project financing, a high level of technology, and firm's advanced experience, knowledge and management skill (Mahalingam & Levitt, 2007). This requires contractors to be capable of managing multi dimensions of construction projects including design, engineering, procurement, and construction. Han et al. (2010), who analyzed the common strategies and lessons obtained from the cases of leading global contractors that have sustained their growth in the competitive global construction during the last decade, found firms significantly increase their upstream and downstream functional capabilities to respond to changes in markets and to increase overseas revenues.

When making project selection decision, decision makers will usually assess the project options by estimating potential risks that may be borne by the company. The assessment of risks requires identification of risks and quantification of their risk significances. Hence, international market project selection decision is a major task by itself having to assess project, environment, and also firm. While there is a plethora of research (Han & Diekmann, 2001b; Hastak & Shaked, 2000; Li, 2009; Low, Liu, & He, 2009; Mahalingam & Levitt, 2007; Zhi, 1995) on what and how the risks encountered may be managed specific to international construction. These studies identified risks prevalent in international construction and later evaluated them and ranked for appropriate risk response measures. However, few have focused specifically on incorporating firms' capabilities when assessing international project risks.

Dikmen and Birgonul (2006) found that risk assessment depended on many factors related to the capabilities of the firms, hence they were considered in their proposed risk rating procedure. Bu-Qammaz, Dikmen, and Birgonul (2009) then attempted to incorporate the influencing factors such as company's experience, project data availability, type of project delivery system, and contract type into the assessment model but the results was not satisfactory. The observations on the field study conducted by Abdul-Rahman, Loo, and Wang (2012) and Loo, Abdul-Rahman, and Wang (2013) likewise realized the significance of determining the relationships of the firms' capabilities and the risk factors involved in risk assessment. Taroun (2014) also concluded in his comprehensive review on the risk literatures since before the 1980s to incorporate additional parameters in risk assessment to reflect risk nature, experience, interdependencies between project risks and relevant influence of project environment on risk assessment. Therefore, risk assessment remains less accurate if the assessment does not involved the incorporation of important influencing factors such as firms' capabilities.

Considering the lack of study on the incorporation of firms' capabilities or influencing factors into risk assessment, this research seeks to contribute to the existing body of knowledge of international construction risk management by determining the extent to which firm's capabilities affect international construction project risks. Not much has been done to empirically investigate the degree to which firm's capabilities affect risks, and thereby developing a risk assessment model that could assist international construction firms in project selection.

1.4 Aim and Objectives

The aim of this research is to develop a risk assessment model, through the determination of the extent to which firm's capabilities impact on international construction project risks, for improved productivity and performance. The objectives of the study are coherent and operational statements, translated from the strategic aim, concerning how the study is to be implemented (Fellows & Liu, 2009). To fulfill the research aim, the following research objectives are proposed:

1. To ascertain current approaches to risk assessment adopted by international construction firms;
2. To identify indicators to measure internal and external international construction risks and firm's capabilities of international contractors;
3. To determine the relationship between firm's capabilities and risks;
4. To develop firm's capability-based risk assessment decision making model;
5. To validate the risk assessment model developed through actual testing on international construction firms.

1.5 Research Questions

For a clearer direction for the research in achieving the research objectives, the above research problems are divided into three questions. Hence, this research will seek answers to the following:

1. What are the current approaches to risk assessment adopted by international construction firms?
2. What are the indicators of internal and external risks for international construction projects?
3. What are the indicators of firm's capabilities that affect risk significance values of international construction?

4. What are the relationships between firm's capabilities and international construction risk significance values?

1.6 Significance of Research

This research is significant because its final output is a remodeled Probability-Impact (P-I) risk model or known as Capability-Risk Assessment (CapRA) model. This CapRA model aims to improve the accuracy and facilitate project selection decision. The existing risk assessment methods for construction industry were reviewed and it was found that P-I Risk model is practical and easy to use for this industry. A parameter, firm's capability, was added to the existing P-I risk model. New mathematical models, which added firm's capability parameter to the P-I risk equation, were formulated to enhance risk significance value prediction with the aid of Partial Least Square-Structural Equation Modeling (PLS-SEM) analysis. The novel mathematical CapRA models were computerized into a calculator to simplify the application.

A scientific method to reveal the anomalies in existing risk assessment models was adopted. The anomaly-seeking research revealed the anomaly in the context of international construction risk assessment. The maiden usage of anomaly-seeking research in the project management field, particularly in risk management, is demonstrated in this study. Through the three methods proposed by anomaly-seeking research, firm's capability was found to be an important component to be considered when assessing the risk factors for international construction. Combining the theories from other management disciplines, this research adopted three streams of strategic management concepts- resource based view, dynamic capabilities, and Porter's generic value chain into an integrated framework for risk assessment (Figure 3.3). This framework may be used by international construction firms to assist them in project selection decision when operating outside their home countries.

1.7 Scope of Research

This research studies the risk management practices and firm's capabilities of international construction firms, who have had experiences in the international construction projects. In other words, these contractors undertake construction projects that are outside their home countries. These firms are registered with the Construction Industry Development Board (CIDB), Malaysia under two different categories and they are both included in the sampling frame. First category is the Malaysian construction firms registered with CIDB to undertake projects overseas. Second category is the foreign construction firms registered with CIDB to undertake projects in Malaysia.

1.8 Research Process

The research process of this study is presented in a flow chart, which shows briefly the steps taken to carry out the research from the beginning to the end. The steps and brief descriptions in point forms are depicted in Figure 1.2.

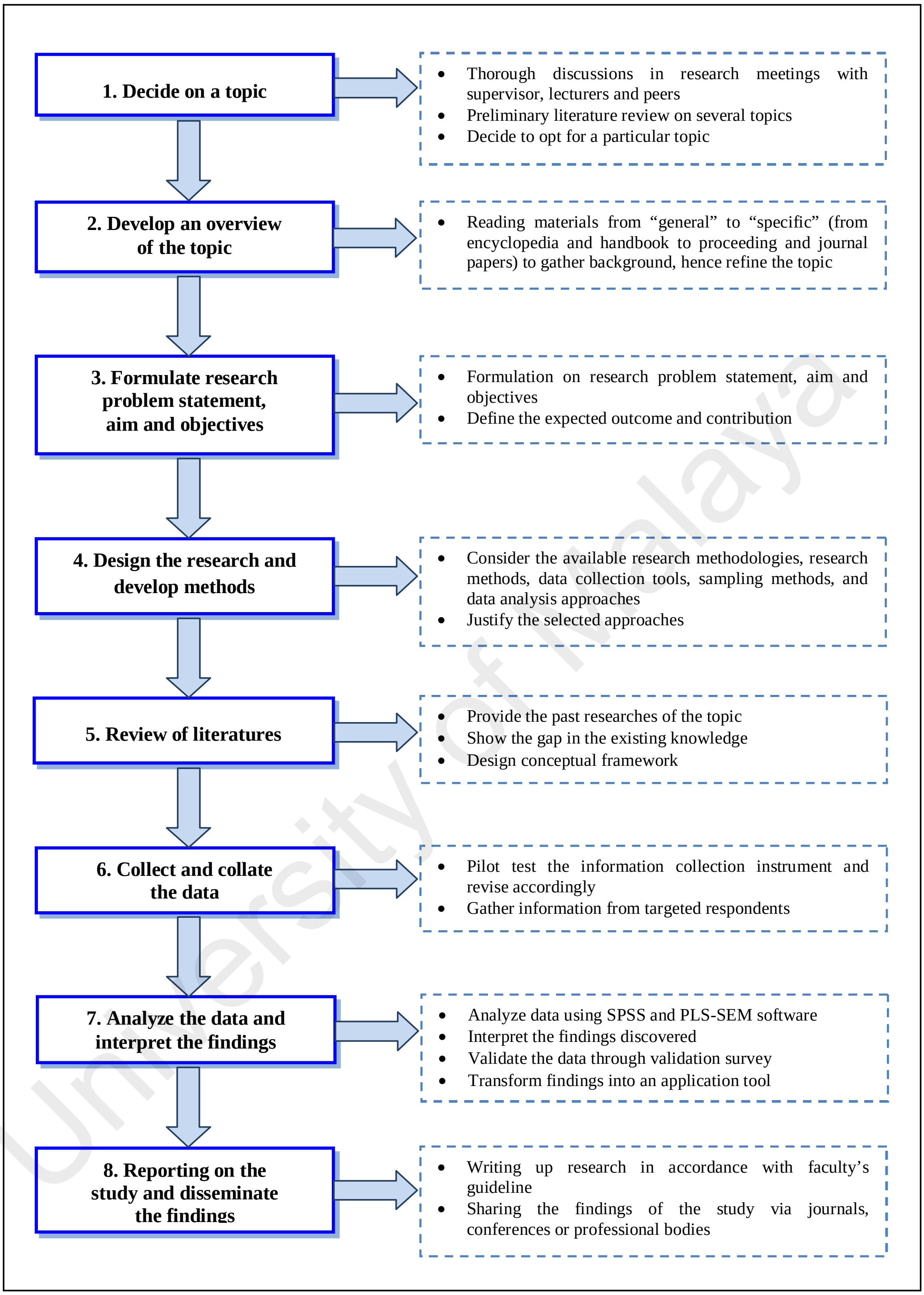


Figure 1.2: Research process flowchart
(Source: Author derived)

1.9 Outline of Thesis Structure

The dissertation is being divided into seven chapters. They are outlined as follow:

Chapter 1: Introduction

Chapter 1 of this dissertation presents an introduction of this study, consisting of research background and problem statement that reflect the gap to be bridged in this study. The aim and objectives, scope of research, and research process are also highlighted to clearly define the desired findings, within the focus and limitation of the research, and the steps to achieve the result.

Chapter 2: Literature Review

Chapter 2 presents previous research on international construction arena and its complexity in entry decision making. The existing decision support tools are also discussed. This chapter also introduces the basic steps of risk management comprising risk identification, risk assessment, and risk response. The dependent variables' measurement scales for this study are gathered from the review of risk identification literature. The review on risk assessment reveals the gap of current methods or tools. The literature on risk response review generic risk response measures. Finally, knowledge gap of this study is presented.

Chapter 3: Conceptual Framework for Integrating Firm's Capability in Assessing Risks

Chapter 3 discusses the process of building theory and anomaly-seeking research. The anomaly-seeking steps are applied in the context of risk assessment for international construction. Having the knowledge gap unfold in the literature review chapter, this chapter reinforces the gap using anomaly-seeking process then proposes a conceptual framework to bridge the gap. The conceptual framework integrates firm's capabilities (independent variables) that are gathered from theories on Resource-Based View (RBV), Dynamic Capability, Porter's Generic Value Chain, and a construction firm's capability framework. This conceptual framework is to be explored in the fieldwork.

Chapter 4: Research Methodology

Chapter 4 outlines the research methodology that is adopted in this research. The choices of the research approach, research method, data collection instrument, data analysis method, and sampling method are laid out with proper and supported justifications. A survey was conducted and data collected using a structured questionnaire. Partial Lease Square-Structural Equation Modeling (PLS-SEM) was used to specify the conceptual framework. Measurement models and structural model are evaluated to achieve the objectives of this research.

Chapter 5: Results and Discussion

Chapter 5 reveals the data collected from questionnaire survey. Firstly, the demographic profile of respondents and their firms is described. The data collected are checked by SPSS 22.0 and SmartPLS 2.0 software. This chapter shows the findings from the quantitative structural equation modeling analysis, evaluating measurement models and structural model.

Chapter 6: Interpretations and Discussion

Chapter 6 describes the data collected from semi-structured interviews. This chapter shows the qualitative findings based on the questionnaire survey. It describes and discusses the relationship between the firm's capabilities and project risk significance values. Having the surveys and interviews interpreted and analyzed, the risk assessment model for the purpose of this study is developed. All information gathered from the literature reviews and fieldworks are analyzed, discussed and detailed out in this chapter.

Chapter 7: Model Validation and Application

Chapter 7 reports on the model validation and application of the structural model developed in Chapter 5. The transformation of the structural model into a remodeled probability-impact (P-I) risk model is discussed. As a result, a Capability-Risk Assessment (CapRA) calculator is developed and then tested. The validation on practicality and application of the CapRA model cum calculator are also described.

Chapter 8: Conclusions and Recommendations

Chapter 8 compiles and concludes the research findings. This chapter summarizes the findings and discussion from the previous chapters. The limitations of the research are highlighted in order to emphasize the recommendations to further or make better this research. With that, academicians with interests are supplied with thoughts for further study in this area of research.

1.10 Summary of Chapter

This chapter has provided the background of the study to set a proper foundation to this study. The aim and objectives are defined to give direction to the study. The problem statement is presented with both the scope and research process briefly outlined. In accordance with the structure of this research, the next chapter presents an overview of international construction and entry decision support tools developed for international construction. Following that, a review of previous researches on risk management is presented. Areas of previous studies on risk assessment are reviewed and later revealing gap of the study.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

This chapter reviews the literature on international construction and risk management. The international construction background is given with the complexity involved in various entry decisions. The existing decision support tools for project selection decision are also discussed. Next, the basic steps of the risk management model comprising of risk identification, risk assessment, and risk response are discussed. The literature for each step of the risk management model are reviewed and described. The literature review of risk identification step reveals the measurement scale for dependent variables of this study, the risk assessment step reveals the gap of current methods or tools, and the risk response step reviews the generic risk response measures. At the end of this chapter, the knowledge gap of this study is presented for exploration.

2.2 International Construction

Ofori (2003) suggests that the definition of an international construction project as one undertaken by an enterprise outside its home-country (for example, ‘firms from one country building under contract in another’ by Strassman and Wells, 1988, p. 2) is out of date, and that the definition must now include projects in a home-country involving foreign firms as competitors (West, 1992; Momaya and Selby, 1998). In this study, author adopts the new definition of international construction (Ofori, 2003), thereby studying the international construction firms undertaking projects outside home-country (for Malaysian firms) and inside home-country (for foreign firms).

The stagnant markets in most of the developed countries like Europe and the U.S. compelled the contractors to work outside their home countries (ENR, 2014).

International contractors are foraying abroad to fuel the firm's bottom line as the domestics construction jobs are scarce. Contractors may hesitate to foray abroad owing to complacency and consideration of the multifaceted risks that linger in international construction. Whilst it is common for firms to be risk averse, tapping into international opportunities may be a much better decision for a firm's growth and sustainability. The Engineering News Record (ENR) Top 250 International Contractors reported to have $543.97 billion in contracting revenue in 2013 from projects outside their home countries, along with $871.50 billion in revenue from domestic projects, for total contracting revenue of $1.42 trillion (ENR, 2014).

This ENR report revealed that there was almost 40 percent of opportunity abroad. It is definitely not as easy as working within the familiar home environment. Nonetheless, the demands for development in certain countries definitely created greater opportunities as compared to the stagnant domestic construction market. Before deciding to foray abroad, it is vital to assess the contracting firm's capabilities. To prevail in securing the project and profiting from it, the construction firm has to be capable in various aspects. Wrong decisions may eventually prove fatal to the firms.

It is noteworthy that the uncertainties involved in international construction projects consist of uncertainties that commonly occur in domestic projects and also the more complex ones from international engagements (Han & Diekmann, 2001a; Han, Diekmann, & Ock, 2005; Ling & Low, 2007). The exposure to more diverse and complex risks than that of the domestic projects implies that international projects are more susceptible to high possibility of loss. Owing to the uncertainties and complexities associated with the international construction domain, the entry decisions for international construction markets are intricate. Han et al. (2010) added that due to the inherent challenges and vast uncertainties in the overseas market conditions, contractors have to be versatile in managing the different dimensions of construction projects including design, engineering, procurement, and construction to respond to changes in markets. The contractors gradually achieve the balance in such growth as they pursue the opportunities in the overseas market.

Han and Diekmann (2001a) mentioned a few country-specific conditions that international construction is inclined to like currency devaluation, currency exchange restrictions, cultural differences, or unstable laws or regulations. Managing risks stemming from both host country conditions and project-specific factors is the key to be successfully carrying out construction projects in international markets. A project success usually depends on the combination of all risks, response strategies used to mitigate risks and a company's ability to manage them (Dikmen, Birgonul, & Han, 2007b).

2.3 Complexity of Entry Decisions for International Construction Market

Globalization opens up tremendous opportunities for contractors to expand into new foreign markets thus allowing local firms to compete internationally. Unfortunately, due to the uncertainties and complexities associated with the international construction domain, the entry decisions for international construction markets are difficult (Han & Diekmann, 2001b).

In addition to its risky nature, the international construction markets entry decision is also a highly integrated, complex decision. Han and Diekmann (2001a) described that entry decision progresses through three sequentially related stages. First stage is to identify the countries that are most business-friendly with the least risks. Second stage is to select potential projects within the chosen country. Final stage is to decide whether ‘to go or not to go’ on a specific project opportunity. Besides the three-staged entry decision progress recommended by Han and Diekmann (2001a), Dikmen et al. (2007b) also echoed the same and further grouped the international construction business entry decisions to be made by contractors into four categories. They are internationalization decision, market selection decision, project selection decision, and mark-up selection.

Internationalization decision is defined differently by different researchers; some say international expansion decision (Gunhan & Arditi, 2005) and others say international market entry decision (Dikmen & Birgonul, 2004). One of the most prominent internationalization frameworks is Porter’s diamond framework. Oz (2001) analysed the international operations of Turkish contractors using Porter’s diamond framework. Porter's diamond framework (Porter, 1990) suggests that the national home base of an organization provides organizations with specific factors, which will potentially create competitive advantages on a global scale. Business leaders may use Porter’s diamond to analyze which competitive factors may reside in their company's home country, and which of these factors may be exploited to create competitive advantages on a global scale for internationalization decision.

Another framework that is prevalent in international business is Dunning’s (2000) eclectic paradigm. Seymour (1987) applies Dunning’s eclectic paradigm to international construction and concludes that the eclectic framework provides a comprehensive and flexible method for analysing the international construction industry despite industry specific characteristics having developed for the study of multinational manufacturing. Dunning (2000) uses the eclectic paradigm to explain, and provide an umbrella for, the major multinational enterprises theories and concludes that the concept needs an add-on dynamic component to embrace both asset augmenting and alliance related cross-border ventures. Similarly, Seymour (1987) noted that the eclectic approach would be more acceptable if dynamic considerations were included after applying the paradigm to international construction.

The diamond framework and eclectic paradigm are some of the frameworks that construction firms use to assess and decide on whether they are competent to undertake construction projects in the international markets. Assessing their firms for the necessary sources of competitive advantage to venture abroad is essential prior to assessing the attractiveness of a particular country or a project. When internationalization corresponds to a firm's corporate objective and with the required competences, the firm may embark on quest to find attractive market and project (Dikmen, et al., 2007b).

Having made the international decision, a construction firm subsequently needs to make market selection decision. This decision includes selecting a candidate country and the most appropriate entry mode. Gunhan and Arditi (2005) and Sadgrove (2015) recommended strengths weaknesses opportunities threats (SWOT) analysis, which helps organizations to assess issues within and outside the organization. Prior to undertaking business in a target market, a detailed SWOT analysis is to be carried out together with an extensive environmental scanning to identify risks and opportunities associated with the said market.

The next decision to be made is the project selection decision, also known as bidding decision. The project selection decision is a crucial step where it screens a list of potential project opportunities. The decision is dependent on the attractiveness of the project and competitive advantage of a company. When contemplating to bid or not to bid for a project, construction firms assess approximate potential profitability of the project and strategic importance of the project for the firm. It is noteworthy that determination of risk level is imperative at this stage (Dikmen, et al., 2007b; Kendrick, 2015).

The last decision is to decide for bid price or better known as mark-up selection decision. When decision to bid for a project is made, the bid price has to be decided. The bid price is determined through cost estimation inclusive of a percentage of mark-up. The mark-up selection decision is influenced by level of uncertainty or the risks involved, probability of winning the bid, and expected profitability or based on general expected utility (Ahmad, 1990).

According to the aim of this study and the four general types of construction business entry decisions delineated above, this study will focus on the project selection decision that weighs both competitiveness of a firm and the risk level of the potential project opportunity.

2.4 Current Decision Support Tools Developed for Project Selection

Since this study focused on project selection decision, some of the decision support tools developed for this purpose are discussed. The decision support tools delineated here are related to factors that influence project selection decision such as political, economic, financial, bidding factors, information, and risks.

Political analysis tool has traditionally been developed for capital investment decisions in the manufacturing industry. The context of the analysis tool does not address that of the construction industry. Hence, Ashley and Bonner (1987) developed a political risk analysis approach for the construction industry. The political risk analysis approach is developed from contractor's perspective and it identifies primary sources of political risks. The political risks are assessed and translated the resultant impacts into cash flow projection and probable cost.

Economic risks are another important factor closely linked to international construction business. Economic risks especially fluctuations in exchange rates have severe impacts on the project success. Demacopoulos (1989) developed an approach that extends traditional cash flow analysis models to incorporate the multiple currencies when evaluating the exposures of construction cost and revenue components. This work has provided the understanding on the impact of economic and competitive aspect of foreign exchange risk on construction firms working in international construction markets. The framework developed also assists international construction firms to systematically evaluate the construction cost and revenue under the foreign exchange exposure.

The next project selection tool is the portfolio management techniques by Kangari and Boyer (1981). Diversification is the basic concept of the portfolio management; it reduces the overall risks of a portfolio of projects. Portfolio management works by acknowledging that any project investment has a given risk and return, therefore a combination of investments where the risks are not closely related to result in a lower risk level for the firm. Han, Diekmann, Lee, and Ock (2004) also developed a multi-criteria decision making framework for financial portfolio risk management, which integrates risk hierarchies at the project and corporate levels.

Ahmad (1990) developed a model for bid or no bid decision problems. He conducted a survey on different factors that influence the bidding decision for an individual project. The bidding factors were categorized into four main categories of job-related, firm-related, market-related, and resources-related. He then proposed an additive multiattribute hierarchy to determine desirability of a project. This proposed model functions as a structured methodology with the set of attributes being defined out for a desirability score that reveals the strength of bidding decision.

Messner and Sanvido (2001) also proposed an information framework model to aid in project selection. An exploratory investigation on the information framework was carried out for international construction projects evaluation. The findings revealed five generic categories of information required to effectively evaluate the international construction projects, namely, organization, commitment, process, environment, and facilities. These led to the development of an information or process model that shows the flows of decisions when deciding to go for a project opportunity.

There are also risk analysis decision support tools that cover a broader perspective of international construction business. The World Bank and UNESCO developed risk analysis tools that analyze construction risks and evaluate the feasibility and soundness of international projects from the lender's position (Pouliquen, 1970). Probability analysis, sensitivity analysis, and simulation methods are the risk analysis techniques proposed. Dikmen and Birgonul (2006) proposed a risk assessment methodology to quantify risks and opportunities related to international construction projects using Analytical Hierarchy Process (AHP) for the firms to compare among project options. Hastak and Shaked (2000) develop a structured approach to evaluate risk indicators within an international construction operation. The approach can estimate risk level of a particular project in a foreign country. Sadenghi, Fayek, & Pedrycz (2010) developed approach to assess random and fuzzy uncertainties in construction projects using Fuzzy Monte Carlo simulation. Han and Diekmann (2001a) developed and tested a risk-based go or no-go decision making model using cross-impact analysis for international construction risk assessment.

The existing tools and methods developed for evaluating complex and risky nature of international construction projects are either specifically for a certain area or underdeveloped. Some existing tools for project selection decision focused on specific fragmented areas like political or economic risk (Ashley & Bonner, 1987; Demacopoulos, 1989). Portfolio management is a wise strategy when choosing an additional project opportunity to diversify the risks of the existing projects (Kangari & Boyer, 1981). The bidding model developed by Ahmad (1990) works well for domestic construction projects, thus it lacks the international aspect. The information framework focused on qualitative tools and lacked computational methodology to assess the project (Messner & Sanvido, 2001). However, the risk analysis or assessment methods cover broader perspective associated with international construction environment. Hence, it is further discussed when discussing the risk assessment methods available for construction industry in the later section.

2.5 Managing Risks in International Construction

The construction industry is subjected to more risks and uncertainties than any other industry (Flanagan & Norman, 1993). Various types of risks are elaborated in the Risk Identification section (Section 2.5.1). Failure to fund, major scope changes, improper material management, failure to allocate resources, inadequate project management control and improper planning and slow mobilization may occur in the absence of risk management.

Not only the risk manager is obliged to carry out the risk management, the party involved in the construction project such as the client, contractor, design team, quantity surveyor and other project stakeholders should be responsible to manage construction risks and be aware of the effects of those risks. Within the framework of risk management, the project management team and responsible parties should decide how to handle or treat each risk and formulate suitable risk treatment strategies or mitigation measures.

No construction project is risk free. Risks can be managed, minimized, shared, transferred or accepted. It cannot be ignored (Latham, 1994). Risk management is a set of methods and activities designed to reduce the disturbances occurring during project delivery. Risk management is used to ensure that all steps needed to achieve the project objective will be taken, delivery of project within schedule and budget and in line with the quantitative and qualitative standards (Kliem & Ludin, 1997).

Some large companies that can afford to absorb loss actively pursue a high risk and high return strategy in their area of experience. Furthermore, the smaller companies tend to spread the risk, in order to reduce its overall effect, at a lower rate of return. They cannot afford to pursue a high risk strategy because of the effect of failure (Uff & Odams, 1995). Therefore, demand and requirement of the risk management are different for each construction project and organization; it might depend on the objectives of the project.

As mentioned in previous chapter, risk management is established as a concept of relevance to construction projects, the process comprises identification, assessment, and response (Perry & Hayes, 1985). Risk management is taking the appropriate actions to respond to the occurrence of risks. These three basic steps of risk management process are to be taken as appropriate actions to respond to the occurrence of risks. There is a synergistic relationship among those steps to ensure the proper management of risks.

Risk management is a discipline for living with the possibility that future events may cause adverse effects (Flanagan & Norman, 1993). Besides, it is a structured and auditable process for the benefit of all members of the project team which is dedicated to the sole purpose of controlling and mitigating uncertainties in a project (Smith, 2003). Risk management techniques are not intended to "kill off" projects, nor to dampen levels of capital investment. They are primarily there to ensure that only those projects which are genuinely worthwhile and meet both internal and external objectives are sanctioned (Thompson & Perry, 1992).

The literature for each step of the risk management model are reviewed and described in this chapter for the following purposes:

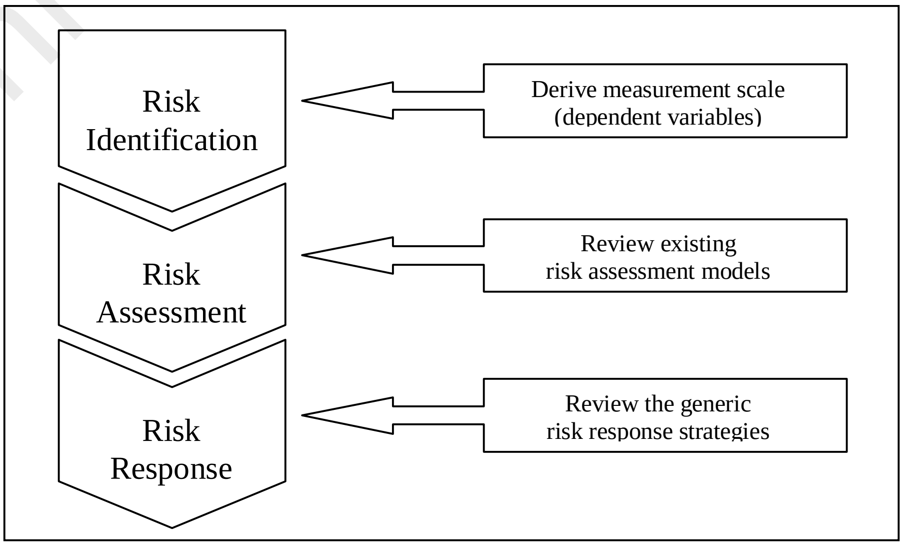


Figure 2.1: Literature review purposes for each step of risk management
(Source: Author derived)

2.5.1 Risk Identification

Risk identification is a process to acknowledge risk events and to identify characteristics of risk events for the selected project based on risk-related information (Choi, Cho, & Seo, 2004). This is an important process which the risk analysis and risk response are based on the identified risks. Bad definition of a risk will breed further risk (Flanagan & Norman, 1993). The information available which might affect the achievement of an objective is collected during the identification of risks.

Risk identification determines the potential risks, which are those that may affect the project. Copious research set forth several methods in classifying project risks and risk sources (Baloi & Price, 2003; Bing, Akintoye, Edwards, & Hardcastle, 2005; Leung, Tummala, & Chuah, 1998; Tah & Carr, 2000). Generally, the risks in a construction projects may be derived from two sources. The first consists of the environmental impacts, or known as external risks (e.g. financial, economic, political, legal and environmental). The second consists of the uncertainties in the project itself, which are known as internal risks (e.g. design, construction, management and relationships) (Aleshin, 2001; Bing & Tiong, 1999; El-Sayegh, 2008; Fang, Li, Fong, & Shen, 2004; Wang & Chou, 2003; Zhi, 1995).

This study found a risk taxonomy pattern adopted by risk management literature concerning a specific country's construction projects. For instance, projects in China (Fang, et al., 2004; Zhi, 1995), Russia (Aleshin, 2001), Taiwan (Wang & Chou, 2003), Vietnam (Van Thuyet, Ogunlana, & Dey, 2007), and UAE (El-Sayegh, 2008) have all adopted the risk classification based on internal and external aspects. The reason is that external risks are originated due to the project environment or usually unique to the country, while internal risks are initiated inside the project and relevant to all projects irrespective of whether they are local or international (Flanagan & Norman, 1993; Aleshin, 2001; Fang et al., 2004; Ling & Hoi, 2006).

2.5.1.1 Risk Factors in International Construction Context

This study adopted 11 constructs (risk categories) consisted of 54 internal and external risk indicators (Table 2.1) as dependent variables. The previous researches on risk management were reviewed to derive the dependent variables and indicators. Even though some of these literatures are pertaining to various types of construction projects and or different countries, still they are of great importance in guiding the risk management research and practice for the international construction industry. In the process of compiling the items, certain risk factors that carried similar meanings but were represented by different phrases were consolidated and renamed in the categories proposed in this study's dependent variables. In other words, some risk factors were being covered in a more relevant category as proposed instead of that from the reference.

Based on the risk categorization from previous literature, the internal risks were grouped into categories of financial, managerial, construction, owner, design consultant, and supervisor, material and equipment, and labour. The external risks were categorized into political and economic, third party, cultural, logistics, and natural environmental risks. The political and economic risks were grouped together as classical economists put forth that it was impossible to understand politics without economics or economics without politics since two fields are certainly different but they are also intimately linked (Friedman, 2011).

Table 2.1: Risk constructs and indicators

Umbrella	Construct	Indicator	Adapted and modified
Internal risks	Financial factor (IFNC)	ifnc_1: Interest rate volatility ifnc_2: Credit rating ifnc_3: Cash flows ifnc_4: Delayed or non-receipt of payment ifnc_5: Financial failures by parties involved ifnc_6: Inadequate financial margins	(Ling & Lim, 2007) (Ling & Hoi, 2006) (Mustafa & Al-Bahar, 1991b) (Perry & Hayes, 1985) (Wang, et al., 1999) (Wang, et al., 2000) (Han & Diekmann, 2001a) (Tchankova, 2002) (Bing, et al., 2005)
	Managerial factor (IMGR)	imgr_1: Change of organization within local partner imgr_2: Inadequate distribution of responsibilities and risks imgr_3: Differences in working method and know-how between partners imgr_4: Poor project organization structure and management team imgr_5: Contract formation and performance imgr_6: Poor communication between parties involved	(Egbu & Serafinska, 2000) (Shen, et al., 2001) (Bing, et al., 2005) (Ling & Low, 2007)
	Construction factor (ICNS)	icns_1: Cost overrun icns_2: Undocumented variation or change order icns_3: Project delay icns_4: Rushed bidding icns_5: Defective work	(Mustafa & Al-Bahar, 1991b) (Egbu & Serafinska, 2000) (Bing, et al., 2005)
	Owner, design consultant, and supervisor factor (IODS)	iods_1: Quality of design iods_2: Owner demand changes iods_3: Efficiency of owner's supervisor iods_4: Defective design	(Bing, et al., 2005) (Perry & Hayes, 1985) (Mustafa & Al-Bahar, 1991b)
	Material and equipment factor (IMEQ)	imeq_1: Suitability of material and equipment imeq_2: Availability of material or equipment imeq_3: Running of construction equipment	(Perry & Hayes, 1985) (Han & Diekmann, 2001a) (Mustafa & Al-Bahar, 1991b)
	Labour factor (ILAB)	ilab_1: Labour relation ilab_2: Gap between implementation and specification ilab_3: Availability of labour ilab_4: Quality performance	(Enshassi, et al., 2008) (Bing, et al., 2005) (Ling & Hoi, 2006) (Mustafa & Al-Bahar, 1991b)

Table 2.1: Risk constructs and indicators (cont'd)

Umbrella	**Construct**	**Indicator**	**Adapted and modified**
External risks	Political and economic factor (EPOE)	epoe_1: War threat or riot or terrorism epoe_2: Expropriation epoe_3: Embargo epoe_4: Delay in approval or permit requirement epoe_5: Corruption and bribe epoe_6: Changes in legislation and policy epoe_7: Constraint on employment of expatriate staff epoe_8: Custom and import restriction epoe_9: Restriction on repatriation of fund epoe_10: Import or export restriction epoe_11: Economic recession	(Perry & Hayes, 1985) (Mustafa & Al-Bahar, 1991b) (Leung, et al., 1998) (Wang, et al., 1999) (Wang, et al., 2000) (Egbu & Serafinska, 2000) (Han & Diekmann, 2001a) (Bing, et al., 2005) (Ling & Hoi, 2006)
	Third party factor (ETRP)	etrp_1: Public security etrp_2: Security of material and equipment etrp_3: Entrance guard of site etrp_4: Industrial relation action etrp_5: Public opinion	(Tchankova, 2002) (Ling & Hoi, 2006) (Egbu & Serafinska, 2000)
	Cultural factor (ECUL)	ecul_1: Cultural difference including language barrier ecul_2: Level of cooperation ecul_3: Need for micro-management ecul_4: Compliance with written contract ecul_5: Ease of settling dispute ecul_6: Safety awareness	(Perry & Hayes, 1985) (Han & Diekmann, 2001a) (Ling, et al., 2007)
	Logistics factor (ELGT)	elgt_1: Loss or damage in the transportation of material and equipment elgt_2: Lack of access and communication	(Perry & Hayes, 1985) (Enshassi, et al., 2008)
	Natural environmental factor (ENAE)	enae_1: Act of God (including fire, flood, earthquake, storm, hurricane or other natural disaster) enae_2: Unforeseen ground condition	(Perry & Hayes, 1985) (Wang, et al., 1999) (Mustafa & Al-Bahar, 1991b) (Egbu & Serafinska, 2000) (Tchankova, 2002) (Bing, et al., 2005) (Enshassi, et al., 2008)

2.5.2 Risk Assessment

The increasing complex and dynamic nature of the construction environment is riskier than perhaps any other industry (Flanagan & Norman, 1993). Sources of risk invariably exist in construction projects and often cause schedule delay or cost overrun (Zavadskas, Turskis, & Tamošaitiene, 2010). Likewise, Project Management Institute (2004) defined risk as an uncertain event that, if occurs, has a positive or negative impact on at least one project objective such as time, cost, or quality. Shimpi and Durbin (2001) emphasized risk as the lifeblood of every organization whereas Gupta (2011) referred risk as the possibility of deviation from the standard pathway that caused adverse situation and reduced goals value.

Since risks cannot be removed, successful projects are those where risks are effectively managed, of which early identification and assessments of risks are essential (Cooke & Williams, 2013). Risk management, therefore, is critical in enhancing project performance and securing project success in construction. Risk management has been perceived as a necessity in today's construction to quantify all risks so that conscious decisions can be carried out (Baloi & Price, 2003) to reduce the uncertainty about future events where information is incomplete, unclear or under discussion (Ward & Chapman, 2003).

Over the years, researchers have proposed a variety of risk management methodologies for real practice. All of them, generally, are similar in process, following a systematic three-step approach: identify, assess and mitigate construction project risks (Berkeley, Humphreys, & Thomas, 1991; Flanagan & Norman, 1993; Lyons & Skitmore, 2004). Out of the three steps, risk assessment process has the most controversial issue in risk management (Baloi & Price, 2003). This can be seen as copious risk assessment approaches are developed to assist construction practitioners in assessing uncertainties and subsequently making appropriate decision.

When a major risk is identified, the reports on analysis must be carried out immediately. Risk assessment or analysis is an adequate and effective assessment of the individual and combined effect of identified risks for successful delivery of the objectives (Egbu & Serafinska, 2000). The identified risks are analysed to assess the extent of all aspects of the risks that might affect the objective to assist business to take the right action.

The major issue is which risks should be receiving attention. The risks that require special attention are those that produce medium and high project risk criterion values. Each risk is assessed in terms of the undesirable event, all the outcomes of event's occurrence, the magnitude or severity of the event's impact, chances/probability of the event happening, when the event might occur in the project and the interaction with other parts of this or other projects (Gray & Larson, 2003).

2.5.2.1 Methods for Risk Analysis

There are various methods that can be used to identify the degree of risk. In most cases, probability and impact are, at best, subjective judgment, and an elementary categorization is sufficient for the purpose (Wideman, 1998).

At the crudest level, the individual major risk categorized can be aggregated into two or three major risk effects and a subjective but experienced judgment made of their effect on cost and time (Smith, 2003). For instance, a minimum rate of return in excess of minimum bank lending rate could be considered. Elementary risk analysis may be adequate when comparing alternatives at the appraisal stage.

Probability analysis is a more sophisticated form of risk analysis (Smith, 2003). Probability is the likelihood of the risk occurring and is generally expressed as a percentage; impact is the consequence it would have on meeting the project's objective if the risk did occur. The probability of occurrence and impact of the event are ranked as high, medium or low.

Table 2.2 below shows the matrix of probability versus impact. Multiplying the probability and impact together will give a range of risk criterion, risk event status and priority ranking. More attention are given to the high probability and high severity of consequence, but the low priority and low impact risk events should not be neglected as they may influence the implementation of a project and block the achievement of the project's objectives.

Table 2.2: Matrix of probability versus impact (Zou, Zhang, & Wang, 2007)

		IMPACT				
		Very High	**High**	**Medium**	**Low**	**Very Low**
PROBABILITY	**Very High**					
	High					
	Medium					
	Low					
	Very Low					

2.5.2.2 Risk Assessment Models

In order to assess the project risks of different milieu, various risk assessment methodologies have been adopted (See Table 2.3). Researchers employed Program Evaluation and Review (PERT) to assess and estimate project duration, range estimate to assess project cost, and Monte Carlo Simulation (MCS) to assess for both project duration and cost.

Table 2.3: Construction project risk assessment methodology

Purpose of assessment	Risk assessment methodology	Author
Time	Program Evaluation and Review Technique (PERT)	(Chapman & Cooper, 1983; Hull, 1990; Mulholland & Christian, 1999; Yeo, 1990)
Cost	Range estimates	(Yeo, 1990)
Time and Cost	Monte Carlo Simulation (MSC)	(Hull, 1990; Molenaar, 2005; Oztas & Okmen, 2004)
Risk rating	Probability distribution	(Chapman & Cooper, 1983; Franke, 1987)
	Probability-Impact (P-I)	(Baccarini & Archer, 2001; Dey, Tabucanon, & Ogunlana, 1994; Cagno, Caron, & Mancini, 2007; Cioffi & Khamooshi, 2009; Hastak & Shaked, 2000; Hillson, 2002; Jannadi & Almishari, 2003; Molenaar, 2005; Santoso, Ogunlana, & Minato, 2003; Shang et al., 2005; Thomas, Kalidindi, & Ganesh, 2006; Wang, et al., 2014; Zhang, et al., 2014)
	Significance-Probability-Impact	(Han, Kim, Kim, & Jang, 2008)
Decision support	Decision trees	(Chapman & Cooper, 1983; Dey, 2001)
	Fault tree	(Thomas, et al., 2006)
	Belief network/ Influence network	(Nasir, McCabe, & Hartono, 2003; Poh & Tah, 2006)
	Case-based reasoning	(Dikmen, Birgonul, & Gur, 2007a)
Subjective assessment	Analytical Hierarchy Process (AHP)	(Dey, 2001; Dey, et al., 1994; Dikmen & Birgonul, 2006; Hastak & Shaked, 2000; Hsueh, Perng, Yan, & Lee, 2007; Mustafa & Al-Bahar, 1991a; Zayed, Amer, & Pan, 2008)
	Fuzzy Sets Theory (FST)	(Baloi & Price, 2003; Choi, et al., 2004; Dikmen, et al., 2007b; Kangari & Riggs, 1989; Paek, Lee, & Ock, 1993; Shang, et al., 2005; Tah & Carr, 2000; Wirba, Tah, & Howes, 1996)
	Fuzzy-AHP	(Zeng, An, & Smith, 2007; Zhang & Zou, 2007; Taylan, et al., 2014)
	Fuzzy-Delphi	(Thomas, et al., 2006)
	Analytic Network Process (ANP)	(Bu-Qammaz, Dikmen, & Birgonul, 2009; Dikmen, Birgonul, & Ozorhon, 2007c)
	Structural Equation Modeling (SEM)	(Eybpoosh, Dikmen, & Talat Birgonul, 2011; Kim, Han, Kim, & Park, 2009)

For traditional risk management, many researchers have derived risk rating for construction project risks from different angles or perspectives using probability distribution, probability-impact, and significance-probability-impact.

Decision support tools like decision trees, fault tree, belief network, influence network, and case-based reasoning use graph or model of decisions and their possible consequences including probability event outcomes, resource costs, and utility. These tools are commonly used in operational research specifically in decision analysis to help identify response strategy.

Researchers realized that human factors such as personal experience, intuition and judgment affect the ratings given (Dikmen, et al., 2007b; Kangari & Riggs, 1989). Hence, Analytical Hierarchy Process (AHP), Fuzzy Sets Theory (FST), Fuzzy-AHP, Fuzzy-Delphi, and Analytic Network Process (ANP) were introduced to handle subjective assessments. These tools develop qualitative risk assessment models which incorporate linguistic variables to assess the risk probability and impact and the interdependencies between risks (Bu-Qammaz, Dikmen, & Birgonul, 2009). Fuzzy generally makes use of linguistic variables used to assess risk probability and impact, while AHP is used to structure and prioritize diverse risk factors (Zeng, An, & Smith, 2007).

Since the interdependencies or extent of influence of firms' capabilities towards the risk factors are the focus of this research, subjective assessment tools are adopted. Although AHP is an effective tool to quantify relative importance using a pair-wise comparison (Saaty, 2003), this method may not be possible to be applied when too many factors and experts are involved in the weighing process. To process these complex relationships of capabilities and risk factors, this study adopts the Partial Least Square of Structural Equation Modeling (PLS-SEM) approach. Recently, Kim, Han, Kim, and Park (2009) and Eybpoosh, Dikmen, and Birgonul (2011) have applied SEM techniques in identifying the risk paths during risk assessment of international construction projects. This PLS-SEM technique is a quantitative technique in determining the weight of the relationships among variables to handle subjective assessments.

2.5.3 Risk Response

To deal with the risks that have been identified and assessed, risk response strategies are the subsequent steps to be made. In the last section on risk assessment, the risk evaluation in terms of its impact and probability has been discussed, this evaluation will then rank risks in the order of importance. In other words, the importance or significance of the risk is based on the combination of probability and impact.

Risk response strategy is based on risk tolerance (Project Management Institute, 2004). Risk tolerance, in terms of significance, is a level of acceptance. A risk which is above the level of risk tolerance is not acceptable, and a risk which is below the level is acceptable. There are several strategies to deal with the risks identified. They are elimination, mitigation, transfer, sharing and retention.

There are many factors that affect the selection of risk strategies. All these factors must be taken into account, for example, risks associated to project objective of cost and schedule must be given priority due to the higher significance level. There are other factors that may affect the choice of risk strategy. For instance, if an identified schedule risk has few other tasks depending on it, this said risk is calculated to have lower importance or significance level than is apparent. Thus, the significance level should be adjusted even though the schedule impact due to the interference may be complicated to judge. The strategy should be appropriate for the risk it is intended for.

2.5.3.1 Types of Risk Response

When a risk event is identified and assessed, a decision must be made concerning which response is appropriate for the specific event. Risk responses are chosen based on the situation. Risk response can be considered in terms of elimination, mitigation, transfer, sharing and retention.

a) Risk Elimination

Risk event can be avoided if a contractor is not placing a bid or the owner not proceeding with project funding. It is perhaps more likely that risk identification and analysis will indicate the need for redesign, more detailed design, further site investigation, different packaging of the work content, alternative contract strategies or different methods of the construction in order to reduce or avoid risks (Smith, 2003).

Risk elimination or avoidance is synonymous with refusal to accept risks. There are a number of ways through which the risks can be eliminated, such as submitting a very high bid, placing conditions on the bid, pre-contract negotiations as to which party takes certain risks, and not bidding on the high-risk portion of the contract (Project Management Institute, 2004). This strategy is to cease the possibility of the risk to occur, or completely eliminate the possibility of the risk.

The easiest way to eliminate a risk is to remove it from the project deliverables. Without the deliverable, the risk will not exist. However, taking away risks signifies taking away profits because making profit is taking risk (Knight, 2012). There are ways to eliminate or avoid the risks by designing around them. This strategy works by designing the project so that the risk cannot happen. For instance, during the designing stage to build an extra storey for a building, it was discovered that the local authority will not approve the plan as it is against the law. Building the extra storey for the building could result in dismantling the storey, incurring extra costs and time. This is clearly not an acceptable risk therefore the strategy is to eliminate the risk.

b) Risk Mitigation

Certain risks that are above the risk tolerance level are not acceptable risks and something has to be done. Risk mitigation is a strategy to reduce the probability or the impact of these unacceptable risks to a point where the risk's severity falls below the unacceptable risk tolerance level (Project Management Institute, 2004).

There are basically two strategies for mitigating risk namely: (a) reduce the likelihood that the event will occur and or, (b) reduce the impact that the adverse event would have on the project (Gray & Larson, 2003). The risk management team will develop and execute a plan to reduce the probability and or impact of an adverse risk event on the project.

One of the ways to reduce the risk exposure is to share the risks with other parties (Flanagan & Norman, 1993). For instance, the general contractor will attempt to reduce his exposure to pay liquidated damages for late completion by imposing liquidated damages clauses in domestic sub-contract agreements.

Risk can be reduced by educating and training the staff to be alert to potential risks and implement physical protection to reduce the likelihood of loss (Gray & Larson, 2003). It is prudent to apply adequate quality management to project and to have systems implemented to ensure consistency. For example, to install sprinkler system even though the regulation might not require the sprinklers to reduce the likelihood of loss from fire damage.

Hence, the risk mitigation strategy involves spending some money from the contingency budget, which was expected value of the risk before mitigation. Certain amount of money is allocated into the project's operating budget to carry out the mitigation strategy. As probability or impact is reduced, the expected value of the risk is as well reduced, and the contingency budget is to be reduced accordingly (Newell & Grashina, 2003).

c) Risk Transfer

Passing risk to another party is common; this transfer does not change risk. Risk transfer does not reduce the criticality of the risk; it just removes it to another party. If the risk occurs, the consequences of risk are carried by the party other than the client. The client is expected to pay the premium for this privilege (Gray & Larson, 2003).

Risk transfer can take two basic forms, either the property or activity responsible for the risk may be transferred to a subcontractor to work on a hazardous process or the property or activity may be retained thus the financial risk is transferred through insurance (Thompson & Perry, 1992).

Risk can be transferred from an owner to a contractor through a fixed price contract. The contractor is to bear any risk event so a monetary risk factor is added to the contract bid price. The owner has to ensure that the contractor is able to absorb the risk before transferring the risk to the particular contractor. In a nutshell, if the risk does not occur, the vendor makes extra money. If risk is transferred this way, the impact of the risk whether it happens or not have been paid or insured (Bajari & Tadelis, 2001).

Perhaps the most common form of risk transfer is by means of insurance which changes an uncertainty exposure to a certain cost (Flanagan & Norman, 1993). In construction industry, insurance cover is becoming more expensive (Edwards, 1995). For some project, risk transfer to insurance is impractical because defining the risk event to an insurance broker unfamiliar with the project is difficult and expensive. The low probability and high severity of impact risk event can be easily defined and insured, such as earthquake and force majeure.

Performance bonds, warranties, and guarantees are other financial instruments used to transfer risk (Gray & Larson, 2003). Withholding retention money on interim payment to the contractor is a way of covering residual risks that may arise. Retention sum is held to ensure the contractor completes their work properly to cover the risk of loss arising from the liquidation of the contractor. Performance bond is provided by an insurance company or bank to ensure that the project will be completed in the event of default by the contractor (Edwards, 1995).

d) Risk Sharing

Risk sharing allocates proportions of risk to different parties. Sharing risk has drawn more attention recently as a tool to reduce risk and cutting project cost as well. Partnering between owner and contractors has prompted the development of continuous improvement procedures to encourage contractor to suggest innovative ways for project implementation (Gray & Larson, 2003). If the risk events occur, the consequences are shared by both parties who enter into the partnership contract.

Risk can be shared with the insurance company. The four forms of risk sharing are co-insurance, re-insurance, excess or deductible, and first loss cover (Hertz, 1964). A captive insurance company is a privately owned insurance company directly related to risk management, which is created and owned by an organization; it insures all the risks encountered by its parent organization (Edwards, 1995).

e) Risk Retention

If a risk significance level is low enough, nothing will be done on the risk unless it occurs. This signifies retention or acceptance of that particular risk, where the significance of the risk is lower than the risk tolerance level (Nocco & Stulz, 2006).

Retaining a risk does not signify that nothing will be done when the risk occurs; it simply means that something will be done only when it occurs. Many of the project risks will fall into this category, where the many insignificant risks are placed. Many of these risks cost little to fix when they occur than it would cost to investigate and plan for them. In some cases, the decision is made to retain the risk event either actively or passively (Carter & Doherty, 1974; Aabo, et al., 2010). Active retention is a deliberate management strategy after a conscious evaluation of the possible losses and costs of alternative ways of handling risk. Passive retention occurs through abandon, ignorance or absence of decision.

There are some risk events that cannot be transferred or reduced such as act of God. These risk events are assumed so because the chance of such events occurring is slim.

The risk is retained by developing a contingency plan to implement if the risk materializes (Gray & Larson, 2003).

A contingency plan is an alternative plan that will be used if a possible foreseen risk event becomes a reality. This is a preventive action that will reduce or mitigate the adverse impact of the risk events. The contingency plan contains a description of a risk; any assumptions used to develop the plan, the probability of risk occurring, its impact, and appropriate responses. The contingency plan should be conducted for the tasks on the critical path of a schedule as risks on such tasks have an impact on the completion date for the entire project (Oberlender, 1993).

2.6 Gap in the Knowledge

Generally, the quest for success in international construction has been one of the important themes in the field of construction risk management. Different models and tools have been proposed based on different assumptions. Their approaches to manage risks are different and are due to certain contexts stemmed from their ideas. Since the models and tools are based on different assumptions, it can be said that no one strategy is perfect.

This study focuses on risk assessment where the identified risks are evaluated and ranked to prioritize risks for management. Wang, Dulaimi and Aguria (2004) carried out a detailed analysis of international construction risks and identified twenty-eight critical risks associated with international construction projects in developing countries. Bing and Tiong (1999) proposed a risk management model for international construction joint ventures (JVs) consisting of three typical risk management phases (identification, analysis, and treatment). They then identified a set of twenty-five risk factors applicable to international construction joint ventures.

Hastak and Shaked (2000) recommended an international construction risk assessment model (ICRAM-1) which can assist the user in evaluating the potential risk involved in expanding operations in an international market by analyzing risk at the macro (or country environment), market and project levels. Hence, ICRAM-1 provides a structured approach, designed to examine a specific project in a foreign country, to evaluate the risk indicators involved in an international construction operation.

Previous researchers who studied the area of risk management for international construction in various contexts mostly worked on the area of risk identification, classification and assessment in order to develop strategies or responses toward the risks encountered. They are contributing to the knowledge of international construction risk management in the various scenarios of joint venture (Bing & Tiong, 1999; Shen, Wu, & Ng, 2001), developing countries (Wang, et al., 2004), and foreign foray (Hastak & Shaked, 2000; Han, et al., 2008; Bu-Qammaz et al., 2009). Despite the vast number of articles on construction risk management, Taroun, Yang and Lowe (2011) concluded from their critical review of the construction risk modeling and assessment literatures published over the last 27 years that construction risk modeling is a developing and ongoing process with no satisfactory theory or tool for assessing construction risk has been developed or proposed.

One of the knowledge gaps is that “probability and impact values are neither constant for each project nor for each company; instead, they depend on many factors related to capabilities of firm, its experience in the market and in similar kind of projects, etc”

(Dikmen & Birgonul, 2006, p. 61). In that particular paper, the flowchart, which depicts the factors that affect risk level in an international project, begins with a company's strength and weaknesses consisting of experience, availability of resources, capabilities, and company strategy. Having ascertained the firm's capabilities, the effect on ability to manage various project risks can then be determined.

If a risk factor is within reasonable control of a company or transferable to other parties through contract conditions, a lower risk rating may be assigned. Thus, the ability of a company to manage risk should be considered during risk modeling (Dikmen, et al., 2007b). Similarly, Keizera, Halman, and Song (2002) mentioned that the magnitude of risk is determined not only by its likelihood and impact but also by a firm's ability to influence risk factors. These again suggest that the influence of firm's capability is crucial to be considered in risk assessment.

According to Dikmen and Birgonul (2006), any strategy used by the firm may reduce the probability of occurrence of a risk event. "Strategy is defined as the determination of the basic long-term goals and objectives of an enterprise, and the adoption of courses of action and the allocation of resources necessary for carrying out these goals" (Chandler, 2003, p. 13). Since resources are part of strategies and capabilities, this research adopted the term 'firm's capability(ies)' throughout the thesis. It is hypothesized that there is significant relationship between firm's capabilities and risk significance values in international construction.

2.7 Summary of Chapter

This chapter begins with the background of the international construction and the complexities of the entry decisions. There are four categories of entry decision and this study focuses on the project selection decision. After reviewing the existing tools for project selection decision, risk analysis or assessment tool is found suitable to cover the breadth of the complexity and intricacy of international construction industry. Later, the risk management is reviewed according to the three main steps. The review on risk identification step revealed the measurement scale for the dependent variables involved in the main study of this research. The previous researches concerning risk assessment are also reviewed to derive the knowledge gap. Risk assessment methodologies are then reviewed to justify the chosen method- structural equation modeling. The risk response step is reviewed to introduce the generic risk response measures available. Finally, the knowledge gap is recapped for further discussion in the following chapter. The following chapter will reinforce the knowledge gap mentioned here and reveal the conceptual framework of this study.

CHAPTER 3
CONCEPTUAL FRAMEWORK FOR INTEGRATING FIRM'S CAPABILITY IN ASSESSING RISKS

3.1 Introduction

Having the knowledge gap unfolds in the literature review chapter, this chapter will propose a conceptual framework to bridge the gap. The knowledge gap is identified as the lack of integrating the firmøs capability when assessing the construction project risks before selecting an international project opportunity. The conceptual framework will integrate firmøs capabilities from Resource-Based View (RBV), Dynamic Capability, Porterøs Generic Value Chain, and a construction firmøs capability framework. In order to incorporate the firmøs capability, the anomaly-seeking research is applied to observe the anomalies in the context of assessing risks in the international construction. First, the process of building theory and anomaly-seeking research is briefly introduced. Second, the process in the context of risk assessment for international construction to develop a conceptual framework is described. The conceptual framework developed is subject to further empirical tests described in the later chapter.

3.2 A Theory of Theory Building

The process of theory building can be divided into several stages. In the earliest stages of theory building, the researchers observe phenomena and carefully describe, measure, and record what they observe. Most of the early Harvard business school case studies written in the 1940s and 1950s had this characteristic- they simply described problems that managers faced (Bower & Gilbert, 2005). At the time, little could be studied as few management theories had yet been developed. The careful description of the phenomena with words and numbers is an important element of work at this stage. This is because the effort to improve theory will prove difficult if subsequent researchers cannot agree on the descriptions of phenomena.

Having observed and described the phenomenon, researchers then classify the phenomenon into categories of similar characteristics. For instance, in physical science, solid, liquid, gas, and plasma comprised as one category, while in medicine, diabetics comprised of juvenile and adult categories. Categorization schemes simplify and organize the world in ways that give light to the consequential differences among phenomenon.

Researchers then build theories that explain the behavior of the phenomena. A theory is a statement of what causes what, and why. Causality that varies by circumstance can be explained if the theory is built upon a sound categorization scheme. The understanding of differences in circumstance is often what enables researchers to understand the causal relationships that constitute the theory. The attempt to articulate statements of cause and effect helps researchers to determine the usefulness of categorization systems (Gilbert & Bower, 2005).

Researchers of management often use different terms for the categorization and theory-building stages of research described. Gilbert and Bower (2005) defined the term *framework* as *categorization* and the term *model* as *theory.* The model is in the form of a regression equation specifying the effect of causal variables on dependent variable. The value of theory or model is in proportion to its predictive power.

3.2.1 Designing Anomaly-Seeking Research

Once a theory has been built upon a categorization scheme, it is used to predict observations under various conditions. If the theory can accurately predict the actual observation, this is a confirmation that the theory is useful under the circumstances in which the data or phenomena were observed. As Figure 3.1 (Bower & Gilbert, 2005) suggests, the theory is then situationally confirmed, but the theory itself remains unimproved. Researchers may often observe an anomaly or unexpected results when using the theory for prediction. Researchers have to cycle back into the categorization stage to find out the reason for the anomaly observed. The objective of this process is to revise theory to account for the phenomena that the prior theory did not explain and to predict accurately the phenomena that prior theory appeared to be anomalous (Bower & Gilbert, 2005).

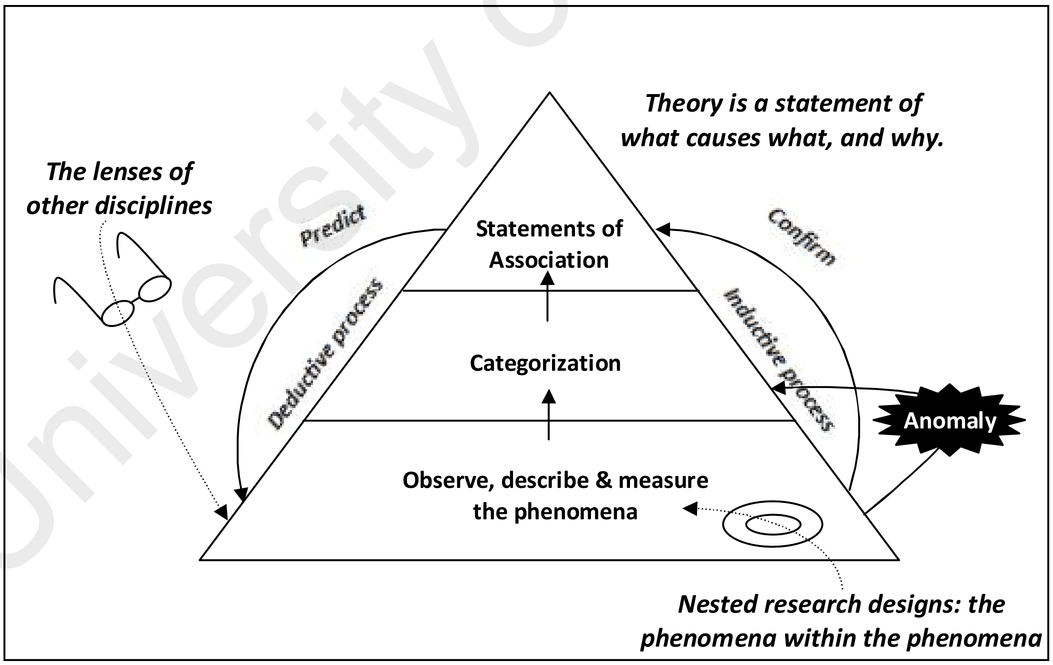


Figure 3.1: The process of building theory (Bower & Gilbert, 2005, p. 77)

Bower and Gilbert (2005) outline three ways to design anomaly-seeking research. The first is to look at the phenomena through the lenses of other methods or disciplines. The second is to look at the phenomena within the phenomena (to execute a nested research design). The third is to look at a broader variety of phenomena than previous researchers were able to examine.

First is to observe the phenomena through the lenses of other disciplines. The anomalies that led to the fall of a theory or paradigm were often observed by researchers with backgrounds of different disciplines (Kuhn, 1970). Examining a situation through the lenses of a different discipline is therefore a mechanism to look for different things than searching within the existing dominant discipline. The examination through the lenses of other academic disciplines improves the chances of observing anomalies leading to better and more valid theory (Bower & Gilbert, 2005). In other words, the process of looking at a situation through the lenses of relevant theories in other disciplines can improve the existing theory.

Second is to study the phenomena within the phenomena. This second method to increase the probability of finding anomaly to build better theory is to execute nested research designs. A nested research design involves studying how individuals act and interact within groups and how the interaction among groups and the companies within which they are embedded affects the actions of individuals, and so on (Bower & Gilbert, 2005). Different from looking at a single level of phenomena, anomalies emerged from studying second-order interactions and relations across levels within a nested design. Nested designs allow for comparisons across nested levels of analysis, which increase the chances of observed anomaly. The differences across nested phenomena led to the observed anomaly.

Lastly is to observe a broad range of phenomena. The third mechanism that researchers can employ to surface an anomaly is to execute a research design that looks at a broader, more diverse range of phenomena than previous researches have examined. Broadening the range of phenomena sometimes involves seeking failures in predicted outcomes. These failures are used to ask questions that eventually lead to revisions in existing theory.

3.3 Anomaly in Risk Assessment Research

On top of the knowledge gap revealed in the previous chapter, this study reinforces the study by applying Bower and Gilbertös (2005) three ways to design anomaly-seeking research in the following sequence; (1) to look at a broader variety of phenomena than previous researchers were able to examine, (2) to look at the phenomena within the phenomena (to execute a nested research design), and (3) to look at the phenomena through the lenses of other methods or disciplines.

3.3.1 Observing a Broad Range of Phenomena

The first step in validating a tentative choice among several opportunities is to determine whether the organization has the capacity to prosecute it successfully (Andrews, 1997). An organizationös capability is demonstrated as its potential ability to achieve against the opposition of circumstance or competition, or simply firmös objective. Any organization has their actual and potential strengths and weaknesses. Formulating strategy involves extending or maximizing the one and containing or minimizing the other, therefore, it is vital to identify and distinguish them from the other. To identify a companyøs own strengths and limitations is much more difficult than to maintain a workable observation of its changing environment.

Andrews (1997) commented that subjectivity, lack of confidence, and unwillingness to face reality are the obstacles for both organizations and individuals to know themselves. He further made comparison between a maturing person and an organization that even though it is difficult but it is crucial for a maturing person to achieve reasonable self-awareness as it is for an organization to identify its core strength and main weakness. Key attributes contained in the appraisal should be identified with consistent criteria established for the purpose of evaluation when strategizing plan. The results would be useful for future strategic planning if the appraisal is focused on strategies, policy commitments, and past practices in the context of discrepancy between organization goals and attainment. Stevenson (1976) quoted a ñkey link in a feedback loopò is the assessment of strengths and weaknesses associated with achieving specific objectives to enable learning from the success or failures of the policies instituted.

The strength of a company is not only a resource for growth and diversification accrues primarily from experience in making and marketing a product line or providing a service, they also consist of the developing strengths and weaknesses of the individuals of the organization, the degree to which individual capability is efficiently applied to task, and the quality of coordination of individual and group effort (Andrews, 1997). To decide among options, matching opportunity to competence can estimate their future significances. It is most desirable to have the combination that establishes companyǿs economic mission and its position in its environment including risks and minimizes companyǿs weaknesses yet maximizes strength (Andrews, 1997). This is in line with Barney (1986, 1991) who mentioned that resources are valuable to a firm if they enable the firm to implement strategies that exploit opportunities or neutralize threats in its environment. Foss and Knudsen (2013) also agreed that almost any strategy textbooks conceptualize strategy as matching strengths of the firm and opportunities of the environment, while simultaneously protecting the weaknesses of the firm from threats in the same environment. Figure 3.2 diagrams the matching of opportunity and resources to determine best option.

3.3.2 Studying the Phenomena within the Phenomena

To build a better theory or model, a nested research design is executed to look into the phenomena within the phenomena. The nested research design involves studying how individuals act and interact within groups and how interaction within groups and companies. This study looked into the previous studies done in the field of international construction risk management. Anomalies and the consequent improved understanding of causality emerged from studying second-order interactions and relations across levels within this nested design.

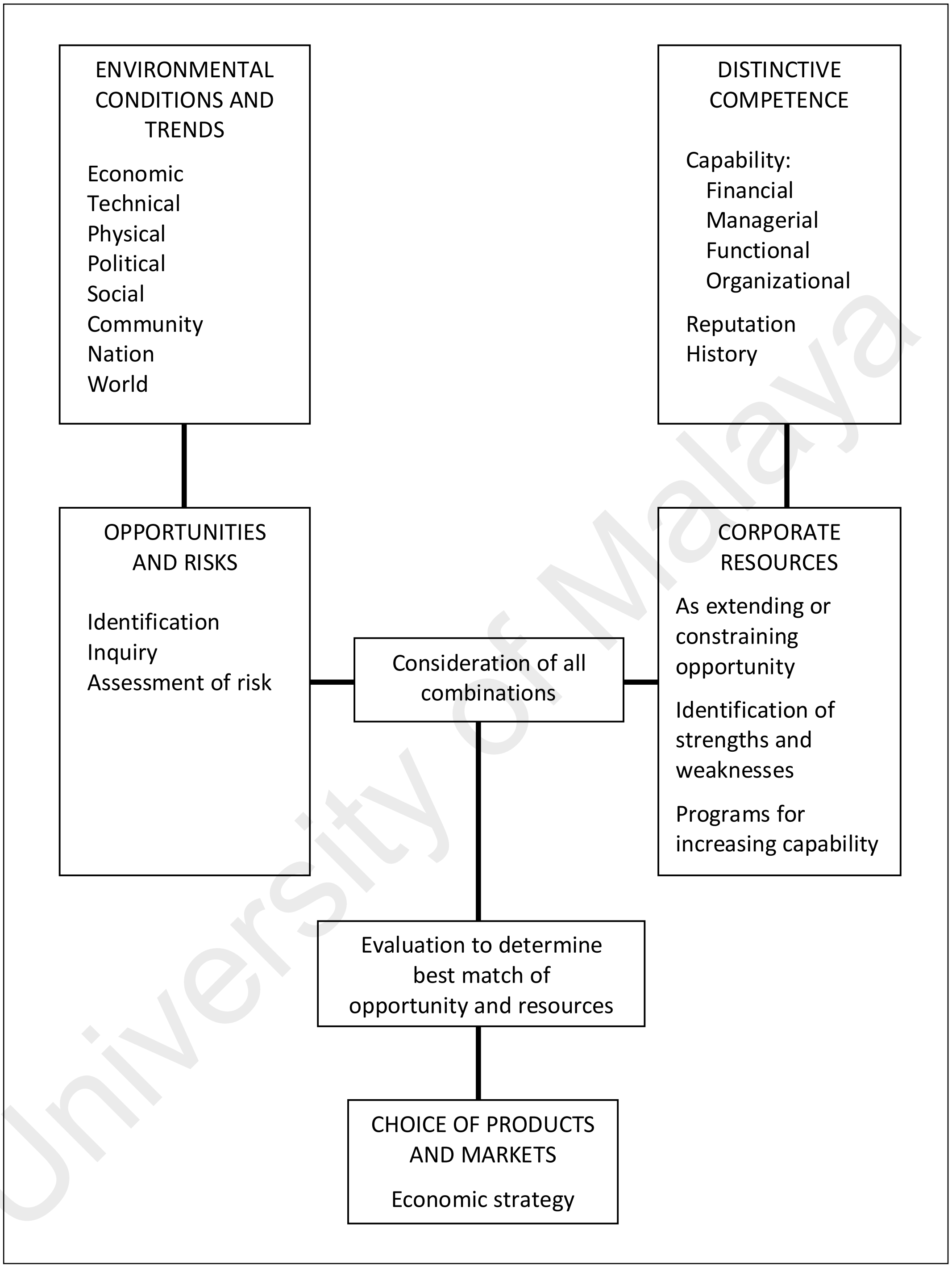


Figure 3.2: Schematic development of choice of products and markets
(Source: Andrews, 1997)

In this study, seven papers related to international construction context are referred to categorize the risk response or strengths mentioned in these papers. The firmôs capabilities are being filtered from other risk response measures based on the definition given by Amit and Schoemaker (1993, p. 35) mentioning that ñResources are stocks of available factors that are owned or controlled by the organization, and capabilities are an organizationôs capacity to deploy resourcesò or simply, it is the bundling of the resources that builds capabilities (Barrick, et al., 2015; Sirmon, Hitt, & Ireland, 2007). It was found that the risk response measures taken to eliminate, mitigate, transfer, share or retain are largely capabilities (Table 3.1). Some capabilities mentioned are financial capacity, managerial skills, networking, and the like to mitigate and eliminate the risks faced. Other risk response measures are transferring and sharing to third parties and retaining the risks due to positive effect of risk or opportunity per se.

Table 3.2 summarizes the composition of risk response measures in international construction, percentage figures are taken from Table 3.1. The summary shows that a minimum of 67 percent of risk response measures taken are firmôs capabilities. This shows that firmôs capability plays important role in risk management for international construction.

Table 3.1: Risk response measures based on risk or threat categories

Author, Year	**(Abdul-Aziz & Wong, 2010)**		**(Bing & Tiong, 1999)**		**(Gunhan & Arditi, 2005)**		**(Han & Diekmann, 2001)**		**(Ling & Hoi, 2006)**		**(Shen, Zhao, & Drew, 2006)**		**(Zhi, 1995)**	
Risk or Threat	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**
Financial	*Require large financial capital to fund the cost of operating in host country.* *Require good relationship with related and support industries for banking and insurance.*		*Select partner with good past record to avoid financial risk.* *Insert reimbursement clause, adjustment clauses in contract.* *Insert dual-currency condition in contract.*		*Have higher credibility and reputation among its clients and suppliers.* *Provide attractive financing packages to potential clients.* *Secure attractive financing packages from financial institutions with a solid balance sheet.* *Have strong working capital and adequate cash flow.* *Secure sizeable low interest loans from financial institutions.* *Offer mixed credits with low interest from their export–import bank.* *Defer loan payments or grant abnormally long payback periods.*		*Negotiate payment methods (in US dollars or local currency) to avoid severe fluctuations in the exchange rate.* *Negotiate tax reduction or exempt conditions to lessen heavy tax burden.* *Negotiate financing requirements to mitigate excessive financial burden.*		*Consider carefully payment currency applied in the contract.* *Price additional taxes into contracts.* *Have self-funding.* *Obtain financial help from home country governments.* *Obtain loans from multi-lateral agencies such as the Asian Development Bank (ADB).* *Obtain loans from overseas capital markets.* *Gain accurate financial and other information about the local entities background checks.*		*Have good finance-raising ability.* *Have proper debt/asset ratio.* *Have good cost control skill.* *Invest on fixed assets to reduce debt.*			

Table 3.1: Risk response measures based on risk or threat categories (contôd)

Author, Year	(Abdul-Aziz & Wong, 2010)		(Bing & Tiong, 1999)		(Gunhan & Arditi, 2005)		(Han & Diekmann, 2001)		(Ling & Hoi, 2006)		(Shen, et al., 2006)		(Zhi, 1995)	
Risk or Threat	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**
Managerial	*Establish good contact and network in home country to obtain support in various aspects.* *Hire internationally experienced staff for technical and managerial skills.* *Offer integrated services, technologies not prevalent in host countries to remain competitive.* *Good domestic reputation to market to foreign clients.*		*Select partner with good track record to reduce managerial issues.* *Define clear authority and responsibility in agreement.* *Define terms and conditions including transfer scope clearly in agreement.* *Establish good accounting standard in management system.* *Select staff carefully and define each staff's scope of work.*		*Equip to carry out far-reaching and ingenious strategic plans.* *Take higher risks with prospects of higher returns.* *Possess qualified personnel constitutes important factor considered in the assessment of potential bidders.*		*Expand firm's resources (financial resources, human resources, and physical resources) to increase the firm's competitive advantages.* *Negotiate processes for dispute resolution (court /forum selection, alternate dispute resolution procedure, etc).*				*Establish information management facilities.* *Hire good human resources including professionals.* *Establish channels for market information.* *Hire personnel with good knowledge on regulations and contract.*		*Record everything in black and white for good documentation practice.*	

Table 3.1: Risk response measures based on risk or threat categories (cont'd)

Author, Year	(Abdul-Aziz & Wong, 2010)		(Bing & Tiong, 1999)		(Gunhan & Arditi, 2005)		(Han & Diekmann, 2001)		(Ling & Hoi, 2006)		(Shen, et al., 2006)		(Zhi, 1995)	
Risk or Threat	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**
Entry	*Good contact and network overseas to secure overseas project.*		*Hire unbiased and experienced staff.* *Allocate work to partner according to his ability.* *Maintain ICJV policies by being dominant over partner in ICJV.* *Control ICJV's board of directors by parent company.* *Subcontract work to experienced and familiar suppliers and subcontractors.* *Subcontract work to local pollution control specialist.* *Hire subcontractors to complement the partner's shortcoming.*		*Korean firms chose a cost leadership strategy and made substantial inroads into the Middle East market through aggressive cost cutting on labor-intensive infrastructure projects.* *Chinese companies with their enormous resources of skilled manpower, provide an example of a strategy based on cost focus.*									

Table 3.1: Risk response measures based on risk or threat categories (cont’d)

Author, Year	**(Abdul-Aziz & Wong, 2010)**		**(Bing & Tiong, 1999)**		**(Gunhan & Arditi, 2005)**		**(Han & Diekmann, 2001)**		**(Ling & Hoi, 2006)**		**(Shen, et al., 2006)**		**(Zhi, 1995)**	
Risk or Threat	**Firm’s capability**	**Other response**	**Firm’s capability**	**Other response**	**Firm’s capability**	**Other response**	**Firm’s capability**	**Other response**	**Firm’s capability**	**Other response**	**Firm’s capability**	**Other response**	**Firm’s capability**	**Other response**
Entry (cont’d)			*Establish good relationship with host government.* *Maintain good contact in name of ICJV.* *Ask parent companies to maintain good relationship for ICJV.* *Maintain good relationship with local environmental authority.* *Appoint independent accounting auditor.*											
Construction	*Employ experienced and capable staff to make project a success.*		*Acquire technology transfer.* *Specify construction extension clause in contract.* *Conduct detailed feasibility study of project.*		*Establish good track record.* *Acquire competitive edge with numerous strategies.* *Prepare ready solution or cheaper one to technical problem.*		*Establish market analysis and a project feasibility study to evaluate market conditions and project soundness.*		*Fly subcontractor to Singapore to observe how marble was properly laid. Only after prolonged observation could the subcontractor undertake the work correctly.*					

Table 3.1: Risk response measures based on risk or threat categories (cont'd)

Author, Year	**(Abdul-Aziz & Wong, 2010)**		**(Bing & Tiong, 1999)**		**(Gunhan & Arditi, 2005)**		**(Han & Diekmann, 2001)**		**(Ling & Hoi, 2006)**		**(Shen, et al., 2006)**		**(Zhi, 1995)**	
Risk or Threat	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**
Construction (cont'd)					*Establish organization and technical know-how.* *Establish specialist expertise with technological advantage and or a niche area to remain competitive in a foreign market.*				*Employ more workers to make up for workers' low productivity and plant inefficiency.* *Devise contingency plans and pay close attention to key activities on the critical path of the program.* *Engage competent foreign project managers and reliable Indian contractors.*					
Owner, design consultant, and supervisor									*Diffuse responsibilities among consultants.* *Draw up service arrangements between the foreign and Indian architects.*					

Table 3.1: Risk response measures based on risk or threat categories (contôd)

Author, Year	(Abdul-Aziz & Wong, 2010)		(Bing & Tiong, 1999)		(Gunhan & Arditi, 2005)		(Han & Diekmann, 2001)		(Ling & Hoi, 2006)		(Shen, et al., 2006)		(Zhi, 1995)	
Risk or Threat	**Firm’s capability**	**Other response**	**Firm’s capability**	**Other response**	**Firm’s capability**	**Other response**	**Firm’s capability**	**Other response**	**Firm’s capability**	**Other response**	**Firm’s capability**	**Other response**	**Firm’s capability**	**Other response**
Owner, design consultant, and supervisor (cont’d)									*Undertake most of design works in home country and use host country A/Es and technicians to do detailed design work.* *Avoid clients from making too many changes in design-build contracts.* *Insert contractual conditions to ‘freeze’ designs as early as possible.* *Have frequent meetings with clients to strengthen communication.*					
Material and equipment	*Source physical assets and equipment from home country or elsewhere.*				*Possess equipment, and plant constitutes important factor considered in the assessment of potential bidders.*				*Import materials to avoid poor or inconsistent quality.*		*Possess advanced machine and equipment.*			

Table 3.1: Risk response measures based on risk or threat categories (contđd)

Author, Year	**(Abdul-Aziz & Wong, 2010)**		**(Bing & Tiong, 1999)**		**(Gunhan & Arditi, 2005)**		**(Han & Diekmann, 2001)**		**(Ling & Hoi, 2006)**		**(Shen, et al., 2006)**		**(Zhi, 1995)**	
Risk or Threat	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**
Labour	*Ensure supply of ample trained workforce.*								*Employ host country staff to carry out the work to lower construction cost.* *Provide some form of training to equip workers with basic skills to achieve minimum quality standards, reasonably level of productivity and safety consciousness.*		*Ensure higher labor productivity to avoid project delay.*			
Political and economic		*Take advantage of the rapid economic development.*	*Select partner to reduce political issues.* *Review and negotiate for conflict and or dispute amicably.*		*Establish international network to ease political risk.* *Secure information on technology, forthcoming projects, buyers, potential competitors, and potential covertures.*	*The attitude (**bribery** is host country) was different when working outside home markets. It was viewed as a cultural difference and therefore unavoidable.*	*Develop a new organization (joint venture, subcontracting with local firm) to obtain competitive advantages and to perform project successfully.*		*Form joint ventures with host country firms because it is perceived that the host country government would not truly welcome 100% wholly foreign owned firm as yet.*			*Reformed policy environment for foreign businesses.* *Governmental promotion for construction.* *Establishment of credit system* *The market access protected by WTO agreement.*	*Contract all local construction firms with lump-sum contracts to reduce the **inflation** impact on construction costs.* *Enjoy **tax exemption policy** of two years at a zero rate when forming joint venture.*	

Table 3.1: Risk response measures based on risk or threat categories (cont'd)

Author, Year	**(Abdul-Aziz & Wong, 2010)**		**(Bing & Tiong, 1999)**		**(Gunhan & Arditi, 2005)**		**(Han & Diekmann, 2001)**		**(Ling & Hoi, 2006)**		**(Shen, et al., 2006)**		**(Zhi, 1995)**	
Risk or Threat	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**
Political and economic (cont'd)					*Engage services of local consulting firm to scout the local markets and submit periodic reports* *Participate in overseas trade missions organised by trade associations or by the government* *Adjust the anticipated* ***rate of inflation*** *in accounting practices, procurement methods, the timing of purchasing decisions, collective bargaining agreements with local unions, and overall cash flow management.*		*Facilitate a positive relationship between the owner/ government and the firm in an effort to gain pivotal information to win a contract and mitigate the owner's interventions.*		*Adopt a structured political risk analysis approach that identifies the primary sources of political risks and their resultant impacts on project cash flow and probable cost.* *Obtain government's guarantees and purchasing insurance for political risk.* *Select projects which are located in provinces that have strong incumbent political leaders so that there is less intense competition during elections.* *Do not participate in tenders during election years.*			*The development of the host country construction industry toward international practice.*	*Adopt a slow depreciation and quick profit return policy for the investment.* *Buy and export some Chinese products that are in demand instead of* ***converting*** *the profits directly to* ***foreign currencies****.* *Appoint a local firm as a consultant, and let the locals deal with sensitive problem like* ***corruption****.* *Maintain close relationships with the local government officials and communicate with them as much as possible to ease* ***bureaucracy****.*	

Table 3.1: Risk response measures based on risk or threat categories (contôd)

Author, Year	**(Abdul-Aziz & Wong, 2010)**		**(Bing & Tiong, 1999)**		**(Gunhan & Arditi, 2005)**		**(Han & Diekmann, 2001)**		**(Ling & Hoi, 2006)**		**(Shen, et al., 2006)**		**(Zhi, 1995)**	
Risk or Threat	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**
Political and economic (cont'd)									*Cooperate and maintain good relationships with the local government.* *Have better contract language to protect foreigners when there are delays in approvals and provide compensations.* *Maintain good relationships with government Authorities.* *Identify all the taxes that need to be paid and price for them in the contract.* *Seek waivers from the host country government if undertake public sector jobs.*					

Table 3.1: Risk response measures based on risk or threat categories (cont'd)

Author, Year	(Abdul-Aziz & Wong, 2010)		(Bing & Tiong, 1999)		(Gunhan & Arditi, 2005)		(Han & Diekmann, 2001)		(Ling & Hoi, 2006)		(Shen, et al., 2006)		(Zhi, 1995)	
Risk or Threat	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**
Third party									*Allocate risk at the operational level to the local partner when construction delays due to strikes and slow working pace.*				*Install building with electric locks,* ***security*** *doors and door phone systems.* *Install closed-circuit television cameras at various strategic locations for* ***site security****.* *Employ several members of staff who know the locals to avoid* ***social misunderstandings.***	
Cultural	*Employ multicultural workforce for cultural differences*		*Employ local staff with bilingual ability.* *Employ local security firm.* *Adopt current international conditions in contract.* *Comply with local culture and tradition.*		*Hire and keep talented key employees to avoid hampering* ***communication*** *with local entities, exacerbating the clash of cultures, leading to misunderstandings of the risks involved.*		*Negotiate applicable contract law (international standard contract, local rules) to mitigate legal / cultural variances.*		*Comply with local culture and tradition.* *Spend much time in foreign country to know more about the country and to establish relationships with the locals.*				*Prefer 'shaking hands' rather than searching lines in* ***contracts****.*	

Table 3.1: Risk response measures based on risk or threat categories (contŏd)

Author, Year	**(Abdul-Aziz & Wong, 2010)**		**(Bing & Tiong, 1999)**		**(Gunhan & Arditi, 2005)**		**(Han & Diekmann, 2001)**		**(Ling & Hoi, 2006)**		**(Shen, et al., 2006)**		**(Zhi, 1995)**	
Risk or Threat	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**
Cultural (cont'd)					*Keep an open mind and not see different ways of doing things as being absolutely right or wrong, since* ***cultures and norms vary*** *enormously.*				*Arrange for staff to be permanently stationed in foreign country on a long term basis.* *Train workmen to adopt safe work practices with effective safety management system on site.*					
Logistics	*Require good relationship with related and support industries for transportation and freight.*		*Employ influential logistic agents.*						*Plan early for logistics as long lead times are involved for the equipment to arrive from overseas.* *Alter designs to adapt to availability of machinery.* *Implement in-house maintenance programs to keep the equipment in good working condition.*				*Provide a free shuttle bus between the location and the inner city for* ***access****.* *Place early booking and pay extra fee for prompt installation of* ***communications*** *facility.*	

Table 3.1: Risk response measures based on risk or threat categories (contꞌd)

Author, Year	(Abdul-Aziz & Wong, 2010)		(Bing & Tiong, 1999)		(Gunhan & Arditi, 2005)		(Han & Diekmann, 2001)		(Ling & Hoi, 2006)		(Shen, et al., 2006)		(Zhi, 1995)	
Risk or Threat	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**	**Firm's capability**	**Other response**
Natural environment-al			*Insure all insurable force majeure risks.*						*Make arrangements to complete the work earlier to avoid risk of inclement weather.* *Make arrangements in the contract to transfer the risk of bad soil conditions to clients.*					
Total Risk Response or Measures	**12**	**1**	**31**	**0**	**25**	**1**	**9**	**0**	**39**	**0**	**10**	**5**	**10**	**0**
Percentage (%)	**92**	**8**	**100**	**0**	**96**	**4**	**100**	**0**	**100**	**0**	**67**	**33**	**100**	**0**

Table 3.2: Composition of risk response measures in international construction

Author, year	**Paper *(No. of risk response)***	**Risk Response**	
		Firm's Capability (%)	**Others (%)**
Abdul-Aziz & Wong, 2010	Competitive assets of Malaysian international contractors *(13)*	92.0	8.0
Bing & Tiong, 1999	Risk management model for international construction joint ventures *(31)*	100.0	0
Gunhan & Arditi, 2005	Factors Affecting International Construction *(26)*	96.0	4.0
Han & Diekmann, 2001	Making a risk-based bid decision for overseas construction projects *(9)*	100.0	0
Ling & Hoi, 2006	Risks faced by Singapore firms when undertaking construction projects in India *(39)*	100.0	0
Shen, Zhao, & Drew, 2006	Strengths, Weaknesses, Opportunities and Threats (SWOT) for foreign-invested construction enterprises: A China study *(15)*	67.0	33.0
Zhi, 1995	Risk management for overseas construction projects *(10)*	100.0	0

3.3.3 Lenses of Other Disciplines

Looking at the anomaly presented in the two methods above, this situation where firmôs capability plays an important part in risk assessment is looked through the lenses of a different discipline. Three strategic management theories are adopted. Resource-Based View (RBV), Dynamic Capabilities, and Porterôs generic value chain are adopted as the lenses from other disciplines and formed the independent variables of this study. The RBV, one of the most widely accepted theoretical perspectives in the strategic management field (Newbert, 2007; Kessler, 2013), is incorporated together with dynamic capabilities, an extension from RBV, to have a holistic view. Besides dynamic capabilities, Porterôs generic value chain is also incorporated to address the lack that Porter mentioned in the discussion at Section 3.3.3.3.

The theory of dynamic capabilities is introduced as an extension to RBV, incorporating a market dynamism dimension to better understand how advantage is gained and maintained. RBV and dynamic capabilities are two leading competitive advantage approaches in strategic management to understand resources and capabilities embedded in operations. In addition, Porterôs generic value chain theory is also introduced, in response to the static nature of RBV, to include the activities as focus of analysis rather than just resources.

3.3.3.1 Resource-Based View

Resource-Based View (RBV) has been the most discussed perspective in strategic management over the last three decades. The RBV paradigm has achieved its popularity in explaining sustainable competitive advantage and firm performance (Barney, 1991).

The gist of RBV is productive use of resources involving the efficiency in resource utilization. Rumelt, Schendel, and Teece (1991, p. 13) noted that specialized resources is created based on efficient operation by *'properly identifying the existence and quality of resources, and in building product-market positions and contractual arrangements that most effectively utilize, maintain, and extend these resources'*. However, Peteraf (1993) put forth that firms have different level of efficiency as some resources are superior to others. Firms with superior resources produce more cost-effectively and increase customer satisfaction, and thus achieve rent. RBV accounted firmsô differences of competitive advantage and durable performance are due to asymmetric resource endowment with differential productivities (Amit & Schoemaker, 1993; Barney, 1986; Mahoney & Pandian, 1992; Wernerfelt, 1984).

Theoretically, RBV addresses primary issues like the reasons of firmsô differences and their means in achieving and sustaining competitive advantage through resources deployment. These ideas have existed since the last 50 years where many researchers have contributed to the advances of this subject. A few advances made on RBV since the 1950s are notions of organizationøs distinctive competence (Selznick, 1957), structure follows strategy (Chandler, 1962), and internal appraisal of strengths and weaknesses proposal leading to the distinctive competencies identification (Andrews, 1997).

However, it was Penrose (1995) who found the RBV idea that views a firm as a bundle of resources. Each firm obtains its uniqueness through heterogeneity of the productive services available from its resources. The firmøs resources heterogeneity is the fundamental notion of the RBV. Barney, a prominent author of the RBV theory, presented a concrete and holistic framework to identify the desirable characteristics of firm resources to achieve sustainable competitive advantage. The said characteristics are to determine whether firmøs resources are (1) valuable (exploit opportunities and/or neutralize threats), (2) rare (among current and potential competitors), (3) inimitable, and (4) non-substitutable (Barney, 1991). Subsequent to Barney (1991), numerous authors like Amit and Schoemaker (1993), Bloodgood (2014), Mahoney and Pandian (1992), Peteraf (1993), and Zhong, et al. (2012) have adopted and even expanded Barneyøs view to include: resource durability, non-tradability, and idiosyncratic nature of resources.

According to RBV, each firm can be conceptualized as a unique bundle of tangible and intangible resources and capabilities (Wernerfelt, 1984). There are various firmøs resources like financial, physical, technological, human, reputation, and organizational

(Hofer & Schendel, 1978). These firmõs resources need to be developed and strategically utilized to achieve profitability (Lavie, 2006). A firmõs resource can be a strength or weakness of a firm. In other words, a firmõs resources at one point could be those tangible and intangible assets tied semi-permanently to the firm. Brand names, in house technology knowledge, skilled personnel, trade contacts, machinery, efficient procedures, capital and et cetera are some of the examples of resources (Wernerfelt, 1984). Penrose (1995) described resources as physical resources of a firm consisting tangible things like plant, equipment, land and natural resources, raw materials, semi-finished goods, waste products and by-products, and even unsold stocks of finished goods. Human resources are also a form of firmõs resources comprising skilled and unskilled labour, clerical, administrative, financial, legal, technical, and managerial staff.

According to Barney (1991) and Baden-Fuller (1995), resources are tangible and easily acquired, yet the source of competitive advantage relies on the firmõs capabilities that are unique to each firm. Day (1994, p. 38) defined ñcapabilities as complex bundles of skills and accumulated knowledge, exercised through organizational processes, that enable firms to coordinate activities and make use of their assetsò. Capabilities constitute individual skills, tacit forms of knowledge and social relations that are embedded in a firmõs routines, managerial processes, forms of communication and culture. Individuals and team members are vital in the routines developments to enhance firmõs capabilities. Top management needs to strategize to effectively utilize a firmõs core resources and capabilities. Thus, aptly strategized firmõs capabilities will deliver better performance or even competitive advantage (Day, 1994; Teece, 2014; Wang & Ahmed, 2007; Wiklund & Shepherd, 2009).

In this study, strategic nature of resources classified in three main categories of physical, human and organizational (Barney, 1991; Grant, 1991, 1996; Penrose, 1995) is adopted (Table 3.2). Physical resources are like plants and equipment, land, natural resources and raw materials; human resources include productive, technical and managerial workers; and organizational resources are formed by the routines that coordinate the human and physical resources in a productive way. Following the RBV theory, the theory of dynamic capabilities (Helfat & Peteraf, 2003; Teece, Pisano, & Shuen, 1997) is introduced as an extension to RBV incorporating a market dynamism dimension for a better understanding on how advantage is eventually gained and maintained. On top of the argument on the lack of market dynamism dimension in RBV, Porter (1991, 1996) added that activities were a more appropriate focus of analysis than resources. Hence, Porterӳ generic value chain theory is also introduced to address the activities dimension in this study.

Table 3.3: Resource-Based View variables
(adapted from Barney, 1991; Grant, 1991; Penrose, 1995)

Capital Resources	**Description**
Physical capital resources	Physical technology used in a firm A firmӳ plant and equipment Its geographic location Its access to raw materials
Human capital resources	Training Experience Judgment Intelligence Relationships Insight of individual managers and workers in a firm
Organizational capital resources	A firmӳ formal reporting structure Its formal and informal planning Controlling and coordinating systems Informal relations among groups within a firm and between a firm and those in its environment

3.3.3.2 Dynamic Capabilities

Dynamic capabilities theory was established within RBV to include the market dynamism (Eisenhardt & Martin, 2000; Zahra, Sapienza, & Davidsson, 2006). Market dynamism refers to the turbulent environments in which firms are operating (Wang & Ahmed, 2007). The RBV proposal concerning a firmôs capability as a competitive source was insufficient as the turbulent environments were not taken into consideration. Winter (2003) purported that change aspects related to ordinary or operational capabilities were captured in dynamic capabilities.

Dynamic capabilities allow competitive advantage to be achieved emphasizing two key aspects (Teece, et al., 1997). Firstly, the term 'dynamic' refers to capacity to renew competences to achieve congruence with the changing business environment. This requires certain innovative responses that are critical at the time-to-market and right timing, the rapid technological change, and the hard-to-determine nature of future competition and markets. Secondly, the term 'capabilities' emphasizes strategic management to appropriately adapt, integrate, and reconfigure internal and external organizational skills, resources, and functional competences to meet the needs of any changing environment.

Helfat et al. (2007) have made use of the term óresourceô (Barney, 1991) and included activities, capabilities, et cetera to allow a firm to achieve competitive advantage. Thereby defining dynamic capabilities as the capacity of an organization to purposefully create, extend or modify its resource base. Danneels (2002) purported that a dynamic perspective is essential for RBV as to consider how firms evolve over time through the deployment and possession of resources. Zahra et al. (2006) added that the dynamic aspect is crucial for firms to continuously renew and reconfigure themselves in order to survive in the industry.

Dynamic capabilities are also defined as *'firm's capacity to renew competencies so as to achieve congruence with the changing business environment'* by *'adapting, integrating, and reconfiguring internal and external organizational skills, resources, and functional competencies'* (Teece, et al., 1997, p. 515). Eisenhardt and Martinôs (2000) definition echoed the same, defining of dynamic capabilities as firmôs processes that use resources, specially the processes to integrate, reconfigure, gain and release resources, to match and even create market change. More recently, Wang and Ahmed (2007, p. 35) view dynamic capabilities as *'firm's behavioral orientation constantly to integrate, reconfigure, renew and recreate its resources and capabilities and, most importantly, upgrade and reconstruct its core capabilities in response to the changing environment to attain and sustain competitive advantage'*. On the whole, the dynamic capabilities view the firmsô capacity to accumulate, deploy, renew, and reconfigure resources in response to changes in external environment affects their performance across firms and over time (Teece, et al., 1997; Winter, 2000).

Vast literature is available discussing the dynamic capabilities and many advances have been made on the theory itself. However, these contributions are mostly grounded on Teece and Pisano (1994) and Teece et al. (1997) initial discussions using the three categories of factors to help determine firmôs distinctive competencies. The three categories of processes, positions and paths that explain the firmôs sources of competitive advantage (Teece, et al., 1997) are adopted in this study (Table 3.3).

Firstly, processes describe the way things are done in the firm comprise three roles: coordination/integration, learning, and reconfiguration (Teece, et al., 1997). First role: Coordination and integration is about managers in charge of coordinating and integrating activities within a firm and that the firmøs failure and success is relied on the effectiveness and efficiency of the internal coordination and integration. Second role: Learning is represented by a process of repetition and experimentation that enables tasks to be performed better and quicker. The learning process is generated via learning that resides in new patterns of interactions involving organizational and individual skills to provide successful solutions to particular problems for organizational knowledge. Coordinative management process also provides potential inter-organizational learning. Teece and Pisano (1994) pointed out that collaborations and partnerships are some of the drivers for organizational learning. Organizational learning allows better performance as a result of experimentation and or more effective routines (Ambrosini & Bowman, 2009; Eisenhardt & Martin, 2000). Third role: Reconfiguration is firmøs ability to reconfigure the firmsô asset structure when required. Firms have to be willing to adopt new progressions for better performance through constant observation of technologies progressions in the market. Karim (2006) added that firmøs structure reconfiguration allows business units to recombine their resources in order to adapt to environmental changes, such as changes in customer demand.

Secondly, positions represent firmsô current portfolio of assets, for instance, plant and equipment, and difficult to trade knowledge assets (Teece, et al., 1997). There are two dimensions for positions, the internal and external positions (Ambrosini & Bowman, 2009). The internal positions refer to the firmsô internal assets such as its technological assets, complementary assets, financial assets, reputational assets, institutional assets (Ambrosini & Bowman, 2009; Teece, et al., 1997). External environment is related to firmøs current endowment in its customer base and its relations with suppliers (Hsu & Wang, 2012; Teece & Pisano, 1994). As for firmsô current position, it is determined by the market assets and organizational boundaries that the firm employs (Kindström, 2013; Teece, et al., 1997).

Thirdly, paths refer to path dependencies and technological opportunities. Path dependencies mean a firmøs future rides on its current position and its history. This suggests that dynamic capabilities are path dependent (Dierickx & Cool, 1989) since firms are shaped by decisions made in the past and stock of assets that the firms hold (Eisenhardt & Martin, 2000; Zollo & Winter, 2002). Path dependencies can be grounded knowledge, resources familiar to firm, or influences from social and collective learning (Monteverde & Teece, 1982; Teece, et al., 1997). Learning is also a dynamic capability identified as a process through which repetition and experimentation allow tasks to be performed more efficiently (Teece, et al., 1997). This signifies that learning plays a significant role in the creation and development of dynamic capabilities. Futures of firms are also dependent on the technological opportunities. Teece et al. (1997) explain technological opportunities as the rate of the industryøs advancement and the rate of scientific breakthroughs made.

The three variables- processes, positions, and paths, formed the core model of dynamic capabilities (Teece, et al., 1997), are able to determine the ability to react to market fluctuations appropriately though efficient resources capitalization.

Table 3.4: Dynamic Capabilities variables (Teece & Pisano, 1994; Teece, et al., 1997)

Component	**Capabilities**
Processes	Coordination/integration Learning Reconfiguration
Positions	Technological assets Complementary assets Financial assets Reputational assets Structural assets Institutional assets Market (structure) assets Organizational boundaries
Paths	Path dependencies Technological opportunities

3.3.3.3 Porter's Generic Value Chain

On contrary to RBV and dynamic capabilities that look at a firm as a whole, Porterøs generic value chain (Porter, 2008) perceives competitive advantage from a collection of activities (Table 3.4 and Table 3.5). The collection of activities stems from the many discrete activities a firm performs in designing, producing, marketing, delivering, and supporting its product.

The difference of the value chains of firms in an industry is reflected in their histories, strategies, and success at implementation (Hill, et al., 2014; Porter, 2008). When a firmøs value chain differs in competitive scope from its competitors, this may represent a potential source of competitive advantage. In addition, a firm that tailors its value chain to serve only a particular industry segment will achieve lower costs or differentiation in serving the said segment compared to its competitors.

The concept of market orientation incorporates knowledge of other members like suppliers and competitors in their industry's value chain (Narver & Slater, 1990). The concept of industry value chains was developed to clarify the business use in constructing competitive advantages within an industry (Porter, 1980, 1985). Each organizationôs value chain is embedded in a larger stream of activities that Porter (1985) refers as the value system. Porter's value system is consistent with general theories of marketing (Priem, 1992) that mention value creation as the ability of the components of the value system or chain that work together cohesively to determine the level of value provided to the ultimate consumer.

An organization should view its marketing system partners as customers with needs that must be met (Chorn, 1991; Webster Jr, 1992). Value can be added into the natural sequence of operations or stages of an industry. An individual business which functions along these stages will be inclined to favor one or the other as its primary stage (Galbraith & Kazanjian, 1986). Galbraith and Kazanjian (1986) further that the stage of its industry supply chain in which an organization chooses to emphasize will have significant economic and marketing implications. Differentiated and unbalanced market orientations may be needed for better marketing systems in their respective efforts to deliver superior levels of end-consumer value. This suggests that an organization must not only focuses on the various market components, depending knowledge from members in industryôs value chain as put forth by Narver and Slater (1990), it must also focuses on the said components appropriately following specific environmental circumstances like industry value chain position.

Industry supply chains can be divided into two halves, upstream and downstream (Galbraith & Kazanjian, 1986; Stadtler, 2015). The factors for success will differ greatly for organizations that center their activities in either half. According to Galbraith and Kazanjian (1986), the upstream competitors are closer to the raw material end of an industry's supply chain. Value can be added by reducing raw material to standardized commodities and intermediate products, which can then be used by down streamers in a variety of products. The upstream end business units of the industry chain do not sell to the ultimate consumer but to other organizations that produce final products using their goods as inputs. Competitive advantage in the upstream stage is more likely to involve process and cost-oriented mechanisms to facilitate the achievement of a low cost position.

On the contrary, downstream competitors are relatively closer to the final consumer. Downstream competitors are characterized as having the ability to produce products that meet the various needs of the consumer and add value via advertising, positioning products, and marketing channels. Apart from competing primarily on cost position, success at the downstream stage is also dependent upon proprietary features (product branding), product development (innovation), and customization (product specialization) (Porter, 1985).

The stage where majority of the business activities occur determines whether an organization is upstream or downstream. A key advantage of the value chain perspective is the prospect to reveal potential shifts in the value creating processes of a company (Porter, 2008). The value chain is important as it gives insights to balance the needs of key constituencies across the organizationǿs competitive setting.

Porter (1985) described a chain of activities common to all businesses, and he divided them into primary and support activities, primary activities relate directly to the physical creation, sale, maintenance and support of a product or service. They consist of the following in Table 3.5 and 3.6:

Table 3.5: Primary activities of Porterôs generic value chain (Porter, 1985)

Activity	**Description**
Inbound logistics	These are all the processes related to receiving, storing, and distributing inputs internally. Supplier relationships.
Operations	These are the transformation activities that change inputs into outputs that are sold to customers. Operational systems
Outbound logistics	These activities deliver your product or service to customer. These are things like collection, storage, and distribution internal or external to organization.
Marketing and sales	These are the processes used to persuade clients to purchase from organization instead of competitors. The benefits communicate them, are sources of value here.
Service	These are the activities related to maintaining the value of organizationôs product or service to customers, once it's been purchased.

The activities below support the primary functions above. Each support, or secondary, activity can play a role. For example, procurement supports operations with certain activities, but it also supports marketing and sales with other activities.

Table 3.6: Support activities of Porterôs generic value chain (Porter, 1985)

Activity	**Description**
Procurement (purchasing)	This is what the organization does to get the resources it needs to operate. This includes finding vendors and negotiating best prices
Human resource management	This is how well a company recruits, hires, trains, motivates, rewards, and retains its workers. People are a significant source of value, so businesses can create a clear advantage with good HR practices.
Technological development	These activities relate to managing and processing information, as well as protecting a company's knowledge technology costs, staying current with technological advances, and maintaining technical excellence are sources of value creation.
Infrastructure	These are a company's support systems, and the functions that allow it to maintain daily operations. Accounting, legal, administrative, management are examples of necessary infrastructure that businesses can use to their advantage.

3.4 Conceptual Framework and Research Hypothesis

With the aid of the anomaly-seeking research, the three methods (Section 3.3.1-3.3.3) elaborated put together the conceptual framework for this study. After the analyses of Resource-Based View, Dynamic Capabilities, and Porterøs generic value chain, this study proposes an integrated framework rooted in these three streams of strategic theories to provide the firmøs capability variables. According to the definitions of RBV (Rumelt, et al., 1991), dynamic capabilities (Teece, et al., 1997), and Porterøs (1985) generic value chain, the proper identification of firmøs resources and capabilities in its value chain is important to put the firm in a strategically competitive position and that they have to be in congruence with the changing business environment. All the three theories mentioned the firmøs capabilities and the extensions from RBV have enhanced RBV to incorporate the market dynamism dimension from dynamic capabilities theory and the value chain activities dimension from Porterøs generic value chain theory.

Physical resources, human resources, organizational resources, and procurement resources are derived from Resource-Based View (RBV) theory. The extension of RBV, the dynamic capabilities, derives physical resources, human resources, organizational, financial, business management, innovation, and organizational learning capabilities. Finally, Porterøs generic value chain theory provides human resources, organizational, business management, construction, innovation, project management, and procurement capabilities. Additionally, to incorporate capabilitiesô indicators that are essential for construction business operation, a paper on construction organizational capability was reviewed (Wethyavivorn, et al., 2009). The firmøs capabilities were gathered from previous literature to design a portion of the survey instrument that identifies firmøs capabilities. The firmô capabilities constructs are operationalized with the measurement indicators adopted from various sources. These are presented in Table 3.7.

Table 3.7: Firmôs capability constructs and indicators

Construct	Reference models	Indicators	Adapted and modified from
Physical (PHYS)	R- Physical technology used in a firm R- A firmôs plant and equipment R- Its geographic location D- Complementary assets (Technological innovations require the use of certain related assets to produce and deliver new products and services.)	phys_1: Excellent construction technology phys_2: Special construction equipment phys_3: Electronic communication	(Barney, 1991) (Teece, et al., 1997) (Wethyavivorn, et al., 2009)
Human Resource (HMRS)	R- Training R- Experience R- Judgment R- Intelligence R- Relationships R- Insight of individual managers and workers in a firm P- Recruits, hires, trains, motivates, rewards, and retains its workers D- Learning	hmrs_1: Organized processes of in-house learning and knowledge development hmrs_2: Systematic on the job training hmrs_3: Good relationship among working team hmrs_4: Competent staff remain long term with firm hmrs_5: Offer good remunerations, promotions and benefits hmrs_6: Employeeôs commitment and loyalty	(Barney, 1991) (Porter, 2008) (Singh, 2012) (Wethyavivorn, et al., 2009) (Teece, et al., 1997) (Protogerou, Caloghirou, & Lioukas, 2012)
Organizational (ORGZ)	R- A firmôs formal reporting structure R- Its formal and informal planning R- Controlling and coordinating systems R- Informal relations among groups within a firm and between a firm and those in its environment P- Infrastructure D- Coordination/integration D- Structural assets	orgz_1: Integration and standardization of business processes orgz_2: Adopt latest management tools and techniques orgz_3: Systematic implementation of business plan orgz_4: Has formal reporting structure orgz_5: Have controlling and coordinating systems orgz_6: Have informal relations among groups within a firm and between a firm and those in its environment orgz_7: Has inventory management orgz_8: Has proper legal, finance, accounting, public affairs, quality management, etc.	(Barney, 1991) (Teece, et al., 1997) (Protogerou, et al., 2012)

Note: Reference model of constructs are denoted by R-Resource-Based View; D-Dynamic Capabilities; P-Porter's generic value chain

Table 3.7: Firmôs capability constructs and indicators (contôd)

Construct	Reference models	Indicators	Adapted and modified from
Financial (FNCL)	D- Financial assets D- Institutional assets	fncl_1: Credit and record with banks fncl_2: Physical assets fncl_3: On-time payment for all payables fncl_4: Reserved cash (retained earnings) fncl_5: Evaluate clientôs risk (financial stability) fncl_6: Cash and investment policy fncl_7: Match sources and utilization of funding fncl_8: Quantitative evaluation of investment	(Teece, et al., 1997) (Wethyavivorn, et al., 2009)
Business Management (BSMG)	D- Reconfiguration D- Reputational assets D- Market (structure) assets D- Organizational boundaries (Boundaries are not only significant with respect to the technological and complementary assets contained within, but also with respect to the nature of the coordination that can be achieved internally as compared to through markets.) P- Outbound logistics P- Marketing and sales	bsmg_1: Effective benchmarking bsmg_2: Systematic formulation of long term strategy bsmg_3: Timely response to competitive strategic moves bsmg_4: Flexible adaptation of human resources to technological and competitive changes bsmg_5: Excellent reputation on project record bsmg_6: Exceptional client relationships bsmg_7: Strong networking bsmg_8: Promoting the sales of the end-product	(Protogerou, et al., 2012) (Teece, et al., 1997) (Wethyavivorn, et al., 2009)
Innovation (INNV)	P- Technological development D- Technological assets D- Technological opportunities (innovation)	innv_1: Implement new knowledge and or technology innv_2: Conduct research and development innv_3: Implement process automation innv_4: Practice intellectual property via patent or copyright	(Singh, 2012) (Teece, et al., 1997)

Note: Reference model of constructs are denoted by R-Resource-Based View; D-Dynamic Capabilities; P-Porter's generic value chain

Table 3.7: Firmôs capability constructs and indicators (contôd)

Construct	Reference models	Indicators	Adapted and modified from
Procurement (PCRM)	P- Purchasing R- Its access to raw materials	pcrm_1: Access to raw materials pcrm_2: Long-term contractual relationship with suppliers and subcontractors pcrm_3: Established selection criteria for suppliers and subcontractors pcrm_4: Supplier credits pcrm_5: Access to spare parts and machines	(Barney, 1991) (Wethyavivorn, et al., 2009) (Singh, 2012)
Organizational Learning (ORGL)	D- Path dependencies	orgl_1: Inter-project meetings orgl_2: Learning from previous investments orgl_3: Previous project cost database	(Teece, et al., 1997) (Wethyavivorn, et al., 2009)
Construction (CNST)	P- Operations P- Service	cnst_1: Large-scale construction project experience cnst_2: Regular equipment maintenance cnst_3: Testing of facility operations	(Porter, 2008) (Wethyavivorn, et al., 2009)
Project Management (PRMG)	P- Inbound logistics	prmg_1: Manage material and equipment scheduling prmg_2: Project cost control (estimation, pricing policy, identification of cost overrun, detailed budgeting) prmg_3: Project quality control prmg_4: Clear project organization structure setup prmg_5: Evaluate suppliers and subcontractorsô performance	(Porter, 2008) (Wethyavivorn, et al., 2009)

Note: Reference model of constructs are denoted by R-Resource-Based View; D-Dynamic Capabilities; P-Porter's generic value chain

A framework consists of firmôs capabilities (Table 3.7) and internal and external risks (Table 2.1) components was established. Figure 3.3 portrays the main constructs of the conceptual framework to fill the gap identified in Chapter 2.

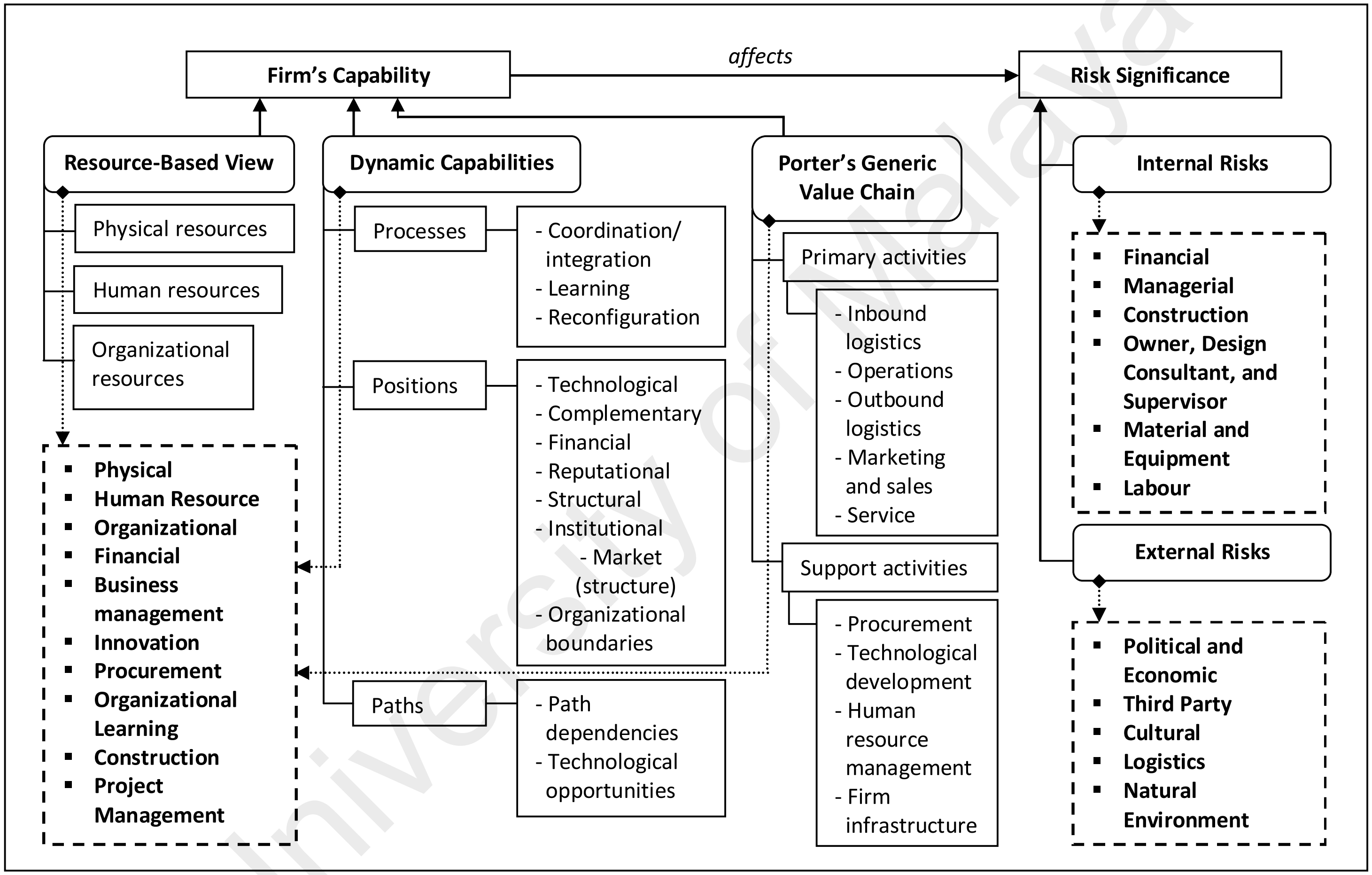


Figure 3.3: Contents of the conceptual framework (Source: Author derived)

According to previous studies (Keizera, et al., 2002; Dikmen & Birgonul, 2006), the magnitude of risk is determined not only by its likelihood and impact but also by a firmǿs ability to influence risk factors and any strategy used by the firm may reduce the probability of occurrence and impact of a risk event. Therefore, the specific research hypothesis is ñ*A combination of physical, human resource, organizational, financial, business management, innovation, procurement, organizational learning, construction, and project management capabilities can lower risk significances in the international construction foray".*

Figure 3.4 also portrays path models consisting of constructs connected to show the hypotheses to be tested. Since the PLS-SEM analysis applied works efficiently with small sample sizes and complex models and makes practically no assumptions about the underlying data (Hair, et al., 2013, p.15). Therefore, all the possible hypothesized paths are included to prevent any assumptions that may deter discoveries of important findings in this exploratory study.

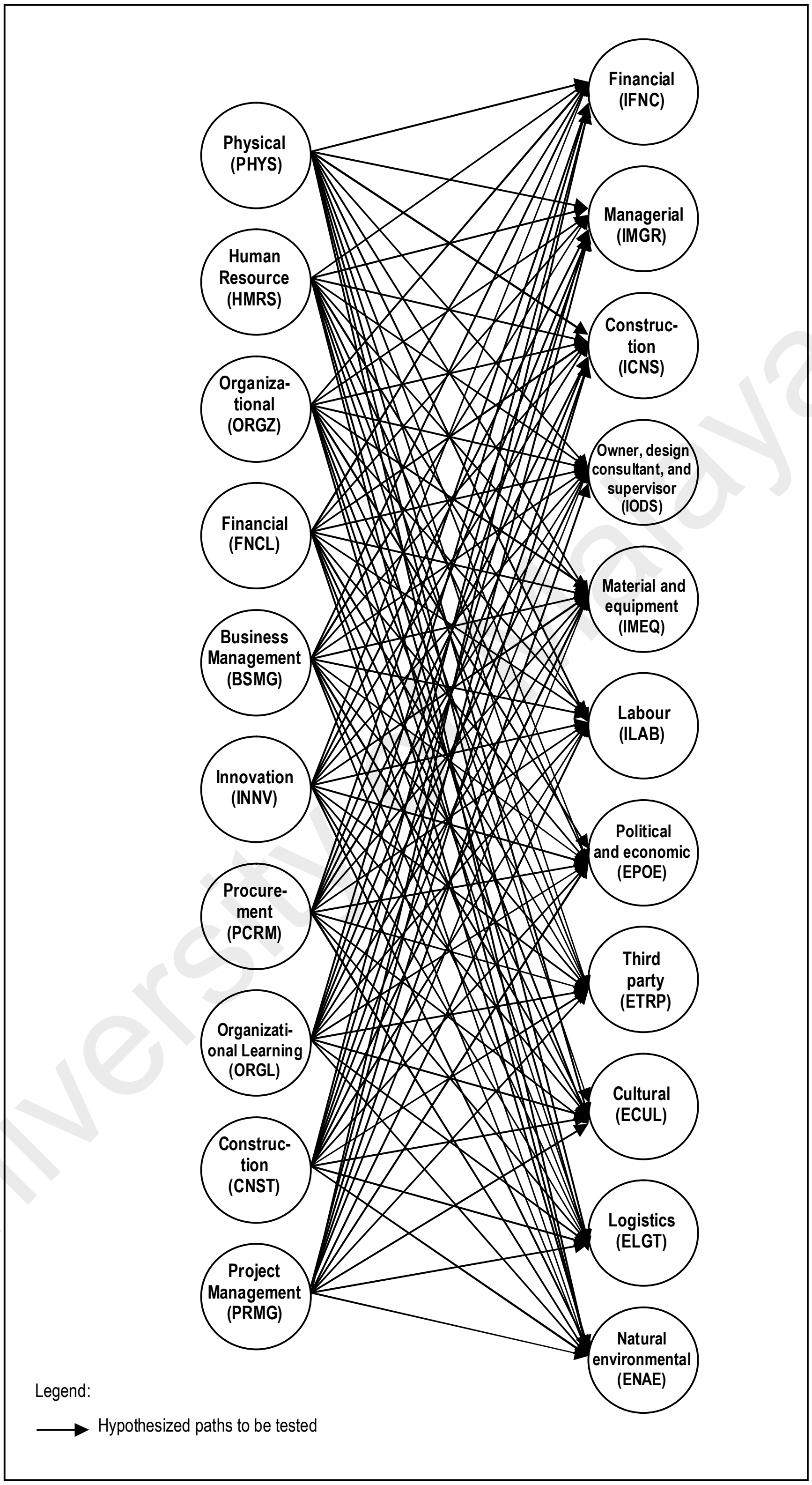


Figure 3.4: Path models showing hypothesized paths

3.5 Summary of Chapter

This chapter begins with the theory of theory building and then introduces the anomaly-seeking research process. The earliest stage of theory building has always been observe, describe, measure, and record because of the few management theories developed. With the vast theories available these days, there is a need to improve the theories in a proper process. The anomaly-seeking research is a process available to build better theory. Hence, the application of anomaly-seeking research process in this study to reinforce the knowledge gap derived from Chapter 2. Later, the theories from Resource-Based View, Dynamic Capabilities, and Porterӳ generic value chain theories are reviewed and integrated to develop the conceptual framework in this chapter. The basic principle, contents and applications of the original models as well as their strengths and weaknesses are discussed. The related strategies and principles, which are appropriate for setting up an integrated framework from diverse perspectives, are identified. From the review, a conceptual framework that combines firmӳ capabilities derived from the three theories is proposed. It is suggested that the integrated framework will be much stronger than each of the theory individually, since the strategies and principles complement each other. The research design to conduct the empirical tests on the hypothesis is reviewed in the next chapter.

CHAPTER 4
RESEARCH METHODOLOGY

4.1 Introduction

This chapter focuses on the rationale on the choice of research methodology and research design in order to accomplish the aim and objectives of the study. As depicted by Creswell (2009, p. 5), "in planning a study, researchers need to think through the philosophical worldview assumptions that they bring to the study, the strategy of inquiry that is related to this worldview, and the specific methods or procedures of research that translate the approach into practice". Consequently, this chapter sets out stepwise discussions on the philosophical worldview of the study, the research strategy of inquiry, and the specific methods of data collection, analysis, and interpretation chosen. Each chosen strategy, method or technique is discussed and justified in order to determine its relevance of this study.

4.2 Research Design

Research design is a plan to conduct a research that spans the decisions from broad assumptions to detailed methods of data collection and analysis (Creswell, 2009). Hence, prior to detailing into methods and techniques, the philosophy worldview assumptions (Creswell, 2009) or paradigm (Lincoln & Guba, 2000; Mertens, 1998) should first be addressed. There are four social science philosophy worldviews or paradigms: postpositivism, constructivism, advocacy or participatory, and pragmatism (Table 4.1). A researcher's worldview or paradigm reflects the beliefs about what reality is (ontology), what counts as knowledge (epistemology) (Crotty, 1998), and how one gains knowledge (methodology) (Neuman, 2000). In other words, the broad assumptions consist of elements are interdependent: assumptions about the nature of reality (ontological assumptions) are logically related to assumptions about the nature of knowledge (epistemological assumptions), which are logically related to assumptions about procedures for investigating what can be known (methodological assumptions). Philosophical worldviews or research paradigms are sets of basic beliefs, accepted on faith, that provide frameworks for the entire research process (Guba, 1990; Guba & Lincoln, 2005).

Table 4.1: Four philosophical worldviews (Creswell, 2009)

Postpositivism	**Constructivism**
• *Determination* • *Reductionism* • *Empirical observation and measurement* • *Theory verification*	• Understanding • Multiple participant meanings • Social and historical construction • Theory generation
Advocacy/Participatory	**Pragmatism**
• Political • Empowerment issue-oriented • Collaborative • Change-oriented	• Consequences of actions • Problem-centered • Pluralistic • Real-world practice oriented

Espousing a worldview assumption or also broadly conceived as research methodology, paradigm, or epistemology and ontology, leads to embracing a qualitative, quantitative, or mixed methods approach in a research (Creswell, 2009). In this instance, the nature of the research aim is to develop a risk assessment model, through the determination of the extent to which firm's capabilities impact on international construction project risks, for improved productivity and performance. Therefore, this study is designed according to the ***postpositivism*** worldview concerns with advancing relationship among variables (Phillips & Burbules, 2000).

The postpositivist is also known as positivist research, empirical science, and postpositivism. The term, post-positivism, means the thinking after positivism, it challenge the traditional notion of the absolute truth of knowledge (Phillips & Burbules,

2000) and recognize that we cannot be positive about our claims of knowledge when studying the behavior and actions of humans. The postpositivist assumptions hold true more for quantitative research than qualitative research. Hence, this study embeds the secondary qualitative data within the primary quantitative data, which is discussed in Section 4.4.

Postpositivists hold a deterministic philosophy in which causes determine effects or outcomes (Creswell, 2009). Postpositivists reflect the need to identify and assess the causes that influence outcomes when studying problems. Creswell (2009) mentions that postpositivism is reductionistic where it reduces ideas to discrete set of variables comprising hypotheses and research questions for test. Postpositivist develops knowledge based on careful observation and measurement of the objective reality that exists in the world. Thus, it is imperative for a postpositivist to develop numeric measures of observations and study the behavior of individuals. This study also develops measurement models prior to testing the relationships between variables.

To understand the world, laws or theories that govern the world are to be tested or verified and refined. Thus, postpositivists begin with a theory, collects data that either supports or refutes the theory, and then makes necessary revisions and conducts additional tests (Creswell, 2009). Therefore, three theories are adopted to develop measurement models and to be tested in the context of this research.

Having addressed the philosophical worldview, next is to describe the research design in sequence of stages as illustrated in Figure 4.1.

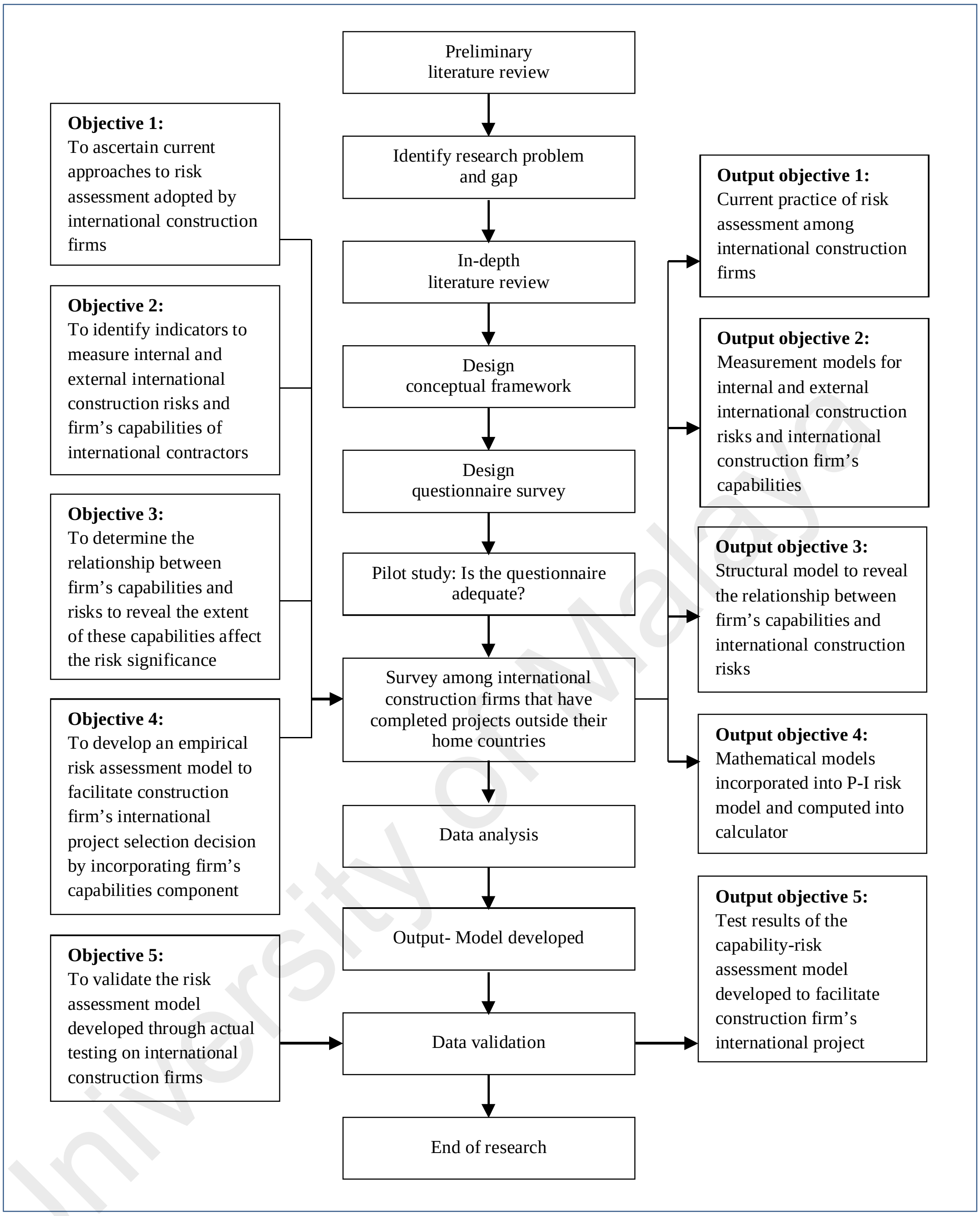


Figure 4.1: Research design (Source: Author derived)

The preliminary literature review provides the background and ideas for identifying research problem and gap. Later on, the in-depth literature review stage intends to provide a foundation for the research by defining a theoretical basis to design both conceptual framework and questionnaire survey. Firstly, the literature review provides the past researches on international construction risk assessment, hence developing a knowledge gap. The literature review also provides a conceptual risk assessment framework containing two major components of firm's capabilities and international construction project risks. The said conceptual framework then leads to construction of the questionnaire survey. Having prepared the questionnaire, it is ready to commence on the data collection of this research.

This research aims to develop a risk assessment model, through the determination of the extent to which firm's capabilities impact on international construction project risks, for improved productivity and performance. The data collection stage started with the pilot testing of the questionnaire developed. Once the questionnaire is ready, it is distributed among international construction firms that have completed projects outside their home countries. The questionnaire is being directed to the international construction firms via postal mail, e-mail, telephone, or face-to-face. The first three objectives of this research are achieved via this first questionnaire survey. The data collected is analyzed using SPSS 22.0 (IBM Corp, 2013) and SmartPLS 2.0 (Ringle, Wende, & Will, 2005) software to deliver the outputs of measurement models for both firm's capabilities and international construction project risks and the structural model of the relationship between them. The data obtained from the respondents are analyzed and organized for results presentation. The outcome of this study is a capability-based risk assessment model for construction firms to decide for international construction projects. This model developed is tested and validated through the validation survey stage. The last objective of this research is also achieved via the validation stage to present test results of the model.

4.3 Research Approach

The general strategy adopted for gathering and analyzing data necessary to answer the research questions is the research approach (Sharma, 2004). Research is generally conducted either to derive a new theory or to test an existing one. Cavana, Delahaye and Sekaran (2001) explained that to derive a new theory, it begins with observing a certain phenomenon and uses inductive reasoning to derive a theory from the said observations. Therefore, the research approach is termed as inductive approach. On the contrary, to test an existing theory, it begins with a theoretical proposition based on the existing theory, and subsequently moves toward concrete empirical evidence to test it. This approach is known as deductive approach (Figure 4.2).

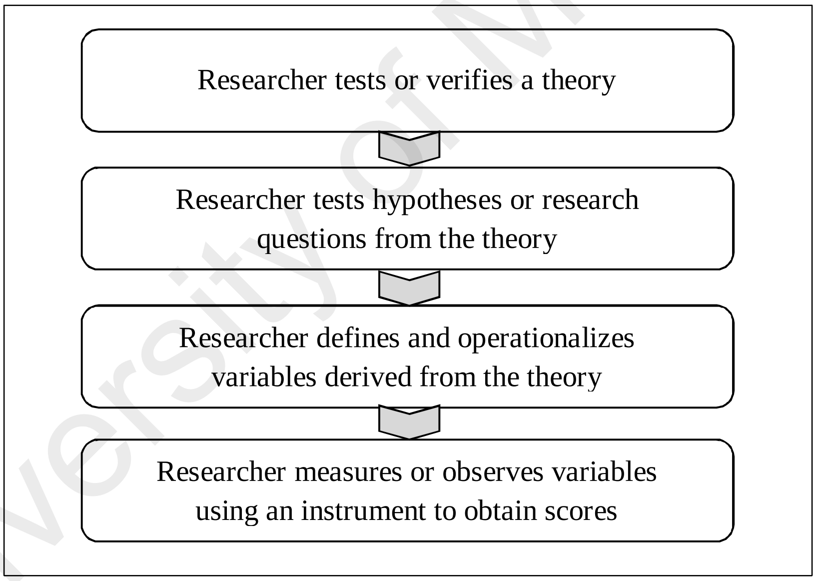


Figure 4.2: The deductive approach (Creswell, 2009, p.57)

This research aims to determine the extent to which firm's capabilities affect international construction project risk significance values. Hence, literature review has been carried out on the theories related to firm's capabilities. The literature review serves as the foundation for the exploration of the conceptual framework, or the theory per se, regarding the relationships between firm's capabilities and international construction project risks. Hence, it can be concluded that this research employed the deductive reasoning approach.

4.4 Research Strategy of Inquiry

In order to achieve valid and reliable findings based on the objectives, the design of a research strategy is crucial (Koszalka & Grabowski, 2003). The selection of strategy depends on the research philosophy (Creswell, 2009; Easterby-Smith, Thorpe, & Lowe, 2002). Constructivist or advocacy or participatory knowledge employs strategies such as phenomenology, grounded theory, ethnography, case study, and narrative. Pragmatic knowledge employs sequential, concurrent, and transformative strategies. Meanwhile, post-positivist knowledge employs surveys and experiments strategies (Creswell, 2009).

Since this research adopted the post-positivist philosophy, surveys and experiments strategies are employed. To determine the relationship as shown in the conceptual framework (Figure 3.3), it is proposed to adopt questionnaire survey and case-based interview approaches in the following phases. The firm's capabilities and international construction project risks are identified through literature review. Based on the questionnaire survey, the indicators for firm's capabilities and project risks and the relationship between them are determined after analysis. Then, validation of the developed model is conducted using case-based interview.

For the survey data collection stage, mixed methods research approach is employed. Campbell and Fisk (1959) used multi-methods to study validity of psychological traits then later evolved in the early 1990s from seeking convergence to actually integrating or connecting quantitative and qualitative data. The various terms used in mixed methods literature are multi-method, convergence, integrated and combined (Creswell, 2009; Creswell & Clark, 2007).

Creswell (2009) put forth six types of design of procedures for a mixed methods study. They are classified under two broad designs with three sub-designs respectively; sequential designs (consisting of sequential explanatory, sequential exploratory, and sequential transformative) and concurrent designs (consisting of concurrent triangulation, concurrent embedded, and concurrent transformative). Prior to selection, there are four important aspects to be considered before adopting a mixed methods strategy, namely timing, weighting, mixing, and theorizing (Creswell, 2009).

The first aspect to be considered is timing, either the qualitative and quantitative data collections are carried out in phases (sequentially) or at the same time (concurrently). Respondents are free to give input on the risks encountered when undertaking international construction projects. For that reason, concurrent timing is chosen for the data collection of both qualitative and quantitative data. The second factor is weight or priority given to qualitative or quantitative research in a particular study. In this study, the quantitative information is emphasized. With that information, it induces the qualitative information simultaneously.

The next aspect is mixing the qualitative and quantitative data by connecting, integrating, or embedding them. In this scenario, the aim is to collect the predominant quantitative data and have the qualitative data provide supportive information. In other words, this study is embedding the secondary qualitative data within the primary quantitative data. The secondary database provides a supporting role in the study. The final aspect is theorizing which means whether a larger, theoretical perspective guides the entire research design. The Resource-Based View, Dynamic Capabilities, and Porter's generic value chain are the theories used to shape the questions asked in the questionnaire.

To recapitulate, all the four aspects considered in planning the mixed methods design are captured in the visual model- a concurrent embedded design (Figure 4.3), in which timing is concurrent, weighting leans towards quantitative data, mixing uses embedding method, and exploiting explicit theories. The purpose of this concurrent embedded mixed methods study is to better understand a research problem by converging both quantitative and qualitative data. In this approach, questionnaire survey is used to measure the relationship between the firm's capability (independent constructs) and risk significance values (dependent constructs). At the same time in the study, the relationship between the two constructs is explored using qualitative interviews with part of the international construction firms in the study. Subsequently, validation interview stage commences after the analysis of the data collected in this stage.

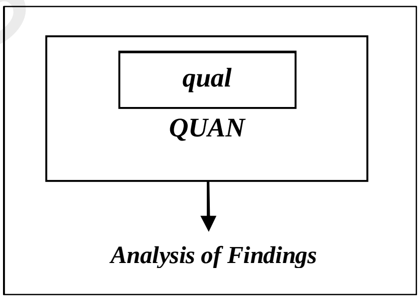


Figure 4.3: The concurrent embedded design adopted (Source: Creswell, 2009, p. 210)

4.5 Time Horizon

In quantitative research, research survey is designed based on two main time horizons: cross-sectional and longitudinal (Creswell, 2009). The main difference between the two time horizons is that a cross-sectional survey collects data from a sample that has been drawn from a predetermined population at one point in time; while a longitudinal survey collects factual information from the same subject or population on a continuing basis (Kumar, 2005).

This research obtains data from various construction firms for an overall picture on the relationship between firm's capabilities and international construction project risks. Therefore, cross-sectional survey has been adopted to determine the prevalence of a phenomenon, situation, problem, attitude, or issue by taking a cross section of the population. Besides, cross-sectional survey design is chosen over longitudinal survey design because the latter is time-consuming, difficult and expensive, vulnerable to increasing non-response over time, and results in incomplete longitudinal data (Van der Stede, Young, & Chen, 2005).

4.6 Data Collection Instrument

Based on the literature review, a data collection instrument in the form of a questionnaire survey was designed. The questionnaire is appended in Appendix A and it comprised of four sections.

Section A solicits the general particulars of the respondents, their firms' particulars including international projects handled. In Section B, the respondents were asked on their practice of risk management in their firm. As for Section C, the respondents were to evaluate on the firm's capabilities that reflect their firm's condition and practice. Lastly, Section D, the respondents were to rate the risks faced based on the likelihood of occurrence and magnitude of impact when undertaking projects abroad.

To capture the capabilities of the firms (Section C) and the risks faced by their firms (Section D), a 5-point Likert scale was proposed, where 1 represents strongly disagree/never/not at all, 3 represents neutral/sometimes/medium, and 5 represents strongly agree/always/very high. In addition, to facilitate measurement model evaluation in data analysis (Section 4.9.4.5b), a global measure or indicator is added to each firm's capability (listed as last additional question for each capability's sets of questions) under Section C. The global indicator summarizes the essence of the construct the formative indicators purport to measure. For example on *PHYS* capability, an additional question 'Firm owns physical resources' was developed and measured on a scale of 1 (neutral) to 5 (strongly agree).

4.7 Pilot Study

The questionnaire was checked on its content validity prior to pilot study. The content validity of the questionnaire was achieved by having the items extracted from past literature of both international and country-specific contexts and questionnaire with reliability coefficient of 0.7 or above and the usage of multi-item scale. This step is important to establish equivalence (He & van de Vijver, 2012) in addition to reporting the reliability and validity (DeVellis, 2011; Nunnally, 1978) in cross-cultural research. Since the international construction firms were the unit of analysis, consideration of cultural influence arose although culture was not investigated in this study. To minimize the bias, cultural decentering method (Van de Vijver & Leung, 1997; Werner & Campbell, 1970) was adopted where the questionnaire was developed simultaneously from international and country-specific contexts and only the common items are retained for the main survey. This cultural decentering method ensured the items to be suitable for a cross-cultural context, often implying the removal of specific items like references to places and currencies from the construct measured.

Before proceeding to the pilot survey, a consultation with content experts was conducted. The consultation involved six subject matter experts consist of two academicians (international construction researchers) and four international construction managerial personnel from different home countries to comment on clarity and ambiguity of terms, relevancy of each item, and suggestion on any other important items.

Having checked the content validity of the questionnaire, qualitative pilot studies were deployed as an informal test on suitability and flow of questions. The aims of the pilot study are to clarify research question boundaries and make the research more focused (Walker, 1997), ensure that the questionnaire is coherent and comprehensible, and ensure that the responses are accurate. In this study, six subject matter experts were chosen to conduct the pilot study; they are made up of two academicians, two contractors, and two consultants. The reason for choosing six experts from three backgrounds is inspired by Hammersley and Atkinson’s (1983) triangulation concept. The triangulation concept states that information about a single phenomenon should be collected from at least three different sources, or at least information should be obtained from three different techniques, because the validity of the information is not established when it comes from only one expert.

The six experts were requested to also highlight questions which were not relevant to the real situation for international construction firms operating outside their home countries. In general, all the experts commented that the questionnaire was comprehensive. However, they were concerned whether the surveys could be completed within one hour since the questionnaire was rather lengthy. Two experts suggested that some of the items are redundant and omitting a few of them will not change the meaning of the construct.

Based on these suggestions, the questionnaire was improved in two aspects. First, to encourage international construction firms to participate in the study, construction firms and respondents were allowed to remain anonymous. Second, some redundant items were deleted to shorten the questionnaire. These adjustment and modification of the questionnaire following a pilot study could improve the accuracy of the data collected.

4.8 Data Collection and Sampling

According to Robson (2002) and Jackson (2015), there are three ways to administer a survey; (i) mail survey, (ii) telephone survey, and (iii) personal survey. All three methods were adopted to suit the preference of the respondents. The questionnaire comes with a cover letter to explain the purpose of the research. In this study, the surveys are administered by postal, online, or email. The respondents were followed up to ensure their receipt of the questionnaire forms and some would request for personal face-to-face survey or telephone survey.

Alston and Bowles (1998) categorized sampling as either probability or non-probability sampling. In probability sampling, each unit of the population has an equal or known chance of being selected for study. There are four main types of probability sampling: simple random sampling, systematic random sampling, stratified random sampling and cluster random sampling. Non-probability sampling, on the other hand, is not representative of the population under study; hence the generalization of results is limited. There are also four common types of non-probability sampling: convenience sampling, quota sampling, purposive sampling and snowball sampling. The characteristics and description of these sampling types are shown in Figure 4.4.

In this study, the unit of analysis is international construction firm. Thus, population of study comprised all the international construction firms globally. However, there is no authoritative list of all international construction firms operating globally. The sampling frame for this study is limited to all international firms registered with Construction Industry Development Board (CIDB), Malaysia. The survey sample is taken from the CIDB list because: (i) it is accessible for the author to collect the data and (ii) both Malaysian and foreign international construction firms are registered with CIDB to operate both in Malaysia (for foreign firms) and overseas (for Malaysian firms). Due to convenience sampling, the samples were drawn from the Construction Industry Development Board (CIDB), Malaysian database. The CIDB documents for the categories of Malaysian international construction firms and foreign international construction firms were used as the sampling frames from which the sampling was drawn. The total number of international construction firms provided by CIDB up to year 2012 is 155, comprising of only 90 local (CIDB, 2012) and 65 foreign (CIDB, 2013) construction firms registered under the ‘International Contractors’ category.

The criteria set for the firms and respondents participate in this study were as below:

- Firm must have undertaken construction projects outside firm’s home country
- Firm must have more than 10 years of construction experience
- Firm must have at least 8 years of international construction experience
- Respondent must have at least 10 years of working experience
- Respondent must be of managerial position

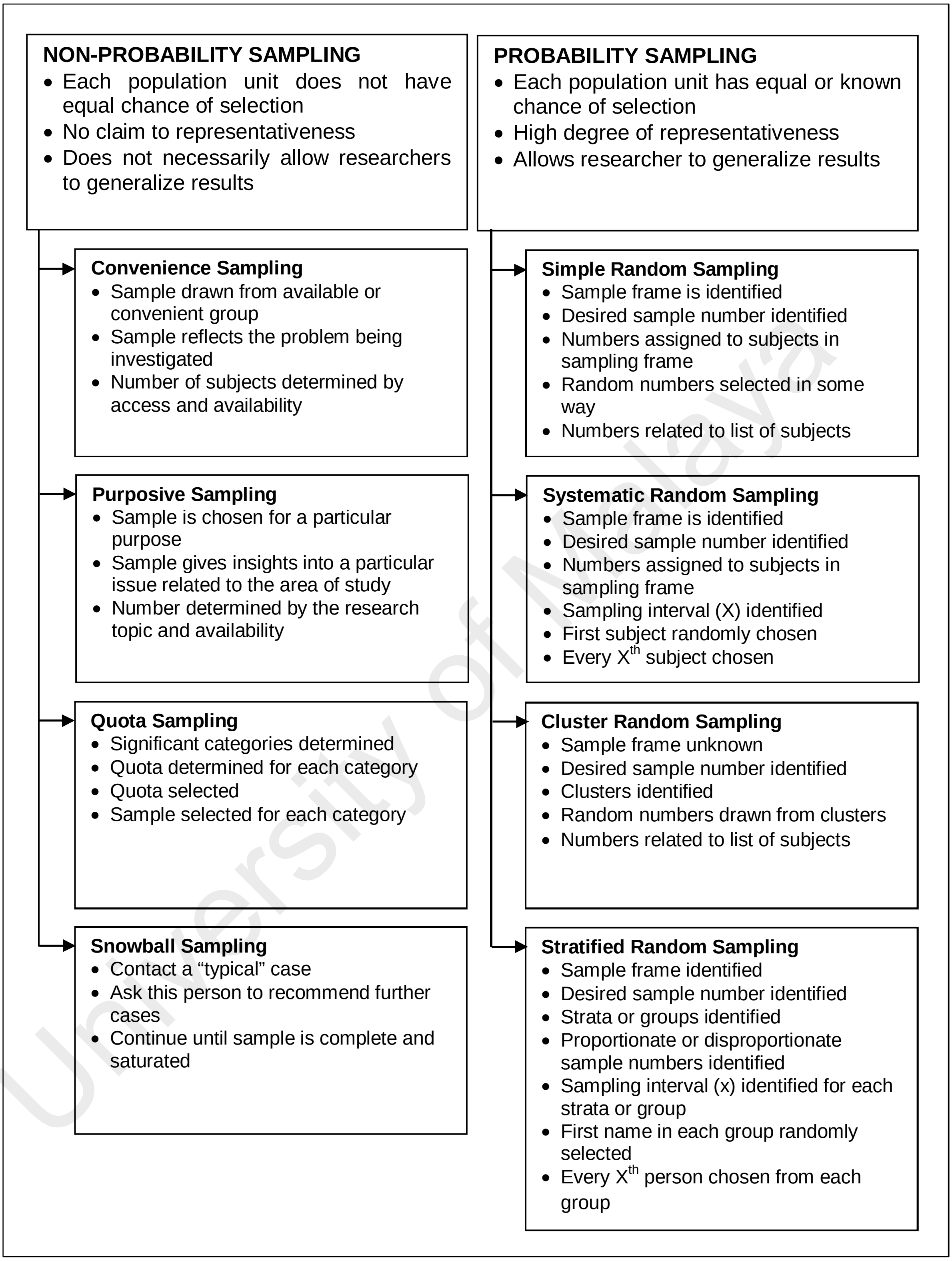


Figure 4.4: Types of sampling used in social research
(Source: Adapted from Alston and Bawles, 1998)

Since the number of international construction firms is small, the questionnaire surveys were posted to all 155 of these construction firms. The survey questionnaire was distributed to senior executives in charge of international construction of 155 international construction firms via postal mail, e-mail, and face-to-face. This study targeted the respondents from the managerial level and above, hence, some firms received more than one questionnaire but were directed toward different respondent. After the mail survey was completed, phone calls were made to all the firms to improve the response rate. A total of 252 survey questionnaires were sent out in 2013 to 2014 to 155 international construction firms and 65 firms responded via either semi-structured interview or questionnaire survey depending on the respondents' locations, giving a response rate of 41.9%.

4.9 Multivariate Data Analysis

A number of statistical techniques are available to analyze relationships among variables. According to Johnson and Wichern (2002) and Sharma (2004), simple regression, t-test, analysis of variance (ANOVA), discriminate analysis, logistic regression, multiple egression, multivariate analysis of variance (MANOVA), cluster analysis, principal components, factor analysis, canonical correlation analysis (CCA) and multiplegroup discriminate analysis (MDA) are some of the data analysis techniques. Two aspects are considered when choosing the analysis technique for any research: First, the aim of the analysis technique must be able to fulfill the research objective. Second, the data collected must be compatible with the situation in which the assumptions of the technique can be applied.

There are two main approaches to classify these multivariate data analysis techniques. The categorization is helpful to identify the aim of the technique and the situation in which the technique can be applied. William and Matthew (1992) classified the techniques into two categories of dependence and interdependence methods. If the interest centers on the association between two sets of variables, dependence methods are used. If the interest centers on the mutual association across all variables with no distinction made among variable types, interdependence methods are opted for. Principal components, factor analysis, multidimensional scaling, and cluster analysis are interdependence methods as shown in Table 4.2. These techniques specialize in identifying the correlations among the data instead of the nature of the data of being independent or dependent.

The outcome of this study is a dependence model since it aims to determine the association between two sets of variables. Hence, this study chose among dependence techniques like multiple regression, MANOVA and CCA. However, a relationship technique using structural equation modeling (SEM) is also studied since its functions are better than the other three modeling techniques noted here.

Table 4.2: Dependence and interdependence techniques
(Adapted by author based on William and Matthew, 1992)

Dependence Models	Interdependence Models
Simple Regression T-test Multiple Regression Analysis of Variance (ANOVA) Discriminant Analysis Multiplegroup Discriminant Analysis (MDA) Logit Analysis Multivariate Analysis of Variance (MANOVA) Canonical Correlation Analysis (CCA)	Principal Components Factor Analysis Multidimensional Scaling Cluster Analysis
IF: the interest centers on the association between two sets of variables, where one set is the realization of a dependent or criterion measure	IF: the interest centers on the mutual association across all variables with no distinction made among variable types

4.9.1 Structural Equation Modeling (SEM)

SEM is not uncommon in social and behavioural research to develop and test theories through survey data. SEM has been applied in business marketing studies (Jensen, 2008; Matzler, Renzl, & Faullant, 2007), strategic management studies (Shook, Ketchen, Hult, & Kacmar, 2004), and construction-related studies in recent years Doloi (2014), Eybpoosh, Dikmen, & Birgonul (2011), Aibinu and Al-Lawati (2010), Cho, Hong, and Hyun (2009), and Mainul Islam and Faniran (2005). SEM is known to have structure that is complex comprising many layers of general and latent variables, yet at the same time, numerous relationships can be discovered in it (Churchill & Lacobucci, 2005).

In this study, ‘constructs’ are the latent variables that cannot be directly observed. There are two types of constructs in this study: First, predictor constructs that are the unobserved independent variables used to predict other constructs, and second, predicted constructs that are the unobserved dependent variables. The predictor and predicted constructs are measured by their corresponding sets of observed variables known as measurement items or indicators. In this study, the observed variables in respective sets are known as measurement items or indicators. SEM works well on prediction of model and it models constructs that are inferred from measurement items or indicators (Schumacker & Lomax, 2004). Chin and Newstead (1999) found SEM technique to be more flexible in modeling as compared to other relationship modeling techniques. Overall, the SEM is known for its ability to predict multiple and interdependent relationships.

DiLalla (2000) made comparison of SEM and other multivariate data analysis techniques. They found that SEM is better than multiple regression technique, which can only be used in the case of only one dependent variable. SEM is also better than canonical correlation analysis as SEM can assess the presence of individual constructs and their interdependent relationships without being tainted by measurement errors. Canonical correlation analysis technique explains the relationship of two sets of variables but does not model the individual variables and this can lead to problems in interpreting the variates (Stevens, 2001). SEM is able to explain the individual measurement items, while MANOVA can only explain predicted variates after they are classified into limited levels (Kline, 2011).

Although SEM has the ability to allow for measurement errors in all observed variables, it also has comprehensive functions for measurement models evaluation. SEM has incorporated extensive statistical functions of confirmatory factor analysis and path analysis into its modeling framework (Bollen & Lennox, 1991). Amoroso and Cheney (1991) added that this integration of the two techniques has materialized the possibility of analyzing interdependent and dependent relationships among all variables in a single mode, thus ensuring a maximally efficient fit between data and model.

Confirmatory factor analysis (CFA), an expansion of the exploratory factor analysis (EFA), contains inferential statistics that tests the uni-dimensionality of a set of measurement items and the significance of the items' factor loadings. As a result, SEM is more than just an exploratory method, its exploratory results may not reproduce the relationships among the variables in another data set (Nunnally, 1978). The function of path analysis in the statistical framework processes complex relationships that cannot be done with a standard regression analysis (DiLalla, 2000). Based on prior assumptions derived from literature, SEM facilitates the specification and examination of multiple relationships between constructs (Kline, 2011).

4.9.2 Types of SEM

There are two SEM-based analytical approaches: the covariance-based approach and the component-based approach. The covariance-based approach or better known as SEM has been very popular in social science research (Chin, 1998). The covariance-based SEM approach contributes in social science research since the 1970s when Jöreskog (1970) developed the concept of maximum likelihood covariance structure analysis and subsequently computerized into the software known as LISREL (Jöreskog & Sörbom, 1978). Various covariance-based SEM software packages such as AMOS, EQS, Mplus, SEPATH and RAMONA proliferated following the increasing popularity of the approach.

The component-based approach or also known as the partial least square (PLS) method is the other SEM-based analytical approach (Fornell & Bookstein, 1982). The PLS method is a variance-based causal modeling approach developed in the 1960s by Herman Wold. Wold presented iterative procedures using least square estimation or single- and multiple-component models for canonical correlation (Wold, 1975). According to Wold (1975), PLS could avoid some restrictive assumptions underlying the maximum likelihood estimation of LISREL. Nonetheless, Wold (1982) and Chin and Newstead (1999) perceived that PLS and LISREL complement one another's weaknesses. PLS-based SEM commercial and academic software packages are also available such as LVPLS, PLS-GUI, Visual PLS, PLS-graph and SmartPLS (Vinzi, Chin, Henseler, & Wang, 2010).

The covariance-based and component-based SEM approaches are different in their objective, approach, assumptions, parameter estimation, latent variable score and sample size requirement. The main difference between these two approaches is their objective. The covariance-based approach is best used for theory testing and development, while the component-based approach is more oriented toward predictive applications (Jöreskog & Wold, 1982). For estimation, the covariance-based approach uses maximum likelihood estimation and attempts to minimize the difference between the sample covariance and those predicted by the model. The component-based approach uses least square estimation instead and attempts to maximize the variance explained by constructs and parameter estimates by minimizing each residual variance separately for improved prediction of corresponding constructs (Chin & Newstead, 1999).

Based on the assumptions of the two approaches, the covariance-based SEM approach tends to be more restrictive and problematic to apply than the component-based approach (Fornell & Bookstein, 1982). The reasons are, firstly, the observations should be normally distributed and independent of one another when using the covariance-based approach, and secondly, a large sample size ranging from 200 to 800 sets of data must be present. The component-based approach, on the other hand, being a more exploratory approach is not constrained by the normality assumption and does not require a large sample size. It also allows the use of non-interval scaled data (Chin, Marcolin, & Newsted, 2003).

The component-based approach estimates constructs as linear combinations of observed variables using weight relations, thus avoiding indeterminacy and providing an exact definition of construct's score (Fornell & Bookstein, 1982). According to Chin et al. (2003), the component-based SEM or PLS-SEM approach is a more comprehensive modeling technique since it consists of many other techniques such as canonical correlation analysis, redundancy analysis, multiple regression, MANOVA and factor analysis. PLS-SEM approach is more suited to explain the relationships among multiple predicted and predictor constructs.

The PLS approach also has its shortcomings (Dijkstra, 1983): First, the correlations of observed indicators tend to be underestimated, whereas the correlations of the observed variables and their respective constructs tend to be overestimated. Second, the parameter estimates in PLS are not as efficient as full-information estimates, thus requires the bootstrap procedure to obtain estimates of standard errors of the parameter estimates. Having reviewed both SEM approaches, the PLS approach was deemed appropriate for the data analysis in this study, mainly because PLS can handle a complex model and neither requires a large sample size nor rigorous restrictions on data distribution. With the 65 observations or data sets in this study, PLS-SEM is deemed a much suited analysis approach than the covariance-based SEM approach. Throughout this study, the term exogenous construct is also referred to as predictor and independent variable, and likewise the term endogenous construct is also referred to as predicted and dependent variable.

4.9.3 PLS Modeling Process

Figure 4.5 shows the six stages involved in the PLS modeling process. The first two stages are to set up the PLS model. Then survey data is entered into the Smart PLS software to execute the model and estimate the parameters in stage four. During this process, confirmatory factor analysis, path analysis and bootstrapping techniques are used. The stage five is to test and validate the model. The stage four and five may be done iteratively along with eliminating certain inconsistent items. The last step is to evaluate the PLS structural model.

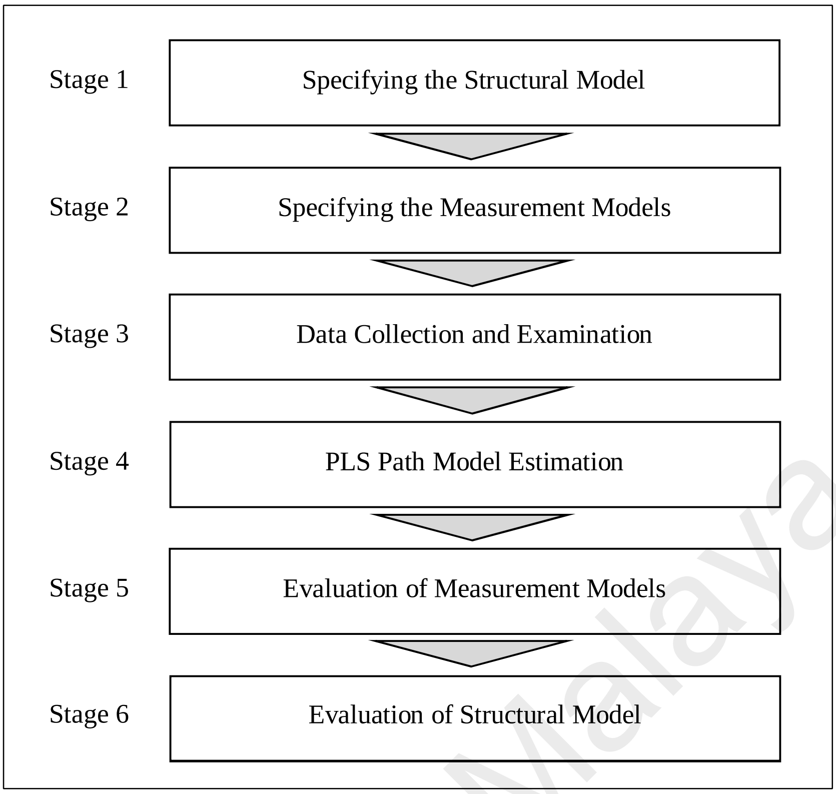


Figure 4.5: Systematic procedure of applying PLS-SEM (adapted from Hair, Hult, Ringle, & Sarstedt, 2013)

4.9.3.1 Stage 1: Specifying the Structural Model

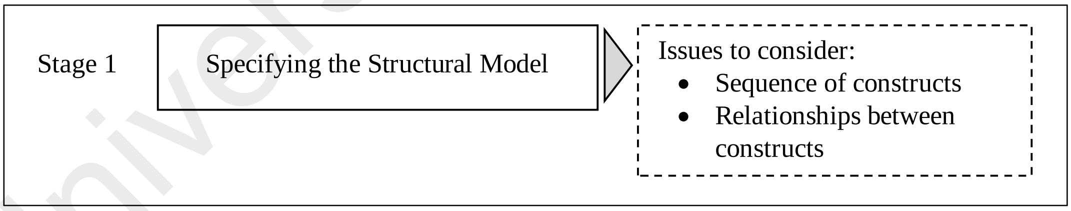


Figure 4.6: Summary of Stage 1: Specifying the structural model

The first stage to carry out the SEM application is to prepare a path model, a diagram that displays the variable relationships and the research hypotheses to be examined (Figure 4.6). In this study, the path models (Figure 3.4) are portrayed in Chapter 3 consisting of constructs connected to show the hypotheses to be tested.

Path models comprise two elements (Hair, Anderson, Tatham, & William, 1995; Hair, et al., 2013): (i) structural model or inner model that specifies the relationships between constructs, and (ii) measurement models or outer models that describe the relationship between constructs and their indicators. Structural model is discussed in this stage while measurement models are covered in Stage 2.

Two primary issues have to be considered when developing a structural model. They are the sequence of the constructs and the relationships between them (Esposito, Chin, Henseler, & Wang, 2010; Hair, et al., 2013). First issue to be considered is the sequence of the constructs. According to Hair et al. (2013), the sequence of the constructs within a structural model is based on theory, logic, or practical experiences observed by the researcher. The sequence of the constructs is displayed from left to right, with the independent constructs on the left and the dependent constructs on the right. This indicates that the constructs on the left are to precede and predict the constructs on the right. These constructs on the left are also known as exogenous latent variables; they have arrows pointing out of them. On the other hand, constructs with arrows pointing into them are known as endogenous latent variables or dependent constructs. They are positioned on the right side of the structural model.

The second issue to be considered is the relationships between the constructs. They are established by drawing arrows, which are pointed to the right. The direction indicates the sequences and those constructs on the left predict those on the right. The predictive relationships are at times referred to as causal links provided the structural theory backs a causal relationship (Hair, et al., 2013).

4.9.3.2 Stage 2: Specifying the Measurement Models

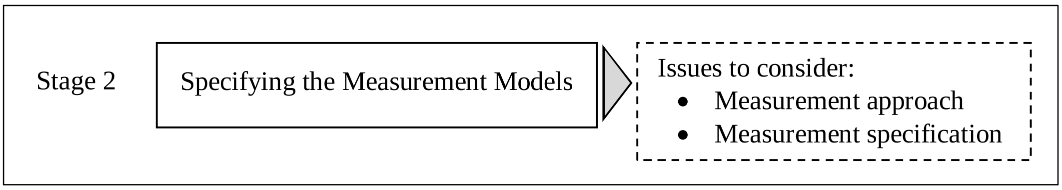


Figure 4.7: Summary of Stage 2: Specifying the measurement models

The first stage specifies the relationships between constructs in the structural model. In this subsequent stage, the relationships between constructs and their respective indicators in the measurement models are specified (Figure 4.7). The measurement models are also called the outer models in PLS-SEM. A sound measurement theory is vital to determine the relationship between a construct and its indicators. A measurement theory specifies how a construct is measured by a set of indicators (Jarvis, MacKenzie, & Podsakoff, 2003). This is a crucial stage to achieve useful results from PLS-SEM. The hypothesis tests among the constructs in the structural model will only be as valid and reliable as the constructs of the measurement models are measured.

There are two ways to obtain the measurement approach. Firstly, the most commonly used approach is to adapt and adopt from the established measurement approaches published in prior research studies or scale handbooks, which almost all social science research today have used (Bearden, Netemeyer, & Haws, 2011; Bruner, Hensel, & James, 2001). Secondly, when the researcher lacks an established measurement approach will resort to developing a new set of measures or substantially modify an existing measurement approach. Some of the references on measurement development can be found in DeVellis (2011), Diamantopoulos and Winklhofer (2001), and Hair et al. (2011). This study has opted for the first approach, which is to adapt and adopt from previous studies' measurement approaches, to explain how the constructs used are measured.

The next consideration when developing the constructs is the type of measurement specification. Two broad types of measurement specifications are available: reflective and formative measurement models. The first measurement specification is the reflective measurement model, which is directly based on classical test theory (Hair, et al., 2013). According to this theory, measures are manifestations or effects of an underlying construct. This is supported by Rossiter (2002) that reflective indicators represent the consequences of the construct. This also signifies that the causality is from the construct to its indicators (Diamantopoulos & Winklhofer, 2001). A reflective measure indicates that a set of indicator items are caused by a particular construct, stemming from the same domain, thus, indicators of a particular construct should be highly inter-correlated (Kline, 2011). Individual items can be interchangeable (Jarvis, et al., 2003), and if a single item is generally left out, it will not change the construct's meaning provided the construct has sufficient reliability. Chin (1998) described reflective measure as a relationship that goes from the construct to its measures and if the assessment of the latent trait changes, all indicators will change in a similar manner.

On the other hand, formative measurement models assume the indicators cause the construct. Jarvis et al. (2003) mentioned one of the characteristics of formative indicators is that they are not interchangeable. Therefore, each formative indicator captures a specific aspect of the construct's domain. The items are combined to ultimately determine the meaning of the construct. This implies that when an indicator is omitted, it potentially changes the nature of the construct. As a result, the breadth of coverage of the construct domain is crucial to ensure the domain content of the construct is adequately captured (Diamantopoulos & Winklhofer, 2001).

Hair et al. (2013) in the discussion of measurement model mode mentioned that the decision as to which measurement model is appropriate is still under debate in various disciplines and is not fully resolved. However, this study adopts both reflective and formative measurement models based on the guidelines mentioned. The independent constructs (*PHYS*, *HMRS*, *ORGZ*, *FNCL*, *BSMG*, *INNV*, *PCRM*, *ORGL*, *CNST*, and *PRMG*) are measured by multiple items or indicators and they have formative measurement models. The indicators of these constructs are not interchangeable (Jarvis, et al., 2003) and they form the construct (Diamantopoulos & Winklhofer, 2001). The dependent constructs of internal (*IFNC*, *IMGR*, *ICNS*, *IODS*, *IMEQ*, and *ILAB*) and external (*EPOE*, *ETRP*, *ECUL*, *ELGT*, and *ENAE*) risks are measured by multiple indicators and they have reflective measurement models. These indicators are consequences of the constructs (Rossiter, 2002) and constructs do not change in nature when an indicator is omitted (Jarvis, et al., 2003).

4.9.3.3 Stage 3: Data Collection and Examination

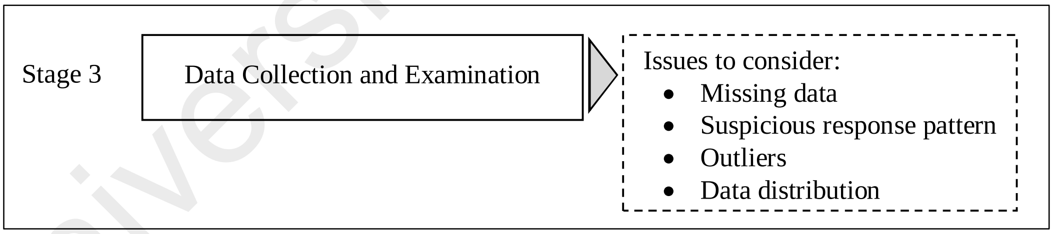


Figure 4.8: Summary of Stage 3: Data collection and examination

The data collection and examination stage is very important for SEM application (Figure 4.8). In the measurement model stage of SEM will identify error in the data and remove it from analysis. Therefore, careful planning and execution at the research design phase is important for any social science research to collect valid and reliable data for analysis. Having the questionnaire survey data collected, there are four primary issues to be considered and examined. These include missing data, suspicious response patterns such as straight lining or inconsistent answers, outliers, and data distribution (Sarstedt & Mooi, 2014).

Missing Data

The first issue is missing data, which is often a problem in social science research that obtains data using survey tool. Missing data occurs when a respondent fails to answer one or more questions. An observation is removed from the data file when the amount of missing data on a questionnaire exceeds 15% (Hair, et al., 2013). There are two ways to handle missing values in SmartPLS 2.0 (Ringle, et al., 2005); firstly, mean value replacement, and secondly, casewise deletion. In mean value replacement, the mean of valid values of the particular indicator is calculated to replace the missing value of the said indicator. There is a setback when using mean value replacement as it decreases the data variability and thus reduces the possibility of finding meaningful relationship. Therefore, this method is recommended only when the data exhibit an extreme low level of missing data at less than 5% of values missing per indicator.

The second method to handle missing value recommended by Ringle et al. (2005) is casewise deletion. It removes all cases from the analysis that contain missing values in any of the indicators used in the model studied. The casewise deletion treatment has to be exercised with precautions, particularly on two issues. First, it is important to ensure that a certain group of respondents is not systematically deleted. This may likely yield biased results when the responses of a particular group are omitted. Second, the number of observations in a data set can dramatically diminish when applying casewise deletion. Therefore, careful check on the number of observations used in the final model estimation is crucial when casewise deletion treatment is exercised.

Suspicious Response Data

Having checked on missing data, the next examination is on the response pattern. Straight lining is commonly found in survey responses. It occurs when a respondent selects the same response for a huge portion of the questions in the survey (Sarstedt & Mooi, 2014). For instance, if on a 5-point likert scale, a respondent marks 3s (the middle response) for all questions, then this particular respondent is most likely removed from the data set. Similarly, if one selects only 1s or only 5s, the said respondent should generally be removed.

Inconsistency in answers is also checked before data analysis. Screening questions are used to ensure that only respondents who meet the criteria can remain in the data set (Schmidt, 1997). For example, the survey of international contractors may screen for respondents who had international construction industry experience. But another survey question is posed and one respondent indicates no international projects track record. Such respondent will be removed from the data set. If reflective measures are used, same question is asked in slightly varied manner. This can be a good measure to eliminate respondent from data set if a respondent gives different answers to the similar questions asked in slightly different way.

Outliers

Next is to identify outliers in the data set. An outlier is an extreme response to a particular question, or extreme responses to all questions (Osborne & Overbay, 2004). Statistical software packages have options to identify outliers. For example, SPSS can run box plots and stem-and-leaf plots to facilitate the outliers identification by respondent number (Mooi & Sarstedt, 2011). Once the outliers are identified, depending on the situation, one can either remove the outlier from the data set or decide if a unique subgroup exists. It is common to simply remove the outliers from the data set when there are only a few of them identified. However, one has to decide if the outlier group represents a distinct or unique subgroup of the sample when the number of outliers increases.

Data Distribution

PLS-SEM is a nonparametric statistical method, which does not require the data to be normally distributed. However, data verification is still important in order to verify that the data do not deviate too far from normal because extremely non-normal data give problems when assessing the parameters' significances. For instance, non-normal data inflate standard errors obtained from bootstrapping and this decrease the likelihood of some relationships may be assessed as significant (Hair, et al., 2011; Henseler, Ringle, & Sinkovics, 2009). Therefore, skewness and kurtosis of data are two measures of distributions that should be examined.

Skewness is to assess the extent to which a variable's distribution is symmetrical (Hulland, Ryan, & Rayner, 2010). The distribution is characterized as skewed when the distribution of responses of a variable stretches toward the right or left tail of the distribution. Based on the general guideline, it is an indication of a substantially skewed distribution if the number is greater than +1 or lower than -1 (Hair, et al., 2013).

Kurtosis measures whether the distribution is too peaked with a very narrow distribution of most responses in the center. For kurtosis, the general guideline is that the distribution is too peaked if the number is greater than +1. Similarly, a distribution is too flat if a kurtosis less than -1 (Hair, et al., 2013).

Distributions exhibiting skewness and or kurtosis that exceed these guidelines are considered non-normal. However, both skewness and kurtosis that are close to zero, representing a normal distribution response pattern, are very unlikely to encounter (Fay & Gerow, 2013).

4.9.3.4 Stage 4: PLS Path Model Estimation

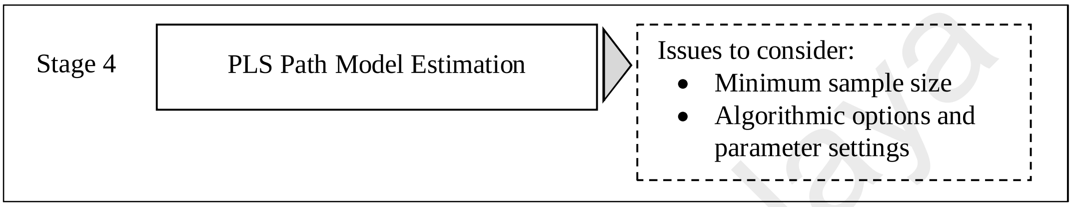


Figure 4.9: Summary of Stage 4: PLS path model estimation

Having examined the data to removed unwanted observation from the data set, researchers should check for the minimum sample size before running PLS path model estimation (Figure 4.9). This study adopted the sample size recommendation in PLS-SEM for a statistical power of 80% (Hair, et al., 2013, p. 21). Following Table 4.3, since the maximum number of arrows pointing at a construct in this study is 10 (Figure 3.4), therefore it needs 59 observations to detect R^2 values of around 0.50, assuming a significance level of 5% and a statistical power of 80%. After the data check, this study has 65 valid observations.

Next, algorithmic options and parameter settings must be selected to estimate a PLS path model. The algorithmic options and parameter settings include selecting (1) the structural model path weighting method, (2) the data metric, (3) initial values to start the PLS-SEM algorithm, (4) the stop criterion, and (5) the maximum number of iterations (Hair, et al., 2013).

Table 4.3: Sample size recommendation in PLS-SEM for a statistical power of 80% (Cohen, 2013)

Maximum Number of Arrows Pointing at a Construct	Significance Level											
	1%				5%				10%			
	Minimum R^2				Minimum R^2				Minimum R^2			
	0.10	0.25	0.50	0.75	0.10	0.25	0.50	0.75	0.10	0.25	0.50	0.75
2	158	75	47	38	110	52	33	26	88	41	26	21
3	176	84	53	42	124	59	38	30	100	48	30	25
4	191	91	58	46	137	65	42	33	111	53	34	27
5	205	98	62	50	147	70	45	36	120	58	37	30
6	217	103	66	53	157	75	48	39	128	62	40	32
7	228	109	69	56	166	80	51	41	136	66	42	35
8	238	114	73	59	174	84	54	44	143	69	45	37
9	247	119	76	62	181	88	57	46	150	73	47	39
10	256	123	79	64	189	91	59	48	156	76	49	41

Three structural model weighting schemes are available in PLS-SEM, they are the centroid weighting scheme, the factor weighting scheme, and the path weighting scheme (Henseler, et al., 2009). Hair et al. (2013) recommended the path weighting scheme approach since little differences in results are found across the three alternatives. This path weighting scheme gives the highest R^2 value for endogenous constructs.

The data metric has to be standardized to run the PLS-SEM algorithm. Standardized data, or more specifically, z-standardization, is where each indicator has a mean of 0 and the variance is 1. This raw data transformation to standardized data is the recommended option available when starting the PLS-SEM algorithm (Ringle, et al., 2005). This option allows the algorithm to calculate standardized coefficients between -1 and +1 for every relationship in both structural and measurement models. An example of the results is that when path coefficient is closer to +1, this indicates strong positive relationship, and vice versa. Values very close to 0 are generally statistically non-significant.

For the relationships in the measurement models, initial values are required when starting the PLS-SEM algorithm. In the first iteration, any nontrivial linear combination of indicators can serve as values for the latent variable scores. Ringle et al. (2005) recommended initialization values of +1 for all relationships in the measurement models during the first iteration since equal weights are found to be good for the algorithm initialization. Subsequently, the initial iteration values are replaced by path coefficients for the relationships in the measurement model. If all indicators have the same direction with all relationships being hypothesized as positive relationships in the path model, the results should be positive coefficients.

Next is to select the stop criterion for the PLS algorithm, which has been designed to run until the results stabilize. When the sum of the outer weights that changes between two iterations is sufficiently low, or drops below a predefined limit, stabilization has been achieved. To warrant that the algorithm converges at reasonably low levels of iterative changes in the latent variable scores, a threshold value of 1.10^{-5} is recommended (Henseler & Chin, 2010).

Lastly, when initiating the PLS-SEM algorithm, it is imperative to ensure that the algorithm stops at the predefined stop criterion. A sufficiently high maximum number of iterations must therefore be selected. Henseler and Chin (2010) noted that the algorithm is very efficient that it converges with a relatively low number of iterations regardless of model complexity, hence they recommended the selection of maximum number of 300 iterations to ensure that convergence is obtained at the stop criterion of 1.10^{-5}.

To facilitate the starting of PLS-SEM path model estimation, Hair et al. (2013, p. 82) provides the rule of thumb for initializing the PLS-SEM algorithm in five points.

- Select the path weighting scheme as the weighting method.
- Use the data metric option that z-standardizes your data input for the PLS-SEM indicator variables (i.e., a mean value of 0, standard deviation of 1).
- Use +1 as the initial value for all outer weights.
- Choose a stop criterion of 1.10^{-5} (i.e., 0.00001).
- Select a value of at least 300 for the maximum number of iterations.

4.9.3.5 Stage 5: Evaluation of Measurement Models

Two types of measurement models, namely reflective and formative measurement models, are elaborated upon here. The reflective measurement models evaluation is first presented as Stage 5a, followed by the formative measurement models evaluation in Stage 5b.

a) Evaluation of Reflective Measurement Models

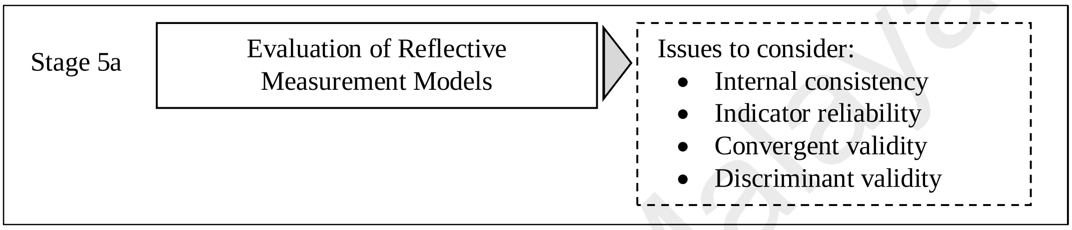


Figure 4.10: Summary of Stage 5a: Evaluation of reflective measurement models

The reflective measurement models assessment (Figure 4.10) consists of four criteria including internal consistency, indicator reliability, convergent validity, and discriminant validity (Hair, et al., 2013).

Criterion 1: Internal Consistency

The first criterion is the internal consistency reliability. This study applied composite reliability instead of the traditional Cronbach's alpha as the measure of internal consistency reliability. This is because Cronbach's alpha assumes all indicators have equal outer loadings on the construct and is sensitive to the number of items in the scale. Thus, Cronbach's alpha tends to underestimate the internal consistency reliability. Composite reliability (ρ_c) takes into account the different outer loadings of the indicator variables and is calculated based on the following formula (Hair, et al., 2013):

$$\rho_c = \frac{[\sum_i l_i]^2}{[\sum_i l_i]^2 + \sum_i \mathrm{var}(e_i)},$$

whereby l_i symbolizes the standardized outer loading of the indicator variable i of a specific construct, e_i is the measurement error of indicator variable i, and var(e_i) denotes the variance of the measurement error, which is defined as 1- l_i^2.

The composite reliability is interpreted similarly to that of Cronbach's alpha, where it varies between 0 and 1 with higher values indicating higher levels of reliability. Nunnally and Bernstein (1994) have given a guideline where composite reliability values of 0.60 to 0.70 are acceptable in exploratory research and values below 0.60 indicate lack of internal consistency reliability.

Criterion 2: Indicator Reliability

Indicator reliability is measured by the association of outer loadings of indicators on the respective construct. The higher outer loadings on a construct signify that the indicators have much in common with the associated construct. When assessing the reliability, all indicators' outer loadings should at a minimum be statistically significant as a significant outer loading may be fairly weak. Hair et al. (2013) recommended adherence to a rule of thumb that outer loadings should be 0.708 or higher. The square of a standardized indicator's outer loading or known as the communality of an item represents the variation of an item being explained by the construct and described as the variance extracted from the item. According to an established rule of thumb, each indicator should have at least 50% of its variance in common with its latent variable (Barroso, Carrión, & Roldán, 2010). This implies that the variance shared between the construct and its indicator is larger than the measurement error variance (Vinzi, et al., 2010). This means an indicator's outer loading should be above 0.708 as the number squared (0.708^2) equals 0.50. In most instances, 0.70 is considered close enough to 0.708 to be acceptable (Hair, et al., 2013).

Weaker outer loadings are commonly observed in social science studies especially when newly developed scales are used. Careful examination must be executed when considering eliminating indicators with outer loadings below 0.70. One should examine the effects of item or indicator removal on both the composite reliability and construct's content validity instead of automatically eliminating the said indicators (Hulland, 1999). In general, indicators with outer loadings between 0.40 and 0.70 are considered for elimination from the scale only when an increase in the composite reliability or the average variance extracted (AVE) above the suggested threshold value is observed as a result of deleting the indicator. The decision of whether to delete an indicator is also affected by the effects of its removal on the content validity. This is because indicators with weaker outer loadings are sometimes retained for their contribution to the content validity (Hair, et al., 2013). However, Hair et al. (2011) pointed out that indicators with very low outer loadings of below 0.40 should always be eliminated from the scale. Figure 4.11 summarizes the recommendations for indicator deletion according to outer loadings.

Criterion 3: Convergent Validity

Convergent validity is to assess the extent to which an indicator correlates positively with alternative indicators of the same construct. To establish convergent validity, the outer loadings of the indicators and the average variance extracted (AVE) are considered. The reflective construct's indicators are treated as different approaches when measuring the same construct. Therefore, the items that are indicators or measures of a specific construct will converge, sharing high proportion of variance (Jarvis, et al., 2003).

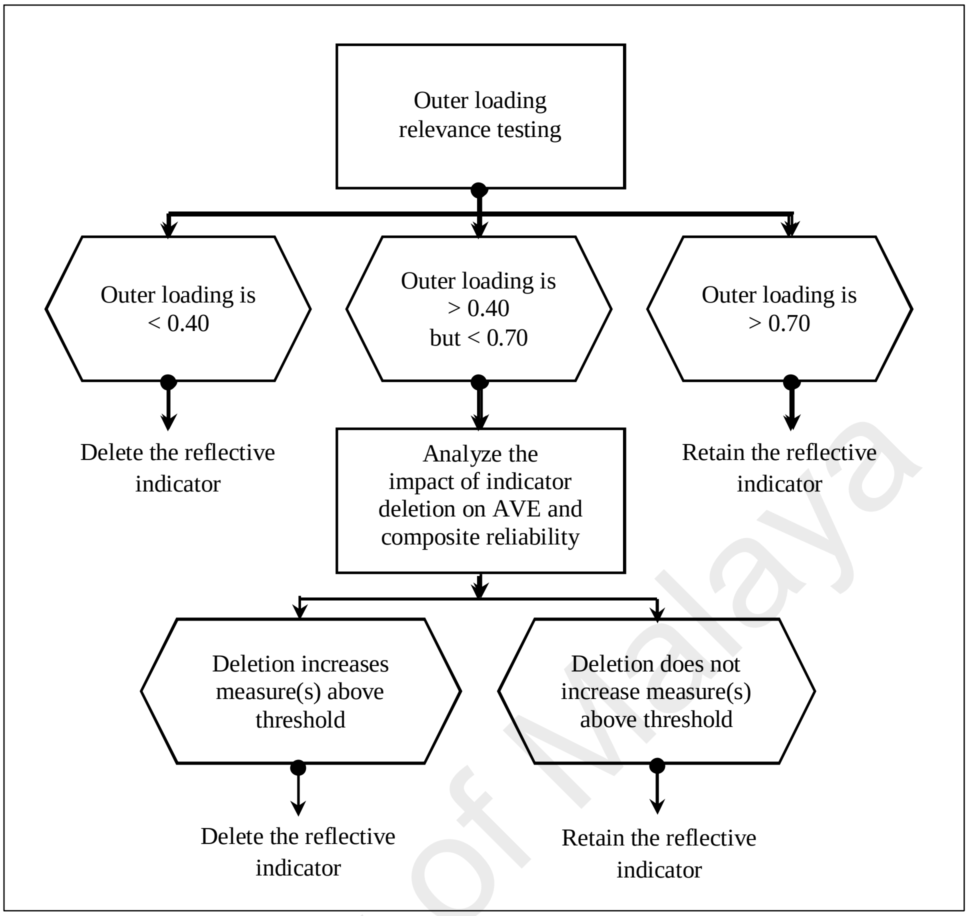


Figure 4.11: Outer loading relevance testing (Hair, et al., 2013)

The average variance extracted (AVE) is a common measure to establish convergent validity on the construct level. The AVE is the grand mean value of the indicators' squared loadings associated with the construct, or simply the sum of the squared loadings divided by the total indicators. In short, the AVE is similar to the communality of a construct. Applying the same logic used for the individual indicators, an AVE value of 0.50 or higher usually suggests that the construct explains more than half of the variance of its indicators. On the contrary, an AVE of less than 0.50 usually suggests that the items contain more errors than the variance explained by the construct (Hair, et al., 2013).

Criterion 4: Discriminant Validity

Discriminant validity is to test the true distinction of a construct from other constructs by empirical standards (Strauss & Smith, 2009). When a discriminant validity is established, it implies that a construct is unique by capturing phenomena not represented by other constructs in the same model. In this study, Fornell-Larcker criterion, which compares the square root of the AVE values with the latent variable correlations, is used to assess discriminant validity (Hair, et al., 2013). Discriminant validity is achieved when the square root of each construct's AVE are greater than its highest correlation with any other construct. Likewise, this criterion can be rephrased as the AVE should exceed the squared correlation with any other construct. The logic of this method is based on the notion that a construct is truly distinct from other constructs when it shares more variance with its respective indicators than with any other construct.

Rules of Thumb

The above are the criteria used to assess the reliability and validity of reflective construct measures. Removal of indicator from a specific construct is considered when criteria are not met. However, the removal of indicators should be carried out with care since taking away of one or more indicators may improve the reliability or discriminant validity but decrease the measurement's content validity. Rules of thumb for evaluating reflective measurement models (Hair, et al., 2013, p. 107) are summarized in four points:

- Internal consistency reliability: composite reliability should be higher than 0.708 (in exploratory research, 0.60 to 0.70 is considered acceptable). Consider Cronbach's alpha as a conservative measure of internal consistency reliability.

- Indicator reliability: the indicator’s outer loadings should be higher than 0.708. Indicators with outer loadings between 0.40 and 0.70 should be considered for removal only if the deletion leads to an increase in composite reliability and AVE above the suggested threshold value.
- Convergent validity: the AVE should be higher than 0.50.
- Discriminant validity:
    - An indicator’s outer loadings on a construct should be higher than all its cross loadings with other constructs.
    - The square root of the AVE of each construct should be higher than its highest correlation with any other construct (Fornell-Larcker criterion).

b) Evaluation of Formative Measurement Models

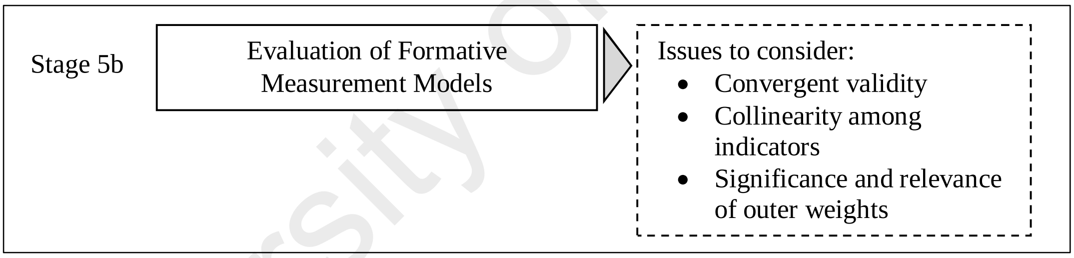


Figure 4.12: Summary of Stage 5b: Evaluation of formative measurement models

The formative measurement models assessment consists of three steps (Figure 4.12) consisting of convergent validity, collinearity among indicators, and significance and relevance of outer weights (Hair, et al, 2013).

Step 1: Convergent Validity

Convergent validity, which tests the correlations among the measures or indicators of a same construct, is assessed when evaluating formative measurement models. The formatively measured construct is tested to see if it is highly correlated with a reflective measure of the similar construct. This analysis is termed as redundancy analysis (Chin,

1998) because the information in the model is redundant where it is included in both the formative and also the reflective constructs. The formatively measured construct is used as an exogenous latent variable to predict an endogenous latent variable consisted of one or more reflective indicators. The path coefficient linking the two constructs indicates the validity of the designated set of formative indicators in tapping the construct of interest (Chin, 1998).

Chin (1998) added that an ideal magnitude of 0.90 or at least 0.80 and above is desired for the path between $Y_l^{\text{formative}}$ and $Y_l^{\text{reflective}}$, which translates into an R^2 value of 0.81 or at least 0.64. The analysis lacks convergent validity when the R^2 value of $Y_l^{\text{reflective}} < 0.64$, thus the formative indicators of the construct $Y_l^{\text{formative}}$ do not sufficiently contribute to its intended content. The formative constructs need to be theoretically or conceptually refined through exchanging and or adding indicators. The reflective latent variable must also be included in both the research design phase and data collection phase. Alternatively, a global item that summarizes the essence of the construct the formative indicators purport to measure can be deployed. A global item is an additional statement developed to be measured on a scale. This question functions as an endogenous single-item construct for the formative measurement validation. Using a single item for validation purpose can avoid lengthy questionnaire whilst achieving the need to validate formative constructs (Sarstedt, Wilczynski, & Melewar, 2013).

Step 2: Collinearity among Indicators

Formative indicators are not interchangeable like reflective indicators; therefore high correlations are not to be expected between items in formative measurement models. Collinearity refers to high correlations between two formative indicators and can be problematic from angles of methodology and interpretation. If high levels of collinearity between formative indicators are detected, these will cause severe impacts on the estimation of weights and statistical significance (Hair, et al., 2013).

Tolerance, represents the amount of variance of one formative indicator not explained by the other indicators in the same block, is computed to assess the level of collinearity. Variance inflation factor (VIF) is another related measure of collinearity and is defined as the reciprocal of the tolerance that is $VIF_{x1} = 1/TOL_{x1}$. Thus, a tolerance value of 0.25 for x_1 (TOL_{x1}) translates into a VIF value of 1/0.25 = 4.00 for x_1 (VIF_{x1}). The term VIF is derived from the square root of the VIF ($\sqrt{VIF}$), that is the degree to which the standard error has been increased as a result of the presence of collinearity. In the example above, a VIF value of 4.00 implies that the standard error has been doubled ($\sqrt{4}$ = 2.00) due to collinearity (Hair, et al, 2013).

The tolerance and VIF are both provided in the regression analysis output of SPSS software. The collinearity diagnostic measures are to be checked especially when nonsignificant weights occur. In the context of PLS-SEM, a tolerance value of 0.20 or lower and a VIF value of 5 or higher respectively indicate a potential collinearity problem. These levels suggest that the remaining formative indicators associated with the same construct are accounted for the 80% of the indicator's variance (Hair, et al., 2011).

The removal of one of the corresponding indicators is considered when the level of collinearity is very high, provided the remaining indicators still sufficiently capture the construct's content from a theoretical perspective (Hair, et al, 2013). Figure 4.13 displays the process to assess collinearity in formative measurement models based on

VIF. The significance and relevance of outer weights should be analyzed only if collinearity is not a critical level in formative measurement models.

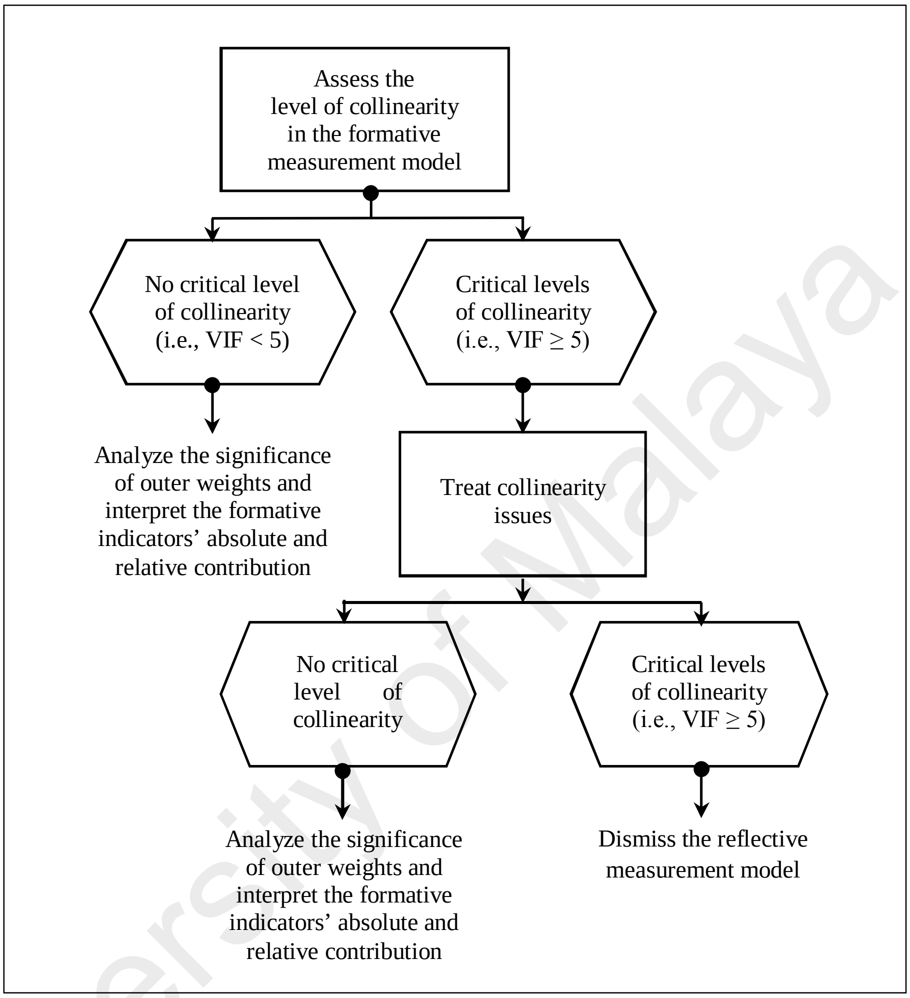


Figure 4.13: Collinearity assessment in formative measurement models using the VIF (Hair, et al., 2013)

Step 3: Significance and Relevance of Outer Weights

A multiple regression with the latent variable scores as the dependent variable and the formative indicators as the independent variables resulted in outer weights. These outer weights are another important criterion for evaluating the contribution and relevance of a formative indicator. In the formative measurement model, the underlying formative indicators formed the construct in a linear combination of the indicator scores and the outer weights. When a multiple analysis yields an R^2 value of 1.0, this suggests that there is no error variance and those indicators explain 100% of the construct. Each indicator's relative importance to the construct is determined by the value of the outer weights compared to one another. Outer weights values estimated are usually smaller than the outer loadings of relative indicators. In order to assess if formative indicators truly contribute to construct, bootstrapping procedure is carried out to test if outer weights are significantly different from zero in formative measurement models (Hair, et al., 2011).

Bootstrapping procedure provides statistical test result of the hypothesis using the standard error derived. A student's *t* test shows whether outer weight, w_1 is significantly different from zero, whether $H_o : w_1 = 0$ or $H_1 : w_1 \neq 0$ using the following formula (Hair et al., 2013):

$$t = \frac{w_1}{se^*_{w1}} ,$$

where w_1 is the weight estimated using the original set of empirical data, and w^*_{w1} is the bootstrap standard error of w_1. This test statistic follows a *t* distribution with degrees of freedom (*df*) equal to the number of observation minus one. A general rule stated that the *t* distribution can give well approximation with normal distribution of more than 30 observations (Hair et al., 2013). When the size of the empirical *t* value is above 1.96, the path coefficient is assumed significant at a significance level of 5% probability of error ($\alpha = 0.05$; two-tailed test). The critical *t* values are 2.57 for significance level of 1% ($\alpha = 0.01$; two-tailed test) and 1.65 for significance level of 10% ($\alpha = 0.10$; two-tailed test). In addition to reporting the significance of a parameter, bootstrap confidence interval also gives added information on the strength of a coefficient estimate. It is the range in which the true population parameter will fall at an assumed 95% confidence level (Hair et al, 2013).

When nonsignificant indicator weights are detected, they should not be directly eliminated. They should be considered for the formative indicators' absolute contribution to its construct, represented by their outer loadings provided along with outer weights. An indicator with nonsignificant outer weight and outer loading of above 0.50 should be considered absolutely important but not relatively important. Hence, the indicator would be retained. However, when an indicator has a nonsignificant weight with outer loading below 0.50, it should be considered for elimination depending on its theoretical relevance and content overlap possibility with other indicators of the same construct (Cenfetelli & Bassellier, 2009).

Since eliminating formative indicators has no effect on the parameter estimates when reestimating the model, formative indicators should not be simply discarded based on statistical outcomes. The relevance of the construct from the angle of content validity has to be considered before removing an indicator from the measurement model (Hair et al, 2013). Figure 4.14 summarizes the decision-making process for keeping or deleting formative indicators.

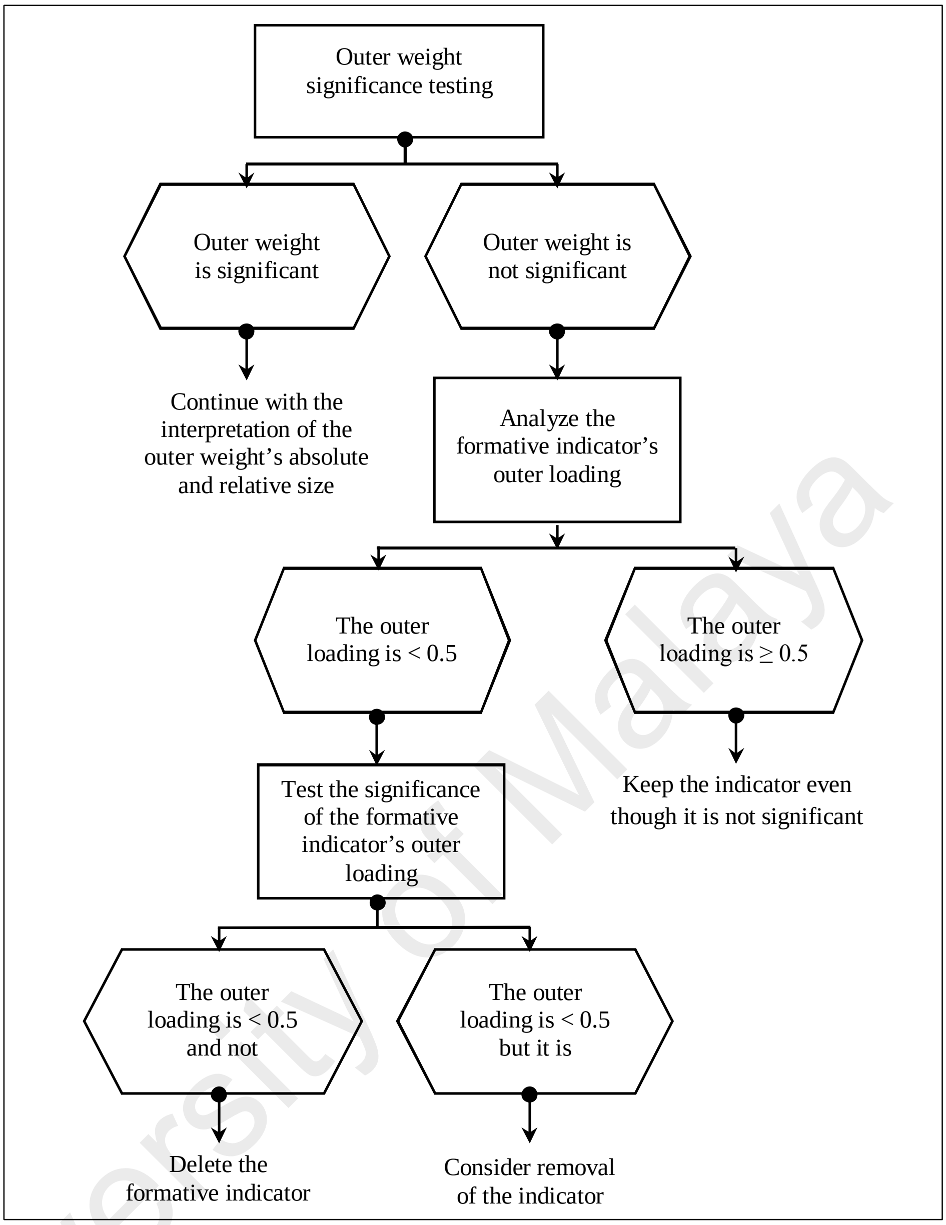


Figure 4.14: Decision-making process for keeping or deleting formative indicators (Hair et al., 2013)

Rules of thumb

In summary, the evaluation of formative measurement models requires establishing the measures' convergent validity, assessing the indicators' collinearity, and analyzing the indicators' relative and absolute contributions, including their significance. Rules of thumb for evaluating formative measurement models (Hair et al., 2013, p. 132) are summarized in six points:

- Assess the formative construct's convergent validity by examining its correlation with an alternative measure of the construct, using reflective measures or a global single item (redundancy analysis). The correlation between the constructs should be 0.80 or higher.
- Collinearity of indicators: Each indicator's tolerance (VIF) value should be higher than 0.20 (lower than 5). Otherwise, consider eliminating indicators, merging indicators into a single index, or creating higher-order constructs to treat collinearity problems.
- Examine each indicator's outer weight (relative importance) and outer loading (absolute importance) and use bootstrapping to assess their significance.
- When an indicator's weight is significant, there is empirical support to retain the indicator.
- When an indicator's weight is not significant but the corresponding item loading is relatively high (i.e., > 0.50), the indicator should generally be retained.
- If both the outer weight and outer loading are nonsignificant, there is no empirical support to retain the indicator and it should be removed from the model.

4.9.3.6 Stage 6: Evaluation of Structural Model

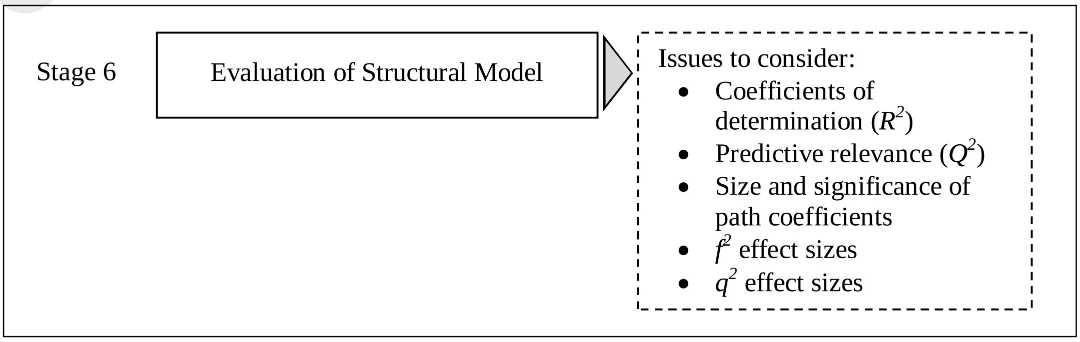


Figure 4.15: Summary of Stage 6: Evaluation of structural model

Once the construct measures are confirmed to be reliable and valid, the next step involves the assessment of the structural model results (Figure 4.15). The model predictive capabilities and the relationships between the constructs will be assessed. Figure 4.16 shows a systematic procedure to assess the structural model results.

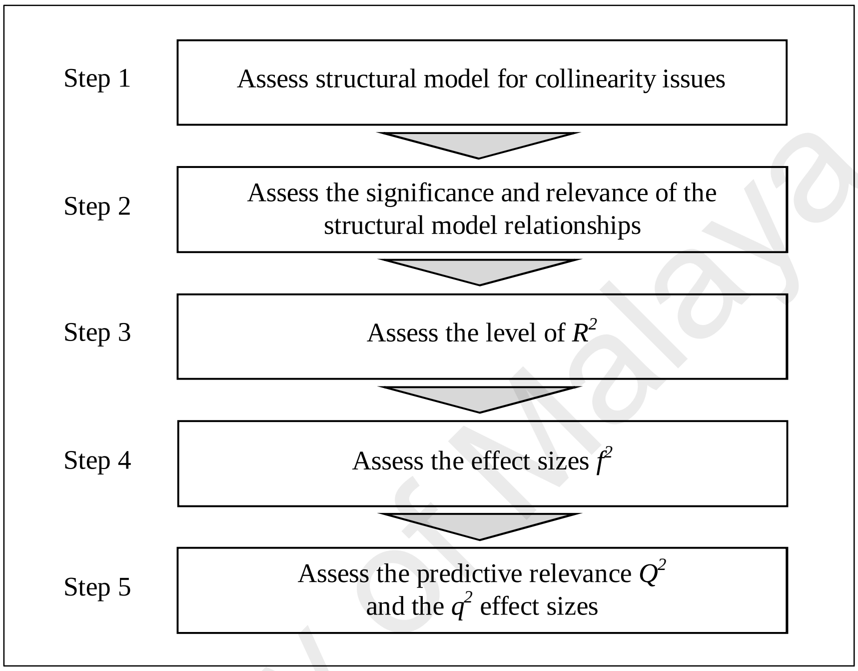


Figure 4.16: Structural model assessment procedure (Hair et al., 2013)

Step 1: Collinearity Assessment

The tolerance and variance inflation factor (VIF) values measures are applied when assessing collinearity. The tolerance and VIF are both provided in the regression analysis output of SPSS statistical software. Each set of predictor constructs is examined separately for each subpart of the structural model. The reason is to check for significant collinearity levels between each set of predictor variables. A tolerance level below 0.20 or a VIF above 5.00 is indicative of collinearity in the predictor constructs (Hair et al., 2011). When collinearity is detected via the tolerance or VIF guidelines, there are three options to treat the situation (Hair et al., 2013). First, to consider eliminating constructs; second, to consider merging predictors into a single construct; or third, to consider creating higher-order constructs to treat the collinearity.

Step 2: Structural Model Path Coefficients

After running the PLS-SEM algorithm, estimates obtained for the structural model relationships are the path coefficients. Path coefficients, with standardized values between -1 to +1, represent the hypothesized relationships among the constructs (Hair et al., 2013). Estimated path coefficients that are close to +1 representing strong positive relationships and vice versa for negative values are almost always statistically significant. However, the closer the estimated coefficients are to zero, the weaker the relationships. Values that are very low or close to zero are usually nonsignificant. To interpret the results of a path model, the significance of all structural model relationships are tested. The significance of the path coefficients are examined using the empirical *t* value, the *p* value, or the bootstrapping confidence interval.

t Values

Bootstrapping provides standard error that shows whether a coefficient is significant or not. The empirical *t* values are computed using the bootstrap standard error. The quantiles from the normal distribution are used as critical values with which to compare the empirical *t* value. The coefficient is significant at a certain error probability or significance level when the empirical *t* value is larger than the critical value. Commonly used critical values for two-tailed tests are 1.65 (significance level = 10%), 1.96 (significance level = 5%), and 2.57 (significance level = 1%). A significance level of 10% is often assumed for exploratory study (Hair et al., 2013).

p Values

Other than *t* values, *p* values correspond to the probability of erroneously rejecting the null hypothesis with the given data at hand. Computation of the exact *p* value can be done using spreadsheet applications such as Mircosoft Excel. For instance, in Microsoft excel, the TDIST function assists the computation by specifying the empirical *t* value, the degrees of freedom (*df*), and whether the test is one-tailed or two-tailed. The function has general form of TDIST(*t* value; *df*; tails) (Fidler & Thompson, 2001).

Bootstrapping Confidence Interval

In addition to calculating *t* and *p* values, the bootstrapping confidence interval is determined for a pre-specified probability of error (Hair et al., 2013). The confidence interval for p_1 is given by

$$p_1 \pm z_{1-\alpha/2} \cdot se^*_{p1},$$

where $z_{1-\alpha/2}$ stems from the standard normal (z) distribution table. For example, when the probability of error is 5% (i.e., $\alpha = 0.05$), $z_{1-\alpha/2} = z_{0.975} = 1.96$. Thus, the lower bound of the bootstrap confidence interval is $p_1 - 1.96 \cdot se^*_{p1}$, and the upper bound is $p_1 + 1.96 \cdot se^*_{p1}$. The original estimate of the structural model path coefficient, p_1 is significant if zero does not fall within the confidence interval at the given significance level.

Step 3: Coefficient of Determination (R^2 Value)

The most common measure to evaluate a structural model's predictive accuracy is coefficient of determination (R^2 value). This coefficient is calculated as the squared correlation between a particular endogenous construct's actual and predicted values. The coefficient represents the exogenous constructs' combined effects on the endogenous construct. Since the coefficient is the squared correlation of actual and predicted values, it also represents the total variance in the endogenous constructs explained by the exogenous constructs associated to it. The R^2 value ranges from zero to one with the higher values indicating higher or better predictive accuracy. The rules of thumb for acceptable R^2 values are difficult to decide since it all depends on the model complexity and the research discipline. However, as a rough rule of thumb, R^2 values of 0.75, 0.50, or 0.25 for endogenous constructs for marketing research can be respectively described as substantial, moderate, or weak (Hair et al., 2011; Henseler et al., 2009).

Step 4: Effect size of f^2

Other than evaluating the R^2 values of all endogenous constructs, f^2 effect size is another measure. It is measured by the change in the R^2 value. When a particular exogenous construct is omitted from the model, it is used to evaluate whether the omitted construct has a meaningful impact on the endogenous constructs. The f^2 effect size is calculated as:

$$f^2 = \frac{R^2_{\text{included}} - R^2_{\text{excluded}}}{1 - R^2_{\text{included}}},$$

where R^2_{included} and R^2_{excluded} are the R^2 values of the endogenous latent variable when a selected exogenous construct is included in or excluded from the model. To calculate the change in the R^2 values, PLS path model is estimated twice. The first time estimating with the exogenous construct included (R^2_{included}), and the second time estimating with the exogenous construct excluded (R^2_{excluded}). The guidelines for assessing f^2 are that values of 0.02, 0.15, and 0.35, respectively, represent small, medium, and large effects (Cohen, 1988) of the exogenous construct.

Step 5: Blindfolding and Predictive Relevance Q^2

In addition to assessing predictive accuracy criterion using the magnitude of the R^2 values, Stone-Geisser's Q^2 value reinforces the result (Geisser, 1974; Stone, 1974). This measure provides indicator for the model's predictive relevance by accurately predicting the data points of indicators in reflective measurement models of endogenous constructs. Q^2 value larger than zero for a reflective endogenous construct suggests that the path model has predictive relevance for the said construct in the structural model. On the contrary, values of zero and below suggest a lack of predictive relevance. The Q^2 value is obtained through the blindfolding procedure by applying a certain omission distance, D.

Blindfolding is a sample reuse technique that first omits every *d*th data point in the endogenous construct's indicators and then estimates the parameters with the remaining data points (Chin, 1998; Henseler, et al., 2009; Tenenhaus, Vinzi, Chatelin, & Lauro, 2005). The omitted data points are regarded as missing values and treated using the mean value replacement when running the PLS-SEM algorithm. The omitted data points are then predicted using those resulting estimates. The Q^2 measure is then calculated using the difference between the true but omitted data points and the predicted ones (Chin, 1998). Blindfolding is an iterative process that will repeat the process until all data points have been omitted and the model is re-estimated.

Cross-validated communality approach is used to calculate Q^2 value. The approach uses only the construct scores estimated for the target endogenous construct, without including the structural model information, to predict the omitted data points. The estimate Q^2 values generated from the blindfolding procedure represent a measure of the path model's ability to predict the originally observed values.

Like the f^2 effect size approach for evaluating R^2 values, the q^2 effect size is also a measure for the relative impact of predictive relevance, defined as follows:

$$q^2 = \frac{Q^2_{\text{included}} - Q^2_{\text{excluded}}}{1 - Q^2_{\text{included}}}.$$

As a guideline, q^2 values of 0.02, 0.15, and 0.35 indicate a small, medium, or large predictive relevance that an exogenous construct has for a certain endogenous construct.

4.10 Validation of Results

After the statistical analysis was completed and the models developed, a validation exercise was conducted with twelve subject matter experts that were randomly selected. They were given the model developed in the form of a calculator on an Excel spreadsheet for case-based interview and a validation survey. The validation survey request was sent out to twenty international construction firms that did not participate in the data collection stage and twelve agreed to participate.

The first validation tool is a calculator in Excel spreadsheet to ease the validation process. The structural models formulated in remodeled equations were computerized into calculator to predict risk significance values for international construction projects. To test the model developed in the calculator form, this study selected three random cases from previous data collection. Three cases and twelve firms were chosen because data sources in the study of a single phenomenon should be collected from at least three sources (Hammersley & Atkinson, 1983). This increases the validity of the information collected. The experts had to fill in their firm's capabilities to predict the risk significance values for these three cases (Appendix B-1 to Appendix B-3). The second validation tool is a validation survey (Appendix C). This validation survey was designed to gather experts' comments on practicality and comprehensiveness of the model developed.

4.11 Summary of Chapter

This chapter described the research methodologies adopted beginning with the paradigm taken, followed by the research design, research approach with the data collection instrument, and data analysis process. In this study, PLS-SEM was chosen as a technique to do statistical modeling. The reason of using PLS-SEM is mainly due to the nature of data in this research. Compared to other modeling techniques, PLS-SEM has lesser requirements for the sample data.

PLS-SEM modeling technique is applied to specify the model studied in accordance with the objectives proposed in the study. The whole process of modeling covers the specification of the structural and measurement models, data collection and examination, execution of the path model estimation, assessment of the models, and interpretation of results to draw conclusion. Certain stages are repeated and the process is cycled, this is to identify both statistically significant relationships and effective path coefficients. The results of the modeling process are presented in next chapter.

CHAPTER 5
RESULTS AND DISCUSSION

5.1 Introduction

This chapter reports on the data collection. Based on the research design delineated in Chapter 4, a questionnaire survey on international construction firms operating outside their home countries was carried out. Having obtained the completed questionnaires, the data were checked by running SPSS 22.0 and SmartPLS 2.0 software. The findings of the survey relating to firm's capabilities and their relationships to project risks will be presented in the following sections.

Prior to discussing the results, the profile of the respondents (Section 5.2) and the response rate were examined in order to establish the reliability of sample data. This is followed by evaluation of measurement models and structural model in Section 5.3.5 and Section 5.3.6 respectively. The final PLS-SEM structural model or Capability-Risk Assessment (CapRA) model developed is presented in Figure 5.2. This developed model known as CapRA hopes to assist international construction firms in project selection decisions when foraying abroad.

5.2 Sample Profile

A total of 252 survey questionnaires were sent out in 2013 to 2014 to 155 international construction firms and 65 firms responded via either structured interview or questionnaire survey depending on the respondents' locations, giving a response rate of 41.9%, which was considered acceptable (Ling et al., 2012; Zhang, 2011). Table 5.1 summarizes the general information on respondents and their firms. The firms participated in this study are local Malaysian contractors with projects abroad (52.3%) and foreign contractors that set up branch offices in Malaysia (47.7%). These foreign contractors' home countries are Japan, China, Korea, Australia, Singapore, United Kingdom, Italy, Spain, and France. These firms have been involved in numerous projects all over the world as indicated in Figure 5.1 and Table 5.2 with majority projects among developing countries in Asia and Middle East. The types of construction facilities involved were mostly general building, commercial, residential, infrastructure, industrial, transportation, and water and power plant. The profile of the firms and countries ventured suggests that the results reflect the global picture of international construction in various developing countries. Majority of the firms had been in the construction business for over 20 years (93.8%) with an average of 23.8 years of experience working outside firms' home countries. The results suggest the respondents firms' vast experience in the industry, which are critical to ensure relevance of responses (Ling et al., 2012).

All the respondents are from senior managerial level and they include directors, associate directors and senior managers. All respondents from foreign firms interviewed and surveyed are senior managers residing in Malaysia to manage and oversee firms' branch offices and they report to their directors at their firms' home countries. All respondents have more than 10 years of experience in the construction industry and they are able to provide relevant information for this research.

Among the 65 firms that participated in this study, 22 construction firms or subject matter experts were interviewed based on the structured questionnaire. The 22 construction firms were made up of 15 Malaysian international construction firms (L1-L15) and 7 foreign international construction firms (F1-F7). All 22 firms have offices in Malaysia and overseas and the interviewees or respondents are from the managerial positions. In addition to responding to the questionnaire survey, their insights and comments during the face-to-face interviews were captured to further elaborate the findings and relationships found.

Table 5.1: Demographic information of respondents

Description	Frequency	%
Firm's home country		
Local	34	52.3
Foreign	31	47.7
Firm's years of operation		
>10≤20 years	4	6.2
>20≤30 years	20	30.8
>30≤40 years	14	21.5
>40≤50 years	3	4.6
>50 years	24	36.9
Firm's years of operation outside home country		
≤10 years	16	24.6
>10≤20 years	26	40.0
>20≤30 years	7	10.8
>30≤40 years	6	9.2
>40≤50 years	4	6.2
>50 years	6	9.2
Firm's entry mode into international construction		
Wholly-owned foreign subsidiary firm	44	67.7
Joint venture with another firm	17	26.2
Both types of entry mode	4	6.2
Designation of respondents		
Director	6	9.2
Associate director	10	15.4
Senior manager	49	75.4
Respondent's years of experience		
>10≤20 years	37	56.9
>20≤30 years	27	41.5
>30 years	1	1.5

Figure 5.1: Locations of ongoing and completed international projects 2008-2013 (Source: Google map, 2014)

Table 5.2: Ongoing and completed international project count (2008-2013) based on region

Location of international projects	Number of projects	%
Asia	220	64.1
Middle East, North Africa and Greater Arabia	65	19.0
Europe	21	6.1
Sub-Sahara Africa	13	3.8
Australia and Oceania	8	2.3
Central American and the Caribbean	7	2.0
South America	5	1.5
North America	4	1.2
Total	343	100.0

5.3 Data Interpretation and Analysis

Prior to analyzing the research model, the current practice of risk assessment was surveyed among the international contractors participated in this study. It was found that 66.2% of the firms used statistical or mathematical model to assist the overseas project selection decision, while 26.2% did not employ any tool, and 7.6% did not respond to this question. When probed further, most firms employed the P-I risk model in their risk assessment while others made simple calculations based on data from previous projects. These results were further affirmed when asked whether intuition was the primary tool in project selection decision, where 61.5% responded no, 27.7% responded yes, and 10.8% did not respond. The international contractors were further surveyed on whether a model that assessed both firm's capability and risks would add value to foray decision. A total of 89.2% responded yes, 3.2% responded no, and 7.6% did not respond. The results showed that international contractors valued the importance of weighing both firm's capability and risks when making international project selection decision.

The research model was then analyzed using SPSS 22.0 (IBM Corp, 2013) and SmartPLS 2.0 (Ringle, Wende, & Will, 2005) software. The SmartPLS 2.0 gives model estimation that delivers empirical measures of both relationships between indicators and constructs (measurement models) and between constructs (structural model). These empirical measures allow the comparison between the theoretically established measurement and structural model with reality (from sample data). The data interpretation and analysis are presented according to stages as delineated in Chapter 4, Figure 4.4.

5.3.1 Stage 1: Specifying the Structural Model

The structural model or also known as path model (Hair, et al., 2013) is developed based on the resource-based view, dynamic capabilities, and Porter's generic value chain theories. The path models (Figure 3.4) illustrate the research hypotheses and also variables relationships between firm's capabilities and international construction project risks to be examined. The goal of this model is to explain the effects of firm's capabilities on risks for international construction projects.

Firm's capabilities are an organization's capacity to deploy resources, which are stocks of available factors that are owned or controlled by the organization (Amit &

Schoemaker, 1993). They are measured using ten constructs that have been validated in various organizational capability research studies using Resource Based View theory, Dynamic Capabilities theory, and Porter's generic value chain theory (Barney, 1991; Porter, 2008; Protogerou, et al., 2012; Singh, 2012; Teece, et al., 1997), and also organizational capability research applied in specifically construction industry (Wethyavivom, et al., 2009). The ten constructs of firm's capabilities are measured by a total of 53 formative indicators (Table 3.7).

As for the international construction project risks, this study adopted five internal and six external risk constructs from various international construction risk management study (Bing, et al., 2005; Egbu & Serafinska, 2000; Enshassi, et al., 2008; Han & Diekmann, 2001a, 2001b; Leung, et al., 1998; Ling, et al., 2007; Ling & Hoi, 2006; Ling & Lim, 2007; Ling & Low, 2007; Mustafa & Al-Bahar, 1991; Perry & Hayes, 1985; Shen, Wu, & Ng, 2001; Tchankova, 2002; Wang, et al., 2000; Wang, et al., 1999) as shown in Table 2.1. They are measured by a total of 54 reflective indicators.

In summary, the conceptual framework (Figure 3.3) has two main conceptual or theoretical components: (1) the firm's capabilities (independent variables or determinants of target constructs) consist of *PHYS, HMRS, ORGZ, FNCL, BSMG, INNV, PCRM, ORGL, CNST,* and *PRMG,* and (2) the international construction project risks (dependent variables or target constructs of interest) consist of internal (*IFNC, IMGR, ICNS, IODS, IMEQ,* and *ILAB*) and external (*EPOE, ETRP, ECUL, ELGT,* and *ENAE*) risks. Figure 3.4 shows the constructs and their relationships, representing the structural model for the PLS-SEM analysis.

5.3.2 Stage 2: Specifying the Measurement Model

The constructs for the independent (firm's capability) and dependent (internal and external risks) variables are not directly observed; hence each construct is specified with a measurement model. Both reflective and formative measurement models are adopted in this study.

This study has ten firm's capability constructs (*PHYS, HMRS, ORGZ, FNCL, BSMG, INNV, PCRM, ORGL, CNST,* and *PRMG*) measured by multiple indicators (Table 3.7). All ten constructs have formative measurement models indicated by arrows pointing from the indicators to the construct. For example, PHYS is measured by means of the three formative indicators *phys_1, phys_2, and phys_3,* which are also the questions in the survey. Respondents had to rate their firms' capabilities when undertaking international construction projects on a 5-point Likert scale from "strongly disagree" to "strongly agree".

On the other hand, the five internal risks (*IFNC, IMGR, ICNS, IODS, IMEQ,* and *ILAB*) and six external risks (*EPOE, ETRP, ECUL, ELGT,* and *ENAE*) constructs are operationalized by multiple indicators and are reflective measurement models (Table 2.1). For example, *EPOE* is measured by five reflective indicators *epoe_4, epoe_5, epoe_6, epoe_8, and epoe_11.* These are the survey questions where respondents are asked to rate the likelihood of a risk event occurring and the magnitude of impact when their firms were undertaking international projects based on a 5-point Likert scale from "never" to "always" and "not at all" to "very high".

5.3.3 Stage 3: Data Collection and Examination

The data set has 65 responses and this data set is keyed into SPSS for data examination. The data set is checked for missing value and only three missing values are detected. Each of the following has one missing value (1.54%); they are *pcrm_5*, *epoe_2*, and *epoe_3*. The missing values are replaced with mean values as Hair et al. (2013) recommended mean value replacement to treat missing values when running PLS-SEM. Hair et al. (2013) added that none of the observation has to be eliminated when missing values per observation is below 15.0%.

Subsequent to the data set's missing values examination, outliers are next diagnosed using boxplots in SPSS 22.0. Statistics show some significant observations but no outliers. Skewness and kurtosis of the data normality are checked. It was found that the skewness and kurtosis values of the indicators are within the -1 and +1 acceptable range (Mooi and Sarstedt, 2011). The data set examination on missing values, outliers and normality of data is hence completed.

5.3.4 Stage 4: PLS Path Model Estimation

Having examined the data set in SPSS 22.0, this study exported the indicator data into SmartPLS 2.0 to estimate the path model. The PLS algorithm function is selected to generate the model estimation. Three key results are provided in the modeling window after model estimation. Firstly, the outer loadings for the measurement models, secondly, the path coefficients for the structural model relationships, and thirdly, the R^2 values of the latent endogenous variables (Figure 5.2).

In this study, the Figure 5.2 revealed structural model results that determined the outer loadings for measurement models, path coefficients for structural model, and R^2 values of endogenous variables. Based on an example of internal financial risk (*IFNC*), the outer loadings for *IFNC* indicators are 0.749 (*ifnc_2*: Credit rating), 0.801 (*ifnc_4*: Delayed or non-receipt of payment), 0.801 (*ifnc_5*: Financial failures by parties involved), and 0.812 (*ifnc_6*: Inadequate financial margins).

Following that, the path coefficients show financial *FNCL* (-0.677) has strongest effect on *IFNC*, followed by business management *BSMG* (-0.412), and construction *CNST* (-0.394), organizational learning *ORGL* (-0.333), project management *PRMG* (-0.245), procurement *PCRM* (-0.238), and organizational *ORGZ* (-0.176) capabilities.

Lastly, the R^2 value of *IFNC* is 0.690 as indicated by the value in the circle. This shows that the seven constructs of *FNCL, BSMG, CNST, ORGL, PRMG, PCRM,* and *ORGZ* explain 69.0% of the variance of endogenous construct IFNC.

5.3.5 Stage 5: Evaluation of Measurement Models

The capability-risk assessment model has ten exogenous latent variables for firm's capabilities (i.e., *BSMG, CNST, FNCL, HMRS, INNV, ORGZ, ORGL, PHYS, PRMG,* and *PCRM*) with formative measurement models, and eleven endogenous latent variables for risks present in international construction (i.e., *IFNC, IMGR, ICNS, IODS, IMEQ, ILAB, EPOE, ETRP, ECUL, ELGT,* and *ENAE*) with reflective measurement models.

5.3.5.1 Stage 5a: Evaluation of Reflective Measurement Models

The reflective measures consisted of internal and external risk constructs are first evaluated based on four criteria (Hair, et al., 2013): internal consistency (composite reliability), indicator reliability, convergent validity (average variance extracted), and discriminant validity.

Criterion 1: Internal Consistency

The composite reliability values of all eleven reflective constructs are 0.795 (*IFNC*), 0.911 (*IMGR*), 0.872 (*ICNS*), 0.940 (*IODS*), 0.877 (*IMEQ*), 0.936 (*ILAB*), 0.727 (*EPOE*), 0.899 (*ETRP*), 0.898 (*ECUL*), 0.919 (*ELGT*), and 0.944 (*ENAE*). These demonstrate that all reflective constructs range from 0.727 to 0.944 have high levels of internal consistency reliability.

Criterion 2: Indicator Reliability

The outer loadings of the reflective constructs above threshold value of 0.708 are accepted (Nunnally & Bernstein, 1994). Indicators with outer loadings between 0.40 and 0.70 are considered for removal from the scale only when deleting the indicator leads to an increase in the composite reliability. Indicators with very low outer loadings (below 0.40) are eliminated from the scale (Hair, et al., 2011). Having considered the recommendations regarding indicator deletion based on outer loadings, Table 5.3 shows the remaining accepted indicators. The indicator *epoe_6* (outer loading: 0.598) has the smallest indicator reliability with a value of 0.358 (0.598^2), while the indicator *etrp_1* (outer loading: 0.970) has the highest indicator reliability with a value of 0.941 (0.970^2). Thus, the tabulated indicators in Table 5.3 for the eleven reflective constructs are well above the minimum acceptable level for outer loadings.

Criterion 3: Convergent Validity

Convergent validity assessment builds on the AVE value as the evaluation criterion. The AVE values of *IFNC* (0.626), *IMGR* (0.798), *ICNS* (0.694), *IODS* (0.879), *IMEQ*

(0.757), *ILAB* (0.830), *EPOE* (0.572), *ETRP* (0.798), *ECUL* (0.796), *ELGT* (0.815), and *ENAE* (0.894) are above the minimum level of 0.50 (Fornell & Larcker, 1981). Thus, the measures of the eleven reflective constructs have high levels of convergent validity.

Criterion 4: Discriminant Validity

Table 5.4 shows the final results of the Fornell-Larcker criterion assessment with the square root of the reflective constructs' AVE on the diagonal and the correlations between the constructs in the lower left triangle. The square roots of the AVEs for the reflective constructs *IFNC* (0.791), *IMGR* (0.893), *ICNS* (0.833), *IODS* (0.938), *IMEQ* (0.870), *ILAB* (0.911), *EPOE* (0.756), *ETRP* (0.893), *ECUL* (0.892), *ELGT* (0.903), and *ENAE* (0.946) are all higher than the correlations of these constructs with other latent variables in the path model. This shows that the results have established discriminant validity.

Table 5.3 summarizes the results of the reflective measurement model assessment (rounded to three decimal places). As can be seen, all model evaluation criteria have been met, providing support for the measures' reliability and validity.

Table 5.3: Results summary for reflective measurement models

Latent Variable	Indicators	Loadings	Indicator Reliability[a]	Composite Reliability[b]	AVE[c]	Discriminant Validity?[d]
IFNC	*ifnc_2*	0.749	0.560	0.795	0.626	Yes
	ifnc_4	0.801	0.642			
	ifnc_5	0.801	0.642			
	ifnc_6	0.812	0.659			
IMGR	*imgr_1*	0.931	0.867	0.911	0.798	Yes
	imgr_4	0.846	0.715			
	imgr_5	0.901	0.811			
ICNS	*icns_1*	0.787	0.620	0.872	0.694	Yes
	icns_3	0.908	0.824			
	icns_5	0.799	0.639			
IODS	*iods_1*	0.955	0.911	0.940	0.879	Yes
	iods_2	0.931	0.867			
	iods_3	0.927	0.859			
IMEQ	*imeq_1*	0.880	0.774	0.877	0.757	Yes
	imeq_2	0.936	0.875			
	imeq_3	0.788	0.621			
ILAB	*ilab_2*	0.946	0.894	0.936	0.830	Yes
	ilab_3	0.825	0.680			
	ilab_4	0.957	0.915			
EPOE	*epoe_4*	0.881	0.776	0.727	0.572	Yes
	epoe_5	0.728	0.530			
	epoe_6	0.598	0.358			
	epoe_8	0.720	0.519			
	epoe_11	0.686	0.471			
ETRP	*etrp_1*	0.970	0.941	0.899	0.798	Yes
	etrp_2	0.886	0.784			
	etrp_3	0.877	0.769			
	etrp_4	0.899	0.807			
	etrp_5	0.829	0.687			
ECUL	*ecul_1*	0.935	0.874	0.898	0.796	Yes
	ecul_2	0.904	0.818			
	ecul_3	0.904	0.818			
	ecul_4	0.888	0.789			
	ecul_5	0.907	0.823			
	ecul_6	0.810	0.656			
ELGT	*elgt_1*	0.920	0.845	0.919	0.815	Yes
	elgt_2	0.885	0.784			
ENAE	*enae_1*	0.943	0.889	0.944	0.894	Yes
	enae_2	0.949	0.900			

Note:
[a]Indicator reliability: Indicators with outer loadings between 0.40 and 0.70 are considered for removal if deletion leads to an increase in composite reliability and AVE above suggested threshold value. epoe_6 is retained when deletion does not increase in composite reliability and AVE above suggested threshold value.
[b]Composite reliability :The threshold value should be at least 0.70 (Hair et al., 2013).
[c]Average Variance Extracted (AVE): The significant value of should be higher than 0.50 (Hair et al., 2013).
[d] Discriminant validity: The square root of the AVE of each construct should be higher than its highest correlation with any other construct (Fornell & Larcker, 1981).

Table 5.4: Fornell-Larcker criterion

	BSMG	*CNST*	*ECUL*	*ELGT*	*ENAE*	*EPOE*	*ETRP*	*FNCL*	*HMRS*	*ICNS*	*IFNC*	*ILAB*	*IMEQ*	*IMGR*	*INNV*	*IODS*	*ORGL*	*ORGZ*	*PHYS*	*PRCM*	*PRMG*
BSMG																					
CNST	0.474																				
ECUL	-0.428	-0.745	0.892																		
ELGT	-0.401	-0.708	0.837	0.903																	
ENAE	-0.346	-0.642	0.782	0.795	0.946																
EPOE	-0.373	-0.531	0.682	0.541	0.615	0.756															
ETRP	-0.412	-0.722	0.827	0.753	0.734	0.690	0.893														
FNCL	0.503	0.714	-0.705	-0.541	-0.513	-0.500	-0.628														
HMRS	0.548	0.646	-0.835	-0.638	-0.709	-0.691	-0.782	0.710													
ICNS	-0.499	-0.467	0.602	0.456	0.503	0.586	0.534	-0.584	-0.703	0.833											
IFNC	-0.432	-0.649	0.673	0.495	0.509	0.727	0.622	-0.653	-0.675	0.706	0.791										
ILAB	-0.353	-0.784	0.890	0.793	0.737	0.633	0.770	-0.727	-0.718	0.581	0.661	0.911									
IMEQ	-0.248	-0.326	0.310	0.127	0.145	0.447	0.305	-0.343	-0.385	0.483	0.646	0.291	0.870								
IMGR	-0.370	-0.638	0.768	0.608	0.581	0.628	0.637	-0.644	-0.721	0.669	0.729	0.770	0.385	0.893							
INNV	0.485	0.449	-0.473	-0.237	-0.301	-0.544	-0.355	0.539	0.554	-0.667	-0.676	-0.473	-0.551	-0.568							
IODS	-0.524	-0.770	0.872	0.737	0.729	0.693	0.836	-0.737	-0.907	0.715	0.729	0.811	0.372	0.737	-0.536	0.938					
ORGL	0.537	0.620	-0.698	-0.584	-0.537	-0.542	-0.661	0.664	0.746	-0.641	-0.619	-0.653	-0.356	-0.534	0.522	-0.761					
ORGZ	0.381	0.681	-0.713	-0.625	-0.544	-0.418	-0.640	0.676	0.619	-0.491	-0.612	-0.651	-0.234	-0.574	0.350	-0.639	0.588				
PHYS	0.553	0.449	-0.343	-0.301	-0.310	-0.240	-0.264	0.449	0.443	-0.287	-0.305	-0.338	-0.185	-0.350	0.385	-0.390	0.400	0.267			
PRCM	0.490	0.715	-0.832	-0.746	-0.597	-0.587	-0.764	0.663	0.763	-0.625	-0.638	-0.767	-0.284	-0.690	0.435	-0.786	0.715	0.651	0.406		
PRMG	0.506	0.636	-0.650	-0.471	-0.440	-0.603	-0.619	0.598	0.712	-0.706	-0.714	-0.616	-0.603	-0.596	0.700	-0.751	0.696	0.491	0.453	0.634	

Note: The grey boxes are AVEs of formatively measured constructs not to be compared with the correlations.

5.3.5.2 Stage 5b: Evaluation of Formative Measurement Models

The formative measures consist of firm's capability constructs are evaluated according to the three steps procedure (Hair, et al., 2013): First step is to assess convergent validity of formative measurement models, second step is to assess formative measurement models for collinearity issues, and last step is to assess the significance and relevance of the formative indicators.

Step 1: Convergent Validity

The measurement models are examined to check whether the formative constructs exhibit convergent validity. Redundancy analysis is carried out for each construct. When designing the questionnaire survey for this study, global single-item measures were incorporated into the questions. The global single-items are generic assessments of the ten firm's capabilities- physical, human resource, organizational, business management, organizational learning, innovation, procurement, organizational learning, construction, and project management. These global single-item measures are use as measures of the dependent constructs in the redundancy analysis.

The redundancy analyses of *PHYS*, *HMRS*, *ORGZ*, *FNCL*, *BSMG*, *INNV*, *PCRM*, *ORGL*, *CNST*, and *PRMG* yield path coefficients of 0.87, 0.83, 0.81, 0.81, 0.80, 0.85, 0.83, 0.87, 0.86, and 0.83, respectively. These path coefficients are above the threshold of 0.80 (Hair, et al., 2013), which provide support for the formative construct's convergent validity. These suggest that all formatively measured constructs have sufficient degrees of convergent validity.

Step 2: Collinearity among Indicators

Statistical software SPSS 22.0 is used to assess formative measurement models for collinearity of indicators. Indicator data were imported from SmartPLS 2.0 into SPSS 22.0 to run a multiple regression with the formative indicators of a specific formative construct as independent variables and any other indicator, not included in this specific measurement model, as the dependent variable. One example is using the indicator *ifnc_2* as the dependent variable and *phys_1*, *phys_2*, and *phys_3* as the independent variables in a regression model to obtain the VIF for the formative indicators of *PHYS* construct.

Table 5.5 displays the resulting VIF values for all formative constructs in the model. According to the results in Table 5.5, *bsmg_7* has the highest VIF value (2.270). This shows that VIF values are uniformly below the threshold value of 5. Since collinearity does not reach critical levels in any of the formative constructs, it is not an issue for the estimation of PLS path model.

Table 5.5: Variance inflation factor results

PHYS		*HMRS*		*ORGZ*		*FNCL*		*BSMG*		*INNV*		*PCRM*		*ORGL*		*CNST*		*PRMG*	
Indica-tors	VIF	Indica-tors	VIF	Indica-tors	VIF	Indica-tors	VIF	Indica-tors	VIF	Indica-tors	VIF	Indica-tors	VIF	Indica-tors	VIF	Indica-tors	VIF	Indica-tors	VIF
phys_1	1.266	*hmrs_1*	1.230	*orgz_1*	2.200	*fncl_1*	1.607	*bsmg_1*	1.488	*innv_1*	1.731	*pcrm_1*	1.670	*orgl_1*	1.105	*cnst_1*	1.231	*prmg_1*	1.113
phys_2	1.279	*hmrs_2*	1.200	*orgz_2*	1.602	*fncl_2*	1.622	*bsmg_2*	1.542	*innv_2*	1.523	*pcrm_2*	1.337	*orgl_2*	1.145	*cnst_2*	1.019	*prmg_2*	1.008
phys_3	1.130	*hmrs_3*	1.432	*orgz_3*	2.259	*fncl_3*	1.811	*bsmg_3*	1.630	*innv_3*	1.711	*pcrm_3*	1.232	*orgl_3*	1.158	*cnst_3*	1.167	*prmg_3*	1.127
		hmrs_4	1.555	*orgz_4*	1.329	*fncl_4*	1.655	*bsmg_4*	1.940	*innv_4*	1.322	*pcrm_4*	1.399					*prmg_4*	1.129
		hmrs_5	1.450	*orgz_5*	1.623	*fncl_5*	1.650	*bsmg_5*	1.957			*pcrm_5*	1.688					*prmg_5*	1.254
		hmrs_6	1.568	*orgz_6*	1.333	*fncl_6*	2.208	*bsmg_6*	2.223										
				orgz_7	1.340	*fncl_7*	2.233	*bsmg_7*	2.270										
				orgz_8	1.598	*fncl_8*	2.078	*bsmg_8*	1.308										

Step 3: Significance and Relevance of Outer Weights

In this last step, the indicators' outer weights are analyzed for their significance and relevance. The significance of outer weights is first considered using bootstrapping option in SmartPLS. In the bootstrapping settings, 64 cases and 500 samples are selected and the computed results show the *t* values for the measurement and structural model estimates. Table 5.6 is a summary of the results of the formatively measured constructs *PHYS*, *HMRS*, *ORGZ*, *FNCL*, *BSMG*, *INNV*, *PCRM*, *ORGL*, *CNST*, and *PRMG* by showing the original outer weights estimates, the *t* values, the corresponding significance levels, and the *p* values. The association of significance levels (marked by *) and the corresponding *p* values (*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$) are also shown in Table 5.6.

Based on the significance levels, all formative indicators are significant except *bsmg_8* and *pcrm_5*. According to the decision-making process for keeping or deleting formative indicators (Figure 4.14), when an indicator's outer weight is not significant, its outer loading is considered. The outer loadings of these two indicators are 0.589 and 0.708, which are above threshold 0.5 mentioned in Figure 4.14, thus these formative indicators are retained even though their outer weights are not significant.

The analysis of formative indicators' outer weights concluded the formative measurement models evaluation. Since the results from Stage 5a and 5b showed that all reflective and formative constructs demonstrate satisfactory levels of quality, the structural model evaluation in Stage 6 is then ensued.

Table 5.6: Outer weights significance testing results

Formative Constructs	Formative Indicators	Outer Weights (Outer Loadings)	*t* Value	Significance Level	*p* Value	90% Confidence Intervals
PHYS	*phys_1*	0.432 (0.830)	4.774	***	0.000	[0.266, 0.598]
	phys_2	0.512 (0.813)	7.943	***	0.000	[0.368, 0.656]
	phys_3	0.191 (0.501)	2.662	**	0.010	[0.060, 0.322]
HMRS	*hmrs_1*	0.308 (0.948)	5.288	***	0.000	[0.179, 0.437]
	hmrs_2	0.271 (0.770)	4.639	***	0.000	[0.185, 0.357]
	hmrs_3	0.261 (0.753)	4.317	***	0.000	[0.171, 0.351]
	hmrs_4	0.288 (0.806)	5.219	***	0.000	[0.180, 0.396]
	hmrs_5	0.285 (0.804)	5.179	***	0.000	[0.207, 0.363]
	hmrs_6	0.270 (0.769)	4.626	***	0.000	[0.171, 0.369]
ORGZ	*orgz_1*	0.231 (0.779)	2.896	***	0.005	[0.132, 0.330]
	orgz_2	0.293 (0.746)	5.408	***	0.000	[0.150, 0.436]
	orgz_3	0.248 (0.781)	3.109	***	0.003	[0.097, 0.399]
	orgz_4	0.175 (0.579)	2.219	**	0.030	[0.066, 0.256]
	orgz_5	0.158 (0.636)	2.003	**	0.049	[0.054, 0.262]
	orgz_6	0.208 (0.740)	2.608	**	0.011	[0.073, 0.343]
	orgz_7	0.270 (0.764)	5.045	***	0.000	[0.119, 0.421]
	orgz_8	0.193 (0.637)	2.447	**	0.017	[0.060, 0.326]
FNCL	*fncl_1*	0.238 (0.884)	4.698	***	0.000	[0.120, 0.356]
	fncl_2	0.126 (0.894)	1.986	*	0.051	[0.004, 0.248]
	fncl_3	0.290 (0.881)	5.518	***	0.000	[0.114, 0.466]
	fncl_4	0.272 (0.882)	5.825	***	0.000	[0.115, 0.429]
	fncl_5	0.171 (0.847)	3.642	***	0.001	[0.106, 0.236]
	fncl_6	0.156 (0.765)	2.460	**	0.017	[0.054, 0.258]
	fncl_7	0.248 (0.825)	4.856	***	0.000	[0.111, 0.385]
	fncl_8	0.155 (0.759)	2.459	**	0.017	[0.056, 0.254]

Note: NS = not significant. *p < 0.10, ** < 0.05, *** < 0.01.

Table 5.6: Outer weights significance testing results (cont'd)

Formative Constructs	Formative Indicators	Outer Weights (Outer Loadings)	*t* Value	Significance Level	*p* Value	90% Confidence Intervals
BSMG	*bsmg_1*	0.169 (0.611)	2.949	***	0.004	[0.110, 0.228]
	bsmg_2	0.117 (0.606)	2.042	**	0.045	[0.018, 0.216]
	bsmg_3	0.300 (0.722)	5.235	***	0.000	[0.130, 0.470]
	bsmg_4	0.236 (0.743)	4.118	***	0.000	[0.137, 0.335]
	bsmg_5	0.352 (0.848)	6.142	***	0.000	[0.182, 0.522]
	bsmg_6	0.195 (0.663)	3.403	***	0.001	[0.132, 0.258]
	bsmg_7	0.314 (0.756)	5.479	***	0.000	[0.122, 0.506]
	bsmg_8	0.088 (0.589)	1.536	NS	0.129	[-0.084, 0.260]
INNV	*innv_1*	0.305 (0.738)	4.843	***	0.000	[0.129, 0.481]
	innv_2	0.251 (0.640)	4.197	***	0.000	[0.152, 0.350]
	innv_3	0.220 (0.584)	3.826	***	0.000	[0.102, 0.338]
	innv_4	0.367 (0.852)	5.583	***	0.000	[0.171, 0.563]
PCRM	*pcrm_1*	0.182 (0.711)	2.669	**	0.010	[0.055, 0.309]
	pcrm_2	0.332 (0.837)	4.869	***	0.000	[0.109, 0.555]
	pcrm_3	0.347 (0.875)	5.089	***	0.000	[0.131, 0.563]
	pcrm_4	0.350 (0.895)	6.350	***	0.000	[0.154, 0.546]
	pcrm_5	0.100 (0.708)	1.467	NS	0.147	[-0.072, 0.272]
ORGL	*orgl_1*	0.207 (0.772)	4.385	***	0.000	[0.109, 0.305]
	orgl_2	0.468 (0.972)	8.113	***	0.000	[0.221, 0.715]
	orgl_3	0.458 (0.968)	7.970	***	0.000	[0.209, 0.707]
CNST	*cnst_1*	0.305 (0.826)	4.715	***	0.000	[0.129, 0.481]
	cnst_2	0.465 (0.911)	6.578	***	0.000	[0.250, 0.680]
	cnst_3	0.447 (0.902)	6.368	***	0.000	[0.226, 0.668]
PRMG	*prmg_1*	0.326 (0.777)	6.248	***	0.000	[0.130, 0.522]
	prmg_2	0.333 (0.783)	6.351	***	0.000	[0.157, 0.509]
	prmg_3	0.329 (0.780)	6.292	***	0.000	[0.133, 0.525]
	prmg_4	0.348 (0.794)	6.571	***	0.000	[0.132, 0.564]
	prmg_5	0.295 (0.721)	5.794	***	0.000	[0.141, 0.449]

Note: NS = not significant. *p < 0.10, ** < 0.05, *** < 0.01.

5.3.6 Stage 6: Evaluation of Structural Model

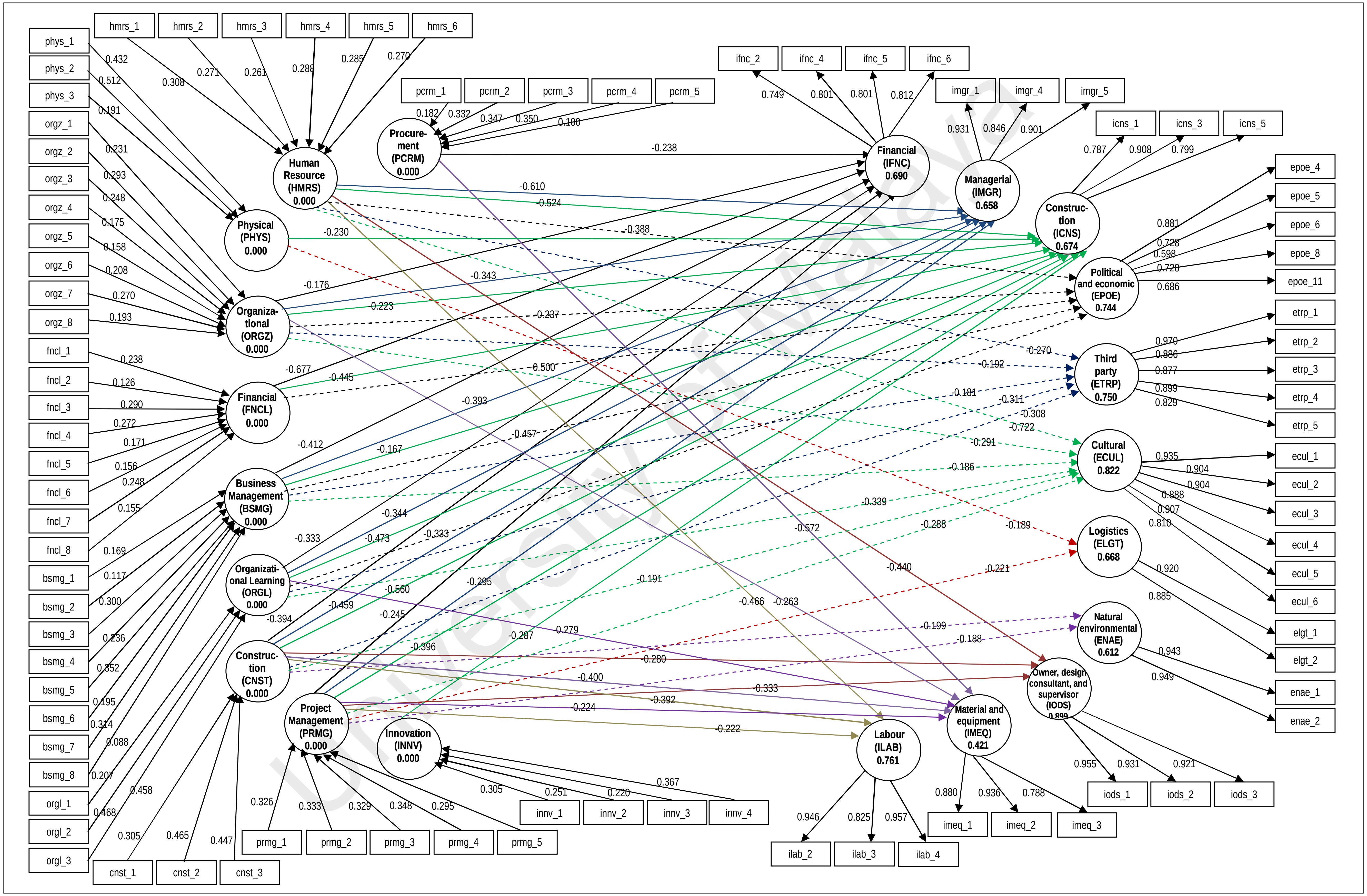
The assessment of the structural model builds on the results from the standard model estimation, the bootstrapping routine, and the blindfolding procedure.

Step 1: Collinearity Assessment

Statistical software SPSS 22.0 is used to assess collinearity of the structural model. Latent variable scores were imported from SmartPLS 2.0 as input into SPSS 22.0 to run a multiple regression with *BSMG* (*1.865*), *CNST* (*3.066*), *FNCL* (*3.102*), *HMRS* (*3.702*), *INNV* (*2.280*), *ORGZ* (*2.420*), *ORGL* (*2.997*), *PHYS* (*1.624*), *PRMG* (*3.316*), and *PCRM* (*3.492*) as predictors of whichever latent variable (*IFNC*, *IMGR*, *ICNS*, *IODS*, *IMEQ*, *ILAB*, *EPOE*, *ETRP*, *ECUL*, *ELGT*, or *ENAE*). The values in brackets show the tolerance (VIF) values and are all below the threshold of 5. Hence, collinearity among the predictor constructs is not an issue in the structural model.

Step 2: Structural Model Path Coefficients

Figure 5.2 shows the structural model results with statistically significant path coefficients (refer Appendix D for enlarged version). The model shows the path coefficients between the exogenous constructs of firm's capabilities and endogenous constructs of risks. The results are delivered following several steps. Firstly, to run bootstrapping procedure to assess whether structural model relationships are significant. With 64 cases and 5,000 samples in the bootstrapping settings, the computed results show the bootstrapping mean values and *t*-values of all the path coefficient estimates. The computed results are converted to their significance levels, *p* values ($*p < 0.10$, $**p < 0.05$, $***p < 0.01$) as indicated in model. Table 5.7 shows the significance testing results of the structural model path coefficients.



Note: Continuous lines- Internal risks, Intermittent lines- External risks

Figure 5.2: Final PLS-SEM structural model

Table 5.7: Significance testing results of the structural model path coefficients

	Path coefficient	*t* Values	Significance Levels	*p* Values	90% Confidence Intervals
BSMG → ICNS	-0.167	1.681	*	0.098	[-0.333, -0.001]
BSMG → ECUL	-0.186	2.154	**	0.035	[-0.330, -0.043]
BSMG → IFNC	-0.412	2.680	***	0.009	[-0.604, -0.220]
BSMG → ILAB	-0.093	1.2 1	NS	0.208	[-0.263, 0.076]
BSMG → ELGT	-0.049	0.444	NS	0.658	[-0.265, 0.167]
BSMG → IMGR	-0.393	2.800	***	0.007	[-0.616, -0.170]
BSMG → IMEQ	0.048	0.319	NS	0.751	[-0.248, 0.344]
BSMG → ENAE	0.072	0.642	NS	0.523	[-0.149, 0.294]
BSMG → IODS	-0.007	0.141	NS	0.889	[-0.106, 0.092]
BSMG → EPOE	-0.457	3.400	***	0.001	[-0.708, -0.206]
BSMG → ETRP	-0.181	2.004	**	0.049	[-0.337, -0.025]
CNST → ICNS	-0.560	3.890	***	0.000	[-0.848, -0.272]
CNST → ECUL	-0.191	1.678	*	0.098	[-0.380, -0.003]
CNST → IFNC	-0.394	2.305	**	0.024	[-0.699, -0.089]
CNST → ILAB	-0.392	2.825	***	0.006	[-0.664, -0.120]
CNST → ELGT	-0.142	0.910	NS	0.366	[-0.477, 0.193]
CNST → IMGR	-0.459	2.748	***	0.008	[-0.768, -0.150]
CNST → IMEQ	-0.400	2.840	***	0.006	[-0.725, -0.075]
CNST → ENAE	-0.199	1.992	*	0.051	[-0.395, -0.003]
CNST → IODS	-0.280	3.342	***	0.001	[-0.444, -0.115]
CNST → EPOE	-0.179	0.817	NS	0.417	[-0.609, 0.251]
CNST → ETRP	-0.308	2.774	***	0.007	[-0.525, -0.090]

Note: NS = not significant. *p < 0.10, ** < 0.05, *** < 0.01. The risk constructs not in groups of external and internal risks because SmartPLS software arrange them in alphabetical order.

Table 5.7: Significance testing results of the structural model path coefficients (cont'd)

	Path coefficient	*t* Values	Significance Levels	*p* Values	90% Confidence Intervals
FNCL → ICNS	-0.445	3.988	***	0.000	[-0.714, -0.176]
FNCL → ECUL	-0.018	0.176	NS	0.861	[-0.217, 0.182]
FNCL → IFNC	-0.677	5.500	***	0.000	[-0.990, -0.364]
FNCL → ILAB	-0.192	1.589	NS	0.117	[-0.428, 0.045]
FNCL → ELGT	0.126	0.944	NS	0.349	[-0.136, 0.389]
FNCL → IMGR	-0.095	0.672	NS	0.504	[-0.370, 0.181]
FNCL → IMEQ	-0.054	0.243	NS	0.809	[-0.488, 0.380]
FNCL → ENAE	0.178	0.94	NS	0.347	[-0.191, 0.548]
FNCL → IODS	-0.064	0.862	NS	0.392	[-0.208, 0.081]
FNCL → EPOE	-0.500	4.800	***	0.000	[-0.674, 0.326]
FNCL → ETRP	0.013	0.114	NS	0.910	[-0.210, 0.236]
HMRS → ICNS	-0.524	2.761	***	0.008	[-0.880, -0.169]
HMRS → ECUL	-0.722	4.185	***	0.000	[-0.930, -0.513]
HMRS → IFNC	-0.099	0.704	NS	0.484	[-0.375, 0.177]
HMRS → ILAB	-0.466	3.118	***	0.003	[-0.751, -0.182]
HMRS → ELGT	-0.197	1.247	NS	0.217	[-0.506, 0.113]
HMRS → IMGR	-0.610	5.486	***	0.000	[-0.943, -0.277]
HMRS → IMEQ	-0.018	0.085	NS	0.932	[-0.439, 0.402]
HMRS → ENAE	-0.012	0.177	NS	0.860	[-0.350, 0.326]
HMRS → IODS	-0.440	4.131	***	0.000	[-0.658, -0.222]
HMRS → EPOE	-0.388	3.124	***	0.003	[-0.604, -0.172]
HMRS → ETRP	-0.270	2.010	**	0.049	[-0.517, -0.023]

Note: NS = not significant. *p < 0.10, ** < 0.05, *** < 0.01. The risk constructs not in groups of external and internal risks because SmartPLS software arrange them in alphabetical order.

Table 5.7: Significance testing results of the structural model path coefficients (cont'd)

	Path coefficient	*t* Values	Significance Levels	*p* Values	90% Confidence Intervals
INNV → ICNS	-0.287	2.253	**	0.028	[-0.536, -0.037]
INNV → ECUL	-0.021	0.186	NS	0.853	[-0.236, 0.195]
INNV → IFNC	-0.065	0.483	NS	0.631	[-0.280, 0.149]
INNV → ILAB	-0.073	0.649	NS	0.519	[-0.294, 0.148]
INNV → ELGT	0.184	1.338	NS	0.186	[-0.085, 0.452]
INNV → IMGR	-0.136	1.661	NS	0.102	[-0.387, 0.116]
INNV → IMEQ	-0.256	1.640	NS	0.106	[-0.563, 0.050]
INNV → ENAE	0.033	0.250	NS	0.803	[-0.224, 0.289]
INNV → IODS	0.058	0.737	NS	0.464	[-0.096, 0.213]
INNV → EPOE	0.034	0.215	NS	0.831	[-0.213, 0.281]
INNV → ETRP	-0.055	0.466	NS	0.643	[-0.239, 0.128]
ORGZ → ICNS	-0.223	2.000	**	0.050	[-0.415, -0.031]
ORGZ → ECUL	-0.291	2.690	***	0.009	[-0.415, -0.131]
ORGZ → IFNC	-0.176	2.087	**	0.041	[-0.303, -0.049]
ORGZ → ILAB	-0.004	0.036	NS	0.972	[-0.194, 0.187]
ORGZ → ELGT	-0.118	1.119	NS	0.267	[-0.326, 0.089]
ORGZ → IMGR	-0.343	3.135	***	0.003	[-0.609, -0.078]
ORGZ → IMEQ	-0.263	2.077	**	0.042	[-0.466, -0.060]
ORGZ → ENAE	-0.161	1.022	NS	0.311	[-0.488, 0.166]
ORGZ → IODS	0.067	0.894	NS	0.375	[-0.080, 0.213]
ORGZ → EPOE	-0.237	2.012	**	0.048	[-0.417, -0.057]
ORGZ → ETRP	-0.192	2.105	**	0.039	[-0.321, -0.063]

Note: NS = not significant. *p < 0.10, ** < 0.05, *** < 0.01. The risk constructs not in groups of external and internal risks because SmartPLS software arrange them in alphabetical order.

Table 5.7: Significance testing results of the structural model path coefficients (cont'd)

	Path coefficient	*t* Values	Significance Levels	*p* Values	90% Confidence Intervals
ORGL → ICNS	-0.473	3.250	***	0.002	[-0.761, -0.185]
ORGL → ECUL	-0.339	2.445	**	0.017	[-0.653, -0.025]
ORGL → IFNC	-0.333	2.040	**	0.045	[-0.580, -0.086]
ORGL → ILAB	-0.042	0.351	NS	0.726	[-0.277, 0.193]
ORGL → ELGT	-0.060	0.525	NS	0.601	[-0.284, 0.164]
ORGL → IMGR	-0.344	2.320	**	0.024	[-0.648, -0.040]
ORGL → IMEQ	-0.279	2.101	**	0.040	[-0.497, -0.061]
ORGL → ENAE	-0.041	0.266	NS	0.791	[-0.347, 0.264]
ORGL → IODS	-0.061	0.699	NS	0.487	[-0.233, 0.110]
ORGL → EPOE	-0.333	2.100	**	0.040	[-0.641, -0.025]
ORGL → ETRP	-0.311	2.101	**	0.040	[-0.562, -0.060]
PHYS → ICNS	-0.230	2.100	**	0.040	[-0.495, -0.059]
PHYS → ECUL	0.068	0.896	NS	0.374	[-0.081, 0.216]
PHYS → IFNC	0.120	1.287	NS	0.203	[-0.063, 0.303]
PHYS → ILAB	0.053	0.594	NS	0.555	[-0.121, 0.226]
PHYS → ELGT	-0.189	1.957	*	0.055	[-0.376, -0.002]
PHYS → IMGR	0.005	0.038	NS	0.969	[-0.227, 0.236]
PHYS → IMEQ	0.102	0.723	NS	0.472	[-0.175, 0.379]
PHYS → ENAE	-0.005	0.041	NS	0.967	[-0.240, 0.230]
PHYS → IODS	0.050	0.444	NS	0.659	[-0.059, 0.160]
PHYS → EPOE	0.156	1.185	NS	0.240	[-0.102, 0.414]
PHYS → ETRP	0.174	1.545	NS	0.127	[-0.047, 0.395]

Note: NS = not significant. *p < 0.10, ** < 0.05, *** < 0.01. The risk constructs not in groups of external and internal risks because SmartPLS software arrange them in alphabetical order.

Table 5.7: Significance testing results of the structural model path coefficients (cont'd)

	Path coefficient	*t* Values	Significance Levels	*p* Values	90% Confidence Intervals
PRMG → ICNS	-0.396	3.082	***	0.003	[-0.504, -0.288]
PRMG → ECUL	-0.288	2.680	***	0.009	[-0.474, -0.101]
PRMG → IFNC	-0.245	2.009	**	0.049	[-0.455, -0.035]
PRMG → ILAB	-0.222	2.107	**	0.039	[-0.418, -0.026]
PRMG → ELGT	-0.221	2.007	**	0.049	[-0.393, -0.049]
PRMG → IMGR	-0.295	2.980	***	0.004	[-0.383, -0.207]
PRMG → IMEQ	-0.224	2.230	**	0.029	[-0.416, -0.032]
PRMG → ENAE	-0.188	2.130	**	0.037	[-0.360, -0.016]
PRMG → IODS	-0.333	3.497	***	0.001	[-0.520, -0.146]
PRMG → EPOE	-0.139	0.821	NS	0.415	[-0.470, 0.193]
PRMG → ETRP	-0.101	0.688	NS	0.494	[-0.345, 0.143]
PCRM → ICNS	-0.255	1.582	NS	0.119	[-0.570, 0.061]
PCRM → ECUL	0.005	0.039	NS	0.969	[-0.229, 0.238]
PCRM → IFNC	-0.238	1.800	*	0.077	[-0.473, -0.003]
PCRM → ILAB	0.019	0.144	NS	0.886	[-0.242, 0.281]
PCRM → ELGT	0.066	0.405	NS	0.687	[-0.253, 0.385]
PCRM → IMGR	0.051	0.323	NS	0.748	[-0.258, 0.359]
PCRM → IMEQ	-0.572	3.451	***	0.001	[-0.896, -0.247]
PCRM → ENAE	0.238	1.517	NS	0.134	[-0.070, 0.546]
PCRM → IODS	-0.147	1.379	NS	0.173	[-0.355, 0.012]
PCRM → EPOE	-0.070	0.414	NS	0.680	[-0.401, 0.261]
PCRM → ETRP	-0.136	1.057	NS	0.294	[-0.389, 0.116]

Note: NS = not significant. *p < 0.10, ** < 0.05, *** < 0.01. The risk constructs not in groups of external and internal risks because SmartPLS software arrange them in alphabetical order.

Step 3: Coefficient of Determination (R^2 Value)

Following the rules of thumb (Hair, et al., 2011; Henseler, et al., 2009) stating R^2 values of 0.75, 0.50, and 0.25 for the endogenous constructs can be described as respectively substantial, moderate, and weak. Hence, the coefficients of determination (R^2 values) of *IODS* (*0.899*), *ECUL* (*0.822*), *ILAB* (*0.761*), *ETRP* (*0.750*), *EPOE* (*0.744*), *IFNC* (*0.690*), *ICNS* (*0.674*), *ELGT* (*0.668*), and *IMGR* (*0.658*) can be considered substantial, whereas the R^2 values of *ENAE* (*0.612*) and *IMEQ* (*0.421*) are moderate (Table 5.8).

Step 4: Effect Sizes f^2 and q^2

Hair et al. (2013) stated that the effect size of f^2 assesses an exogenous construct's contribution to an endogenous construct's R^2 value. The f^2 values of 0.02, 0.15 and 0.35 indicate an exogenous construct's small, medium, or large effect, respectively, on an endogenous construct. Similarly, the predictive relevance q^2, values of 0.02, 0.15, and 0.35 respectively indicate that an exogenous construct has a small, medium, or large effect predictive relevance for a certain endogenous construct. Table 5.9 summarized the results of the f^2 and q^2 effect sizes with respect to all the relationships in the model, along with the path coefficients. For example, the path coefficient from *BSMG* to *IFNC* is -0.412; the f^2 (q^2) effect size is 0.329 (0.187).

Step 5: Blindfolding and Predictive Relevance Q^2

Next is to run blindfolding procedure to assess the predictive relevance of the path model. With 64 cases and an omission distance of $D = 7$, the computed results provide us with the predictive relevance Q^2 (Table 5.8). All Q^2 values are considerably above zero, this support the model's predictive relevance regarding the endogenous latent variable (Hair, et al., 2013). The paths that did not pass the tests were excluded from further analysis. Finally, statistically significant paths were obtained (Table 5.7) and the final structural model confirmed. Table 5.8 shows the results of R^2 and Q^2 values.

Table 5.8: Results of R^2 and Q^2 values

Endogenous Latent Variable	R^2 **Value**	Q^2 **Value**
IFNC	0.6903	0.4326
IMGR	0.6584	0.4990
ICNS	0.6739	0.4535
IODS	0.8992	0.7839
IMEQ	0.4210	0.3171
ILAB	0.7607	0.6287
EPOE	0.7441	0.5007
ETRP	0.7502	0.6200
ECUL	0.8220	0.7166
ELGT	0.6681	0.4187
ENAE	0.6120	0.4638

Table 5.9: Summary of f^2 and q^2 effect sizes results for all path models

	IFNC			
	Path Coefficients	**f^2 Effect Size**	**q^2 Effect Size**	**Inference**
BSMG***	-0.412	0.329	0.187	MLE
CNST**	-0.394	0.217	0.150	MLE
FNCL***	-0.677	0.542	0.307	MLE
HMRS	-0.099	0.008	0.003	SE
INNV	-0.065	0.006	0.002	SE
ORGZ**	-0.176	0.097	0.067	SME
ORGL**	-0.333	0.183	0.128	SME
PHYS	0.120	0.002	0.000	SE
PRMG**	-0.245	0.135	0.094	SME
PCRM*	-0.238	0.023	0.015	SE

	IMGR			
	Path Coefficients	**f^2 Effect Size**	**q^2 Effect Size**	**Inference**
BSMG***	-0.393	0.314	0.178	MLE
CNST***	-0.459	0.367	0.208	MLE
FNCL	-0.095	0.008	0.003	SE
HMRS***	-0.610	0.488	0.277	MLE
INNV	-0.136	0.012	0.005	SE
ORGZ***	-0.343	0.274	0.156	MLE
ORGL**	-0.344	0.139	0.077	SME
PHYS	0.005	0.000	-0.001	SE
PRMG***	-0.295	0.236	0.134	MLE
PCRM	0.051	0.004	0.002	SE

	ICNS			
	Path Coefficients	**f^2 Effect Size**	**q^2 Effect Size**	**Inference**
BSMG*	-0.167	0.029	0.020	SE
CNST***	-0.560	0.448	0.253	MLE
FNCL***	-0.445	0.164	0.142	MLE
HMRS***	-0.524	0.419	0.238	MLE
INNV**	-0.287	0.158	0.110	SME
ORGZ**	-0.223	0.123	0.085	SME
ORGL***	-0.473	0.378	0.214	MLE
PHYS**	-0.230	0.127	0.088	SME
PRMG***	-0.396	0.317	0.180	MLE
PCRM	-0.255	0.022	0.009	SE

Note:
The values of f^2 and q^2 effect sizes can be represented by 0.02 (small), 0.15 (medium), and 0.35 (large) (Hair et al, 2013).
Indicator: SE- small effect size, SME- small to medium effect size, and MLE- medium to large effect size.

Table 5.9: Summary of f^2 and q^2 effect sizes results for all path models (cont'd)

	IODS			
	Path Coefficients	**f^2 Effect Size**	**q^2 Effect Size**	**Inference**
BSMG	-0.007	0.000	0.000	SE
CNST***	-0.280	0.224	0.127	SME
FNCL	-0.064	0.005	0.002	SE
HMRS***	-0.440	0.323	0.183	MLE
INNV	0.058	0.005	0.002	SE
ORGZ	0.067	0.006	0.002	SE
ORGL	-0.061	0.005	0.002	SE
PHYS	0.050	0.004	0.002	SE
PRMG***	-0.333	0.266	0.151	MLE
PCRM	-0.147	0.012	0.005	SE

	IMEQ			
	Path Coefficients	**f^2 Effect Size**	**q^2 Effect Size**	**Inference**
BSMG	0.048	0.004	0.002	SE
CNST***	-0.400	0.320	0.181	MLE
FNCL	-0.054	0.005	0.002	SE
HMRS	-0.018	0.002	0.001	SE
INNV	-0.256	0.010	0.005	SE
ORGZ**	-0.263	0.145	0.010	SME
ORGL**	-0.279	0.154	0.011	SME
PHYS	0.102	0.009	0.003	SE
PRMG**	-0.224	0.123	0.010	SME
PCRM***	-0.572	0.458	0.259	MLE

	ILAB			
	Path Coefficients	**f^2 Effect Size**	**q^2 Effect Size**	**Inference**
BSMG	-0.093	0.008	0.003	SE
CNST***	-0.392	0.314	0.178	MLE
FNCL	-0.192	0.016	0.007	SE
HMRS***	-0.466	0.373	0.211	MLE
INNV	-0.073	0.006	0.002	SE
ORGZ	-0.004	0.000	0.001	SE
ORGL	-0.042	0.004	0.001	SE
PHYS	0.053	0.004	0.002	SE
PRMG**	-0.222	0.122	0.001	SME
PCRM	0.019	0.002	0.001	SE

Note:
The values of f^2 and q^2 effect sizes can be represented by 0.02 (small), 0.15 (medium), and 0.35 (large) (Hair et al, 2013).
Indicator: SE- small effect size, SME- small to medium effect size, and MLE- medium to large effect size.

Table 5.9: Summary of f^2 and q^2 effect sizes results for all path models (cont'd)

	EPOE			
	Path Coefficients	**f^2 Effect Size**	**q^2 Effect Size**	**Inference**
BSMG***	-0.457	0.366	0.207	MLE
CNST	-0.179	0.015	0.006	SE
FNCL***	-0.500	0.399	0.227	MLE
HMRS***	-0.388	0.310	0.176	MLE
INNV	0.034	0.003	0.001	SE
ORGZ**	-0.237	0.080	0.034	SME
ORGL**	-0.333	0.112	0.048	SME
PHYS	0.156	0.013	0.005	SE
PRMG	-0.139	0.012	0.005	SE
PCRM	-0.070	0.006	0.002	SE

	ETRP			
	Path Coefficients	**f^2 Effect Size**	**q^2 Effect Size**	**Inference**
BSMG**	-0.181	0.061	0.026	SME
CNST***	-0.308	0.246	0.140	MLE
FNCL	0.013	0.001	0.000	SE
HMRS**	-0.270	0.091	0.039	SME
INNV	-0.055	0.005	0.002	SE
ORGZ**	-0.192	0.065	0.028	SME
ORGL**	-0.311	0.105	0.045	SME
PHYS	0.174	0.015	0.006	SE
PRMG	-0.101	0.009	0.003	SE
PCRM	-0.136	0.012	0.005	SE

	ECUL			
	Path Coefficients	**f^2 Effect Size**	**q^2 Effect Size**	**Inference**
BSMG**	-0.186	0.103	0.071	SME
CNST*	-0.191	0.018	0.011	SE
FNCL	-0.018	0.002	0.001	SE
HMRS***	-0.722	0.578	0.327	MLE
INNV	-0.021	0.002	0.001	SE
ORGZ***	-0.291	0.233	0.132	MLE
ORGL**	-0.339	0.188	0.129	SME
PHYS	0.068	0.006	0.002	SE
PRMG***	-0.288	0.230	0.130	MLE
PCRM	0.005	0.000	-0.002	SE

Note:
The values of f^2 and q^2 effect sizes can be represented by 0.02 (small), 0.15 (medium), and 0.35 (large) (Hair et al, 2013).
Indicator: SE- small effect size, SME- small to medium effect size, and MLE- medium to large effect size.

Table 5.9: Summary of f^2 and q^2 effect sizes results for all path models (cont'd)

	ELGT			
	Path Coefficients	**f^2 Effect Size**	**q^2 Effect Size**	**Inference**
BSMG	-0.049	0.004	0.002	SE
CNST	-0.142	0.012	0.005	SE
FNCL	0.126	0.011	0.004	SE
HMRS	-0.197	0.017	0.007	SE
INNV	0.184	0.016	0.006	SE
ORGZ	-0.118	0.010	0.004	SE
ORGL	-0.060	0.005	0.002	SE
PHYS*	-0.189	0.033	0.023	SE
PRMG**	-0.221	0.123	0.084	SME
PCRM	0.066	0.006	0.002	SE

	ENAE			
	Path Coefficients	**f^2 Effect Size**	**q^2 Effect Size**	**Inference**
BSMG	0.072	0.006	0.002	SE
CNST*	-0.199	0.024	0.018	SE
FNCL	0.178	0.015	0.006	SE
HMRS	-0.012	0.001	0.000	SE
INNV	0.033	0.003	0.001	SE
ORGZ	-0.161	0.014	0.005	SE
ORGL	-0.041	0.003	0.001	SE
PHYS	-0.005	0.000	0.000	SE
PRMG**	-0.188	0.105	0.071	SME
PCRM	0.238	0.018	0.008	SE

Note:
The values of f^2 and q^2 effect sizes can be represented by 0.02 (small), 0.15 (medium), and 0.35 (large) (Hair et al, 2013).
Indicator: SE- small effect size, SME- small to medium effect size, and MLE- medium to large effect size.

5.4 Summary of Chapter

This chapter reports the two main quantitative research results: the measurement models and the structural model. Prior to reporting the statistical results, the current practice of risk assessment among international construction firms is reported. Thus, the first objective has been achieved.

The capability-risk assessment (CapRA) model consists of ten exogenous latent variables for firm's capabilities with formative measurement models and eleven endogenous latent variables for risks present in international construction with reflective measurement models (Section 5.3.5).

The endogenous latent variables consist of *IFNC, IMGR, ICNS, IODS, IMEQ, ILAB, EPOE, ETRP, ECUL, ELGT,* and *ENAE* risks. The reflective measurement models evaluation results show that there are a minimum of 2 indicators to a maximum of 6 indicators or measurement items for a risk construct. Inconsistent indicators or measurement items are eliminated following the rules of thumb in Section 4.9.4.5a. The exogenous latent variables consist of *BSMG, CNST, FNCL, HMRS, INNV, ORGZ, ORGL, PHYS, PRMG,* and *PCRM* firm's capabilities. The formative measurement models evaluation results show that there are a minimum of 3 indicators and a maximum of 8 indicators that are important to a firm's capability construct. Inconsistent indicators or measurement items are also eliminated following the rules of thumb in Section 4.9.3.5. These results show that they have met the second objective of this study by identifying indicators to measure risks and firm's capabilities.

The structural model evaluation tests all 110 possible or hypothesized relationships between exogenous and endogenous latent variables. The third objective of this research is to determine the relationship between firm's capabilities and risks, it is found that only 53 out of 110 hypothesized relationships are significantly important.

The next chapter presents the qualitative findings gathered from 22 international construction firms.

CHAPTER 6
INTERPRETATION AND DISCUSSION

6.1 Introduction

This chapter reports on the qualitative findings gathered from 22 international construction firms. The data are analyzed according to questions and content analysis is carried out to present the following results and discussion. The first section (Section 6.2) presents interpretation of the underlying indicators of firm's capabilities. The next section (Section 6.3) interprets firm's capabilities that bring negative effects to project risks.

6.2 Interpretation and Discussion of Indicators of Firm's Capability

After evaluation of the reflective measurement model, the ten firm's capabilities in CapRA model are identified with their underlying indicators. The firm's capabilities from Resource-Based View, Dynamic Capabilities, and Porter's Generic Value Chain theories supported the underlying firm's capability indicators (Table 3.7).

6.2.1 Physical Capability- PHYS

In PHYS, Resource-Based View and Dynamic Capabilities accentuated physical resources for organization. Three main indicators are categorized under *PHYS* (Table 3.7), namely *phys_1*: Excellent construction technology, *phys_2*: Special construction equipment, and *phys_3*: Electronic communication. Figure 6.1 shows the physical construct and outer weights for the indicators.

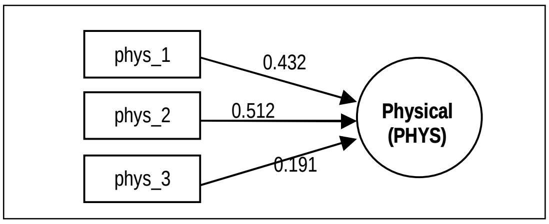


Figure 6.1: Physical construct and indicators

The first two indicators (*phys_1* and *phys_2*) emphasizing "construction technology and equipment" are predominant. This is consistent with Gunhan and Arditi (2005) who mentioned that technology advancement enhances the strategies acquired by industry members to remain competitive. Technology, which is defined as the knowledge and expertise employed, is significant in technically sophisticated projects. Sophisticated projects in the international market such as chemical plants, refineries, power plants, and industrial complexes emphasize the merits of sophisticated technology (Neo, 1976). Technology does not remain stagnant; it is growing and developing, and accelerating the pace of globalization. The last indicator on *phys_3* (electronic communication) plays an important part when talking about globalization. Technology is undeniably one of the most effective weapons that make possible the penetration into foreign markets.

6.2.2 Human Resource Capability- HMRS

Six indicators of HMRS were generated to support Resource-Based View, Porter's Generic Value Chain, and Dynamic Capabilities theories on staff development. They are *hmrs_1*: Organized processes of in-house learning and knowledge development, *hmrs_2*: Systematic on the job training, *hmrs_3*: Good relationship among working team, *hmrs_4*: Competent staff remain long term with firm, *hmrs_5*: Offer good remunerations, promotions and benefits, and *hmrs_6*: Employee's commitment and loyalty. The outer weights of the human resource indicators are shown in Figure 6.2.

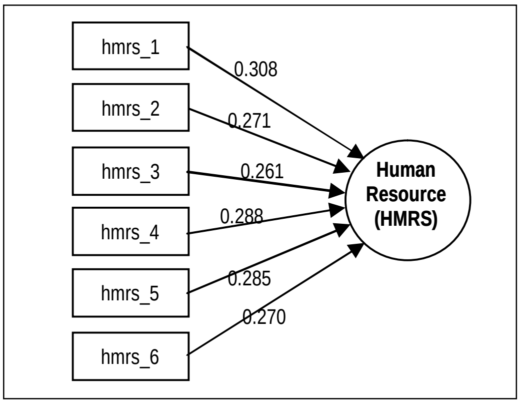


Figure 6.2: Human resource construct and indicators

Human resource capability includes staff development like indicators *hmrs_1* (Organized processes of in-house learning and knowledge development) and *hmrs_2* (Systematic on the job training). Training and learning of human resource will require good relationship among working team (*hmrs_3*). Neo (1976) mentioned that qualified personnel is one of the contractor's capabilities assessed for potential bidders in international construction, hence it is crucial to recruit and keep competent staff (*hmrs_4* and *hmrs_6*). To do so, indicator *hmrs_5* (Offer good remunerations, promotions and benefits) is emphasized as one of the human resource capabilities.

6.2.3 Organizational Capability- ORGZ

Resource-Based View, Porter's Generic Value Chain, and Dynamic Capabilities theories contributed nine indicators of ORGZ. They are *orgz_1*: Integration and standardization of business processes, *orgz_2*: Adopt latest management tools and techniques, *orgz_3*: Systematic implementation of business plan, *orgz_4*: Has formal reporting structure, *orgz_5*: Has controlling and coordinating systems, *orgz_6*: Has informal relations among groups within a firm and between a firm and those in its environment, *orgz_7*: Has inventory management, and *orgz_8*: Has proper legal, finance, accounting, public affairs, quality management, etc. Figure 6.3 illustrates the outer weights of these eight indicators for *ORGZ* construct.

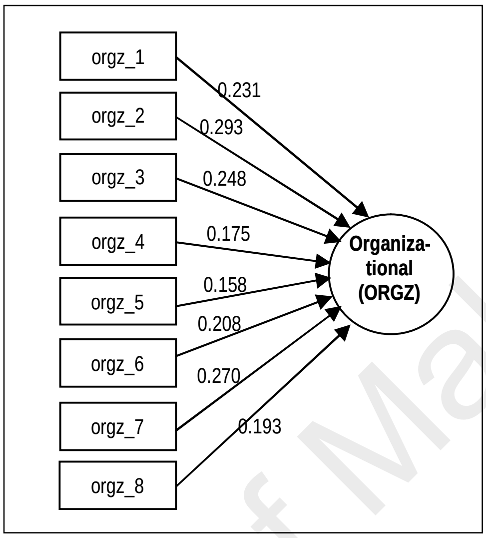


Figure 6.3: Organizational construct and indicators

Indicators related to business plan and relations are represented in organizational capability construct like *orgz_1*: Integration and standardization of business processes, *orgz_3*: Systematic implementation of business plan, and *orgz_6*: Has informal relations among groups within a firm and between a firm and those in its environment. This organizational capability also emphasized on having latest management tools and techniques (*orgz_2*) and other management skills like inventory (*orgz_7*), legal, finance, accounting, public affairs, quality management, and etc. (*orgz_8*). With such management and business skills incorporated, a firm has to be equipped with formal reporting structure (*orgz_4*) and controlling and coordinating systems (*orgz_5*).

6.2.4 Financial Capability- FNCL

Eight indicators are drawn to support Dynamic Capabilities' financial and institutional assets, they are *fncl_1*: Credit and record with banks, *fncl_2*: Physical assets, *fncl_3*: On-time payment for all payables, *fncl_4*: Reserved cash (retained earnings), *fncl_5*: Evaluate client's risk (financial stability), *fncl_6*: Cash and investment policy, *fncl_7*: Match sources and utilization of funding, and *fncl_8*: Quantitative evaluation of investment. Figure 6.4 shows the outer weights for the indicators of FNCL construct.

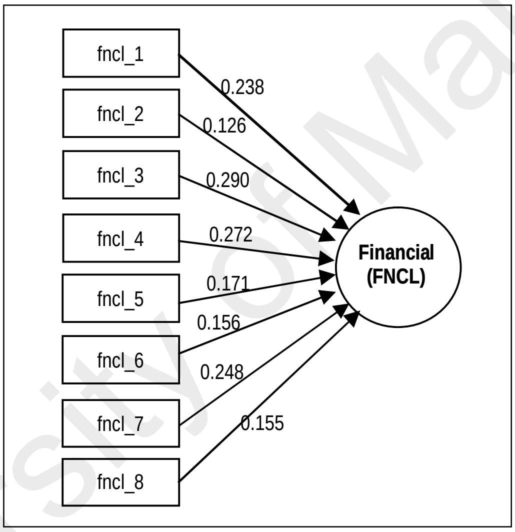


Figure 6.4: Financial construct and indicators

Financial capability of a firm is an important strategic asset (Warszawski, 1996), the four indicators on credit and record with banks (*fncl_1*), physical assets (*fncl_2*), on-time payment for all payables (*fncl_3*), and reserved cash (*fncl_4*) generally depict a firm's financial status. When the status is robust, the firm has the capacity to conduct far-reaching business plans with no issue for creditworthiness and reputation among its suppliers, clients, and financial institutions. This is parallel with Low (1996) who mentioned that a solid balance sheet is also the first prerequisite to secure attractive financing packages from financial institutions. Gunhan and Arditi (2005) added that financial capability of the client or investor is very important as compared to that of contractor since he is the paymaster. Therefore, indicator *fncl_5* (Evaluate client's risk- financial stability) is emphasized.

The financial strength of a construction company is closely related to strength of working capital and to adequacy of cash flow even though the size of contractor's working capital is very much smaller than the owner's investment in the project (Price, 1995). Therefore, a firm's proper planning of its finance through cash and investment policy (*fncl_6*), matching sources and utilization of funding (*fncl_7*), and quantitative evaluation of investment (*fncl_8*) are crucial.

6.2.5 Business Management Capability- BSMG

As shown in Table 3.6, eight indicators categorized within business management capability to support Dynamic Capabilities and Porter's Generic Value Chain theories on business and organization structure. The indicators consist of *bsmg_1*: Effective benchmarking, *bsmg_2*: Systematic formulation of long term strategy, *bsmg_3*: Timely response to competitive strategic moves, *bsmg_4*: Flexible adaptation of human resources to technological and competitive changes, *bsmg_5*: Excellent reputation on project record, *bsmg_6*: Exceptional client relationships, *bsmg_7*: Strong networking, and *bsmg_8*: Promoting the sales of the end-product. The outer weights of the eight indicators of business management construct are shown in Figure 6.5.

Stallworthy and Kharbanda (1983) explained that the business role is increasingly important since project financing is crucial in export project development rather than technological excellence alone. With excellent reputation on project record (*bsmg_5*) and systematic formulation of long term strategy (*bsmg_2*), firm is able to secure financial support and business. Relationship and networking (*bsmg_6* and *bsmg_7*) also play vital role in business management; a firm is able to secure information on technology, impending projects, clients, buyers, potential competitors, and potential partners. These information works well for construction firm in formulating suitable competitive strategy (Quak, 1991).

To be competitive in this international construction, execution of numerous business strategies requires effective benchmarking (*bsmg_1*) followed by changes and responses. Human resources have to have flexible adaptation to technological and competitive changes (*bsmg_4*). The response to competitive strategic moves has got to be timely (*bsmg_3*). Promoting the sales of the end-product (*bsmg_8*) not only benefits the client, it can also be one of the means to enhance firm's reputation to secure more business opportunities.

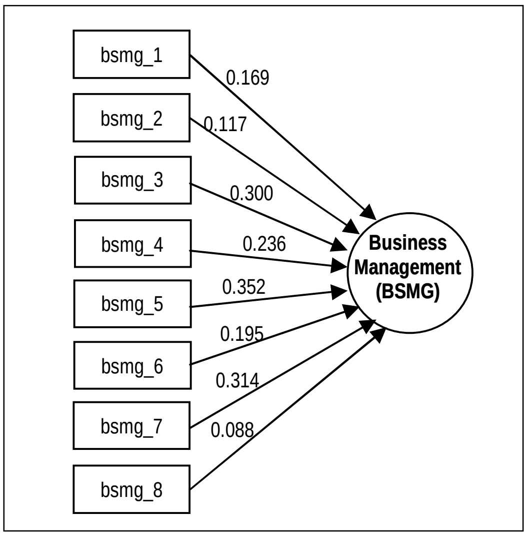


Figure 6.5: Business management construct and indicators

6.2.6 Innovation Capability- INNV

Porter's Generic Value Chain and Dynamic Capabilities theories' technological development, assets and opportunities are categorized as innovation capability, supported by four indicators consisting of *innv_1*: Implement new knowledge and or technology, *innv_2*: Conduct research and development, *innv_3*: Implement process automation, and *innv_4*: Practice intellectual property via patent or copyright. Figure 6.6 portrays the outer weights of the four indicators of innovation construct.

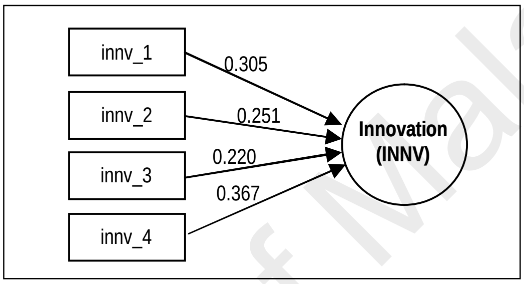


Figure 6.6: Innovation construct and indicators

The one with the highest outer weight is practice intellectual property via patent or copyright (*innv_4*), followed by implement new knowledge and or technology (*innv_1*). To compete for specialist subcontracts or a desired consortium partnership, having specialist technologies enable smaller companies to place themselves in a niche international market (Quak, 1991). Sillars and Kangari (1997) found that the provision of new technologies is a method for securing project in situations where competitive pricing (low price), one of the major challenges in foreign market, is often offered by a local construction firm. Hence, to be more competitive, foreign companies with the advent of the specialized knowledge in building structures or handling high-technology equipments can project their expertise towards the need of the host country.

The third highest outer weight indicator is conduct research and development (*innv_2*). This is in line with Low (1996) mentioning that companies from industrialized countries emphasized on research and development and are commonly the providers of new technologies in the less developed countries. The last indicator is implement process automation (*innv_3*), which Sillars and Kangari (1997) put forth besides a few specialization examples like construction of energy efficient buildings and inclusion of telecommunication requirements, automation practice of modern management methods to achieve on-schedule and within-budget project completion for large and complex infrastructure projects are effective as well. Evidences show that possession of advanced technology put companies at great competitive state and usually monopolizing the market (Gunhan & Arditi, 2005).

6.2.7 Procurement Capability- PCRM

In *PCRM*, Porter's Generic Value Chain and Resource-Based View emphasized on purchasing and access to raw materials. Five indicators under *PCRM* consisted of *pcrm_1*: Access to raw materials, *pcrm_2*: Long-term contractual relationship with suppliers and subcontractors, *pcrm_3*: Established selection criteria for suppliers and subcontractors, *pcrm_4*: Supplier credits, and *pcrm_5*: Access to spare parts and machines. The five procurement indicators and their outer weights are shown in Figure 6.7.

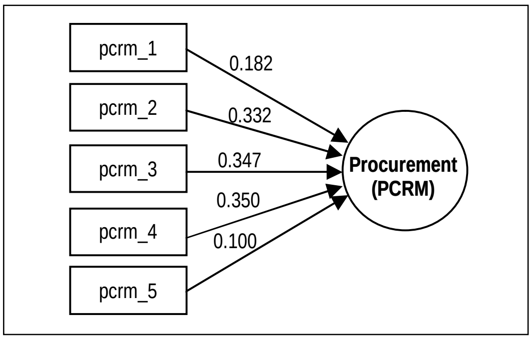


Figure 6.7: Procurement construct and indicators

In the assessment of potential bidders in international construction, a contractor's capabilities in terms of qualified personnel, equipment and plant are one of the important factors to be considered (Neo, 1976). Moreover, equipment and field resources have been listed as a primary strength for construction companies (Friedman, 1984). Among the five indicators, three indicators have higher weights on *PCRM* related to procuring material and or equipment from suppliers and subcontractors. Two of these indicators are to have long-term contractual relationship with suppliers and subcontractors (*pcrm_2*) and supplier credits (*pcrm_4*), these safeguard the source of materials, equipment or plant even on credit terms. Moreover, construction firms have to establish selection criteria for suppliers and subcontractors (*pcrm_3*) to safeguard the firm from problems arise in procuring goods. In terms of access to raw materials, spare parts, and machines (*pcrm_1* and *pcrm_5*), they are very important, however, the access would be not as convenient depending on the accessibility of construction sites.

6.2.8 Organizational Learning Capability- ORGL

Three indicators are drawn to support Dynamic Capabilities' path dependencies, they are *orgl_1*: Inter-project meetings, *orgl_2*: Learning from previous investments, and *orgl_3*: Previous project cost database. Figure 6.8 displays the organizational learning construct and the three indicators' outer weights.

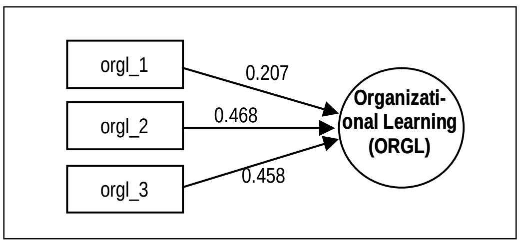


Figure 6.8: Organizational learning construct and indicators

The indicators *orgl_1, orgl_2,* and *orgl_3* contribute much for organizational learning of any organization. Managing knowledge within a firm is difficult when it comes to handling construction project, which is neither continuous in process nor similar from project to project. Hence, the two predominant indicators are learning from previous investments (*orgl_2*) and previous project cost database (*orgl_3*). These require more of inter-project meetings (*orgl_1*) to learn from the other project teams. Organizational learning ensures valuable knowledge is passed down and not gone when staff leaves the firm.

6.2.9 Construction Capability- CNST

Porter's Generic Value Chain's operations and services are categorized as construction capability, supported by three indicators (*cnst_1*: Large-scale construction project experiences, and *cnst_2*: Regular equipment maintenance, *cnst_3*: Testing of facility operations). The construction construct and its indicators with outer weights are shown in Figure 6.9.

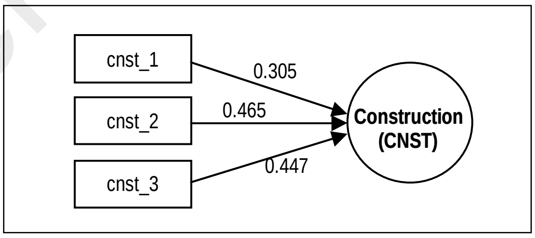


Figure 6.9: Construction construct and indicators

To venture into the foreign market, firms with large-scale construction project experience (*cnst_1*) have the competitive edge in the international construction. This is supported by Quak (1991) who explained that an experienced firm has the capability in solving technical problems efficiently. Firstly, the firm would have either a ready solution or a cheaper solution to a technical problem, similar to the problem faced in the past that has had its solution invested. Secondly, the firm's previous performances would have demonstrated that the firm has the organization, technical know-how, and experience to overcome technical challenges that arise in the course of a construction project. These would comprise of construction capability indicators like *cnst_2*: Regular equipment maintenance and *cnst_3*: Testing of facility operations. Overall, a construction firm with a vast construction project experience is marketable to potential international clients and consortium partners.

6.2.10 Project Management Capability- PRMG

Five indicators support Porter's Generic Value Chain's inbound logistics. Since this study is related to construction industry, the five indicators of inbound logistics are project management capability, namely *prmg_1*: Manage material and equipment scheduling, *prmg_2*: Project cost control (estimation, pricing policy, identification of cost overrun, detailed budgeting), *prmg_3*: Project quality control, *prmg_4*: Clear project organization structure setup, and *prmg_5*: Evaluate suppliers and subcontractors' performance. The outer weights of the five project management indicators are illustrated in Figure 6.10.

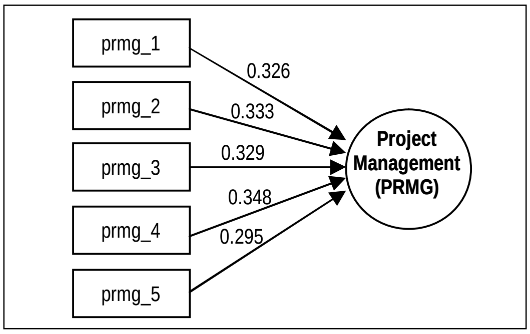


Figure 6.10: Project management construct and indicators

The project management capability indicators are associated with material and equipment scheduling management (*prmg_1*), project cost control (*prmg_2*), project quality control (*prmg_3*), clear project organization structure setup (*prmg_4*), and suppliers and subcontractors' performance evaluation (*prmg_5*). The common nature of international projects are usually very complex, have multiple ownership, detailed financial provisions, and different political ideologies. With these, projects are more difficult to manage than domestic projects due to the vast number and uncertain risks involved (Han, et al., 2005). For that reason, Strassmann and Wells (1988) affirmed that United States contractors have the competitive edge due to their efficiencies in project management instead of being familiar with the building methods for structures. Their successes in winning overseas contracts are often attributed to their organization and management skills rather than experience with advanced technologies.

6.3 Relationship of Firm's Capability towards Risks Significance

Having assessed and discussed the measurement model in the previous section, this section discusses the structural model. The structural model identified and confirmed through the assessments from the standard model estimation, the bootstrapping routine, and the blindfolding procedure is useful in understanding the relationships among firm's capabilities and risks. The path coefficients describing the hypothesized relationships among firm's capability (independent constructs) and risk (dependent constructs) are assessed. Figure 5.2 shows the final PLS model, also known as CapRA model in this study, consisted of 10 independent constructs and 11 dependent constructs. The nonsignificant paths are not shown in the model. However, the abovementioned Table 5.6 consists of both the significant and nonsignificant hypothesized relationships. In this study, there are 53 significant paths or relationships.

6.3.1 Discussions on Relationship of Firm's Capability towards Risk

This section interprets the findings of the CapRA model. The interpretations involved discussion on independent constructs and dependent constructs including their measurement indicators. The discussions are based on the interview with 22 construction firms or subject matter experts with overseas construction experience mentioned in Section 5.2. The 22 construction firms were made up of 15 Malaysian international construction firms (L1-L15) and 7 foreign international construction firms (F1-F7). They responded to the questionnaire survey and additional insights and comments were captured for the purpose of adding meaning to the findings and relationships found.

Figure 5.2 shows there are 53 significant negative paths, which support the hypothesis of the firm's capabilities of Resource-Based View, Porter's Generic Value Chain, and Dynamic Capabilities have combined effects on risks. According to the hypothesis "*A combination of physical, human resource, organizational, financial, business management, innovation, procurement, organizational learning, construction, and project management capabilities can lower risk significances in international construction foray*", the significant paths supported the hypothesis indicating all firm's capability factors play negative roles towards risk significances.

The negative path coefficient simply indicates that as one variable increases, the other decreases, and vice-versa (Stockburger, 2013). So, this study can also interpret them as the absence of a certain firm's capabilities play positive role towards or increase risk significance value. Since the hypothesis of this study stated that firm's capabilities can lower risk significances, therefore this study interprets negative path coefficient as negative role and thus lower risk significance value.

There are nonsignificant paths that are not shown in Figure 5.2, this suggest that not all firm's capabilities contribute to each and every risks. Hence, this section looks into each risk and discusses the firm's capabilities that have significant effects towards risk significance.

6.3.1.1 Relationships between Firm's Capability and Financial (IFNC) Risk

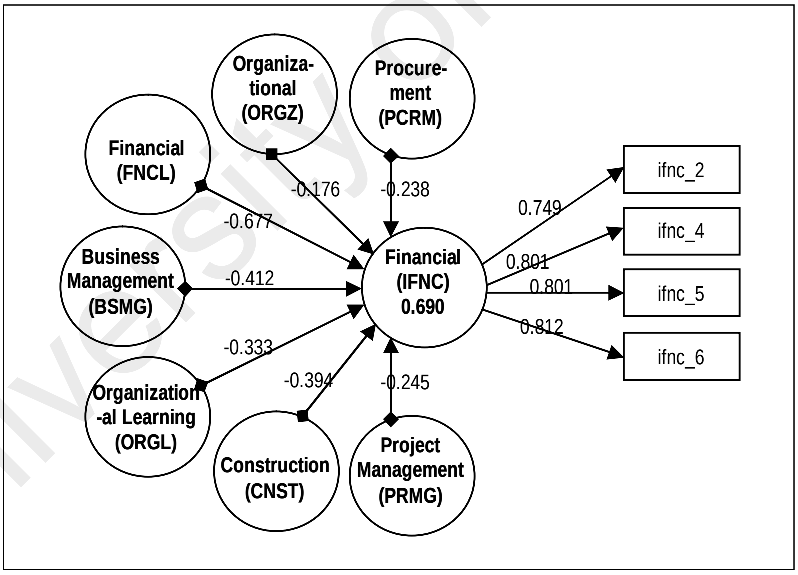


Figure 6.11: Relationships between firm's capability and IFNC

The internal financial (*IFNC*) risk consisted of four indicators, they are *ifnc_2*: Credit rating, *ifnc_4*: Delayed or non-receipt of payment, *ifnc_5*: Financial failures by parties involved, and *ifnc_6*: Inadequate financial margins.

Figure 6.11 shows financial (*FNCL*), business management (*BSMG*), and construction (*CNST*), organizational learning (*ORGL*), project management (*PRMG*), procurement (*PCRM*), and organizational (*ORGZ*) capabilities have negative coefficients, indicating that having *FNCL, BSMG, CNST, ORGL, PRMG, PCRM,* and *ORGZ* capabilities would lower *IFNC* risk significance value. In order to significantly lower financial risk significance value, construction firms must have financial (-0.677), business management (-0.412), construction (-0.394), organizational learning (-0.333), project management (-0.245), procurement (-0.238), and organizational (-0.176) capabilities.

A construction firm's *FNCL* capability such as credit and record with banks (*fncl_1*), physical assets (*fncl_2*), on-time payment for all payables (*fncl_3*), and reserved cash (*fncl_4*) are indicators considered by bank when firm seeks to borrow from them. The subject matter expert L7 and L8 agreed that credit record with bank, physical assets and reserved cash, and on-time payment for loans are important criteria for bank to assess their firms' credit rating. The experts said construction firms will strive to achieve the highest possible credit rating because it impacts highly on the interest rates charged by lenders or banks. This is in line with Altman (2006) mentioning that the probability of debt default and recovery rate in the event of default are inversely related. This means the higher the credit rating, the lower the chance of debt default by a borrower, meanwhile low credit rating signifies high chance of debt default.

The contractor has to be robust cash reserves (*fncl_4*) when venturing abroad to minimize the impact of the risks of delayed or non-receipt of payment (*ifnc_4*) and financial failures by parties involved (*ifnc_5*) occurring. This is a chain effect where the contractor will only pay the suppliers and subcontractors when client has paid them. Many subject matter experts commented that the "pay when paid" clause in contract, which slows payment from main contractor to subcontractors, is prohibited. This is not widely practiced where many still withhold payments to subcontractors as a reserve (Mincks & Johnston, 2010), causing a major obstruction to the subcontractor's growth. If there is delayed payment (*ifnc_4*) from the client, most experts pay the subcontractors from their cash reserves (*fncl_4*) to maintain the good working relationship with subcontractors. A better solution is to curb the root cause at the client's side. Many experts also shared that they evaluate client's financial stability (*fncl_5*) before coming into contract to avoid client's delayed or non-receipt of payment (*infc_4*) or financial failure (*infc_5*).

Construction firms carried out quantitative evaluation of investment (*fncl_8*) on project opportunities to lower the risk of inadequate financial margins (*infc_6*) when undertaking a project. The construction firms interviewed have their own quantitative evaluation on investment (*fncl_8*), most of them utilized the return on investment (ROI) calculation. Expert L1 elaborated that their firm has own calculation for investment evaluation, which requires large amount of data on activities, operations, and resources. The evaluation examines the project's operations and activities including nature of work to assess the cost effectiveness. This will allow little room for inadequate financial margins (*ifnc_6*) if project ventured has been well studied.

BSMG capability is important to reduce the *FNCL* risk significance value. To reduce the risk of poor credit rating (*ifnc_2*), it is desirable for construction firm to have excellent reputation on project record (*bsmg_5*). Lender or bank considers the firm's earning power, business and financial risks, asset protection, cash flow adequacy, financial flexibility, and quality of accounting to give a picture of firm's credit rating. Excellent reputation in previous investments also helps to give good credit rating, which may result in obtaining credit at lower interest rate and of reasonable repayment period (Chandra, 2011). Construction firms needed strong networking (*bsmg_7*) in the construction industry to obtain information about the financial profile of a client. With the insider information revealed (Styhre, Josephson, & Knauseder, 2004), contractors will decline to work with client whose financial capacity is in doubt.

Construction firm with exceptional client relationship (*bsmg_6*) may be aware of the financial status of a client. If the client is having difficulties, construction firm should not go into contract with them so that the risk of delayed or non-receipt of payment (*ifnc_4*) can be avoided. Expert L10 shared that they had exceptional relationship with their client (*bsmg_6*) and it helped them when the economy was down and the client delayed the payment (*ifnc_4*). Since they had good relationship with the client, it was easier for them to follow up with the payment. This is similar to what is put forth by Argrove (2012), a London building contractor, in which they accentuated the good relationship between the client and contractor's quantity surveyor to ensure good project cash flow. This working relationship, collaborating in finding pragmatic win-win solutions to problems, is paramount to maintaining project cash flow. Both contractor and client should adhere to payment and schedule clauses in contract, agree to format for valuation submission, keep final account rolling as variations arise, and maintain good bookkeeping and communication between both parties.

To lower the risk of inadequate financial margins (*ifnc_6*), construction firms depended on their large-scale construction project experiences (*cnst_1*), learning from previous investments (*orgl_2*), and previous project cost database (*orgl_3*) as comparative yardstick. Experts agreed that their previous database and invaluable experiences provided them the information needed to study the profitability of the potential venture. Both experts L3 and F5 particularly mentioned their own firm's previous database weighs more than any other database because it is a reflection of financial margin made to the amount of their firm's capital invested. Lavender (2014) agreed that a figure of profit must be related to the amount of capital employed in the firm or size of the firm and thus profits made by firms of different sizes cannot be regarded as equal performance. He added that the investment analysis is only beneficial when compared to firm's previous performance.

PRMG capability helps to reduce *FNCL* risks. Project cost control (*prmg_2*) such as estimation, pricing, detailed budgeting and cost overrun identification are important to mitigate delayed or non-receipt of payment (*ifnc_4*) and inadequate financial margins (*ifnc_6*) risks. Expert L1 and L5 mentioned that cost control is an ongoing process from inception to completion of project. The estimation, pricing and budgeting are crucial to ensure project profit. In the event of cost overrun, perhaps caused by delayed or non-receipt of payment from client, firm may plan for alternative operation cost.

PRMG and *PCRM* capabilities help to reduce the risk significance value of financial failures by parties involved (*ifnc_5*). In particular, establishing selection criteria for suppliers and subcontractors (*pcrm_3*) and evaluating their performances (*prmg_5*) may lower the risk of their financial failures (*ifnc_5*). Expert F4 elaborated that construction firm will prequalify prospective subcontractors, evaluating their financial strength, character, experience, and ability to perform the work. The prequalification process (*pcrm_3* and *prmg_5*) will help the contractor weed out unqualified subcontractors that lack capability to perform the work or lack financial strength to successfully complete the work. Contractor relied on subcontractors to perform part of the services in a project, but failure by any subcontractor to satisfactorily provide supplies or perform services on timely basis may affect contractor's ability to perform as prime contractor. Subcontractor performance deficiencies expose contractor to liability and affect contractor's future business. Similarly, delays in obtaining components and parts from suppliers that are financially incapable also may affect contractor's ability to meet clients' needs and profitability (Bragg, 2006).

ORGZ capability like controlling and coordinating (*orgz_5*), formal reporting (*orgz_4*), and various managing tools and techniques (*orgz_2*, *orgz_7* and *orgz_8*) are important to reduce delayed or non-receipt of payment (*ifnc_4*), financial failures by parties involved (*ifnc_5*), and inadequate financial margins (*ifnc_6*) risk significance values. Lowering financial risk significance value requires systematic monitoring and controlling, *ORGZ* capability is a must have for construction firms to be alert of any financial risks and devise plans to mitigate their impact when risk arises (Kenett & Raanan, 2011).

6.3.1.2 Relationships between Firm's Capability and Managerial (IMGR) Risk

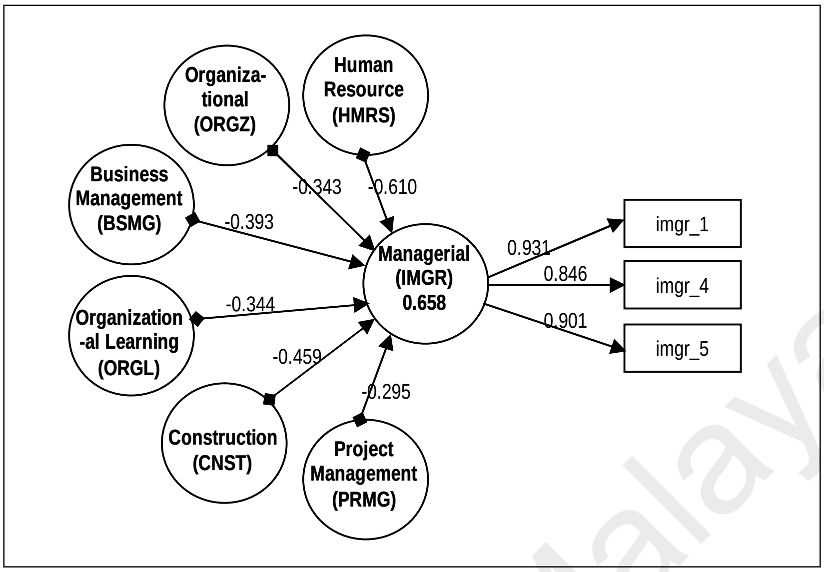


Figure 6.12: Relationships between firm's capability and IMGR

The internal managerial (*IMGR*) risk consisted of three indicators, they are *imgr_1*: Change of organization within local partner, *imgr_4*: Poor project organization structure and management team, and *imgr_5*: Contract formation and performance.

Figure 6.12 illustrates that human resource (*HMRS*), construction (*CNST*), business management (*BSMG*), organizational learning (*ORGL*), organizational (*ORGZ*), and project management (*PRMG*) capabilities are significantly related to IMGR. These firm's capabilities have negative coefficients. These indicate that in order to significantly lower managerial risk significance value, construction firms must be equipped with human resource (-0.610), construction (-0.459), business management (-0.393), organizational learning (-0.344), organizational (-0.343), and project management (-0.295) capabilities.

To manage change of organization within local partner (*imgr_1*) and or poor project organization structure and management team (*imgr_4*), it is crucial for construction firm to have competent staff (*hmrs_4*) to manage the changes and maintain good relationship among working team (*hmrs_3*). All subject matter experts felt that competent staff (*hmrs_4*) and good working team (*hmrs_3*) are significant to address managerial issues. All organizational change involves changes in three main areas-content, people, and process. "Content" is what is going to change like structure, system, and products, "people" refers to human side of change, while "process" refers to how the content and people changes are planned and implemented (Anderson & Anderson, 2011). Experts L2 and L15 commented that competent staff is not only required to respond to event of changes within project organization or organization within local partner, but also required in a functional working team that can re-collect itself when changes occur within them. Gilley (2005) also found that simply being responsive to change is not enough as firm and employees must be able to anticipate or drive change to ensure firm's sustainability.

In the event of failure to adhere to contract or poorly constructed contract (*imgr_5*), competent and qualified staff (*hmrs_4*) well versed with construction contract helps to alleviate the impact. Expert F6 related that staffs with vast experience handling international projects are more capable to handle contractual issues. Prior entering into contract, experienced and competent staff will be able to identify problems that may crop up in the contract clauses and negotiate with client for terms to protect their firm before signing. If client does not adhere to the contract, staff will be able to resolve the dispute with substantial evidence following what is spelt out in the contract, either through litigation or amicable mechanisms.

Firm's *CNST* capability shows a negative relationship with *IMGR*. This shows that having large-scale construction project experiences (*cnst_1*) helps lessen risk significance of change of organization within local partner (*imgr_1*) and poor project organization structure and management team (*imgr_4*). This is true when large-scale construction project involves a few construction firms and complex organization structure. Expert L4 agreed that experience in large-scale projects help to resolve issues like organizational change faster. L4 partnered with a local contractor in an infrastructure project owned by the government of that foreign country. They wanted a local partner to have an easy way out through the bureaucratic process with local authority, while the local partner wanted to learn their technology for tunnel construction. In the midst of the project, the local partner had an internal organizational change and an important person from their side in the management team was affected. L4 with their professionalism and expertise in handling large project negotiated to temporarily occupy their seat in management with the well-thought-out terms from previous projects experiences until they have a replacement. Their partnership turned out well and is in the midst of phase two of the public project.

Strong networking (*bsmg_7*) and exceptional client relationship (*bsmg_6*) help to lower the risk significance of change of organization within local partner (*imgr_1*) and contract formation and performance (*imgr_5*). Subject matter expert L4 shared their experience with a local partner for a public project in a foreign country. Bureaucracy is one of the top business hurdles in that country, and with that, L4 entered into the project with a local construction firm. When organizational change (*imgr_1*) happened within that local partner, L4 stepped in to temporarily fill up the local partner's position in the management team. L4 had strong network (*bsmg_7*) with the local authority before venturing into the country and that helped them when the local partner was not able to perform their part. The bureaucratic procedure for approval of documents was settled through L4's network in the local authority. When contract fails (*imgr_5*), exceptional client relationship (*bsmg_6*) helps to resolve issues. Experts believed that there are countries where for contract enforcement does not work at all except for relationships. Expert F2 explained that contracts are supposed to make business specific but their experience with public projects in certain countries ruled by a monarchy tell them otherwise. Client who is a member of the royal family may overrule the law. Resolving disputes through contractual means depleting firm's resources and burning bridges with client in such country. However, an exceptional client relationship (*bsmg_6*) will buy your way out to resolve the disputes amicably and, more often than not, secure more projects to come.

In other countries where businesses are agreed and legally bound in contract, firm's organizational learning (*ORGL*) and organizational (*ORGZ*) capabilities are useful to reduce the risk significance from poor contract formation and performance (*imgr_5*). The learning from previous investments (*orgl_2*) and other projects via inter-project meetings (*orgl_1*) are helpful sources of contractual knowledge including loopholes or risks for the upcoming projects. Lessons learnt can be drawn from past projects and precautions made to avoid the same contractual mistake, be it in contract negotiation at pre-contract or in the midst of construction operation. To have a valid case in any dispute, the organizational capability helps to provide substantive documentation in the right order. When client fails to perform as stipulated in contract (*imgr_5*), construction firm with the proper legal management (*orgz_8*) and formal reporting structure (*orgz_4*) will have documentation to substantiate the claim.

A clearly defined project organization structure setup (*prmg_4*) is desirable at project commencement to mitigate risks of organizational change within local partner (*imgr_1*) and poor project organization structure and management team (*imgr_4*). This is a slippery slope, without a clearly defined project organization structure setup (*prmg_4*), it would be chaotic when making management decisions in the construction phase. Organization decision is complex, it requires an organization structure, communication, and also the influence of external affiliation on organization behavior (Pettigrew, 2014).

6.3.1.3 Relationships between Firm's Capability and Construction (ICNS) Risk

The internal construction (*ICNS*) risk consisted of three indicators, they are *icns_1*: Cost overrun, *icns_3*: Project delay, and *icns_5*: Defective work.

Figure 6.13 depicts that capabilities are significantly related to *ICNS*. These firm's capabilities with their negative coefficients show that higher of firm's capabilities would lead to lower *ICNS* risk significance value. In order to significantly lower construction risk significance value, construction firms must have construction (-0.560), human resource (-0.524), organizational learning (-0.473), financial (-0.445), project management (-0.396), innovation (-0.287), physical (-0.230), organizational (-0.223), and business management (-0.167) capabilities.

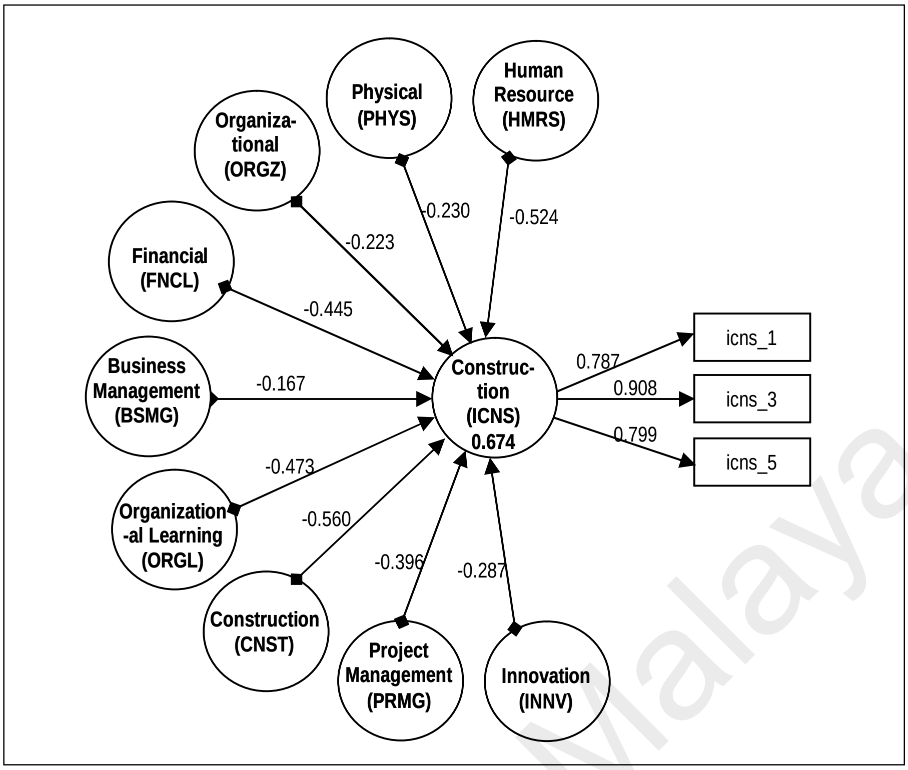


Figure 6.13: Relationships between firm's capability and ICNS

Firm's *CNST*, *HMRS*, *ORGL*, *FNCL*, and *PRMG* capabilities are crucial during construction operation. Construction firms with large-scale construction project experiences (*cnst_1*) are definite to reduce the chances of cost overrun (*icns_1*), project delay (*icns_3*), and defective work (*icns_5*). Unavailability of construction equipment will lead to project delay (*icns_3*), regular equipment maintenance (*cnst_2*) has to be performed. All subject matter experts agreed that vast construction experiences (*cnst_1*) are what any international construction firm must have accumulated before their overseas foray. Non-adherence to predetermined time, cost, and quality of any construction project will then be kept to minimum.

The firm's *HMRS* capability also plays a vital role to keep the *ICNS* risks at bay. The abovementioned construction experiences (*cnst_1*) is inadequate without competent and qualified staffs (*hmrs_4*) to keep time and cost within schedule and budget (*icns_1* and *icns_3*), and produce work in accordance with specifications and of good quality (*icns_5*). Experts agreed that competent staff is essential to manage project but qualified and good staff are leaving their firms. They try to retain and attract competent staff with better offer of good remuneration, promotion opportunity and various benefits (*hmrs_5*). In the event of project delay (*icns_3*) owing to workers low productivity and plant inefficiency, more workers are employed to accelerate the construction work (Ling & Hoi 2006). However, expert L1 commented that construction skilled labour is scarce. Hence, systematic on the job training (*hmrs_2*) is implemented to train the unskilled labour, which is obtainable from labour staffing agency. This will lower the risk of low quality or defective work (*icns_5*).

A successful construction project requires the right balance between time, cost, and quality. To achieve time, cost, and quality for a project, construction firms need *ORGL* capability. Learning from previous investments (*orgl_2*) and inter-project meetings (*orgl_1*) will provide much needed information regarding past projects and risks involved. Balancing time, cost, and quality of any project involves different risks such as cost overrun (*icns_1*), project delay (*icns_3*), and defective work (*icns_5*). All the experts agreed that project success requires a balancing act in achieving the three objectives, which tend to pull in different directions. Learning from previous projects (*orgl_1* and *orgl_2*) could shed more light on how to balance each objective without compromising the other. One expert L6 explained that while the key to project success is by achieving the right balance of time, cost, and quality, the balancing act is tricky as depends much on the project. Balancing between these three factors will vary depending on the specific requirements of a project, and their impacts on each other are unique to the project's circumstances. Expert F1 commented that those previous project cost database (*orgl_3*) helps in providing some basic to work on costing for future projects, this can mitigate the risk of cost overrun (*icns_1*) during construction operation.

Having a good financial (*FNCL*) management is important for lowering the *ICNS* risk significance value. Prior to entering into any project, quantitative evaluation of investment (*fncl_8*) is a standard practice for any construction firm. During the construction phase, the practice of matching sources and utilization of funding (*fncl_7*) must be carried out regularly. This would keep track of all expenditures, managing them within the budget set and not running into the risk of cost overrun (*icns_1*) during construction. Expert F6 commented that a good construction and management team of any firm should be able to work within a reasonable set budget. F6 added that at times, the constraint of limited budget actually stimulated creativity and innovation. Their firm had to explore creative ways in managing the daily expenditures at their firm abroad to save cost. A sound *FNCL* management (*icns_1*) does often contribute to delivering quality (*icns_5*) project and meeting deadline (*icns_3*).

The construction project will be influenced by the project management (*PRMG*) team and competency to be a success. Project cost control (*prmg_2*) is carried out at all times as Ling and Hoi (2006) pointed out the importance of devising contingency plans and paying close attention to key activities on the critical path of the program. The contingencies are downside risk estimates generally applied to cost planning and timescales to insure risks like cost overrun (*icns_1*) and project delay (*icns_3*). To mitigate the impact of project delay (*icns_3*), work acceleration has to be deployed including timely management and scheduling of material and equipment (*prmg_1*). The signs of project delay can be identified from the critical path timeline for early acceleration preparation of material and equipment scheduling and labour roster for extra work shifts. Contractor's work supervisor must monitor the project quality (*prmg_3*) to avoid defective work (*icns_5*). Expert L3 explained that it is ethical for construction firm to give quality work as per indicated in the work specification. They regretted for slack in quality control (*prmg_3*) as it consumed additional cost and time (*icns_1* and *icns_3*) for rework when work did not comply with specification and quality (*icns_5*).

PHYS capabilities are required to be able to improve construction quality and speed, and at the same time deterring cost overrun (*icns_1*), project delay (*icns_3*), and defective work (*icns_5*). Excellent construction technology (*phys_1*) and special construction equipment (*phys_2*) are able to improve the traditional construction methods and perhaps needed for unusual construction nature. Expert F7 explained that certain nature of work requires special technology and equipment (*phys_1* and *phys_2*) to expedite the work with quality. It may be costly to acquire the equipment and learn the technology at the early stage, but some investments are inevitable for a firm's expansion.

Firm should be equipped with *INNV*, *ORGZ*, and *BSMG* capabilities and these have to be regular practices, not limited to only during construction. To be able to adjust to competitive industry, construction firm should have innovation (*INNV*) capability. Risks like cost overrun (*icns_1*), project delay (*icns_3*), and defective work (*icns_5*) are commonly found in construction projects. However, *INNV* may be a solution for some recurring problems. A construction firm may implement new knowledge or technology (*innv_1*) to lower the probabilities of *ICNS* risk. *INNV* works through acquiring technology transfer (Bing & Tiong, 1999) and also preparing ready and or cheaper solution to resolve technical problems (Gurhan & Arditi, 2005). Getting new technology and solution to technical glitches needed much research and development (*innv_2*). A few experts commented that research and development is getting more common in the construction industry trailing other industries. Much manual construction methods have to be taken over by machines (*innv_3*) to expedite the work whilst reducing manpower and accidents. Expert L13 agreed and gave the example of Industrialized Building System (IBS) as one of the automated construction processes that can reduce cost in the long run (*icns_1*), shorten construction time (*icns_3*), and maintain consistency in quality (*icns_5*).

Firm's organizational (*ORGZ*) capability is to manage and monitor the operation of offices and construction projects abroad. The standard controlling and coordinating systems (*orgz_5*) and formal reporting structure (*orgz_4*) practices keep the headquarter office well informed of the project status abroad. All the experts agreed that keeping their home office informed of the project status abroad gave them time to arrange for their resource allocation especially the operating fund. Working team must alert and highlight any risks to the headquarter office in their reports. Other than regulatory or political risks, adopting latest management tools and techniques (*orgz_2*) may help to identify the *ICNS* risks. Three experts mentioned that they implemented management technique like Earned Value Management (EVM) that monitors project performance, determining whether the project is ahead of, or behind schedule (*icns_3*), and under, or over budget (*icns_1*).

Having business management (*BSMG*) capability helps firms to decrease *ICNS* risk significance values. Construction firms should have systematic formulation of long term strategy (*bsmg_2*) before their overseas foray. All the experts agreed it is imperative to observe the market and strategize their plans before ventures. This is consistent with Bing and Tiong (1999) and Han and Diekmann (2001b) who observed that market conditions and project soundness are evaluated by establishing market analysis and project feasibility study. Expert L1, L5, L7, and F5 sent their key personnel from business and development department to the intended country for market observation and networking (*bsmg_7*). The observation was ongoing for months to almost two years to be definite of their investments abroad. Knowing every nook and cranny of the construction condition, resource supplies, and political and regulations in the particular country will give firm's the added advantage to exploit positive risks and mitigate negative risks. Gunhan and Arditi (2005) also affirmed that positioning firm as specialist expertise with technological advantage and or a niche area (*bsmg_2*) helps firm to remain competitive in a foreign market.

6.3.1.4 Relationships between Firm's Capability and Owner, Design Consultant, and Supervisor (IODS) Risk

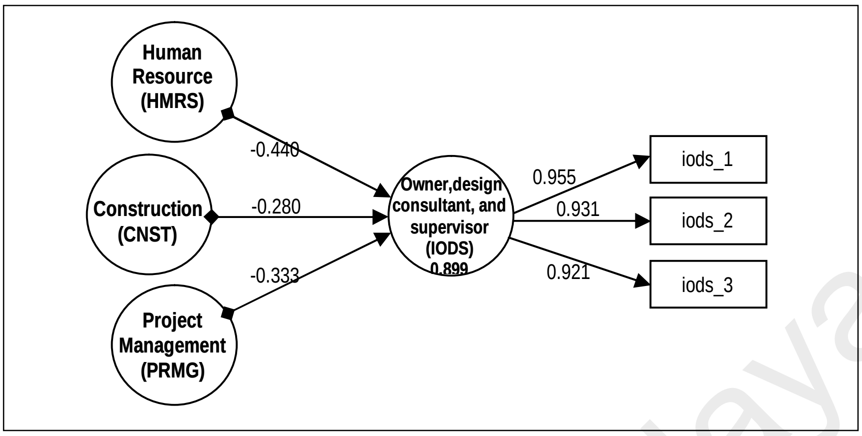


Figure 6.14: Relationships between Firm's Capability and IODS

The internal owner, design consultant, and supervisor (*IODS*) risk consisted of three indicators, they are *iods_1*: Quality of design, *iods_2*: Owner demand changes, and *iods_3*: Efficiency of owner's supervisor.

Figure 6.14 shows human resource (*HMRS*), project management (*PRMG*), and construction (*CNST*) capabilities have negative coefficients, indicating that having *HMRS*, *PRMG*, and *CNST* capabilities would lower *IODS* risk significance value. In order to significantly lower owner, design consultant, and supervisor risk significance value, construction firms must have human resource (-0.440), project management (-0.333), and construction (-0.280) capabilities.

Results show that construction firm's human resource (*HMRS*) capability is significantly important to lower the *IODS* risk significance value. Good relationship among working team (*hmrs_3*) is essential to lower *IODS* risks like owner demand changes (*iods_2*) and efficiency of owner's supervisor (*iods_3*). The working or construction team, consisting of contractor, architect and owner, is the group responsible for a project's planning, design and construction. This team is to coordinate and communicate the change of design well with each party, then address additional cost and time required for the change as well. The success of a project requires competent personnel (*hmrs_4*) in the working team to have the authority to make timely decisions on changes to cost and schedule.

The subject matter expert F3 shared that they encountered defective design (*iods_1*), owing to improper coordination among the client, engineers, and architects, which caused many changes and variations. F3 agreed that good relationship among working team and competent personnel could incorporate input from the each party and mitigate the risk of uncoordinated designs (*iods_1*). This is parallel with Enshassi, Mohamed and Abu-Mosa (2008), who found that defective design risk (*iods_1*) is mitigated with concentrated effort to coordinate between architectural and engineering designs, and that a coordinated design avoids the risks thereafter.

Results show that construction firm needed project management (*PRMG*) capability to lower *IODS* risks. It is imperative for firm to have clear project organization structure setup (*prmg_4*), this will determine the personnel who has the authority to make decision and take charge when owner demand changes (*iods_2*), poor design quality (*iods_1*), or inefficiency of owner's supervisor (*iods_3*). A working team without the right organizational structure setup will wreak havoc (Simons, 2013) when it comes to *IODS* risks. When design changes happen, *PRMG* capability like cost control (*prmg_2*) and quality control (*prmg_3*) are crucial to ensure the said changes can be executed within a reasonable budget and of good quality.

A firm's construction (*CNST*) capability is closely related to *IODS* risks. Firm's large-scale construction project experience (*cnst_1*) will provide them with ample knowledge about risks arising from *IODS*. Much prevention can be done at the early stage of construction to settle coordination and design issues with the consultants and owner. An experienced contractor would be able to capture issues in design feasibility (*iods_1*) or changes required by owner (*iods_2*) before the actual work is conducted. Expert L6 agreed that usually experienced contractor could point out design feasibility problems and counter propose solution to owner. Expert L9 added that the nature of work is the utmost important issue to consider before bidding for a job. If the nature of work is within their firm's expertise, it is not a problem for them to capture defective designs at tendering stage, and all the more if constructions are of conventional designs.

6.3.1.5 Relationships between Firm's Capability and Material and Equipment (IMEQ) Risk

The internal material and equipment (*IMEQ*) risk consisted of three indicators, they are *imeq_1*: Suitability of material and equipment, *imeq_2*: Availability of material or equipment, and *imeq_3*: Running of construction equipment.

Figure 6.15 depicts procurement (*PCRM*), construction (*CNST*), organizational learning (*ORGL*), organizational (*ORGZ*), and project management (*PRMG*) firm capabilities are negatively related to material and equipment (*IMEQ*) risk significance. These results indicate that construction firm needs procurement (-0.572), construction (-0.400), organizational learning (-0.279), organizational (-0.263), and project management (-0.224) capabilities to lower the material and equipment risk significance value.

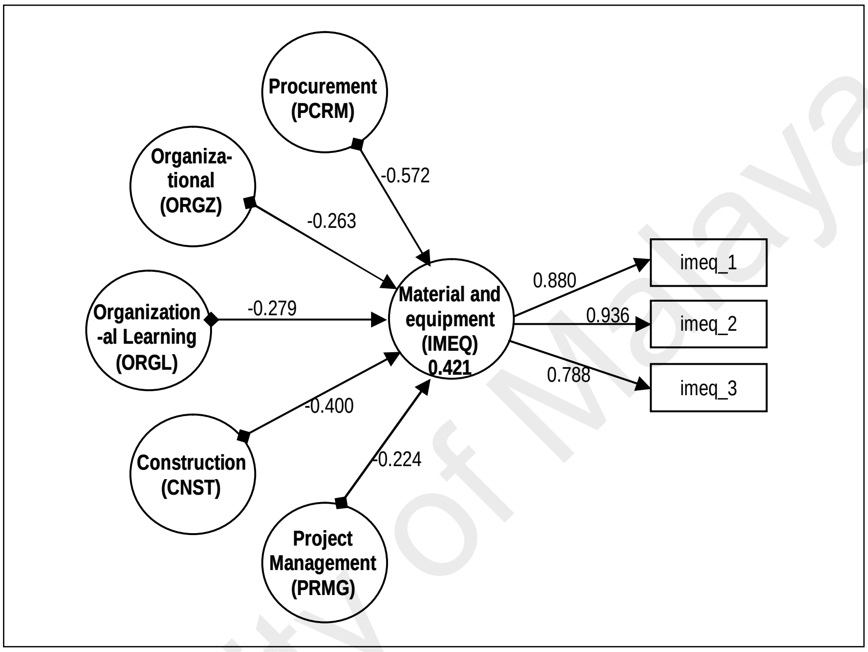


Figure 6.15: Relationships between firm's capability and IMEQ

Results show that procurement (*PCRM*) has a negative coefficient, indicating that *PCRM* is significantly important to reduce material and equipment (*IMEQ*) risk significance value. *PCRM* capability of a construction firm is largely depended upon a firm's connection with the suppliers and subcontractors. Long-term contractual relationship with suppliers (*pcrm_2*) will reduce the risk of unavailability of material or equipment (*imeq_2*). The long-term business relationship established can build better supplier credits (*pcrm_4*). F1 and L11 agreed that their firms could get material or equipment from their suppliers at better credit terms when the suppliers have been in business with them long enough. L11 and L12 emphasize having established selection criteria for suppliers and subcontractors (*pcrm_3*) to avoid suppliers and subcontractors that are not timely in delivery and service or do not supply and install quality products.

Having learnt from previous investments (*orgl_2*) or from inter-project meetings (*orgl_1*), a construction firm can understand the *IMEQ* risks. Learning from past projects handled, the firm will be more aware of the suitability of material and equipment (*imeq_1*) and similarly, the availability of those material and equipment (*imeq_2*) can be sourced earlier if they are not easily obtainable. The information is to be stored and documented as these are invaluable. The higher the *IMEQ* risks, the lower the chances a project is going to be completed on time and within budget.

The subject matter experts agreed that *IMEQ* must be managed in order to ensure smooth-running projects. F3, L7, F5, and F7 agreed that the risk of availability of material and equipment (*imeq_2*) must be managed at the beginning. They mentioned that most projects in developing areas may not be rich in manufacturing materials and equipments, most likely the materials and equipment are transported from another state or imported from another country. Time and cost to obtain the right material and equipment must be taken into account in making the cost projections. F5 added that the previous project cost database (*orgl_3*) of projects in similar host country can provide guidance to the material and equipment prices including transportation costs.

Project cost control (*prmg_2*) is important to calculate and price the costs for obtaining the material and equipment into the project amount, which includes the cost of delivery method. In addition to cost control for project, the organization needed controlling and coordinating systems (*orgz_5*) to manage the accounts (*orgz_8*) and inventory (*orgz_7*). Regular reports (*orgz_4*) should be conveyed to head office to ensure project is running healthily and on track. Without structured organization system, the head office may lose track of the project team abroad that struggles with resources obtaining material and equipment to continue with the project.

To ensure smooth running of construction operation, the risk of unavailability or breakdown of material and equipment (*imeq_2* and *imeq_3*) must be managed. The construction capability of regular equipment maintenance (*cnst_2*) is a must for construction firm. This is coupled with material and equipment scheduling (*prmg_1*). Expert L1 and L2 related that they always carry out maintenance (*cnst_2*) and scheduling of material and equipment (*prmg_1*) for their projects. The maintenance for equipment will prolong the lifespan of the equipment but when any equipment is sent for repair, a backup is scheduled to ensure running of the construction work. Adhering to the project milestone, the specific material and equipment has to be ready for the particular construction work activity. L2 added that stocking up material and equipment is also not desirable as it may consume extra storage space and or impede cash flow.

6.3.1.6 Relationships between Firm's Capability and Labour (ILAB) Risk

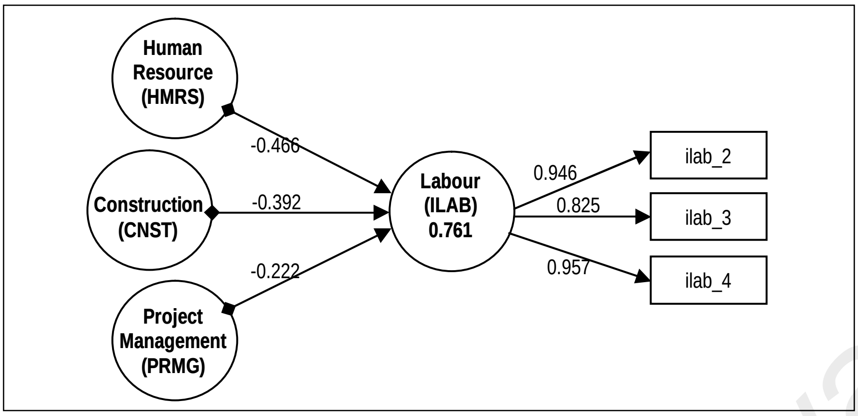


Figure 6.16: Relationships between firm's capability and ILAB

The internal labour (*ILAB*) risk consisted of three indicators, they are *ilab_2*: Gap between the implementation and specification, *ilab_3*: Availability of labour, and *ilab_4*: Quality performance.

Figure 6.16 shows human resource (*HMRS*), construction (*CNST*), and project management (*PRMG*) capabilities are negatively related to labour (*ILAB*) risk significance. This signifies the higher *HMRS, CNST*, and *PRMG* firm's capabilities, the lower the risk significance value in *ILAB.* In order to significantly reduce the labour risk significance value, construction firms must have human resource (-0.466), construction (-0.392), and project management (-0.222) capabilities.

Results depict that human resource (*HMRS*) has a negative coefficient, indicating that the better a firm's human resource capability, the lower the labour (*ILAB*) risk significance value. To address labour construction performance in the aspects of ensuring quality construction (*ilab_4*) and minimizing the gap between implementation and specification (*ilab_2*), the results suggest that construction firms should organized in-house learning and knowledge development (*hmrs_1*), systematic on the job training (*hmrs_2*) for their labour. This is not possible if a firm is without competent staff (*hmrs_4*) that can provide training and pass down knowledge.

The subject matter experts agreed that hiring and retaining qualified staff is the labour issue for construction firm. The contractors are experiencing labour shortage (*ilab_3*) especially the skilled labour, who find the job dirty and involves long working hours yet the wage does not commensurate with the job nature. The unskilled labour can be acquired from agents that bring in immigrant workforce. F3, L6, and L13 are looking into their employment package to sweeten the job position with better remuneration, promotion and benefit (*hmrs_5*) to increase the employee's commitment and loyalty (*hmrs_6*). An effective compensation package will attract, retain, and motivate staff, however, constant assessment of remuneration package is good for company's future health (Wang, 2004).

To be able to carry out quality construction, an experienced construction firm is needed. A firm with large-scale construction project experiences (*cnst_1*) with regular equipment maintenance (*cnst_2*) and facility operation tests (*cnst_3*) will be able to mitigate poor quality (*ilab_4*) in construction as well as gap between implementation and specification (*ilab_2*). Such construction experience had to be complemented with good project management (*PRMG*) capability like project quality control (*prmg_3*) with timely material and equipment scheduling (*prmg_1*) to avoid the lack of things needed in midst of construction work activity, which may compromise the construction quality.

6.3.1.7 Relationships between Firm's Capability and Political and Economic (EPOE) Risk

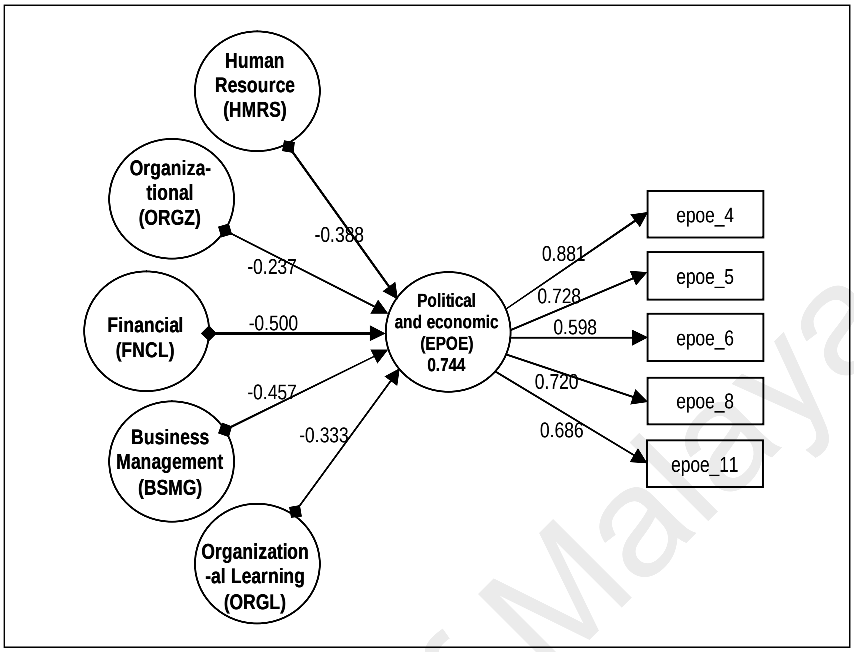


Figure 6.17: Relationships between firm's capability and EPOE

The external political and economic (*EPOE*) risk consisted of five indicators, they are *epoe_4*: Delay in approval or permit requirement, *epoe_5*: Corruption and bribe, *epoe_6*: Changes in legislation and policy, *epoe_8*: Custom and import restriction, and *epoe_11*: Economic recession.

The results in Figure 6.17 suggest that to significantly reduce the political and economic risk significance, construction firms must have its financial (-0.500), business management (-0.457), human resource (-0.388), organizational learning (-0.333), and organizational (-0.237) capabilities in place. All subject matter experts interviewed agreed that *EPOE* risks are most determining factor when it comes to deciding to go for the project of the particular country or not. The stability of the host country depends much on their political and economic stance. Therefore, the experts agreed that a strong combination of firm's financial, business management, human resource, organizational learning and organizational capabilities could counter the *EPOE* risks.

Financial (*FNCL*) and business management (*BSMG*) capabilities are two highest path coefficients toward *EPOE* at -0.500 and -0.457 respectively. In the face-to-face interviews, most experts mentioned that strong financial and business management capabilities alleviate delay issues arising from permit approval, changes in legislation and policy, and or corruption and bribe. These issues are time-consuming and they are to be calculated as risks. The relationship between financial capability and *EPOE* is consistent with Zhi (1995) and Shen et al. (2006) findings where construction firms should form cash and investment policy (*fncl_6*) that provide guidelines for those responsible for management of the company's cash for any instability caused by *EPOE* risk of foreign country.

Experts F4, L13, and L14 commented that robustness of financial and business plans was crucial in managing the *EPOE* risks. They had strategized their business plans by having good relationship with clients (*bsmg_6*) and strong networking with host country (*bsmg_7*) to understand the plight that they may need to go through. For instance, F4 mentioned one of their projects in India needed extra time when they import their materials from a state to another state. They had miscalculated the time needed for the transportation of the materials as there were restrictions along the delivery route. F4 added that corruption and bribe may be imposed to get through faster without much difficulty but it was not recommended as it will only further aggravate the corrupted construction business situation. All construction firms must not capitulate to corruption but cost in extra time for the bureaucracy. L13 and L14 also mentioned of sturdy financial reserved (*fncl_4*) and physical assets (*fncl_2*) are able to support the cash flow needed at time of delay. L14 described that the liquidity from other projects in hand can be borrowed to cover for the urgent need of the international project.

The issue described by F7 emphasized the importance of networking to learn the knack of doing business at the host country. It is important for international construction firms to establish international network and maintain close relationship with local government officials to ease political risk and bureaucracy (Gunhan & Arditi, 2005; Zhi, 1995; Han & Diekmann, 2001). Majority of the subject matter experts emphasized having competent staff (*hmrs_4*) with international construction experience, they will be able to handle the projects with their invaluable knowledge. In order to keep the competent staff, experts agreed that firm should offer them good remuneration, promotion and benefit (*hmrs_5*) package. Ten firms also mentioned appointing local consulting firm as another option to hiring competent staff.

Wang et al. (2004) found that reputable third party consultant is usually employed by firms to forecast market demand of the foreign country. Gunhan and Arditi (2005) also mentioned engaging local consultant's service to scout local markets and provide periodic reports. F2, L5, L10 and F5 had strategized for long term plan (*bsmg_2*) to fuel the bottom lines of their home countries' businesses by sending their competent staff to the targeted host country to scout for opportunities and observe the *EPOE* status. F2 even had their staff there for almost two years to establish networking with local officials and report back to home country on the *EPOE* stability.

Experts L1 and L12 mentioned that all the information and reports gathered about the host country are to be properly documented as future endeavors' learning reference. These would be the past database (*orgl_2* and *orgl_3*) for organizational learning purpose. L12 added a systematic and structured business plan (*orgz_3*) with formal reporting structure (*orgz_4*) had to be implemented in any firm since projects differed from one another and the proper documentation structure would be the link for organizational and project learning. L1 also emphasized the formal reporting structure (*orgz_2*) to control and coordinate the financial system (*orgz_5*). L1 explained with example of his firm's practice that matching sources and utilization of funding (*fncl_7*) must be done in periodic reports (*orgz_4*) during the operation of construction to monitor (*orgz_5*) the cash flow for the project.

6.3.1.8 Relationships between Firm's Capability and Third Party (ETRP) Risk

The external third party (*ETRP*) risk consisted of five indicators, they are *etrp_1*: Public security, *etrp_2*: Security of material and equipment, *etrp_3*: Entrance guard of site, *etrp_4*: Industrial relation action, and *etrp_5*: Public opinion.

Figure 6.18 suggests that to significantly reduce the third party risk significance, construction firms must have its organizational learning (-0.311), construction (-0.308), human resource (-0.270), organizational (-0.192), and business management (-0.181) capabilities in place. Majority of the subject matter experts interviewed did not encounter *ETRP* risk like security or protest problems, however some had taken extra precautions from previous project experience.

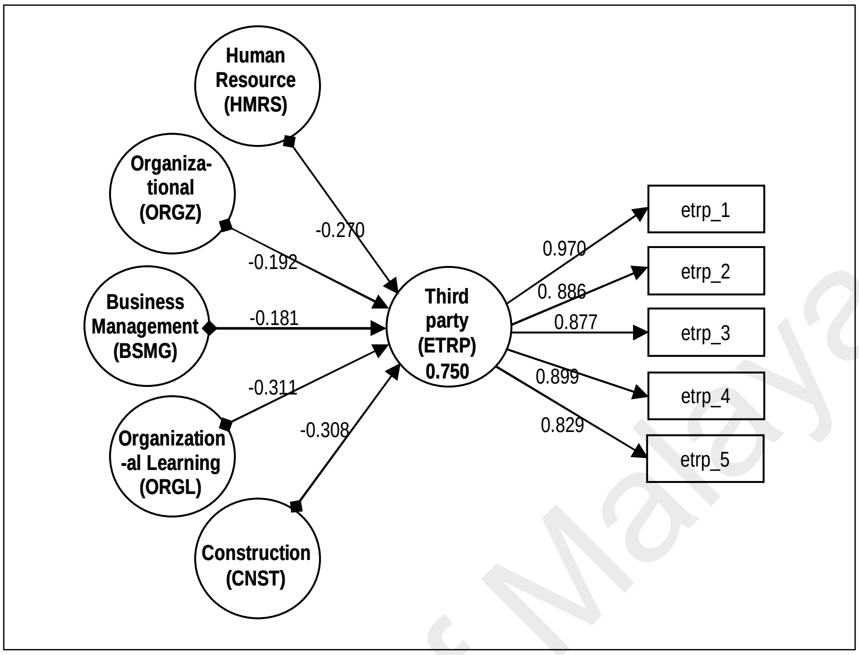


Figure 6.18: Relationships between firm's capability and ETRP

The relationship between organizational learning (*ORGL*) and *ETRP* is affirmed by most experts as their firms gain knowledge through learning from past projects and other project teams (*orgl_1, orgl_2, orgl_3*). Much information can be gathered regarding crime and security conditions (*etrp_1, etrp_2*) of the host country. Some of the experts described specific situations on learning *ETRP* risks from *ORGL* and precautionary measures taken. L6 and L12 had projects ongoing in countries that were less safe for women; their firms made it a point not to send their female staff when handling projects in the particular countries.

The result indicates more of construction (*CNST*) capability will lead to lower risk significance of *ETRP*. This suggests that if contractors want to lower *ETRP* risk significance, they should have large-scale construction project experiences (*cnst_1*), regular equipment maintenance (*cnst_2*), and testing of facility operations (*cnst_3*). Construction firms with large-scale construction project experiences (*cnst_1*) are known to be experienced in managing stakeholders including public opinion (*etrp_5*) and industrial relation action (*etrp_4*). They would have taken out insurance to cover the increasing costs from the third party (Kinnunen, 2000). A subject matter expert F4 expressed that large projects normally involve many stakeholders and it is a norm to have third party (*ETRP*) risks involving stakeholders (*etrp_4* and *etrp_5*). If the dissatisfaction of the stakeholders especially the public is not well managed, this could lead to late site possession. The protest normally occurs at the preliminary stage and is handled by client's side. However, late site possession will be a challenge for incapable contractor.

To achieve low risk significance value for *ETRP*, construction firms should have good human resource capability. Handling the *ETRP* risks, the firms should train their staff (*hmrs_1* and *hmrs_2*) to manage issues arising from the third party to ease the process of their construction business. Experts L10 and L12 shared that they have a corporate communication department that handles the issues raised particularly from the public (*etrp_5*) regarding projects that they are undertaking. L12 mentioned that the corporate communication personnel are competent to handle the issues from project. The corporate communication team would have meetings with top management to decide on the direction and strategy to deal with the public. They have protocol to adhere to when dealing project issues. In response to public concerns, they disclose news stage by stage to media at press conference on the project progress and today they even respond to comments at social media platform.

The results also show that organizational capability (*ORGZ*) helps firms to lower ETRP risk significance value. Firm's organizational capability helps to improve the security (*etrp_1, etrp_2,* and *etrp_3*) at construction site which then minimizes loss from theft and or sabotage. Most subject matter experts agreed that thefts at site rarely happen. This is because most construction firms practice inventory management (*orgz_7*) coupled with proper controlling and coordinating system (*orgz_5*) when managing the construction site daily activities. Two experts related two different incidents on security of material and equipment (*etrp_2*).

F2 mentioned an insider theft job happened at the construction site. The theft of construction material was not discovered until it occurred for the third time because they were not properly monitored when site guard and site employees allied to steal. The loss was only discovered when the site administrator reported the loss during inventory management. Investigation was only launched thereafter. F5 mentioned that the controlling and coordinating must be conducted regularly and it helps to monitor the construction site.

L8 also shared an experience of sabotage of construction equipment at their site. Some foreign workers attempted to sabotage the equipment to delay the construction work for certain reason. However, their attempt was to no avail as L8 conducted regular equipment maintenance (*cnst_2*) as an insurance against project delay. L8 added that if any common construction equipment was down for operation, they must have backups.

Firm's business management (*BSMG*) capability is significantly important to reduce *ETRP* risks. A construction firm with excellent reputation on project record (*bsmg_5*) helps to ease the tense situation of public opinion (*etrp_5*). Expert L1 mentioned that the public has more confidence in a reputable contractor and the public opinion hurled towards the contractor might not be too severe.

6.3.1.9 Relationships between Firm's Capability and Cultural (ECUL) Risk

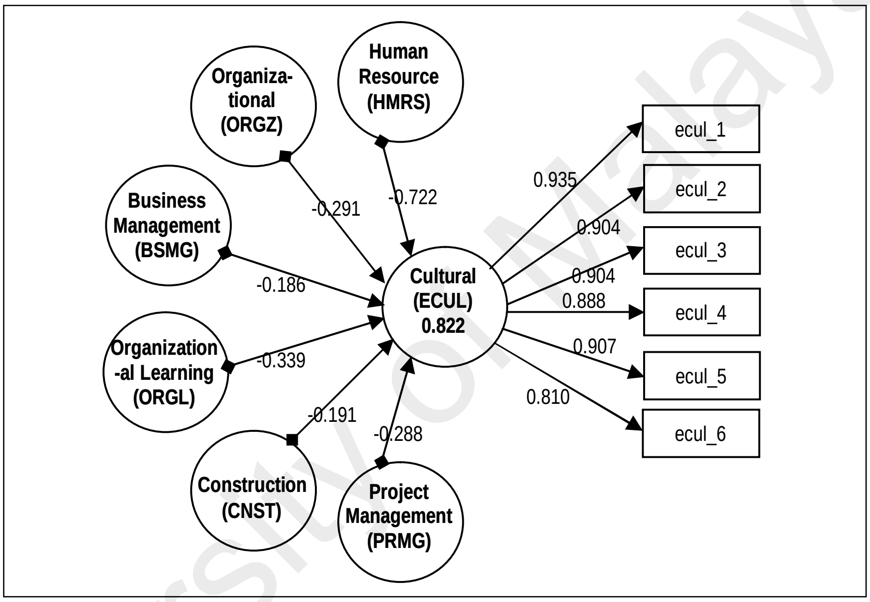


Figure 6.19: Relationships between firm's capability and ECUL

The external cultural (*ECUL*) risk consisted of six indicators, they are *ecul_1*: Cultural difference including language barrier, *ecul_2*: Level of cooperation, *ecul_3*: Need for micro-management, *ecul_4*: Compliance with written contract, *ecul_5*: Ease of settling dispute, and *ecul_6*: Safety awareness.

Figure 6.19 suggests that to significantly reduce the cultural risk significance, construction firms must have its human resource (-0.722), organizational learning (-0.339), organizational (-0.291), project management (-0.288), construction (-0.191), and business management (-0.186) capabilities in place. All subject matter experts believed that *ECUL* risks are faced by contractors when undertaking construction projects in a foreign land. The cultural differences and working know how are vastly different for a construction firm coming from a totally different region of the world. Hence, the experts agreed that a strong combination of firm's human resource, organizational learning, organizational, project management, construction and business management capabilities could lower the *ECUL* risk significance values.

Results show that human resource (*HMRS*) capability is highly significant to counter cultural (*ECUL*) risks. Competent staffs (*hmrs_4*) are crucial when it comes to overseas foray since cultural difference (*ecul_1*) can be adapted easily. To overcome low level of cooperation (*ecul_2*), need for micro-management (*ecul_3*), or low level of safety awareness (*ecul_6*), proper staffs preparation like in-house learning and knowledge development (*hmrs_1*) and on the job training (*hmrs_2*) are required. Applicants for international positions are to be selected based on their competence, adaptability, and personal characteristics. Relevant training and development are critical for international business success for both employees and companies (Dlabay & Scott, 2011).

The organizational learning from previous investments (*orgl_2*) would reveal a certain countries' culture in complying with written contract (*ecul_4*) and settling dispute (*ecul_5*). When facing problems like *ecul_4* and *ecul_5*, proper documentation is pertinent to record facts, emails, meeting minutes, reports and the like. In view of these cultural differences, organizational capability is crucial for it has a structured system in controlling, coordinating (*orgz_5*), and reporting (*orgz_4*).

On top of that, proper managements of legal, finance, accounting and even public affairs (*orgz_8*) will give consistency to present a strong case in any legal disputes.

All subject matter experts agreed that organizational capability assists in handling risks such as *ecul_4* and *ecul_5* and not only that this capability facilitates the management and monitoring of the firm itself especially on financial health and firm growth. L1 and L9 related particularly on the ‘timing’ of the documentation practice. Both L1 and L9 emphasized on the chronological order of the facts, emails, meeting minutes, reports, et cetera recorded must be in good sequence. Many times the exact ‘time’ documented on any document are the determining factor to win a case in court or to settle a dispute amicably.

Clear project organization structure setup (*prmg_4*) is a must to manage organization staff. Organization structure helps to determine task allocation, coordination, and supervision clearly. With the clear organization structure, this can lower the risks of non-cooperation (*ecul_2*) and micro-management (*ecul_3*) among staff.

Vast construction project experiences (*cnst_1*) do contribute to lowering cultural difference (*ecul_1*). This is true when a construction project is undertaken at culturally rich countries. L5 related an experience when handling a mix development project at one of the developing countries. They were carrying out the project on a piece of cemetery land. The relocation of the graves was obstructed by the locals unless the contractor hired shamans to have a week-long ceremony to relocate the graves one by one. L5 was not informed by the client and suffered some loss for construction time and sabotage at site.

Cultural risks are minor issues if one understands and knows the ways to them. To understand the cultures, it takes time to digest the information and strategize (*bsmg_2*) before venturing abroad. Many subject matter experts agreed that studying the targeted countries and their construction industries are crucial before their ventures. Prior to their overseas ventures, experts sent their business and development personnel over to the particular country to observe the culture and establish networking (*bsmg_7*) with local officers and agents. This is consistent with Ling and Hoi (2006) who mentioned that to lower cultural risk, contractors spend much time in a foreign country to know more about the country and establish relationships with the locals. Contractors also arranged staff to be stationed in that foreign country for a certain period to handle projects there.

6.3.1.10 Relationships between Firm's Capability and Logistics (ELGT) Risk

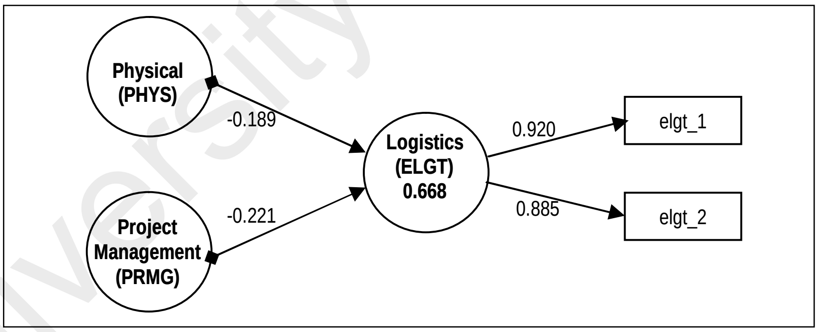


Figure 6.20: Relationships between firm's capability and ELGT

The external logistics (*ELGT*) risk consisted of *elgt_1*: Loss or damage in the transportation of material and equipment and *elgt_2*: Lack of access and communication.

Figure 6.20 shows physical (*PHYS*) and project management (*PRMG*) capabilities have negative coefficients, indicating that less of *PHYS* and *PRMG* would lead to higher risk significance value in *ELGT*. In order to significantly reduce the logistics risk significance value, construction firms must have physical (-0.189) and project management (-0.221) capabilities.

To minimize the risk of loss or damage in the transportation of material and equipment (*elgt_1*), project management (*PRMG*) capability is needed. Before committing to a supplier, construction firm must evaluate suppliers and subcontractors' performance (*prmg_5*). There are times when the loss and damage of material and equipment is due to supplier's fault for engaging a poor logistic company to save cost. To respond to loss or damage of material and equipment, it is necessary for construction firm to contract with suppliers who can deliver the goods speedily. Construction firms have to wisely manage the material and equipment scheduling (*prmg_1*) to lower the risk significance of *ELGT* cropping up. The subject matter experts L1, L2, L7, and F6 agreed that they did schedule the required materials and or equipments reasonably earlier than the commencement of the scheduled work. L2 added that scheduling of equipment (*prmg_1*) works not only for unavailability due to logistic problem; it also applies for sudden breakdown of equipment. Construction firm has to prepare backups for frequently used equipment that may often have overworked.

The risk of lack of access and communication (*elgt_2*) is little encountered for sites that are not too remote. With the advent of telecommunication (*phys_3*) and information technology, the regular communication and update received from project team outside home country is possible. Access and communication (*elgt_2*) is made possible with the advent of communication technology and globalization of markets.

6.3.1.11 Relationships between Firm's Capability and Natural Environmental (ENAE) Risk

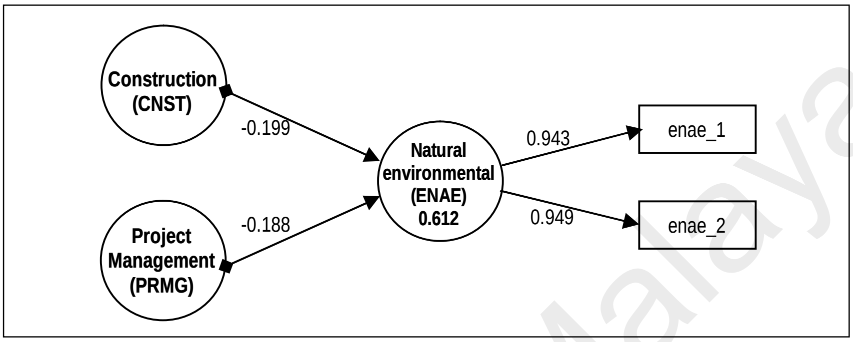


Figure 6.21: Relationships between Firm's Capability and ENAE

The external natural environmental (*ENAE*) risk consisted of *enae_1*: Act of God (including fire, flood, earthquake, storm, hurricane or other natural disaster) and *enae_2*: Unforeseen ground condition.

Figure 6.21 shows construction (*CNST*) and project management (*PRMG*) capabilities have negative coefficients, indicating that having *PHYS* and *PRMG* capabilities would lower *ENAE* risk significance value. In order to significantly lower natural environmental risk significance value, construction firms must have construction (-0.199) and project management (-0.188) capabilities.

Incorporation of natural hazard and risk assessment information into the development planning process is most evident to manage *ENAE* risks for sound environmental management (Tobin & Montz, 1997). A combination of both vast experience in large-scale construction projects (*cnst_1*) and quality control (*prmg_3*) helps to manage projects from risks like act of god (*enae_1*) and unforeseen ground condition (*enae_2*). L3 and F3 also mentioned about *ENAE* risks for projects outside their home countries. Some *ENAE* are predictable and probably can be forecasted, they can take precautions; some *ENAE* are not predictable and or detected from tests, they need to accelerate and reschedule the construction milestones to ensure project completion.

L3 shared that they encountered projects where flash flood (*enae_1*) occurs and their previous project experience (*cnst_1*) taught them to schedule material and equipment (*prmg_1*) according to weather season. This consistent with Ling and Hoi (2006) who mentioned that contractors make arrangements to complete the affected work earlier to avoid risk of inclement weather. F3 mentioned that quality must not be compromised. Certain work like concreting and curing must not be scheduled during rainy season to ensure quality of the structure. This will also ensure that no additional costs for rework incurred when structure quality failed at work inspection by consultant.

L15 mentioned that their large-scale construction project experiences (*cnst_1*) helped them when undertaking a project at a desert country. The risk of unforeseen ground condition (*enae_2*) was not detected in the geotechnical soil test but L15 insisted to price in the risk of unforeseen ground condition to avoid making losses. They were not awarded the project as another counterpart of same home country, being the lowest priced, was given the project. This firm was unable to complete the project and brought the case to litigation. Pricing (*prmg_2*) in unforeseen ground condition (*enae_2*) and inclement weather (*enae_1*) is crucial for contractors who are going for projects with non-familiar natures. Other than project management capability, Ling and Hoi (2006) and Zou et al. (2007) found some firms make arrangement in contract to transfer the risk of bad soil condition to clients prior to construction.

6.4 Summary of Chapter

This chapter reports and discusses qualitative research results gathered from 22 interviews on both the measurement models and structural model. The ten formatively measured variables of firm's capabilities constructs for capability-risk assessment (CapRA) model are discussed. The exogenous latent variables consist of *BSMG, CNST, FNCL, HMRS, INNV, ORGZ, ORGL, PHYS, PRMG,* and *PCRM* firm's capabilities. Each construct is discussed on the relationship between the indicators and their firm's capability construct. The endogenous latent variables consist of *IFNC, IMGR, ICNS, IODS, IMEQ, ILAB, EPOE, ETRP, ECUL, ELGT,* and *ENAE* risks. The reflectively measured variables for each risk construct are also discussed.

The fourth objective of this research is to develop an empirical risk assessment model to facilitate construction firm's international project selection decision by incorporating firm's capabilities component, this is achieved by the results of the structural model. The developed model is known as capability-risk assessment (CapRA) model. The results of the structural model are discussed based on the findings of the interviews. It is also discovered that four firm's capabilities have less influence on the international risks studied, they are financial (*FNCL*) capability with only three significant path coefficients, innovation (*INNV*) capability with only one, physical (*PHYS*) and procurement (*PCRM*) capabilities with two each. This suggests that human resource (*HMRS*), organizational (*ORGZ*), business management (*BSMG*), organizational learning (*ORGL*), construction (*CNST*), and project management (*PRMG*) capabilities are more influential towards international construction risk significances.

The next chapter presents the validation and application of the CapRA model.

CHAPTER 7
MODEL VALIDATION AND APPLICATION

7.1 Introduction

This chapter reports the model validation and application of the structural model developed in Chapter 5. The transformation of the structural model into a remodeled probability-impact risk model is discussed. This transformation involves the formulation of equations to be computed in the Capability-based Risk Assessment (CapRA) calculator. This is followed by the testing of the CapRA model cum calculator developed. The practicality and application of the CapRA model cum calculator are later described.

7.2 Transforming the Probability-Impact Risk Model

The final objective of this study is to validate the risk assessment model developed through actual testing on international construction firms (Section 1.4). Prior to putting the model to test, the model developed from this study is transformed into a remodeled Probability-Impact (P-I) risk model, hereby known as the capability-risk assessment (CapRA) model. The conventional P-I risk model is first explained, followed by the 'upgraded' P-I model with added feature or CapRA model. In next section, CapRA model is formulated into a CapRA calculator to facilitate application and accuracy test.

7.2.1 The Conventional P-I Risk Model

The Probability-Impact (P-I) risk model has been adopted by researchers since the 1980s till post 2005 and it is still dominating the risk management literatures (Taroun, 2014). In this study, the authors remodelled the P-I risk model to incorporate firm's capabilities in the assessment based on data collected.

The conventional P-I risk model considers two attributes for a risk: the probability or likelihood level of risk occurrence, denoted by α; and the magnitude of impact or severity if this risk occurs, denoted by β. In this approach, the users were asked to rate the two attributes for each risk. For α, the users rate probability level of risk occurrence of a particular risk from five a 5-point Likert scale from "never" to "always". For β, the users rate the magnitude of impact if the said risk occurs by selecting from a 5-point Likert scale of "not at all" to "very high". The relative significance among risks is then established by a Risk Significance index, which is the multiplication of the probability of risk occurrence and the degree of impact. Thus, the significance score for each risk assessed is represented by the P-I risk model:

$$S^i = \alpha^i \beta^i \qquad \text{Eq. 7-1}$$

Where S^i = significance score assessed risk i;

α^i = probability of occurrence of risk i; and

β^i = degree of impact of risk i.

7.2.2 The Capability-Risk Assessment Model

In this study, the authors incorporated the relationships between firm capability and risk significance value into the existing function of P-I risk model, which is also known as the Capability-Risk Assessment (CapRA) model. Since Dikmen and Birgonul (2006) and Han amd Diekmann (2001) asserted that risk assessment depended on many factors related to capabilities of the firms, it is deduced that firm's capabilities is one of the influencing factors that is highly related to the accuracy of risk assessment. Firm's capabilities acts as mitigation; it decreases the probability of the risk event and the impact. This study gathered the past experience of international contractors to develop CapRA model as follows:

$$S^i = \propto^i \beta^i \left\{1 + R^{2i}\left[\frac{\sum_k^n a_k x_k}{n}\right]\right\} \qquad \text{Eq. 7-2}$$

Where S^i = significance value assessed of risk *i*;

α^i = probability of occurrence of risk *i*;

β^i = degree of impact of risk *i*;

R^{2i} = coefficient of determination of risk *i*;

a_k = constant of firm's capability *k*;

x_k = capability of *k* rated as -1 or 0 or +1; and

k = 1, 2, 3, …, *n*.

The mathematical formulation of this CapRA model is translated as the coefficient of determination of risk *i*, R^{2i} represents the portion of significance score of risk *i*, S^i influenced by firm's capability, *k*, where the firm's capability is represented by a constant (or path coefficient), a_k and its rating on the particular firm's capability, x_k.

The calculation of S^i is based on the user's ratings on five-point scales for α *and* β (never-always and not at all-very high). For the purpose of computing, the scales are converted to numerical scales 0 to 1. This study assigned a value of 1.0 to "always" or "very high"; a value of 0.75 to "very often" or "high"; a value of 0.50 to "sometimes" or "medium"; a value of 0.25 to "rarely" or "low"; and a value of 0 to "never" or "not at all" as adapted from (Shen, Wu, & Ng, 2001; Zou, Zhang, & Wang, 2007).

The newly incorporated constant of firm's capability, a_k is path coefficient obtained from PLS-SEM structural model as presented in Figure 5.2. Users are required to rate firm's capability *k*, which reflects their firm's environment in x_k. The firm's capability of *k*, x_k can only be rated in forms of agree, neutral, or disagree, which each is represented by value of +1, 0 or -1 respectively.

The coefficient of determination of risk *i*, R^{2i} represents the firm's capability combined effects on the risk significance. In other words, it represents the amount of variance in the endogenous constructs (risk significances) explained by all of the exogenous constructs (firm's capabilities) linked to it. The values of R^{2i} are also found in Figure 5.2.

From the final PLS-SEM structural model in Figure 5.2, different sets of firm's capabilities are statistically significant predictors of international project risks. The models to predict risk significance values for the international project risks are listed in Table 7.1 based on Eq. 7-2.

Table 7.1: Equations for CapRA model

Risk	CapRA Model Equation
	Internal Risks
Financial *(IFNC)*	$S^{IFNC} = \alpha^{IFNC} \beta^{IFNC}$ {1 + 0.690 [(-0.677FNCL) + (-0.412BSMG) + (-0.394CNST) + (-0.333ORGL) + (-0.245PRMG) + (-0.238PCRM) + (-0.176ORGZ)]/7)}
Managerial *(IMGR)*	$S^{IMGR} = \alpha^{IMGR} \beta^{IMGR}$ {1 + 0.658 [(-0.610HMRS) + (-0.459CNST) + (-0.393BSMG) + (-0.344ORGL) + (-0.343ORGZ) + (-0.295PRMG)]/6)}
Construction *(ICNS)*	$S^{ICNS} = \alpha^{ICNS} \beta^{ICNS}$ {1 + 0.674 [(-0.560CNST) + (-0.524HMRS) + (-0.473ORGL) + (-0.445FNCL) + (-0.396PRMG) + (-0.287INNV) + (-0.233ORGZ) + (-0.230PHYS) + (-0.167BSMG)]/8)}
Owner, design consultant, and supervisor *(IODS)*	$S^{IODS} = \alpha^{IODS} \beta^{IODS}$ {1 + 0.899 [(-0.440HMRS) + (-0.333PRMG) + (-0.280CNST)]/3)}
Material and equipment *(IMEQ)*	$S^{IMEQ} = \alpha^{IMEQ} \beta^{IMEQ}$ {1 + 0.421 [(-0.572PCRM) + (-0.400CNST) + (-0.279ORGL) + (-0.263ORGZ) + (-0.224PRMG)]/5)}
Labour *(ILAB)*	$S^{ILAB} = \alpha^{ILAB} \beta^{ILAB}$ {1 + 0.761 [(-0.466HMRS) + (-0.392CNST) + (-0.222PRMG)]/3)}
	External Risks
Political and economic *(EPOE)*	$S^{EPOE} = \alpha^{EPOE} \beta^{EPOE}$ {1 + 0.744 [(-0.500FNCL) + (-0.457BSMG) + (-0.388HMRS) + (-0.333ORGL) + (-0.237ORGZ)]/5)}
Third party *(ETRP)*	$S^{ETRP} = \alpha^{ETRP} \beta^{ETRP}$ {1 + 0.750 [(-0.311ORGL) + (-0.308CNST) + (-0.270HMRS) + (-0.192ORGZ) + (-0.181BSMG)]/5)}
Cultural *(ECUL)*	$S^{ECUL} = \alpha^{ECUL} \beta^{ECUL}$ {1 + 0.822 [(-0.722HMRS) + (-0.339ORGL) + (-0.291ORGZ) + (-0.191CNST) + (-0.186BSMG)]/5)}
Logistics *(ELGT)*	$S^{ELGT} = \alpha^{ELGT} \beta^{ELGT}$ {1 + 0.668 [(-0.221PRMG) + (-0.189PHYS)]/2)}
Natural environmental *(ENAE)*	$S^{ENAE} = \alpha^{ENAE} \beta^{ENAE}$ {1 + 0.612 [(-0.199CNST) + (-0.188PRMG)]/2)}

7.3 Validating the Capability-Risk Assessment Model

The quantitative validation on the CapRA equations can be found in Section 5.3.6 on effect sizes and predictive relevance. This section will discuss on the validation on CapRA model based on experts' comments.

7.3.1 Validation Phase

After the models were formulated in remodeled equations (Table 7.1), they were computerized into a CapRA calculator to predict risk significance values for international construction projects. For the validation to test the CapRA calculator, instead of analyzing the individual cases provided by experts, this study applied case control method with three random cases selected from previous data collection. The reason to choose three cases and twelve construction firms is because Flick (2008) mentioned that data triangulation combines data drawn from different sources and at different times, in different places or from different people. Hammersley and Atkinson (1983) stated that data sources for a single phenomenon should be collected from at least three sources. This increases the validity of the information collected. The experts had to fill in their firm's capabilities to predict the risk significance values for these three cases (see Appendix B-1 to Appendix B-3).

After filling in the CapRA calculator, the validation experts were each given a validation survey (see Appendix C). This validation survey was prepared to seek the experts' comments on the practicality and comprehensiveness of the CapRA model. The validation survey request was sent out to twenty international construction firms that did not participate in the questionnaire survey during data collection stage and twelve agreed to participate in the face-to-face validation survey. The demographic information of the twelve international construction firms is shown in Table 7.2.

In the validation stage of this study, twelve international construction firms (T1 to T12) participated in the validation of the developed model. All twelve firms have offices in Malaysia and overseas, seven originated from Malaysia and five others from Japan, China, Korea, Australia, and Italy. The profile of these respondents shows that three of them are directors, two are associate directors, and seven are senior managers. They have on average 25 years of construction experience. The experts' designations and work experience suggest that they are able to contribute relevant information to this study.

7.3.2 Testing the CapRA Calculator Prototype

The data collected from the validation process was used to test the CapRA model. Using the equations in Table 7.1, the risk significance values for the three case control projects can be predicted in the CapRA calculator (Figure 7.1). Two out of the three case control data projects have similar risk significance values before applying the CapRA model. The computed CapRA results were then compared to the conventional Probability-Impact risk model results. Figure 7.2 consists of steps of CapRA calculator test with the graphical user interface (GUI) on the left and translated mechanism and computation on the right.

Table 7.2: Demographic information of international construction firms participated in models validation

Description	Frequency	%
Firm's home country		
Local	7	58.3
Foreign (Japan, China, Korea, Australia, Italy)	5	41.7
Firm's years of operation		
>20≤30 years	1	8.3
>30≤40 years	3	25.0
>40≤50 years	3	25.0
>50 years	5	41.7
Firm's years of operation outside home country		
≤10 years	1	8.3
>10≤20 years	4	33.3
>20≤30 years	2	16.7
>30≤40 years	0	0.0
>40≤50 years	3	25.0
>50 years	2	16.7
Firm's entry mode into international construction		
Wholly-owned foreign subsidiary firm	5	41.7
Joint venture with another firm	5	41.7
Both types of entry mode	2	16.6
Designation of respondents		
Director	3	25.0
Associate director	2	16.7
Senior manager	7	58.3
Respondent's years of experience		
>20≤30 years	11	91.7
>30 years	1	8.3

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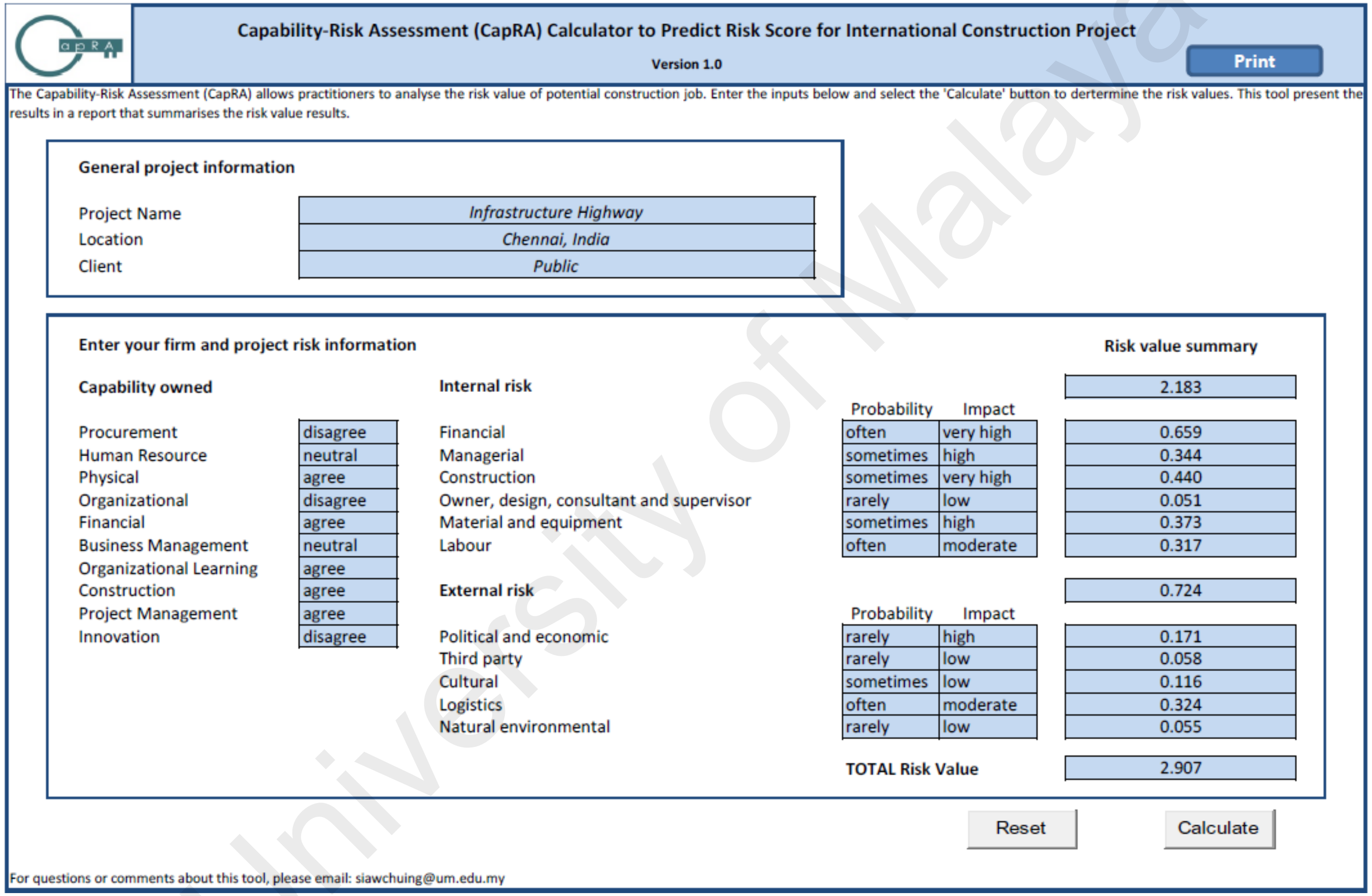

Figure 7.1: CapRA calculator

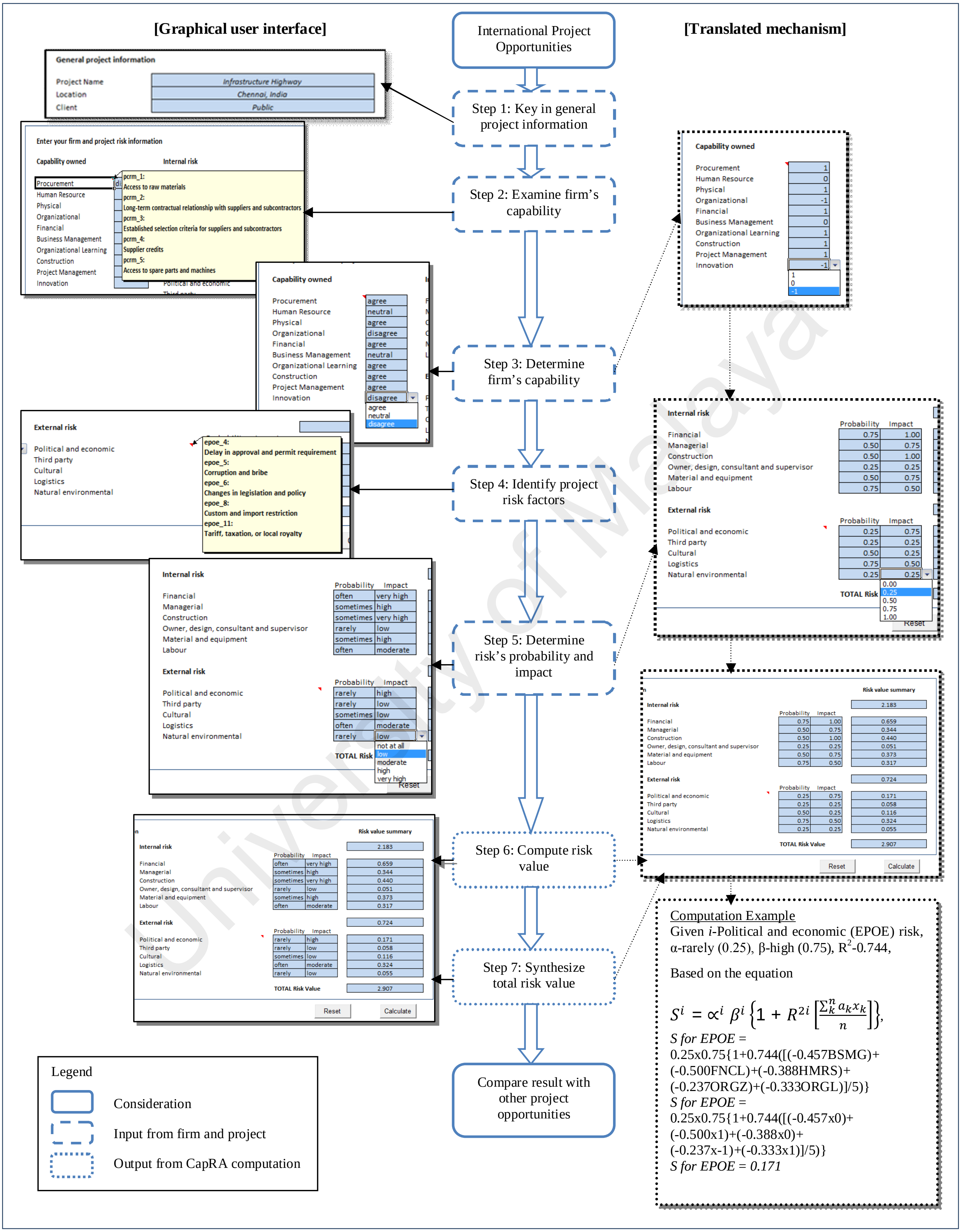

Figure 7.2: Mechanism and interface of CapRA model

7.3.2.1 Mechanism and Computation of CapRA Calculator

International Project Opportunities

In this test, each international construction firm (Company T1 to T12) was to select one of the international construction opportunities to go for after the Capability-Risk Assessment (CapRA) calculation. The three real data case control projects were derived from past projects completed within 2008 to 2013; they were given ratings of a poor and two moderate (with similar risk significance values prior to CapRA calculation) projects.

Step 1: Key in general project information

Each international construction firm is to key in general information of the project considered such as project name, location, and client. In this prototype test, the projects' information was preset.

Step 2: Examine firm's capabilities

Construction firms are required to assess their firm's capabilities by first considering the indicators of firm's capabilities as indicated in comment box as shown in Figure 7.2. For example, procurement capability is referred to *long-term contractual relationship with suppliers and subcontractors (pcrm_2)*, *established selection criteria for suppliers and subcontractors (pcrm_4)*, and *supplier credits (pcrm_5)*.

Step 3: Determine firm's capabilities

Construction firms then rate the firm's capabilities that best reflect their firm's current conditions in a three-point scale of agree, neutral, and disagree. For the computation of CapRA calculator, the firm's capabilities linguistic ratings in the graphic user interface were translated into 1 for 'agree', 0 for 'neutral', and -1 for 'disagree'. The construction firms rated their firm's capabilities in this CapRA calculator test as follow:

Construction firm T1 rated ‘neutral’ for their firm’s organizational, financial, organizational learning, and construction capabilities, and ‘disagree’ for procurement, human resource, physical, business management, project management, and innovation capabilities.

Construction firm T2 rated ‘agree’ for physical, financial, organizational learning, construction, and project management capabilities, ‘neutral’ for human resource and business management capabilities, and ‘disagree’ for procurement, organizational, and innovation capabilities.

Construction firm T3 rated ‘agree’ to all firm’s capabilities.

Construction firm T4 rated ‘agree’ for human resource, physical, financial, construction, and project management capabilities, and ‘neutral’ for their firm’s procurement, organizational, business management, organizational learning, and innovation capabilities.

Construction firm T5 rated ‘agree’ to all firm’s capabilities except for a ‘neutral’ for innovation capability.

Construction firm T6 rated ‘agree’ for human resource, physical, organizational, financial, business management, construction, and project management capabilities, and ‘neutral’ for their firm’s procurement, organizational learning, and innovation capabilities.

Construction firm T7 rated ‘agree’ for human resource, physical, organizational, financial, organizational learning, construction, and project management capabilities, ‘neutral’ for their firm’s procurement, and business management capabilities, and ‘disagree’ for innovation capability.

Construction firm T8 rated ‘agree’ for all firm’s capabilities except for a ‘neutral’ for procurement capability.

Construction firm T9 rated ‘agree’ for human resource, physical, financial, organizational learning, construction, and project management capabilities, ‘neutral’ for their firm’s organizational, business management, and innovation capabilities, and ‘disagree’ for procurement capability.

Construction firm T10 rated ‘agree’ for procurement, physical, financial, business management, organizational learning, construction, and project management capabilities, and ‘neutral’ for their firm’s human resource, organizational, and innovation capabilities.

Construction firm T11 rated ‘agree’ to all firm’s capabilities.

Construction firm T12 rated ‘agree’ for human resource, organizational, financial, business management, organizational learning, construction, project management, and innovation capabilities, ‘neutral’ for their firm’s physical capability, and ‘disagree’ for procurement capability.

Step 4: Identify project risk factors

Construction firms are required to assess risks present in the potential project by first considering the indicators for a particular risk category as indicated in comment box as shown in Figure 7.2. For example, external political and economic risk (*EPOE*) consists of indicators like delay in approval and permit requirement (*epoe_4*), corruption and bribe (*epoe_5*), changes in legislation and policy (*epoe_6*), custom and import restriction (*epoe_8*), and tariff, taxation, or local royalty (*epoe_11*).

Step 5: Determine risk's probability and impact (α, β)

Construction firms then determine risks present in potential project in terms of likelihood of occurrence (α) and magnitude of impact (β). For the purpose of validation, the α, β ratings for the three case control projects are provided to standardize the projects studied (or act as controlled variables). The linguistic ratings were translated into values; a value of 1.0 for “always” or “very high”; a value of 0.75 for “very often” or “high”; a value of 0.50 for “sometimes” or “medium”; a value of 0.25 for “rarely” or “low”; and a value of 0 for “never” or “not at all”.

Case 1 is a highway project in Chennai, India rated as a moderate project with *IFNC* (0.75, 1.00), *IMGR* (0.50, 0.75), *ICNS* (0.50, 1.00), *IODS* (0.25, 0.25), *IMEQ* (0.50, 0.75), *ILAB* (0.75, 0.50), *EPOE* (0.25, 0.75), *ETRP* (0.25, 0.25), *ECUL* (0.50, 0.25), *ELGT* (0.75, 0.50), *and ENAE* (0.25, 0.25).

Case 2 is an educational institution project in Saudi Arabia rated as a poor option with *IFNC* (1.00, 1.00), *IMGR* (1.00, 0.75), *ICNS* (1.00, 1.00), *IODS* (1.00, 1.00), *IMEQ* (0.75, 1.00), *ILAB* (0.75, 0.50), *EPOE* (1.00, 1.00), *ETRP* (0.50, 0.25), *ECUL* (0.75, 0.50), *ELGT* (0.25, 0.25), and *ENAE* (0.75, 1.00).

Case 3 is a factory project located in Vietnam, also rated as a moderate project with *IFNC* (0.50, 1.00), *IMGR* (0.75, 0.50), *ICNS* (0.75, 1.00), *IODS* (0.50, 0.75), *IMEQ* (0.25, 0.25), *ILAB* (0.50, 0.75), *EPOE* (0.25, 0.75), *ETRP* (0.25, 0.25), *ECUL* (0.75, 0.50), *ELGT* (0.25, 0.50), and *ENAE* (0.25, 0.25).

Step 6: Compute risk value

With the input from step 1-5, CapRA calculator computes the risk values for each risk category. Based on the equation $S^i = \propto^i \beta^i \left\{1 + R^{2i}\left[\frac{\sum_k^n a_k x_k}{n}\right]\right\}$, risk value for each risk category is computed based on the formula derived from the final PLS-SEM structural model in Figure 5.2. A computation example is as demonstrated in Figure 7.2.

Step 7: Synthesize total risk value

The CapRA calculator will then sum up the total risk value by adding up all the risk value from each risk category. The following is an example for calculating the risk significance value for external political and economic (*EPOE*) risk.

Computation Example

Given *i* represents external political and economic (*EPOE*) risk, probability of impact, α is rarely (0.25), degree of impact, β is high (0.75), and coefficient of determination, R^2 is 0.744. Based on the equation,

$$S^i = \propto^i \beta^i \left\{1 + R^{2i}\left[\frac{\sum_k^n a_k x_k}{n}\right]\right\}$$

Risk significance value,

S for EPOE = 0.25x0.75{1+0.744([(-0.457BSMG)+(-0.500FNCL)+(-0.388HMRS)+(-0.237ORGZ)+(-0.333ORGL)]/5)}

= 0.25x0.75{1+0.744([(-0.457x0)+(-0.500x1)+(-0.388x0)+(-0.237x-1)+(-0.333x1)]/5)}

= 0.171

After running CapRA calculator on case 1, Step 1-7 are repeated for case 2 and 3.

Compare result with other project opportunities

The results from Case 1 to 3 are compared to select the one with lowest risk value. Table 7.3 shows the comparison of final risk values of Case 1 to 3 for Company T1 to T12. It was found that Case 1 is most appropriate for construction firm T1 to venture on and Case 3 for the rest of the construction firms T2 to T12. Construction firm T10 may choose between Case 1 and Case 3 since they have similar risk significance values. Case 1 and 3 started off with similar risk values of 3.250; however, risk scores were apportioned in different categories as described in Step 5. Different firms have varied strengths and weaknesses rated as firms' capabilities in Step 3.

7.3.2.2 Accuracy and Ability of CapRA Models

Table 7.3 also shows the accuracy and ability of the CapRA models to predict risk significance values. The risk values of the same 0 to 1 scale calculated using Probability-Impact (P-I) and CapRA risk assessment models were compared. The percentage error (PE) ranges from -11.9% to +22.9%, -12.6% to +24.1% and -14.0% to +25.6% for case 1, case 2 and case 3 respectively. These PEs show the differences of applying CapRA model as compared to the conventional P-I risk assessment. Thus, the PEs can represent the accuracy percentage (Figliozzi, 2008; Makridakis, 1993) of applying CapRA model in comparison to P-I risk model. The positive signs of the mean percentage errors (MPE%) suggest that the CapRA models tend to undervalue project risk significance values than that of P-I risk model.

When using these CapRA models, the final risk significance values would be reduced by about 16% to 21%. The test results suggest that the CapRA models are relatively accurate in predicting international project risk significance values. This validation results may be interpreted as the construction firms participated (T2 to T12) were being biased causing the project risk significance values lower than what they really are (positive MPE%) except for T1. This may be attributed to the construction firms (T2 to T12) were all highly capable due to their vast international project experiences or the firms would like to appear well. On the contrary, novice construction firms like T1 may have resulted in negative MPE% that is higher project risk significance values relative to P-I risk model.

The CapRA equations in Table 7.1 provide valuable insights to the different firm's capabilities in lowering the risk significance values of different risk categories. The coefficients related to each construct are useful guidance for international construction firms to decide the firm's capabilities to be committed.

Table 7.3: Final risk values of cases compared between Probability-Impact and CapRA models

Firm	Case 1, Highway in India					Case 2, Educational Institution in Saudi					Case 3, Factory in Vietnam				
	P-I	CapRA	PE %	MPE %	MAPE %	P-I	CapRA	PE %	MPE %	MAPE %	P-I	CapRA	PE %	MPE %	MAPE %
T1	3.250	**3.638**	-11.9	16.2	18.2	7.188	8.097	-12.6	17.3	19.4	3.250	3.704	-14.0	18.5	20.9
T2		2.908	10.5				6.417	10.7				**2.869**	11.7		
T3		2.507	22.9				5.457	24.1				**2.418**	25.6		
T4		2.764	15.0				6.024	16.2				**2.667**	17.9		
T5		2.518	22.5				5.479	23.8				**2.434**	25.1		
T6		2.637	18.9				5.725	20.4				**2.537**	21.9		
T7		2.635	18.9				5.726	20.3				**2.535**	22.0		
T8		2.543	21.8				5.517	23.2				**2.433**	25.1		
T9		2.717	16.4				5.897	18.0				**2.594**	20.2		
T10		**2.693**	17.1				5.977	16.8				**2.693**	17.1		
T11		2.507	22.9				5.457	24.1				**2.418**	25.6		
T12		2.610	19.7				5.598	22.1				**2.469**	24.0		

Note: Bold **figure** has lowest risk significance value; P-I is Probability-Impact Risk Model ($S^i = \alpha^i \beta^i$); CapRA is $S^i = \propto^i \beta^i \left\{1 + R^{2i}\left[\frac{\sum_k^n a_k x_k}{n}\right]\right\}$; PE is Percentage Error; MPE is Mean Percentage Error; MAPE is Mean Absolute Percentage Error

7.3.3 Validation Experts' Comments on the CapRA Model

This section reports the twelve experts' (T1 to T12) perspectives on the CapRA model cum calculator and its comprehensiveness for the international construction industry. After the twelve experts had keyed in their firms' capabilities for case control projects in the CapRA calculator, they were being interviewed further to comment on the model developed. During the validation interview, the constructs and relationships between the constructs of CapRA model were explained based on the validation survey. They were asked to comment on both the structures and practicality of the CapRA model.

7.3.3.1 Structures of the CapRA Model

In this study, the independent and dependent variables are firm's capabilities and international construction project risks.

Firm's capabilities consisted of ten constructs: physical (*PHYS*), human resource (*HMRS*), organizational (*ORGZ*), financial (*FNCL*), business management (*BSMG*), innovation (*INNV*), procurement (*PCRM*), organizational learning (*ORGL*), construction (*CNST*), and project management (*PRMG*) capabilities.

CapRA's international construction project risks consisted of eleven constructs in two categories of internal and external risks. Internal risk category consists of six constructs: financial (*IFNC*), managerial (*IMGR*), construction (*ICNS*), owner, design consultant, and supervisor (*IODS*), material and equipment (*IMEQ*), and labour (*ILAB*) risk constructs. External risk category comprises of five constructs: political and economic (*EPOE*), third party (*ETRP*), cultural (*ECUL*), logistics (*ELGT*), and natural environmental (*ENAE*) risk constructs.

The twelve subject matter experts (T1 to T12) agreed with the CapRA's international project risks' constructs, consisted of the internal and external risk factors, to assess an international construction project's risk significance value. The experts opined that the ten firm's capability constructs that affect both internal and external international construction project risks are pertinent to assess the project risk level in the international construction market. Nine experts drew a conclusion from the summary of CapRA model in the validation survey that firm's capabilities comprising of human resource (*HMRS*), organizational (*ORGZ*), business management (*BSMG*), organizational learning (*ORGL*), construction (*CNST*), and project management (*PRMG*) are more important than the other capabilities' constructs in managing international construction projects. Four experts added that the international construction risk constructs consisting of internal risk constructs like *IFNC, IMGR, ICNS, IODS, IMEQ,* and *ILAB* are more crucial than the constructs focusing on external risks like *EPOE, ETRP, ECUL, ELGT,* and *ENAE*. One of the subject matter experts explained that:

The construction industry is all about development and improving human life. In addition to that, from a contractor's point of view, we would like to minimize costs and make profit whilst constructing a quality building or infrastructure. So when a construction firm decided to venture outside their home country, it is crucial for a firm to own capabilities which enable the management of project risks arising from within themselves, or the internal risks of their project and organization. If we are unable to manage our internal risks like managing the project and working team, as what we have been doing for domestic construction projects, we cannot take a bolder step to expand our firm by going abroad. Building a robust construction firm has been a long haul but that is inevitable to be where we are today. We made less profit for our firm's revenue when we first began our venture abroad, but the robust capabilities to manage internal *risks, which are similar to handling domestic projects contributed to our international success. The human resource and business management capabilities are crucial when expanding business abroad; the strengths have been accumulated over years outside (undertaking projects outside home country). I must say the focus on the internal risk factors is what gave us success in the overseas venture.*

Three other subject matter experts opined that firm's capabilities in managing external risks unique to country ventured should deserve utmost consideration when assessing international construction project risk values. One expert explained that:

Despite the fact that the internal risk category is necessary, external risk category is even more crucial for a firm to assess on in an international construction risk assessment. Without close scrutiny and assessment on external risks, our construction team abroad will face much unexpected risks abroad and worse when our team is not being equipped with the knowledge and capabilities to manage them. Knowingly that the more that our firm is exposed to in the international construction market, the more knowledge and information we acquire. However, the risk assessment that focused more on external risks will reveal further on the capabilities that our firm should commit for overseas expansion. The external risk assessment is an important strategy to improve our organization public image and client satisfaction. Preparing blueprint with dynamic team and strategies prior to venture is what it needs for foreign investment.

The other five experts agreed to the CapRA model that covered both internal and external risks when assessing the international construction project risk value. They commented that a balance of both is needed when assessing projects abroad. The other two different perspectives show that internal and external categories of risks to assess the international construction project are both important. Despite the differences between the two perspectives, there is a connection that both play contributory roles in the international project assessment. There are two angles to explain whether the focus should be on internal or external risks. Firstly, the firms that have operated long enough in the international construction market will tend to evaluate their success and achievement abroad are due to their efficiencies in managing internal risk factors. These firms would emphasize on internal risks assessment to build a robust firm foundation before venturing. Secondly, some firms may look at the overseas market as a secondary option for their firm's growth. In view of this, the development strategy would focus more on the external risks, which these firms are unfamiliar of or have lesser exposure.

The twelve experts had similar views on the relationships between firm's capabilities and international construction risks, which path coefficients are all denoted with negative sign. The expert's view supports the findings that a high commitment of firm's capabilities brings negative effect on risk significance value. In particular, all the experts emphasized the combined effect of business management (*BSMG*) and human resource (*HMRS*) capabilities on risk. An expert explained the said effect using their firm as an example:

It is common to "look before you leap" in the process of deciding to go or not to go for a project opportunity abroad. The "looking" process is not that simple. For example, in our firm, we have our qualified managerial level personnel to travel to a specific country where construction business opportunities are plenty. The initial intention is to scout for project opportunities and, at the same time, to have more linkages with potential clients, local officers, and suppliers. Gradually, we realize the effect of long term strategizing that actually paid off to be well prepared before investing our funds *there. The key person that we sent is our experienced business development manager who later came back with reports, providing the information needed like culture, bureaucracy, logistics, regulations, risks and statistics. This enabled us to achieve better success.*

In lowering project risk values, the experts shared that organizational learning (*ORGL*) capability is considered crucial. They emphasized that organizational learning is necessary to manage project abroad. Organizational learning involves the knowledge management within the firm themselves to share within different project teams and pass down to newly recruited staff. An expert explained that:

Based on our experiences in overseas construction projects, organizational learning is truly invaluable information that facilitates our work abroad. Information may be scarce at the initial stage of our operations outside our home country but we can gain it from feasibility studies and copious research on the material available online. There are plenty of statistics and reliable information online, however we lack personnel who will access, research, and filter the information to come out with good report. However, good documentation of the past international projects handled should come in handy when new opportunities arise.

All the experts agreed that construction (*CNST*), project management (*PRMG*), and organizational (*ORGZ*) capabilities are definitely relevant when coping with project risks in international construction. They are in the construction business and construction is definitely their forte, whereas project management and organizational capabilities, they complement the construction capability to ensure a smooth project delivery. A systematic organizational capability of any firm will affect the project management capability as they deal a lot on documenting and managing cost and schedule and processing them to be sent back to headquarter office. Both capabilities are crucial to manage the project and organization simultaneously.

Turning to the one crucial necessity before overseas foray, the experts commented that without financial (*FNCL*) capability, overseas expansion is impossible. All of them share the same opinion that financial capability helps them in many unexpected circumstances, which signifies lowering the project risk significance values. Any firm should be financially robust before thinking of going abroad. One expert mentioned that:

Even before bidding for projects, we sent key personnel to observe and scout for opportunities at a country. Sometimes, the results can be not a viable place to invest in. Now, if it is viable, what about the cost of the resources you deployed to study, establish connection, set up office, settle down key staff, and the like, which take months or years before you even break the ground. Besides, financial strength is needed when there is a delay at construction site and or delay in payment from client, which can be quite common in international construction.

The experts' views support the findings that procurement (*PCRM*) and innovation (*INNV*) capabilities do not affect the external risk. The experts explained that network in procurement and being innovative in technical or non-technical skills affect only the internal operation of a firm and their project.

7.3.3.2 Practicality and Comprehensiveness of the CapRA Model

The experts were positive when assessing the practicality of this CapRA model, especially when attempting the CapRA calculator prototype. They said that this model impressed them because it is concise and precise. The experts also commented that they would use the CapRA calculator since it is user-friendly and only ratings are needed without much complicated data input. After the try-out on the prototype, one of them commented that:

The CapRA calculator had the related indicators in the comment boxes for both firm's capabilities and risks constructs and they could easily select the ratings from the drop down menus after determining their firm's capabilities. The results were computed and displayed according to the risk categories. Both the final total risk significance value for the project assessed and the breakdown of the final risk significance value in internal and external risk categories are shown. In our position (senior manager), we really do not have time to consider long list of indicators, but CapRA calculator has them kept within a page containing the crucial information. It will be easy for printing and documenting for comparison with other projects.

In addition, the experts shared that the CapRA model itself showed comprehensive relationships between the combined firm's capabilities and their effects on the international construction risk categories. The relationships shown in the CapRA structural model are beneficial to them. One expert said that:

The relationships within the CapRA model help us to understand our firm's capabilities by considering the indicators associated to each capability. On top of that, we manage to understand the capabilities that we should commit on to lower the chances of loss and or mitigate the impacts when risks arise. We are able to know what other *international construction firms are equipped with when foraying outside. By self-evaluating the projects in hand with the risk data, we will be able to identify which firm's capabilities to be emphasized to lower the risk values. We can compare the potential project opportunities in future with CapRA and adjust the firm's capability accordingly if it differs for our subsidiary company.*

Considering the comprehensiveness of the CapRA model, the experts agreed that this model has identified the important firm's capabilities, and determined the relationships between the said firm's capabilities and the international construction project risks. However, the experts also gave two suggestions for model improvement:

Suggestion 1: One expert suggested that the 'nature of work' should be considered as one of the risk categories.

Suggestion 2: Two experts suggested that 'partnering' should be considered as a form of firm's capability.

In response to the first suggestion, 'nature of work' can be so unique that it requires extra time and stringent quality control to be completed. These can be translated into higher construction (indicators: cost overrun, project delay, and defective work) risks' probability and impact. Hence, the 'nature of work' risk construct is not included in this research. However, future research may consider 'nature of work' construct to be studied.

Concerning the second suggestion, 'partnering' is a 'borrowed' firm's capability where firm shares the risks to their joint venture partner. This is a way to lower the international construction risks by joint venturing with local partner. However, this is true if a firm has a clear idea of what their local partner is capable of; else it will still be a risk and will not be wise to lower any particular risk significance value. This research considered ‘partnering’ in the aspects of human resource and project management capabilities (indicators: good relationship among working team, and clear project organization structure setup). Since ‘partnering’ has an effect on project risk values, future research may also study the effect of ‘partnering’ as mediating construct.

7.4 Discussion on the CapRA Model

In this study, the structural CapRA model (Figure 5.2) developed can be used as a self-assessment tool by international construction firms to assess the international construction project’s risk values. International construction firms may understand the relationships between firm’s capabilities and international construction project risks. The paths of combined firm’s capabilities bring negative effects on international construction project risk significance values.

To facilitate the application of CapRA model, the CapRA equations listed in Table 7.1 have been computerized into CapRA calculator. To operate the CapRA calculator, the mechanism and computation has been illustrated in Figure 7.2 and described in Section 7.3.2.1. The CapRA calculator works for firm’s own assessment to compare among the international project opportunities available. The calculator can perform better when the total risk figures of the project opportunities are too close or similar resulting in indecisiveness in a firm to decide which opportunity to go for. This calculator will improve the calculation of risk values with the added feature of firm’s capabilities in the model. This CapRA model can be useful especially for construction firms that are novice in the international construction market.

CapRA calculator was designed to dynamically compute firm's capabilities into assessment of risks and hence supplement the conventional Probability-Impact (P-I) risk model. To enhance the conventional P-I risk model, the study employed PLS-SEM to design the formulae in the CapRA calculator. As illustrated in Step 2 and Step 4 of Figure 7.2, the indicators of both firm's capabilities and risks are static, while the indices fluctuate and require the continuous update by the construction firm. The CapRA facilitates the construction firm to decide accurately with a computerized tool (CapRA calculator) assessing firm's capabilities and risks present in the potential opportunities.

From the validation on the effectiveness of CapRA calculator application and mechanism, the rating of firm's capabilities affects risk values. Based on path coefficients and coefficients of determination derived from structural model in Figure 5.2, the formulated equations were computerized into CapRA calculator in Figure 7.1. This CapRA calculator then works to improve the conventional P-I risk model in deriving a more accurate risk values taking into account of risk nature and complexity like project environment and influencing factor. From this validation, the CapRA model demonstrated that experienced firms that agree to all firm's capabilities like construction firm T3 and T11 receive risk values that are much lower than the P-I's risk values in first column of Table 7.3 (under P-I risk model), which is without the incorporation of influencing factor, firm's capabilities. The remaining firms that have a mix of agree and neutral responses to firm's capabilities obtain slightly lower risk values and construction firm T1, a novice firm with more neutral and disagree responses to firm's capabilities receives much higher risk values as compared to P-I's risk values. Hence, the firm's capability is indirectly associated with risk value.

The conventional P-I risk models are useful and significant in its contribution despite the mushrooming of other tools using Analytical Hierarchy Process (AHP) (Hsueh, Perng, Yan, & Lee, 2007; Zayed, Amer, & Pan, 2008), Fuzzy Sets Theory (FST) (Choi, et al., 2004; Dikmen, et al., 2007b), Analytic Network Process (ANP) (Bu-Qammaz, et al., 2009; Dikmen, et al., 2007c), and or the combination. The conventional P-I risk model has been enhanced with features like risk discrimination factor (Cervone, 2006) and factor index (Zeng, An, & Smith, 2007). Both risk discrimination factor and factor index are designed to gauge the interdependencies between risks like surrounding environment and influences between the identified risks. In order to capture the interdependencies between risks and to reflect the complexity within a real project environment, this CapRA model cum calculator has eliminated the collinearity or interdependencies between risks (predictor constructs) via the collinearity test as performed when evaluating the structural model in Section 5.3.6. Furthermore, the influence of firm's capabilities is added into the formulae with partial effect (depending on the coefficients of determination of R^2) on the risks.

This remodelled P-I risk model or CapRA model hopes to improve the accuracy and facilitate project selection process. This outcome echoed what Taroun (2014) concluded in his comprehensive review on the risk literatures since before the 1980s, recommending the extension of the P–I risk model by incorporating additional parameters to reflect risk nature, experience, interdependencies between project risks and relevant influence of project environment on risk assessment.

7.5 Summary of Chapter

In this chapter, the CapRA structural model provided the equations to predict international construction project risk values. These equations are then transformed into a remodelled Probability-Impact (P-I) Risk model, known as the Capability-Risk Assessment (CapRA) model. The CapRA model was computerized into a calculator for application.

Twelve sets of new data were collected to test the accuracy of the CapRA model cum calculator. In the test for accuracy based on the mean percentage error and mean absolute percentage error, it was found that the CapRA model will affect the final output by about 16% to 21% in comparison with the conventional P-I risk model output.

The validation survey revealed that the experts find the CapRA model comprehensive. They also find that both the contents of the constructs and the relationships between the constructs of CapRA model to be concise and precise for self-assessment. The CapRA calculator makes it even more practical and user-friendly for self-assessment. A summary and conclusions of this study will be presented in the next chapter.

CHAPTER 8
CONCLUSIONS AND RECOMMENDATIONS

8.1 Introduction

Globalization has created more opportunities for construction firms to enter the international construction markets, various strategies and approaches are available for international construction firms to achieve better performance in the global construction market. Previous construction risk-related studies have developed decision support models underpinned by influencing factors concepts to help international construction firms in project selection decision. However, no study has hitherto developed a integrated approach by combining resource based view theory, dynamic capabilities theory, and Porter's generic value chain theory to help international construction firms to assess both firms' capabilities and risks inherent in projects for project selection decision, or simply bidding decision.

Based on the concept of matching the project opportunity and firm's capabilities, the model to assist project selection decision of international construction firms is established in this study by combining resource based view theory, dynamic capabilities theory, and Porter's generic value chain theory (Chapter 3). The conceptual framework postulates that international construction firm's capabilities affect risk significance values of international construction project. There are two main components that make up the conceptual framework: firm's capabilities as the independent constructs and risk categories as the dependent constructs.

To fulfill the objectives, this study adopted a survey research design. A questionnaire was used as the data collection instrument (Appendix A) and distributed to all international construction firms registered with CIDB, Malaysia in the international contractor category consisting both Malaysian and foreign international construction firms. A total of 65 sets of data were collected via posts, emails, and 22 sets were supplemented by face-to-face interviews. The SPSS software and SmartPLS 2.0 statistical software were used to analyze the data (Chapter 5). Subsequently, another survey was conducted to collect 12 new data sets for model validation (Chapter 7).

This chapter is devoted to the conclusions of the findings. This research has undertaken a study of international construction firm's capabilities and international project risk significances with the aim of determining the relationship between firm's capabilities and risk significance values. The overall aim and objectives of the study, contributions of the study, limitation of the study and suggestions for future research are summarized.

8.2 Conclusion of the Main Findings

The main findings drawn from the research are discussed in terms of achieving the research objectives.

8.2.1 Research Objective 1

Based on the first objective of this research, "to ascertain current approaches to risk assessment adopted by international construction firms", a research question was formulated, what are the current approaches to risk assessment adopted by international construction firms?

The research was able to achieve research objective 1 and the research question formulated through the first questionnaire survey. The current practice of risk assessment was surveyed among the international contractors participated in this study (Section 5.3). It was found that 66.2% of the firms used statistical or mathematical model to assist the overseas project selection decision and most firms employed the P-I risk model in their risk assessment while others made simple calculations based on data from previous projects. The result was affirmed when a total of 61.5% of international construction firms responded no when asked whether intuition was the primary tool in project selection decision. Lastly, 89.2% of firms felt that a model that assessed both firm's capability and risks would add value to foray decision.

8.2.2 Research Objective 2

Based on the second objective of this research, "to identify indicators to measure internal and external international construction risks and firm's capabilities of international contractors", two research questions were formulated, they are: (1) what are the indicators of internal and external risks for international construction projects? and (2) what are the indicators of firm's capabilities that affect risk significance values of international construction?

The research was able to achieve research objective 2 and the two research questions formulated based on the said objective by deploying the first questionnaire survey. First, the indicators of internal and external international construction risks were measured using reflective measurement models (Section 5.3.5.1). From the PLS-SEM assessment results of the reflective measurement models, the indicators of the internal and external international construction risks are shown in Table 5.2. Out of the 54 internal and external risk indicators, only 39 indicators remained after the measurement model evaluation.

The risk constructs are measured by a minimum of two to a maximum of six reflective indicators. Political and economic risk's (*EPOE*) indicator has the lowest outer loading (*epoe_11: Economic recession* at 0.686), whereas third party risk's (*ETRP*) indicator has the highest outer loading (*etrp_1: Public security* at 0.970). The constructs for logistics (*ELGT*) and natural environmental (*ENAE*) risks are each measured by two indicators. The managerial (*IMGR*), construction (*ICNS*), owner, design consultant, and supervisor (IODS), material and equipment (*IMEQ*), and labour (*ILAB*) risks' constructs are each measured by three indicators. Financial risk (*IFNC*) construct is measured by four indicators. The constructs for political and economic (*EPOE*) and third party (*ETRP*) risks are each measured by five indicators. Finally, the cultural risk (*ECUL*) construct is measured by six indicators.

Second, the indicators of firm's capabilities were measured using formative measurement models (Section 5.3.5.2). From the PLS-SEM assessment results of the formative measurement models, the indicators of the firm's capabilities are shown in Table 5.5. All 54 firm's capabilities indicators remained after the measurement model evaluation.

The firm's capabilities are measured by a minimum of three to a maximum of eight formative indicators. The constructs for physical (*PHYS*), organizational learning (*ORGL*), and construction (*CNST*) capabilities are each measured by three indicators with outer weights between 0.191 and 0.570, 0.307 and 0.568, 0.405 and 0.565 respectively. Innovation capability (*INNV*) construct is measured by four indicators with outer weights between 0.320 and 0.467. Procurement (*PCRM*) and project management (*PRMG*) capability constructs are each measured by five indicators with outer weights between 0.100 and 0.433 and 0.395 and 0.448 respectively. Human resource capability (*HMRS*) construct is measured by six formative indicators with outer weights between 0.361 and 0.408. Finally, organizational (*ORGZ*), financial (*FNCL*), and business management (*BSMG*) capability constructs are each measured by eight formative indicators with outer weights between 0.158 and 0.343, 0.126 and 0.350, 0.088 and 0.352 respectively.

8.2.3 Research Objective 3

Based on the third research objective, "To determine the relationship between firm's capabilities and risks", a research question was formulated, what are the relationships between firm's capabilities and international construction risk significance values?

Having the independent and dependent constructs' measurement models evaluated, research objective 3 and the aforementioned research question were also accomplished by conducting the first questionnaire survey. All 110 possible relationships between firm's capabilities and risks were assessed, those hypothesized relationships that did not meet the criteria were removed (Section 5.3.6).

The path coefficients revealed the extent of the firm capabilities' effects on risk significances. From the PLS-SEM assessment results of the structural model, only the path coefficients of significant relationships between firm's capabilities and risk significances were shown in Figure 5.2. However, both the significant and nonsignificant paths can be found in Table 5.6.

Only 53 out of 110 hypothesized relationships were significantly important and it was an interesting discovery that four firm's capabilities have less influence on the international risks studied, they are financial (*FNCL*) capability with only three significant path coefficients, innovation (*INNV*) capability with only one, physical (*PHYS*) and procurement (*PCRM*) capabilities with two each. This also suggests that human resource (*HMRS*), organizational (*ORGZ*), business management (*BSMG*), organizational learning (*ORGL*), construction (*CNST*), and project management (*PRMG*) capabilities are more influential towards international construction risk significances. However, it should be noted that the firm's capabilities that have fewer influence on risks do not imply that they are not important as the magnitude of the significant influence may be big.

8.2.4 Research Objective 4

The fourth objective is "to develop firm's capability-based risk assessment decision making model". Incorporating the findings from research objective 2 and 3, a Capability-Risk Assessment (CapRA) model was developed to assist international construction firms in international project selection decision (Figure 5.2). Hence, research objective 4 was achieved.

The proposed CapRA model consists of two main components, the firm's capabilities made up of ten constructs and the international construction risks composed of eleven constructs. The model shows the relationships between firm's capabilities and risk significances. The particular combination of firm's capabilities that affect a particular risk construct is portrayed. In particular, the CapRA model shows that the impact seven firm's capabilities on financial (*IFNC*) risk significance accounts for 69.0%. Similarly, the impact of six firm's capabilities on managerial (*IMGR*) risk significance accounts for 65.8%, as are nine capabilities on construction (*ICNS*) for 67.4%, three capabilities on owner, design consultant, and supervisor (*IODS*) for 89.9%, five capabilities on material and equipment (*IMEQ*) for 42.1%, three capabilities on labour (*ILAB*) for 76.1%, five capabilities on political and economic (*EPOE*) for 74.4%, five capabilities on third party (*ETRP*) for 75.0%, six capabilities on cultural (*ECUL*) for 82.2%, two capabilities on logistics (*ELGT*) for 66.8%, and two capabilities on natural environmental (*ENAE*) for 61.2%. Considering the indicators used to measure the firm's capability constructs, these issues are important issues that need to be addressed to lower the exposure to the particular risk.

Besides understanding the effect of firm's capabilities onto risks, this study has converted the model into a computerized system known as CapRA calculator to facilitate application of the CapRA model. The mathematical equations developed from the results of structural equation modeling were computerized into spreadsheets. The construction firms could then assess their international project options by simply entering the scores of their firm's capabilities and scores of project's probability of occurrence and severity of impact. As a result, the CapRA calculator will enhance the accuracy of the prediction of risk significance values among the project options with the incorporation of firm's capabilities component, thereby assisting firms in project selection decision.

8.2.5 Research Objective 5

Based on the final objective of this research, "to validate the risk assessment model developed through actual testing on international construction firms", it was achieved through both quantitative and qualitative validations.

Based on the data collected, the CapRA model was confirmed via the PLS-SEM process in the effect size and predictive relevance tests (Section 5.3.6). In addition, ten firm's capability constructs (independent constructs) and the eleven internal and external risk constructs (dependent constructs) were confirmed via PLS-SEM. Having a model trimming process to remove redundant independent constructs for the respective dependent constructs, the R^2 values for financial (*IFNC*), managerial (*IMGR*), construction (*ICNS*), owner, design consultant, and supervisor (*IODS*), material and equipment (*IMEQ*), and labour (*ILAB*) internal risk constructs indicate that 69.0%, 65.8%, 67.4%, 89.9%, 42.1%, and 76.1% of their corresponding variance can be explained by six patterns of combined critical firm's capability constructs. Likewise, the R^2 values for political and economic (*EPOE*), third party (*ETRP*), cultural (*ECUL*), logistics (*ELGT*), and natural environmental (*ENAE*) external risk constructs indicate that 74.4%, 75.0%, 82.2%, 66.8%, and 61.2% of their corresponding variance can be explained by five patterns of combined critical firm's capability constructs (Section 5.3.6 and Figure 5.2).

After subjecting the data to PLS-SEM, the resultant CapRA model is obtained (Figure 5.2). Eleven mathematical models were also developed from the CapRA model in Table 7.1. The said equations were tested with new data sets collected from twelve international construction firms to assess the robustness in terms of accuracy and ability of the model (Section 7.3.2.2). The results showed that when using the CapRA models, the final risk significance values would be reduced by 16% to 21% in comparison with conventional P-I risk model. The test results suggested that CapRA models are relatively accurate in predicting international project risk significance values. With the testing and validation of the CapRA model conducted, hence the research objective four was achieved.

The research hypothesis stated in section 3.4, '*A combination of physical, human resource, organizational, financial, business management, innovation, procurement, organizational learning, construction, and project management capabilities can lower the risk significances in the international construction foray*'. The results show that to predict international construction risk significances, which also lower the risk significance values or scores, international construction firms are to adopt a combination of firm's capabilities. However, not all firm's capabilities can influence risk significance of all risks, some requires less combination and some requires more combination of firm's capabilities. The nonsignificant hypothesized paths had been trimmed off during the PLS-SEM process. This suggests that the risk significance values differ with different firm's capabilities owned by firm. For instance, international construction firm experiences a lower exposure to financial (*IFNC*) risk if they have a combination of seven firm's capabilities (maximum): procurement (*PCRM*), organizational (*ORGZ*), financial (*FNCL*), business management (*BSMG*), organizational learning (*ORGL*), construction (*CNST*), and project management (*PRMG*). In this example, the lower *IFNC* risk significance value can be achieved even with having less than seven firm's capabilities. The findings thus validate the hypothesis which states that in order to lower risk significance value, international construction firms need to adopt a combination of different firm's capabilities.

8.3 Implication to International Construction Firms

With the successful development and testing of the CapRA model, it is recommended that international construction firms use the model to help them select overseas projects, and from there identify the lack of their firms' capabilities to be enhanced for success in project ventures.

Decision makers in international construction firms can apply the CapRA model cum calculator to decide on an international project opportunity. Firm needs to gather information on each of the project opportunity including country risk rating and type of project involved. The information may be obtained from reliable external sources like country reports, worldbank reports and rating agencies, and internal sources like past project database, heuristic input, and insider information. Then, firm analyses own firm's capabilities objectively, this may change if changes within firm occurs. Both ratings for project risks and firm's capabilities are then keyed into the CapRA for risk significance values computation. The total risk score for the said project is obtained. The steps are repeated for the other project opportunities to obtain the total risk scores. Finally, all CapRA results are compared among the job opportunities and select the project with the lowest risk score.

The CapRA risk assessment model helps to improve the management of project risks. The calculation from CapRA model allows construction firms to monitor the risk categories with higher risk values and make plans for risk mitigation. CapRA model allows firm to check the associated firm's capabilities affecting the risk categories, then firm may improve on lowering the risk significance values by improving its capabilities. This CapRA serves as a checklist as there are outer weights attached to each firm's capability. This facilitates the firm to detect their weaknesses and improve on them.

With numerous inputs from a construction firm, the CapRA calculator could also contribute as a company database. It stores firm's record on various projects for organizational learning purpose and thus assists inexperienced personnel. The CapRA calculator also expedites the decision making process instead of going through numerous meetings involving much manpower and time. However, the CapRA calculator would need some time to build up firm's database with the past project records, which can be achieved by allocating a team to kick-start the process of building up the database for risk department for international projects.

The CapRA is more useful for novice firm whose intention is to grow in their firm's capabilities and also to expand into the international market. Novice firm does not have enough heuristic input to adjust the risk scores obtained from external sources based on their firm's capabilities. However, CapRA can assist to compute the risk scores according to the firm's capabilities. This is because the absence of certain firm's capabilities may increase the risk scores of a project and vice versa. All in all, CapRA is a promising tool for the construction industry as it is practical, time-cost saving, and simple to use.

As for the Malaysian construction firms, the CapRA can assist them to achieving the Eleventh Malaysia Plan (11MP), which targets to increase construction sector's contribution to 5.5% to GDP by 2020 (Economic Planning Unit, 2015). The strategies to propel the construction related sector forward include increasing internationalisation of firms. 11MP also encourages highperforming SMEs to forge partnerships with larger corporations or form multidisciplinary consortia when bidding for international projects. The Services Export Fund, which covers activities such as tendering, negotiating, and conducting feasibility studies for international projects as well as export promotion activities, will assist construction firms to secure opportunities abroad (Economic Planning Unit, 2015). The CapRA can assist firms to focus on building capability and serve as feasibility study by assessing risk prior to venture.

8.4 Contributions

This study contributes to both knowledge and practice by developing and testing a model to facilitate project selection decision for international construction firms.

First, this study contributes to the knowledge of risk assessment for construction industry. Among the existing risk assessment methods, the Probability-Impact (P-I) risk model is most widely studied and applied in the industry. The potential of enhancing the P-I risk model is vast and this study has made an enhancement by incorporating the firm’s capability component. This firm’s capability component has a huge impact on significances of international construction risks, which was scientifically discovered through the method made known in the second contribution to knowledge that follows.

The second contribution to the knowledge is that this study demonstrates the usage of anomaly-seeking research in the construction project management field, particularly on risk assessment in construction. To the best of the authors’ knowledge, this anomaly-seeking research has not been applied in project management field. Three methods had been adopted to surface the anomaly in the international construction risk assessment research. The common anomalous component found missing from the risk assessment studies was firm’s capability. The lenses from strategic management field were then introduced to come up with the proposed capability reflective measurement model, which also bring to the next contribution.

The third contribution to the knowledge is that this study adopts three streams of strategic management concepts- resource based view, dynamic capabilities, and Porter’s generic value chain theories into an integrated framework for risk assessment in international construction. The theories are useful especially when deriving measurement scales for firm’s capability component.

The final contribution to the knowledge is that this study adopted partial least squares structural equation modeling (PLS-SEM) when analyzing the data and most importantly, deriving mathematical equations. This study has demonstrated the potential of PLS-SEM to enhance P-I risk model equation. The path coefficients and coefficient of determination obtained from PLS-SEM analysis enhance the conventional P-I risk model equation, deriving the novel CapRA model equations (Table 6.1).

This study also contributes to practice by providing international construction firms with a model to guide them in their project selection decision making. The usage of the CapRA model enables international construction firms to be informed of the combination of firm's capabilities needed to lower the exposure to certain risks. This allow international construction firms to make proper assessment of firm's capabilities and project risks before coming into any decision. It also allows firm to improve on any capabilities that they lack to lower the exposure to international project risks.

The next contribution to practice is the CapRA model can be used by international construction firms to assess their firm's strengths or capabilities. Rating firm's capability to compute project risk significance scores, firms may obtain an indication on the weaknesses or the lack of their firm's capabilities to thrive in the international construction market. Corrective actions may be initialized to lower firm's exposure to risks.

The CapRA model contributes to practice by listing the outer weight for each indicator of any firm's capability. This is a practical contribution whereby international construction firms are informed of the relative importance of the underlying items of a firm's capability. Adjustments can be made accordingly to the importance to build on their firm's capabilities or strengths. This information is useful for international construction firms but is even more relevant for novice construction firms with intent to foray outside their home countries.

Through the implementation of the CapRA model cum calculator, these construction firms could accurately decide on an international project opportunity with the correct input of firm's capabilities and risks present. With such risk assessment, the project risks were effectively handled. The construction firms can monitor the risk categories of higher risk values and make plans for risk mitigation. In addition, the CapRA model works as a checklist and guidance for construction firms to boost their firm's capabilities on a certain risk category or area to be a lot more competitive in the international arena.

8.5 Limitations of the Research

The first limitation of this research is that this research is focused on incorporating the effect of firm's capabilities into the risk assessment model. Other influencing factors such as contract clauses, entry modes and et cetera are not included in this study. This is because this study cannot cover all aspects within a limited time period and also it may involve a lengthy survey.

The second limitation of this research is the reliability of the data gathered. The questions in the survey were asked on a Likert scale, which ratings derived may not be totally reliable since different respondent may attach different value to different point of the scale. There also may have a gap between assumed knowledge and real knowledge of the respondents. For instance, respondents are assumed to have access to all information to answer the questions, but in fact they may not have the knowledge to answer some of the questions. This weakens the reliability of the data collected.

However, face-to-face interviews were conducted to minimize this weakness. Questions in doubt were explained until they were clear to respondents.

The third limitation is the relatively small sample size, which may have restricted the generalizability of the findings. Some statistically nonsignificant relationships in this research may appear significant if a larger sample size is provided. To address this weakness, PLS-SEM modeling technique was adopted for it is able to process small sample size.

8.6 Recommendations for Future Research

The findings of this study and the inputs from the practitioners and academics raised a few directions for future studies:

- To incorporate other influencing variables such as various contract clauses to make the CapRA model more comprehensive and useful; and
- To develop CapRA to cover other application fields such as crisis and disaster management and supply chain, and operational industries.

The recommendations for future research may improve the knowledge bank of the risk management, in particular risk assessment. Meanwhile, the construction players could benefit from the effort of the academicians bringing closer not only the theoretical knowledge gap but also the industrial knowledge gap.

REFERENCES

Aabo, T., Fraser, J. R., & Simkins, B. J. (2005). The rise and evolution of the chief risk officer: Enterprise risk management at Hydro One. *Journal of Applied Corporate Finance, 17*(3), 62-75.

Abdul-Aziz, A.-R., & Wong, S. S. (2010). Competitive assets of Malaysian international contractors. *Journal of Financial Management of Property and Construction, 15*(2), 176-189.

Abdul-Rahman, H., Loo, S. C., & Wang, C. (2012). Risk identification and mitigation for architectural, engineering and construction (AEC) firms operating in Gulf. *Canadian Journal of Civil Engineering, 39*(1), 55-71.

AbouRizk, S. (2003). *Risk and uncertainty in construction, construction and management group*. Alberta: University of Alberta.

Ahmad, I. (1990). Decision-support system for modeling bid/no-bid decision problem. *Journal of Construction Engineering and Management, 116*(4), 595-608.

Aibinu, A. A., & Al-Lawati, A. M. (2010). Using PLS-SEM technique to model construction organizations' willingness to participate in e-bidding. *Automation in Construction, 19*(6), 714-724.

Aleshin, A. (2001). Risk management of international projects in Russia. *International Journal of Project Management, 19*(4), 207-222.

Alston, M. and Bowles, W. (1998) *Research for Social Workers: An introduction to methods.* St. Leonards, NSW: Allen and Unwin.

Altman, E. I. (2006). *Default recovery rates and LGD in credit risk modeling and practice: an updated review of the literature and empirical evidence.* New York: New York University, Stern School of Business.

Ambrosini, V., & Bowman, C. (2009). What are dynamic capabilities and are they a useful construct in strategic management? *International Journal of Management Reviews, 11*(1), 29-49.

Amit, R., & Schoemaker, P. J. (1993). Strategic assets and organizational rent. *Strategic Management Journal, 14*(1), 33-46.

Amoroso, D. L., & Cheney, P. H. (1991). Testing a causal model of end-user application effectiveness. *Journal of Management Information Systems, 8*(1), 63-89.

Anderson, D., & Anderson, L. A. (2011). Conscious change leadership: Achieving breakthrough results. *Leader to Leader, 62*, 51-59.

Andrews, K. R. (1997). *The concept of corporate strategy*. In N. J. Foss (Ed.), Resources, firms, and strategies: A reader in the resource-based perspective. Oxford: Oxford University Press.

Argrove. (2012). Cash flow. Retrieved from http://argrove.co.uk/cash-flow/

Ashley, D. B., & Bonner, J. J. (1987). Political risks in international construction. *Journal of Construction Engineering and Management, 113*(3), 447-467.

Baccarini, D., & Archer, R. (2001). The risk ranking of projects: A methodology. *International Journal of Project Management, 19,* 139-145.

Baden-Fuller, C. (1995). Strategic Innovation, Corporate Entrepreneurship and Matching Outside-in to Inside-out Approaches to Strategy Research. *British Journal of Management, 6*(1), S3-S16.

Bajari, P., & Tadelis, S. (2001). Incentives versus transaction costs: A theory of procurement contracts. *RAND Journal of Economics*, 387-407.

Baker, S., Ponniah, D., & Smith, S. (1999). Risk response techniques employed currently for major projects. *Construction Management & Economics, 17*(2), 205-213.

Baloi, D., & Price, A. D. (2003). Modelling global risk factors affecting construction cost performance. *International Journal of Project Management, 21*(4), 261-269.

Barber, R. B. (2005). Understanding internally generated risks in projects. *International Journal of Project Management, 23*(8), 584-590.

Barney, J. B. (1986). Strategic factor markets: Expectations, luck, and business strategy. *Management science, 32*(10), 1231-1241.

Barney, J. B. (1991). Firm resources and sustained competitive advantage. *Journal of Management, 17*(1), 99-120. doi: 10.1177/014920639101700108

Barrick, M. R., Thurgood, G. R., Smith, T. A., & Courtright, S. H. (2015). Collective Organizational Engagement: Linking Motivational Antecedents, Strategic Implementation, and Firm Performance. *Academy of Management Journal, 58*(1), 111-135.

Barroso, C., Carrión, G. C., & Roldán, J. L. (2010). Applying maximum likelihood and PLS on different sample sizes: studies on SERVQUAL model and employee behavior model. In *Handbook of partial least squares* (pp. 427-447). Berlin Heidelberg: Springer.

Bearden, W. O., Netemeyer, R. G., & Haws, K. L. (2011). *Handbook of marketing scales: Multi-item measures for marketing and consumer behavior research* (3rd ed.). Thousand Oaks, CA: SAGE Publications, Inc.

Berkeley, D., Humphreys, P., & Thomas, R. (1991). Project risk action management. *Construction Management and Economics, 9*(1), 3-17.

Bing, L., & Tiong, R. L. K. (1999). Risk management model for international construction joint ventures. *Journal of Construction Engineering and Management, 125*(5), 377-384.

Bing, L., Akintoye, A., Edwards, P. J., & Hardcastle, C. (2005). The allocation of risk in PPP/PFI construction projects in the UK. *International Journal of Project Management, 23*(1), 25-35.

Bloodgood, J. (2014). Enhancing the resource-based view of the firm: Increasing the role of awareness. *Strategic Management Review, 8*(1), 61-75.

Bollen, K., & Lennox, R. (1991). Conventional wisdom on measurement: A structural equation perspective. *Psychological bulletin, 110*(2), 305.

Bower, J. L., & Gilbert, C. G. (2005). *From resource allocation to strategy.* New York: Oxford University Press.

Bragg, S. M. (2006). *Outsourcing: A Guide to ... Selecting the Correct Business Unit ... Negotiating the Contract ... Maintaining Control of the Process.* US: Wiley & Sons.

Bruner, G. C., Hensel, P. J., & James, K. E. (2001). *Marketing scales handbook 3*. Chicago: American Marketing Association.

Bu-Qammaz, A. S., Dikmen, I., & Birgonul, M. T. (2009). Risk assessment of international construction projects using the analytic network process. *Canadian Journal of Civil Engineering, 36*, 1170-1181.

Burchett, J., Tummala, R., & Leung, H. (1999). A world-wide survey of current practices in the management of risk within electrical supply projects. *Construction Management & Economics, 17*(1), 77-90.

Cagno, E., Caron, F., & Mancini, M. (2007). A multi-dimensional analysis of major risks in complex projects. *Risk Management, 9*, 1-18.

Campbell, D. T., & Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological bulletin, 56*(2), 81.

Carter, R. L., & Doherty, N. A. (1974). The development and scope of risk management. Handbook of risk management, *Supplement, 55*, 1-1.

Cavana, R. Y., Delahaye, B. L., & Sekaran, U. (2001). *Applied business research: qualitative and quantitative methods*. Australia: John Wiley & Sons Australia, Ltd.

Cenfetelli, R. T., & Bassellier, G. (2009). Interpretation of formative measurement in information systems research. *Management Information Systems Quarterly, 33*(4), 7.

Cervone, H. F. (2006). Project risk management. *OCLC Systems and Services, 22*, 256-262.

Chandler, A. D. (1962). Strategy and structure: The history of American industrial enterprise. MIT Press, Cambridge, Mass.(1977) The Visible Hand, Harvard University Press, Cambridge, Mass.(1980) The Growth of the Transnational Industrial Firm in the United States and the United Kingdom: a Comparative Analysis', *Economic History Review, 33*, 396-410.

Chandler, A. D. (2003). *Strategy and Structure: Chapters in the History of the American Industrial Enterprise.* Washington, D. C.: Beard Books.

Chandra, P. (2011). *Financial management*. Delhi: Tata McGraw-Hill Education.

Chapman, C., & Cooper, D. (1983). Risk engineering: Basic controlled interval and memory models. *Journal of the Operational Research Society, 34*(1), 51-60.

Chin, W. W. (1998). The partial least squares approach to structural equation modeling. *Modern methods for business research, 295*(2), 295-336.

Chin, W. W., & Newsted, P. R. (1999). Structural equation modeling analysis with small sample using partial least squares. In R. H. Hoyle (Ed.), *Statistical Strategies for Small Sample Research* (pp. 308-337). Thousands Oaks: Sage Publication.

Chin, W. W., Marcolin, B. L., & Newsted, P. R. (2003). A partial least squares latent variable modeling approach for measuring interaction effects: Results from a Monte Carlo simulation study and an electronic-mail emotion/adoption study. *Information systems research, 14*(2), 189-217.

Cho, K., Hong, T., & Hyun, C. (2009). Effect of project characteristics on project performance in construction projects based on structural equation model. *Expert Systems with Applications, 36*(7), 10461-10470.

Choi, H. H., Cho, H. N., & Seo, J. W. (2004). Risk assessment methodology for underground construction projects. *Journal of Construction Engineering and Management, 130*(2), 258-272.

Chorn, N. H. (1991). The “alignment” theory: Creating strategic fit. *Management Decision, 29*(1).

Churchill, G. A., & Lacobucci, D. (2005). *Marketing Research: Methodological Foundations* (9th ed.). Ohio: Thomson/South-Western.

CIDB. (2012). *Malaysian construction industry directory (MCID) 2011-2012*. Kuala Lumpur: Construction Industry Development Board.

CIDB. (2013). *List of Foreign Contractors Registered as International Contractors.* Kuala Lumpur: Construction Industry Development Board.

Cioffi, D. F., & Khamooshi, H. (2009). A practical method of determining project risk contingency budgets. *Journal of the Operational Research Society, 60*, 565-571.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale: Erlbaum.

Cohen, J. (2013). *Statistical Power Analysis for the Behavioral Sciences.* London: Routledge.

Cooke, B., & Williams, P. (2013). *Construction planning, programming and control*: New York: John Wiley & Sons.

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches* (3rd ed.). Thousand Oaks, CA: Sage.

Creswell, J. W., & Clark, V. L. P. (2007). Designing and conducting mixed methods research. California: Sage Publications.

Crotty, M. (1998). *The foundations of social research: Meaning and perspective in the research process*. London: Sage.

Danneels, E. (2002). The dynamics of product innovation and firm competences. *Strategic Management Journal, 23*(12), 1095-1121.

Day, G. S. (1994). The capabilities of market-driven organizations. *Journal of Marketing, 58*(4), 37-52.

Del Cano, A., & de la Cruz, M. P. (2002). Integrated methodology for project risk management. *Journal of Construction Engineering and Management, 128*(6), 473-485.

Demacopoulos, A. C. (1989). *Foreign exchange exposure in international construction.* PhD Thesis. Boston: Massachusetts Institute of Technology.

DeVellis, R. F. (2011). *Scale development: Theory and applications*. (2nd ed., Vol. 26). Oaks, CA: Sage Publications.

Dey, K. P. (2001). Decision support system for risk management: A case study. *Management Decision, 39*(8), 634-649.

Dey, P., Tabucanon, M. T., & Ogunlana, S. (1994). Planning for project control through risk analysis: A petroleum pipeline-laying project. *International Journal of Project Management, 12*(1), 23-33.

Diamantopoulos, A., & Winklhofer, H. M. (2001). Index construction with formative indicators: an alternative to scale development. *Journal of Marketing research, 38*(2), 269-277.

Dierickx, I., & Cool, K. (1989). Asset stock accumulation and sustainability of competitive advantage. *Management science, 35*(12), 1504-1511.

Dijkstra, T. (1983). Some comments on maximum likelihood and partial least squares methods. *Journal of Econometrics, 22*(1), 67-90.

Dikmen, I., & Birgonul, M. T. (2004). Neural network model to support international market entry decisions. *Journal of Construction Engineering and Management, 130*(1), 59-66.

Dikmen, I., & Birgonul, M. T. (2006). An analytic hierarchy process based model for risk and opportunity assessment of international construction projects. *Canadian Journal of Civil Engineering, 33*(1), 58-68.

Dikmen, I., Birgonul, M. T., & Gur, K. (2007a). A case-based decision support tool for bid mark-up estimation of international construction projects. *Automation in Construction, 17*, 30-44.

Dikmen, I., Birgonul, M. T., & Han, S. (2007b). Using fuzzy risk assessment to rate cost overrun risk in international construction projects. *International Journal of Project Management, 25*(5), 494-505.

Dikmen, I., Birgonul, M. T., & Ozorhon, B. (2007c). Project appraisal and selection using the analytical network process. *Canadian Journal of Civil Engineering, 34*, 786-792.

DiLalla, L. F. (2000). Structural equation modeling: Uses and issues. In Tinsley, H., & Brown, S. (Eds.) *Handbook of applied multivariate statistics and mathematical modeling* (439-464). New York: Academic Press.

Dlabay, L., & Scott, J. (2011). *International Business* Mason, OH: South-Western Cengage Learning.

Doloi, H. (2014). Rationalizing the Implementation of Web-Based Project Management Systems in Construction Projects Using PLS-SEM. *Journal of Construction Engineering and Management, 140*(7), 04014026.

Dunning, J. H. (2000) The eclectic paradigm as an envelope for economic and business theories of MNE activity. *International Business Review*, *9*, 163–90.

Easterby-Smith, M., Thorpe, R., & Lowe, A. (2002). *Management research: An introduction* (2nd ed.). London: Sage.

Economic Planning Unit. (2015). Eleventh Malaysia Plan 2016-2020: Anchoring growth on people. Putrajaya: The Economic Planning Unit.

Edwards, L. (1995). *Practical risk management in the construction industry*. London: Thomas Telford.

Egbu, C., & Serafinska, Z. (2000). *Attitudes to risk management in diverse project environments*. Paper presented at the COBRA 2000 Conference. Greenwich: RICS Research Foundation.

Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: what are they? *Strategic Management Journal*, *21*(10-11), 1105-1121.

El-Sayegh, S. M. (2008). Risk assessment and allocation in the UAE construction industry. *International Journal of Project Management*, *26*(4), 431-438.

ENR. (2007). *Top 225 International Contractors, Engineering News Record*. New York: McGraw-Hill.

ENR. (2008). *Top 225 International Contractors, Engineering News Record*. New York: McGraw-Hill.

ENR. (2009). *Top 225 International Contractors, Engineering News Record*. New York: McGraw-Hill.

ENR. (2010). *Top 225 International Contractors, Engineering News Record*. New York: McGraw-Hill.

ENR. (2011). *Top 225 International Contractors, Engineering News Record*. New York: McGraw-Hill.

ENR. (2012). *Top 225 International Contractors, Engineering News Record*. New York: McGraw-Hill.

ENR. (2013). *Top 250 International Contractors, Engineering News Record*. New York: McGraw-Hill.

ENR. (2014). *Top 250 International Contractors, Engineering News Record*. New York: McGraw-Hill.

Enshassi, A., Mohamed, S., & Abu-Mosa, J. (2008). Risk management in building projects in Palestine: Contractors' perspective. *Emirates Journal for Engineering Research*, *13*(1), 29-44.

Esposito, V. V., Chin, W. W., Henseler, J., & Wang, H. (2010). *Handbook of partial least squares: Concepts, methods and applications.* Heidelberg: Springer.

Eybpoosh, M., Dikmen, I., & Talat Birgonul, M. (2011). Identification of risk paths in international construction projects using structural equation modeling. *Journal of Construction Engineering and Management*, *137*(12), 1164-1175.

Fang, D., Li, M., Fong, P. S.-W., & Shen, L. Y. (2004). Risks in Chinese construction market- Contractors' perspective. *Journal of Construction Engineering and Management, 130*(6).

Fay, D. S., & Gerow, K. (2013). A biologist's guide to statistical thinking and analysis. WormBook: The online review of C. elegans biology.

Fidler, F., & Thompson, B. (2001). Computing correct confidence intervals for ANOVA fixed-and random-effects effect sizes. *Educational and Psychological Measurement, 61*(4), 575-604.

Figliozzi, M. A. (2008). Planning approximations to the average length of vehicle routing problems with varying customer demands and routing constraints. *Transportation Research Record: Journal of the Transportation Research Board, 2089*(1), 1-8.

Flanagan, R., & Norman, G. (1993). Risk management and construction. Oxford: Wiley-Blackwell.

Flick, U. (2008). *Managing quality in qualitative research.* London: Sage.

Fornell, C., & Bookstein, F. L. (1982). Two structural equation models: LISREL and PLS applied to consumer exit-voice theory. *Journal of Marketing Research, 19*(4), 440-453.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing research, 18*(1), 39-50.

Foss, N. J., & Knudsen, C. (2013). *Towards a Competence Theory of the Firm.* London-New York: Routledge.

Franke, A. (1987). Risk analysis in project management *International Journal of Project Management, 5*(1), 29-34.

Friedman, W. (1984). *Construction marketing and strategic planning.* New York: McGraw-Hill.

Friedman, G. (2011). Global economic downturn: A crisis of political economy. *STRATFOR Global Intelligence*. Retrieved from http://www.stratfor.com/weekly/20110808-global-economic-downturn-crisis-political-economy.

Galbraith, J. R., & Kazanjian, R. K. (1986). Organizing to implement strategies of diversity and globalization: the role of matrix designs. *Human Resource Management, 25*(1), 37-54.

Geisser, S. (1974). A predictive approach to the random effect model. *Biometrika, 61*(1), 101-107.

Gilley, A. (2005). *The manager as change leader*. Westport, CT: Praeger Publishers.

Google map. (2014). *World map image.*

Grant, R. M. (1991). The resource-based theory of competitive advantage: Implications for strategy formulation. *Knowledge and strategy, 33*(3), 3-23.

Grant, R. M. (1996). Prospering in dynamically-competitive environments: Organizational capability as knowledge integration. *Organization science, 7*(4), 375-387.

Gray, C., & Larson, E. (2003). Project management: The managerial approach. New York: McGraw Hill.

Guba, E. G. (1990). The alternative paradigm dialog. In E. G. Guba (Ed.), *The paradigm dialog* (pp. 17-30). Newbury Park, CA: Sage.

Guba, E. G., & Lincoln, Y. S. (2005). Paradigmatic controversies, contradictions, and emerging influences. In N. K. Denzin & Y. S. Lincoln (Eds.), *The Sage Handbook of Qualitative Research* (3rd ed., pp. 191-215). Thousand Oaks, CA: Sage.

Gunhan, S., & Arditi, D. (2005). Factors affecting international construction. *Journal of Construction Engineering and Management, 131*(3), 273-282.

Gupta, P. (2011). Risk management in Indian companies: EWRM concerns and issues. *The Journal of Risk Finance, 12*(2), 121-139.

Hair, J. F., Anderson, R. E., Tatham, R. L., & William, C. (1995). *Multivariate data analysis with readings*. New Jersey: Prentice Hall.

Hair, J. F., Hult, G. T. M., Ringle, C., & Sarstedt, M. (2013). *A primer on partial least squares structural equation modeling (PLS-SEM)*. Thousand Oaks: SAGE Publications, Incorporated.

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *The Journal of Marketing Theory and Practice, 19*(2), 139-152.

Hammersley, M., & Atkinson, P. (1983). *Ethnography principles in practice*. London: Routledge.

Han, S. H., & Diekmann, J. E. (2001a). Approaches for making risk-based go/no-go decision for international projects. *Journal of Construction Engineering and Management*, *127*(4), 300-308.

Han, S. H., & Diekmann, J. E. (2001b). Making a risk-based bid decision for overseas construction projects. *Construction Management and Economics, 19*(8), 765-776.

Han, S. H., Diekmann, J. E., & Ock, J. H. (2005). Contractor's risk attitudes in the selection of international construction projects. *Journal of Construction Engineering and Management, 131*(3), 283-292.

Han, S. H., Diekmann, J. E., Lee, Y., & Ock, J. H. (2004). Multicriteria financial portfolio risk management for international projects. *Journal of Construction Engineering and Management, 130*(3), 346-356.

Han, S. H., Kim, D. Y., Jang, H. S., & Choi, S. (2010). Strategies for contractors to sustain growth in the global construction market. *Habitat International, 34*(1), 1-10.

Han, S. H., Kim, D. Y., Kim, H., & Jang, W. S. (2008). A web-based integrated system for international project risk management. *Automation in Construction, 17*(3), 342-356.

Hastak, M., & Shaked, A. (2000). ICRAM-1: Model for international construction risk assessment. *Journal of Management in Engineering, 16*(1), 59-69.

Hayes, R. W., Perry, J., Thompson, P., & Willmer, G. (1986). *Risk management in engineering construction: Implications for project managers.* Swindon, UK: SERC.

He, J., & van de Vijver, F. (2012). Bias and equivalence in cross-cultural research. *Online readings in psychology and culture*, *2*(2), 1-19.

Helfat, C. E., & Peteraf, M. A. (2003). The dynamic resource-based view: Capability lifecycles. *Strategic Management Journal, 24*(10), 997-1010.

Helfat, C. E., Finkelstein, S., Mitchell, W., Peteraf, M. A., Singh, H., Teece, D. J., & Winter, S. G. (2007). *Dynamic capabilities: Understanding Strategic Change in Organizations.* London: Blackwell.

Henseler, J., & Chin, W. W. (2010). A comparison of approaches for the analysis of interaction effects between latent variables using partial least squares path modeling. *Structural Equation Modeling, 17*(1), 82-109.

Henseler, J., Ringle, C. M., & Sinkovics, R. R. (2009). The use of partial least square path modeling in international marketing. *Advances in International Marketing, 20*, 277-320.

Hertz, D. B. (1964). Risk analysis in capital investment. *Harvard Business Review, 42*(1), 95-106.

Hill, C., Jones, G., & Schilling, M. (2014). *Strategic management: theory: An integrated approach.* Boston: Cengage Learning.

Hillson, D. (2002). Extending the risk process to manage opportunities. *International Journal of Project Management, 20*, 235-240.

Hofer, C., & Schendel, D. (1978). *Strategy Formulation: Analytical Concepts.* St. Paul: West Series in Business Policy and Planning.

Hsu, L. C., & Wang, C. H. (2012). Clarifying the effect of intellectual capital on performance: the mediating role of dynamic capability. *British Journal of Management, 23*(2), 179-205.

Hsueh, S. L., Perng, Y. H., Yan, M. R., & Lee, J. R. (2007). On-line multi-criterion risk assessment model for construction joint ventures in China. *Automation in Construction, 16*, 607-619.

Hull, J. K. (1990). Application of risk analysis techniques in proposal assessment. *International Journal of Project Management, 8*(3), 152-157.

Hulland, J. (1999). Use of partial least squares (PLS) in strategic management research: A review of four recent studies. . *Strategic Management Journal, 20*(2), 195-204.

Hulland, J., Ryan, M. J., & Rayner, R. K. (2010). Modeling customer satisfaction: A comparative performance evaluation of covariance structure analysis versus partial least squares. In V. E. Vinzi, W. W. Chin, J. Henseler & H. Wang (Eds.), *Handbook of partial least squares: Concepts, methods and applications* (pp. 307-325). Berlin: Springer.

IBM Corp. (2013). *IBM SPSS Statistics for Windows (Version 22.0).* Armonk, NY: IBM Corp.

Jackson, S. (2015). *Research methods and statistics: A critical thinking approach.* US: Cengage Learning.

Jannadi, O. A., & Almishari, S. (2003). Risk assessment in construction. *Journal of Construction Engineering and Management, 129*(5), 492-500.

Jarvis, C. B., MacKenzie, S. B., & Podsakoff, P. M. (2003). A critical review of construct indicators and measurement model misspecification in marketing and consumer research. *Journal of Consumer Research, 30*(2), 199-218.

Jensen, M. B. (2008). Online marketing communication potential: Priorities in Danish firms and advertising agencies. *European Journal of marketing, 42*(3/4), 502-525.

Johnson, R. A., & Wichern, D. W. (2002). *Applied multivariate statistical analysis* (Vol. 5). Upper Saddle River, NJ: Prentice Hall.

Joreskog, K. G. (1970). A general method for estimating a linear structural equation system. *ETS Research Bulletin Series,* (2), i-41.

Jöreskog, K. G., & Sörbom, D. (1978). *LISREL IV: Analysis of linear structural relationships by the method of maximum likelihood.* Chicago: International Educational Services.

Jöreskog, K. G., & Wold, H. (1982). The ML and PLS techniques for modeling with latent variables: historical and comparative aspects. *Systems under indirect observation: Causality, structure, prediction, 1*, 263-270.

Kangari, R., & Boyer, L. (1981). Project selection under risk. *Journal of the Construction Division, 107*(4), 597-608.

Kangari, R., & Riggs, L. S. (1989). Construction risk assessment by linguistics. *IEEE Transaction on Engineering Management, 36*(2), 126-131.

Karim, S. (2006). Modularity in organizational structure: the reconfiguration of internally developed and acquired business units. *Strategic Management Journal, 27*(9), 799-823.

Keizera, J. A., Halman, J. I., & Song, M. (2002). From experience: Applying the risk diagnosing methodology. *Journal of Product Innovation Management, 19*(3), 213-232.

Kendrick, T. (2015). *Identifying and managing project risk: Essential tools for failure-proofing your project.* New York: AMACOM Div American Mgmt Assn.

Kenett, R., & Raanan, Y. (2011). *Operational risk management: A practical approach to intelligent data analysis.* West Sussex, UK: John Wiley.

Kessler, E. H. (Ed.). (2013). *Encyclopedia of management theory.* Thousand Oaks: Sage Publications.

Kim, D. Y., Han, S. H., Kim, H., & Park, H. (2009). Structuring the prediction model of project performance for international construction projects: A comparative analysis *Expert Systems with Applications, 36*, 1961-1971.

Kindström, D., Kowalkowski, C., & Sandberg, E. (2013). Enabling service innovation: a dynamic capabilities approach. *Journal of business research, 66*(8), 1063-1073.

Kinnunen, S. (2000). *Guidance for Good Bridge Design: Guide to Good Practice*: International Federation for Structural Concrete. Switzerland: fib Fédération internationale du béton.

Kliem, R. L., & Ludin, I. S. (1997). *Reducing project risk.* Hampshire: Gower Publishing, Ltd.

Kline, R. B. (2011). *Principles and practice of structural equation modeling* (3rd ed.). New York: Guilford Press.

Knight, F. H. (2012). *Risk, uncertainty and profit*. Mineola, NY: Courier Dover Publications.

Koszalka, T. A., & Grabowski, B. L. (2003). Combining assessment and research during development of large technology integration projects. *Evaluation and Program Planning, 25*(2), 203-213.

Kuhn, T. (1970). *The structure of scientific revolutions* (2nd ed.). Chicago: University of Chicago.

Kumar, R. (2005). *Research methodology: A step-by-step guide for beginners* (2nd ed.). London: Sage Publications Ltd.

Latham, S. M. (2014). *Constructing the team*. London: HM Stationery Office.

Lavender, S. (2014). *Management for the construction industry.* UK: Routledge.

Lavie, D. (2006). The competitive advantage of interconnected firms: An extension of the resource-based view. *Academy of management Review, 31*(3), 638-658.

Leung, H., Tummala, R., & Chuah, K. (1998). A knowledge-based system for identifying potential project risks. *Omega, 26*(5), 623-638.

Li, S. (2009). Risk management for overseas development projects. *International Business Research, 2*(3), P193.

Lincoln, Y. S., & Guba, E. G. (2000). Paradigmatic controversies, contradictions, and emerging confluences In Y. S. Lincoln & E. G. Guba (Eds.), *Handbook of qualitative research* (pp. 163-188). Thousand Oaks, CA: Sage.

Ling, F. Y. Y., & Hoi, L. (2006). Risks faced by Singapore firms when undertaking construction projects in India. *International Journal of Project Management, 24*(3), 261-270.

Ling, F. Y. Y., & Lim, H. L. (2007). Foreign firms' financial and economic risk in China. *Engineering, Construction and Architectural Management, 14*(4), 346-362.

Ling, F. Y. Y., & Low, S. P. (2007). Legal risks faced by foreign architectural, engineering, and construction firms in China. *Journal of Professional Issues in Engineering Education and Practice, 133*(3), 238-245.

Ling, F. Y. Y., Ang, A. M. H., & Lim, S. S. Y. (2007). Encounters between foreigners and Chinese: Perception and management of cultural differences. *Engineering, Construction and Architectural Management, 14*(6), 501-518.

Loo, S. C., Abdul-Rahman, H., & Wang, C. (2013). Managing External Risks for International Architectural, Engineering, and Construction (AEC) Firms Operating in Gulf Cooperation Council (GCC) States. *Project Management Journal, 44*(5), 70-88. doi: 10.1002/pmj.21365

Low, S. P., Liu, J., & He, S. (2009). External risk management practices of Chinese construction firms in Singapore. *KSCE journal of Civil Engineering, 13*(2), 85-95.

Lu, W. (2014). Reliability of Engineering News-Record international construction data. *Construction Management and Economics, 32*(10), 968-982.

Lyons, T., & Skitmore, M. (2004). Project risk management in the Queensland engineering construction industry: a survey. *International Journal of Project Management, 22*(1), 51-61.

Mahalingam, A., & Levitt, R. E. (2007). Institutional theory as a framework for analyzing conflicts on global projects. *Journal of Construction Engineering and Management*, *133*(7), 517-528.

Mahoney, J. T., & Pandian, J. R. (1992). The resource-based view within the conversation of strategic management. *Strategic Management Journal, 13*(5), 363-380.

Mainul Islam, M., & Faniran, O. O. (2005). Structural equation model of project planning effectiveness. *Construction Management and Economics, 23*(2), 215-223.

Makridakis, S. (1993). Accuracy measures: theoretical and practical concerns. *International Journal of Forecasting, 9*(4), 527-529.

Matzler, K., Renzl, B., & Faullant, R. (2007). Dimensions of price satisfaction: a replication and extension. *International Journal of Bank Marketing, 25*(6), 394-405.

Mertens, D. M. (1998). *Research methods in education and psychology: Integrating diversity with quantitative and qualitative approaches* Thousand Oaks, CA: Sage.

Messner, J. I., & Sanvido, V. E. (2001). An information model for project evaluation. *Engineering Construction and Architectural Management, 8*(5-6), 393-402.

Mills, A. (2001). A systematic approach to risk management for construction. *Structural survey*, *19*(5), 245-252.

Mincks, W., & Johnston, H. (2010). *Construction jobsite management*. Clifton Park, NY: Delmar Cengage Learning.

Molenaar, K. R. (2005). Programmatic cost risk analysis for highway mega projects *Journal of Construction Engineering and Management, 131*(3), 343-353.

Monteverde, K., & Teece, D. J. (1982). Supplier switching costs and vertical integration in the automobile industry. *The Bell Journal of Economics*, 206-213.

Mooi, E., & Sarstedt, M. (2011). *A concise guide to market research: The process, data, and methods using IBM SPSS statistics*. Berlin: Springer.

Mulholland, B., & Christian, J. (1999). Risk assessment in construction schedules. *Journal of Construction Engineering and Management, 125*(1), 8-15.

Mustafa, M. A., & Al-Bahar, J. F. (1991a). Project risk assessment using the analytic hierarchy process. *IEEE Transactions on Engineering Management, 38*(1), 46-52.

Narver, J. C., & Slater, S. F. (1990). The effect of a market orientation on business profitability. *Journal of Marketing, 54*(4), 20-35.

Nasir, D., McCabe, B., & Hartono, L. (2003). Evaluating risk in construction-schedule model (ERIC–S): Construction Schedule Risk Model. *Journal of Construction Engineering and Management, 129*(5), 518-527.

Neo, R. B. (1976). *International construction contracting*. Essex, UK: Bowker Publishing.

Neuman, W. L. (2000). *Social research methods: Qualitative and quantitative approaches* (4th ed.). Boston: Allyn & Bacon.

Newbert, S. L. (2007). Empirical research on the resource-based view of the firm: an assessment and suggestions for future research. *Strategic management journal, 28*(2), 121-146.

Newell, M. W., & Grashina, M. N. (2003). *The project management question and answer book*. New York: AMACOM Div American Mgmt Assn.

Nocco, B. W., & Stulz, R. M. (2006). Enterprise risk management: theory and practice. *Journal of Applied Corporate Finance, 18*(4), 8-20.

Nunnally, J. C. (1978). *Psychometric methods*. New York, NY: McGraw-Hill.

Nunnally, J. C., & Bernstein, I. (1994). *Psychometric theory*. New York: McGraw-Hill.

Oberlender, G. D. (1993). *Project management for engineering and construction* (Vol. 2). New York: McGraw-Hill.

Ofori, G. (2003). Frameworks for analysing international construction. *Construction Management and Economics, 21*(4), 379-391

Osborne, J. W., & Overbay, A. (2004). The power of outliers (and why researchers should always check for them). *Practical assessment, research & evaluation, 9*(6), 1-12.

Osipova, E. (2008). *Risk management in construction projects: a comparative study of the different procurement options in Sweden.* Ph.D. Thesis. Sweden: Luleå University of Technology.

Oztas, A., & Okmen, O. (2004). Risk analysis in fixed-price design–build construction projects. *Building and Environment, 39*, 229-237.

Paek, J. H., Lee, Y. W., & Ock, J. H. (1993). Pricing construction risks: Fuzzy set theory. *Journal of Construction Engineering and Management, 119*(4), 743-756.

Penrose, E. T. (1995). *The theory of the growth of the firm, 1959.* Oxford: Blackwell.

Perry, J., & Hayes, R. (1985). *Risk and its management in construction projects.* In ICE Proceedings, *78*(3), 499-521. London: Thomas Telford.

Peteraf, M. A. (1993). The cornerstones of competitive advantage: A resource-based view. *Strategic Management Journal, 14*(3), 179-191.

Pettigrew, A. M. (2014). *The Politics of Organizational Decision-Making.* UK: Taylor & Francis.

Pheng, L. S. (1996). *Theory and practice of construction export marketing*. Burlington, Vermont, U.S.: Ashgate Publishing Company.

Phillips, D. C., & Burbules, N. (2000). *Postpositivism and educational research*. Lanham, MD: Rowman & Littlefield.

Poh, Y. P., & Tah, J. H. M. (2006). Integrated duration-cost influence network for modelling risk impacts on construction tasks. *Construction Management and Economics, 24*, 861-868.

Porter, M. E. (1980). *Competitive strategy*. New York: The Free Press.

Porter, M. E. (1985). *Competitive strategy: Creating and sustaining superior performance*. New York: The Free Press.

Porter, M.E. (1990). *The Competitive Advantage of Nations.* New York: The Free Press.

Porter, M. E. (1991). Towards a dynamic theory of strategy. *Strategic Management Journal, 12*(S2), 95-117.

Porter, M. E. (1996). *What is strategy?* Boston: Harvard Business School Publishing

Porter, M. E. (2008). *Competitive advantage: Creating and sustaining superior performance.* New York: The Free Press.

Pouliquen, L. Y. (1970). *Risk analysis in project appraisal*. World Bank Staff Occasional Paper 11. Baltimore: Johns Hopkins University Press.

Price, A. D. F. (1995). *Financing international projects, international construction management series 3*. Geneva, Switzerland: International Labour Office.

Priem, R. L. (1992). An application of metric conjoint analysis for the evaluation of top managers' individual strategic decision making processes: A research note. *Strategic Management Journal, 13*(S1), 143-151.

Project Management Institute. (2004). *A Guide to the Project Management Body of Knowledge (PMBOK Guide).* Newton Square, PA: Project Management Institute.

Quak, S. K. (1991). *Marketing abroad: Competitive strategies and market niches for the Singapore construction industry*. Singapore: Pacific Trade Press Pte Ltd.

Ringle, C. M., Wende, S., & Will, A. (2005). *SmartPLS 2.0 (beta)*. Hamburg: Softwarepacket.

Robson, C. (2002). *Real world research: A resource for social scientists and practitioner-researchers* (Vol. 2): Blackwell Oxford.

Rossiter, J. R. (2002). The C-OAR-SE procedure for scale development in marketing. *International journal of research in marketing, 19*(4), 305-335.

Rumelt, R. P., Schendel, D., & Teece, D. J. (1991). Strategic management and economics. *Strategic Management Journal, 12*(S2), 5-29.

Saaty, R. W. (2003). *Decision making in complex environments, the Analytic Hierarchy Process (AHP) for decision making and the Analytic Network Process (ANP) for decision making with dependence and feedback* Pittsburg, Penn., USA: The Creative Decisions Foundation.

Sadeghi, N., Fayek, A. R., & Pedrycz, W. (2010). Fuzzy Monte Carlo simulation and risk assessment in construction. *Computer‐Aided Civil and Infrastructure Engineering, 25*(4), 238-252.

Sadgrove, M. K. (2015). *The complete guide to business risk management.* UK: Ashgate Publishing, Ltd..

Santoso, D. S., Ogunlana, S. O., & Minato, T. (2003). Assessment of risks in high rise building construction in Jakarta. *Engineering, Construction and Architectural Management, 10*(1), 43-55.

Sarstedt, M., & Mooi, E. (2014). *Descriptive statistics: A concise guide to market research* (pp. 87-139). Berlin Heidelberg: Springer.

Sarstedt, M., Wilczynski, P., & Melewar, T. (2013). Measuring reputation in global markets—A comparison of reputation measures' convergent and criterion validities. *Journal of World Business, 48*(3), 329-339.

Schmidt, W. C. (1997). World-Wide Web survey research: Benefits, potential problems, and solutions. *Behavior Research Methods, Instruments, & Computers, 29*(2), 274-279.

Schumacker, R. E., & Lomax, R. (2004). *A beginner's guide to structural equation modeling*. New York: Psychology Press.

Selznick, P. (1957). *Leadership in Administration*. New York: Harper and Row.

Seymour, H. (1987). *The Multinational Construction Industry*. London: Croom Helm.

Shang, H., Anumba, C. J., Bouchlaghem, D. M., Miles, J. C., Cen, M., & Taylor, M. (2005). An intelligent risk assessment system for distributed construction teams. *Engineering, Construction and Architectural Management, 12*(4), 391-409.

Sharma, M. (2004). *Research Methodolgy.* New Delhi, India: Anmol Publications Pvt. Ltd.

Shen, L. Y., Wu, G. W. C., & Ng, C. S. K. (2001). Risk assessment for construction joint ventures in China. *Journal of Construction Engineering and Management, 127*(1), 76-81.

Shen, L. Y., Zhao, Z. Y., & Drew, D. S. (2006). Strengths, weaknesses, opportunities, and threats for foreign-invested construction enterprises: A China study. *Journal of Construction Engineering and Management, 132*(9), 966-975.

Shimpi, P. A., & Durbin, D. (2001). *Integrating corporate risk management*: New York: Texere Publishing.

Shook, C. L., Ketchen, D. J., Hult, G. T. M., & Kacmar, K. M. (2004). An assessment of the use of structural equation modeling in strategic management research. *Strategic Management Journal, 25*(4), 397-404.

Sillars, D. N., & Kangari, R. (1997). Japanese construction alliances. *Journal of Construction Engineering and Management, 123*(2), 146-152.

Simons, R. (2013). *Levers of organization design: How managers use accountability systems for greater performance and commitment*: Boston: Harvard Business Review Press.

Sirmon, D. G., Hitt, M. A., & Ireland, R. D. (2007). Managing firm resources in dynamic environments to create value: Looking inside the black box. *Academy of management Review, 32*(1), 273-292.

Smith, N. J. (2003). *Appraisal, risk and uncertainty*. London: Thomas Telford.

Smith, N. J., Merna, T., & Jobling, P. (2013). *Managing risk in construction projects* New York: John Wiley & Sons.

Smith, P. G., & Merritt, G. M. (2002). *Proactive risk management*. New York, USA: Productivity Press.

Stadtler, H. (2015). Supply chain management: An overview. In *Supply chain management and advanced planning* (pp. 3-28). Berlin Heidelberg: Springer.

Stallworthy, E. A., & Kharbanda, O. P. (1983). *Total project management*. Aldershot, Hants, U.K.: Gower Publishing Co.

Stevens, J. (2001). *Applied multivariate statistics for social sciences* (4th ed.). New Jersey: Lawrence Erlbaum Associates.

Stevenson, H. H. (1976). Defining corporate strengths and weaknesses. *Sloan Management Review, 17*(3), 51-68.

Stockburger, D. W. (2013). *Introductory statistics: Concepts, models, and applications* (3rd web ed.). Missouri: Missouri State University.

Stone, M. (1974). Cross-validatory choice and assessment of statistical predictions. *Journal of the Royal Statistical Society. Series B (Methodological)*, 111-147.

Strassmann, W. P., & Wells, J. (1988). *The global construction industry, strategies for entry, growth and survival*. London: Unwin Hyman.

Strauss, M. E., & Smith, G. T. (2009). Construct validity: Advances in theory and methodology. *Annual review of clinical psychology, 5*, 1.

Styhre, A., Josephson, P. E., & Knauseder, I. (2004). Learning capabilities in organizational networks: case studies of six construction projects. *Construction Management and Economics, 22*(9), 957-966.

Tah, J. H., & Carr, V. (2000). A proposal for construction project risk assessment using fuzzy logic. *Construction Management & Economics, 18*(4), 491-500.

Taroun, A. (2014). Towards a better modelling and assessment of construction risk: Insights from a literature review. *International Journal of Project Management, 32*(1), 101-115.

Taroun, A., Yang, J., & Lowe, D. (2011). Construction risk modelling and assessment: Insights from a literature review. *The Built & Human Environment Review, 4*(1).

Taylan, O., Bafail, A. O., Abdulaal, R. M., & Kabli, M. R. (2014). Construction projects selection and risk assessment by fuzzy AHP and fuzzy TOPSIS methodologies. *Applied Soft Computing, 17*, 105-116.

Tchankova, L. (2002). Risk identification– Basic stage in risk management. *Environmental Management and Health, 13*(3), 290-297.

Teece, D. J. (2014). The foundations of enterprise performance: Dynamic and ordinary capabilities in an (economic) theory of firms. *The Academy of Management Perspectives*, *28*(4), 328-352.

Teece, D. J., & Pisano, G. (1994). The dynamic capabilities of firms: an introduction. *Industrial and Corporate Change, 3*(3), 537-556.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal, 18*(7), 509-533.

Tenenhaus, M., Vinzi, V. E., Chatelin, Y.-M., & Lauro, C. (2005). PLS path modeling. *Computational Statistics & Data Analysis*, *48*(1), 159-205.

Thomas, A. V., Kalidindi, S. N., & Ganesh, L. S. (2006). Modeling and assessment of critical risks in BOT road projects. *Construction Management and Economics, 24*, 407-424.

Thompson, P., & Perry, J. G. (1992). *Engineering construction risks: A guide to project risk analysis and assessment implications for project clients and project managers*. London: Thomas Telford.

Tobin, G. A., & Montz, B. E. (1997). *Natural Hazards: Explanation and Integration*. New York: Guilford Press.

Uff, J., & Odams, A. M. (1995). *Risk, management and procurement in construction*: Kings College, London: Centre of Construction Law and Management.

Uher, T. E., & Toakley, A. (1999). Risk management in the conceptual phase of a project. *International Journal of Project Management, 17*(3), 161-169.

Van der Stede, W. A., Young, S. M., & Chen, C. X. (2005). Assessing the quality of evidence in empirical management accounting research: the case of survey studies. *Accounting, Organizations and Society, 30*(7), 655-684.

Van de Vijver, F. J. R., & Leung, K. (1997). *Methods and data analysis for cross-cultural research.* Newbury Park, CA: Sage.

Van Thuyet, N., Ogunlana, S. O., & Dey, P. K. (2007). Risk management in oil and gas construction projects in Vietnam. *International Journal of Energy Sector Management*, *1*(2), 175-194.

Vinzi, V. E., Chin, W. W., Henseler, J., & Wang, H. (2010). *Handbook of Partial Least Squares: Concepts, Methods and Applications*: Springer.

Walker, D. H. T. (1997). Choosing an appropriate research methodology. *Construction Management and Economics, 15*(2), 149-159.

Wang, S. L. (2004). *Incentive compensation: Bonusing and motivation.* Master of Science in Civil and Environmental Engineering, Cambridge, Massachusetts: Massachusetts Institute of Technology.

Wang, C. L., & Ahmed, P. K. (2007). Dynamic capabilities: A review and research agenda. *International Journal of Management Reviews, 9*(1), 31-51.

Wang, M.-T., & Chou, H.-Y. (2003). Risk allocation and risk handling of highway projects in Taiwan. *Journal of Management in Engineering, 19*(2), 60-68.

Wang, F., Ding, L. Y., Luo, H. B., & Love, P. E. (2014). Probabilistic risk assessment of tunneling-induced damage to existing properties. *Expert Systems with Applications, 41*(4), 951-961.

Wang, S. Q., Dulaimi, M. F., & Aguria, M. Y. (2004). Risk management framework for construction projects in developing countries. *Construction Management and Economics, 22*(3), 237-252.

Wang, S. Q., Tiong, R. L., Ting, S. K., & Ashley, D. (1999). Political risks: analysis of key contract clauses in China's BOT project. *Journal of Construction Engineering and Management, 125*(3), 190-197.

Wang, S. Q., Tiong, R. L., Ting, S., & Ashley, D. (2000). Evaluation and management of foreign exchange and revenue risks in China's BOT projects. *Construction Management & Economics, 18*(2), 197-207.

Ward, S., & Chapman, C. (2003). Transforming project risk management into project uncertainty management. *International Journal of Project Management, 21*(2), 97-105.

Warszawski, A. (1996). Strategic planning in construction companies. *Journal of Construction Engineering and Management, 122*(2), 133-140.

Webster Jr, F. E. (1992). The changing role of marketing in the corporation. *Journal of Marketing*, 1-17.

Werner, O., & Campbell, D. T. (1970). Translating, working through interpreters, and the problem of decentering. In R. Naroll & R. Cohen (Eds.), *A handbook of cultural anthropology* (pp. 398-419). New York: American Museum of National History.

Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal, 5*(2), 171-180.

Wethyavivorn, P., Charoenngam, C., & Teerajetgul, W. (2009). Strategic assets driving organizational capabilities of Thai construction firms. *Journal of Construction Engineering and Management, 135*(11), 1222-1231.

Wideman, R. (1998). *Project and program risk management,* PMBOK Handbook Series, Vol. 6. Newtown Square, PA: Project Management Institute.

Wiklund, J., & Shepherd, D. A. (2009). The effectiveness of alliances and acquisitions: The role of resource combination activities. *Entrepreneurship Theory and Practice*, *33*(1), 193-212.

William, R. D., & Matthew, G. (1992). *Multivariate analysis: Methods and applications*. New York: Wiley.

Winter, S. G. (2003). Understanding dynamic capabilities. *Strategic Management Journal, 24*(10), 991-995.

Wirba, E. N., Tah, J. H. M., & Howes, R. (1996). Risk interdependencies and natural language computations. *Engineering, Construction and Architectural Management*, *3*(4), 251-269.

Wold, H. (1975). Soft modeling by latent variables: The nonlinear iterative partial least squares approach. *Perspectives in probability and statistics, papers in honour of MS Bartlett*, 520-540.

Wold, H. (1982). Soft modelling: The basic design and some extensions. *Systems Under Indirect Observation, PartII*, 36-37.

Yeo, K. T. (1990). Risks, classification of estimate and contingency management. *Journal of Management in Engineering, 6*(4), 458-470.

You, T., & Zi, H. (2007). The economic crisis and efficiency change: evidence from the Korean construction industry. *Applied Economics, 39*(14), 1833-1842.

Zahra, S. A., Sapienza, H. J., & Davidsson, P. (2006). Entrepreneurship and dynamic capabilities: a review, model and research agenda. *Journal of Management studies, 43*(4), 917-955.

Zavadskas, E. K., Turskis, Z., & Tamošaitiene, J. (2010). Risk assessment of construction projects. *Journal of Civil Engineering and Management, 16*(1), 33-46.

Zayed, T., Amer, M., & Pan, J. (2008). Assessing risk and uncertainty inherent in Chinese highway projects using AHP. *International Journal of Project Management, 26,* 408-419.

Zeng, J., An, M., & Smith, N. J. (2007). Application of a fuzzy based decision making methodology to construction project risk assessment *International Journal of Project Management, 25,* 589-600.

Zhang, X. L. (2011). Social risks for international players in the construction market: China study. *Habitat International, 35*(3), 514-519.

Zhang, L., Skibniewski, M. J., Wu, X., Chen, Y., & Deng, Q. (2014). A probabilistic approach for safety risk analysis in metro construction. *Safety science, 63,* 8-17.

Zhang, G., & Zou, P. X. W. (2007). Fuzzy analytical hierarchy process risk assessment approach for joint venture construction projects in China. *Journal of Construction Engineering and Management, 133*(10), 771-779.

Zhi, H. (1995). Risk management for overseas construction projects. *International Journal of Project Management, 13*(4), 231-237.

Zhong, B. J., Morris, S. S., Snell, S. A., & Wright, P. M. (2012). Resource-Based View of International Human Resources: The Role of Integrative and Creative Capabilities in Gaining Competitive Advantage for MNCs. In *Handbook of Research in International Human Resource Management* (2nd ed.), eds. GK Stahl, I. Björkman and S. Morris, London: Edward Elgar, 436-452.

Zollo, M., & Winter, S. G. (2002). Deliberate learning and the evolution of dynamic capabilities. *Organization science, 13*(3), 339-351.

Zou, P. X., Zhang, G., & Wang, J. (2007). Understanding the key risks in construction projects in China. *International Journal of Project Management, 25*(6), 601-614.

LIST OF PUBLICATIONS

Abdul-Rahman, H., Loo, S. C., & Wang, C. (2012). Risk identification and mitigation for architectural, engineering, and construction firms operating in the Gulf region. *Canadian Journal of Civil Engineering, 39*(1), 55-71.

Abdul-Rahman, H., Wang, C., Loo, S. C. (2014). *Risk management in construction.* UM Press. ISBN: 978-983- 100-776

Loo, S. C., & Abdul-Rahman, H. (2012). Malaysian contractors in Gulf construction: A preliminary study on financial and economic risks. *International Journal of Engineering & Technology* (0975-4024), 4(4).

Loo, S. C., Abdul-Rahman, H., & Wang, C. (2013). Foraying into international construction market: A review on the incorporation of firms' capabilities in risk assessment methodology. *International Journal of Real Estate Studies, 8*(1), 1-15.

Loo, S. C., Abdul-Rahman, H., & Wang, C. (2013). Managing external risks for international architectural, engineering, and construction (AEC) firms operating in Gulf Cooperation Council (GCC) states. *Project Management Journal, 44*(5), 70-88.

Loo, S. C., Abdul-Rahman, H., & Wang, C. (2014). *Anomaly-seeking research: International construction capability measurement model*. Paper presented at Asia Pacific Social Science Conference.

Loo, S. C., Abdul-Rahman, H., & Wang, C. (2015). *Mathematical models for relative quantification of firm's capabilities on international construction project risks.* Paper presented at Advances in Business-Related Scientific Research Conference.