Identification of Risk Factors, Success Practices, and Feasibility of the Best Value Approach Application to Improve Construction Performance in Vietnam and Other Developing Countries

by

Nguyen Tran Khoi Le

A Dissertation Presented in Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

Approved March 2019 by the
Graduate Supervisory Committee:

Oswald Chong, Chair
Kenneth Sullivan
Dean Kashiwagi

ARIZONA STATE UNIVERSITY

May 2019

ABSTRACT

The Vietnam Construction Industry (VCI) has been facing risks that cause delays, budget overrun, and low customer satisfaction that required continuously research efforts to manage them. This research assesses the current conditions of the VCI in terms of performance, common risks, and success factors; and explores the potential of using the Best Value Approach (BVA), an innovative procurement and project management technology, to improve overall VCI performance. VCI risk factors were presented in an analysis of the data collected from a survey that include the 23 common risk factors that cause non-performance in construction projects in developing countries. The factors were consolidated from an extensive literature reviews, and inputs were solicited from 103 construction practitioners in Vietnam. The study reveals the top five risk factors as the bureaucratic administrative system, financial difficulties of owner, slow payment of completed works, poor contractor performance, financial difficulties of contractor. Factor analysis explored the correlations among the risks and yielded four outcomes – Lack of Site and Legal Information, Lack of Capable Managers, Poor Deliverables Quality, and Owner's Financial Incapability. VCI success factors were revealed from a survey that is adopted from 23 Critical Success Factors (CSFs) related to common construction risks, found through extensive literature reviews, and inputs were solicited from 101 VCI participants. The experts ranked those CSFs with respect to impact to project success. The study reveals the top impactful CSFs such as all project parties clearly understand their responsibilities, more serious consideration during contractor selection stage, test contractors' experience and competency through successful projects in the past. Factor analysis was conducted to explore the principal success factor groupings and yielded four outcomes – Improving Management Capability, Adequate Pre-Planning, Stakeholders' Management, and Performance-based Procurement. An analysis from six industry experts determined how current VCI conditions, namely risk and success factors, are related to BVA. Sixteen BVA success principles were identified and ranked based on their perceived impact to project performance by an industry survey with 98 VCI practitioners. The results show high agreement rate with all sixteen BVA principles. The majority of participants agreed that BVA would improve project performance and were interested in learning more about BVA. The results encourage further BVA testing and education in the VCI.

TABLE OF CONTENTS

CHAPTER Page

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION AND OBJECTIVES

Introduction

Construction industry lays the foundation for both developing and developed economies as it provides the infrastructure for any nations. It contributes to economic growth, delivers jobs and provides critical infrastructure (e.g. healthcare facilities and transportation network) to support the growth and development of various economic sectors. Economic growth results in improving the quality of life of a country, where (only) well invested construction projects would alleviate people from poverty as more wealth is created. While the construction industry is one of the oldest industries in any civilizations, modern construction industry (even the ones in the developed countries) is still marred with inefficiencies and disputes that resulted in inefficient capital investment and utilization (Rivera et al., 2017). Investment in construction faces multiple scrutiny where many countries still face project delays, budget overrun, low stakeholders' satisfaction, and in the worst cases, corruption, even though these are the essential elements to determine how successful a construction project truly is (Long et al., 2004).

The challenges that the developing and developed countries face are different. This study would focus on Vietnam and thus deploy research only from similar countries, especially those rapidly developing countries in Asia. The study also focuses on identify the risks that put construction project cost, schedule and quality at stake, particularly those that hinder construction project performance in the developing countries (Koushki et al., 2005; Sambasivan, 2007; Toor et al., 2008, Le-Hoai, 2008). Particular attention is given to the development of factor models for enhancing the construction project performance in the developing countries.

Once regarded as an economic disaster, Vietnam is now emerging as the latest East Asian growth engine which attracts the attention of global investors. Today, Vietnam is currently among the countries with the highest gross domestic product (GDP) growth rates. In 2002, GDP growth in Vietnam hit 7% (high) and recorded the fastest economic growth in Southeast Asia. In 2007, the GDP kept growing to 8.5%, marking the third consecutive year above the 8% benchmark for this small country (Ling & Bui, 2010; Long et al., 2004). That was an all-time high record in terms of growth rate, placing Vietnam second only to China in the Asia region. In 2009, Vietnam was one of the only South East Asian emerging economies not to have gone into a recession during the 2008 U.S. financial crisis. Since 2013, GDP growth has been recovering and increasing above 6% on average until now. In comparison, the U.S. GDP growth has been 3.2% on average in the past 10 years.

The construction sectors account for significant economic growth in Vietnam. The Vietnam Construction Industry (VCI) has been growing at 15% annually in the past 10 years. In 2002, VCI comprised 39% of the GDP growth rate. In 2011, VCI increased its contribution to 41.1%. Thanks to the promotion of industrialization from the Vietnamese government and infusing of foreign investments through the Official Development Assistance (ODA) program, construction growth rate has been healthy and consistent over the years (Nguyen Duy et al., 2004; Khanh & Kim, 2014; Luu et al., 2008). However, despite large growth and increasing demand for construction, multiple research efforts in the past 15 years have identified that there are still risks existing in the VCI that hinder performance. It is therefore imperative to develop and conduct research on risk management solutions for common risks in Vietnam. It is therefore imperative to develop and conduct research on potential solutions to improve the VCI project performance.

Objectives of the Study

The research objectives of this study are as follows:

First, to identify risk factors affecting construction project performance in developing countries, particularly Vietnam. The research would first identify the risk factors through extensive literature review for developing countries, and prior research in the field. The research would then rank and examine the frequency, relevance, severity and importance of the identified risk factors. After which, the research team would determine how different construction stakeholders rank the risk factors, and how they perceive their impacts. The analysis would finally identify and model the potential relationships between risks, and the results are simplified factors that would be used at the project pre-planning phase and throughout the project.

Second, to identify success factors that could address common risks and improve project performance in the VCI. The research would first identify the success factors through extensive literature review for developing countries, and prior research in the field. After which, the research team would determine how different construction stakeholders rank the success factors, and how they perceive their impacts. The analysis would finally identify and model the potential relationships between those factors, and the results are simplified factors that would be used to improve project management capability in the VCI. Other countries that face similar construction risks as Vietnam would also find the results useful.

Third, to explore the potential of the Best Value Approach (BVA) and its project delivery process, Performance Information Procurement System (PIPS or BVA PIPS), in construction project applications in the VCI to improve overall performance. Although the research targets the VCI, the methodology presented can be used in other construction industries. Hence, the results would be useful, not only for VCI practitioners, but also for those in other developing countries.

CHAPTER 2

LITERATURE REVIEW

Risk Factors in the VCI

Extensive literature reviews, case analysis, and discussion with multiple construction stakeholders were conducted to identify the relevant construction risk factors for developing countries. Over ninety (90) risk factors pertaining to construction projects were compiled for the studies from the following countries: Kuwait (Koushki et al., 2005), Malaysia (Sambasivan & Soon, 2007), Jordan (Sweis et al., 2008), Ghana (Frimpong et al., 2003), Nigeria (Aibinu et al., 2006), Vietnam (Le-Hoai, 2008), Thailand (Toor & Ogunlana, 2008), Indonesia (Kaming et al., 1997), Lebanon (Mezher & Tawil, 1998), Zambia (Kaliba et al., 2009), India (Doloi, et al., 2012), Egypt (Aziz & Abdel-Hakam, 2016), Uganda (Alinaitwe et al., 2013), Gaza (Enshassi et al., 2009), Palestine (Mahamid et al., 2012), and Oman (Ruqaishi & Bashir, 2015). Summaries from some of the major studies include:

- Koushki et al. (2003) interviewed over 450 private residential owners and developers in Kuwait and identified the major factor contributing to projects' time-delay and cost-increase to include inadequate budget and time allocated at the design phase. Other causes of delays and cost overruns included high number of change orders, financial constraints, owners' lack of experience in construction, contractor-related problems, and material-related problems.
- Sambasivan & Soon (2006) conducted a survey on 150 owners, consultants, and contractors in Malaysia to identify the ten most impactful causes as

contractor's improper planning, contractor's poor site management, inadequate contractor experience, inadequate client's finance and payments for completed work, problems with subcontractors, shortage in material, labor supply, equipment availability and failure, lack of communication between parties, and mistakes during construction stage. The main effects of these causes were: time overrun, cost overrun, disputes, arbitration, litigation, and total abandonment.

- Sweis et al. (2007) collected data from 29 consultants, 36 contractors, and 26 clients on project delay in Jordan and found that poor planning of scheduling, financial difficulties, too many change orders, shortage of manpower (skilled, semi-skilled, unskilled labor), and incompetent technical staff assigned to the project were the leading risk causes for delays. These causes were pertained to the internal environment of the supply chain, especially that of the contractor, while exogenous factors had relatively lesser impact on project delay.
- Frimpong et al. (2001) research using questionnaire surveys to identify and evaluate the relative importance risk factors pertaining to the non-performance if Ghana groundwater construction projects revealed that the major risk factors included monthly payment difficulties from agencies, poor contractor management, material procurement, poor technical performances, and escalation of material prices. Most of the identified problems originated from poor resources management (human, technical, and material).
- Le-Hoai (2008) performed a comprehensive study on the most common and other general problems of construction projects in Vietnam and found that the

problems with high occurrence and impacts include: inaccurate time estimating, slow site clearance, excessive change orders, slow government permits, severe overtime, inadequate modern equipment, lack of capable representatives, bureaucracy, obsolete technology, and unsatisfactory site compensation.

- Toor and Ogunlana (2007) examined the causes of construction delays in Thailand and found that the most significant problems were the lack of standardization in design, lack of contractor's experience and control over project, inadequate experience of staff, lack of competent subcontractors/supplies, unrealistic project schedule, lack of responsibility, contractor's financial difficulties, poor contract management, poor site access or availability, and poor efficiency of supervisor or foreman.

Similar risk factor found in the literature review were grouped under one risk factor. For example, "Lack of design standardization" found in Toor and Ogunlana (2007) is grouped under "Ineffective Designs and Frequent Design Changes" as shown in Table 1. The reason for grouping them is to simplify the research process and analysis procedures while staying relevant to the research. The standardization process would allow the research team to focus on identify the factors first, before further studies would be conducted to better identify the details. The research grouped the risk factors into twenty-three (23) common risk factors for developing countries as shown in Table 1. Literature review showed that the developing countries faced many common risk factors despite differences in socio-economic, cultural, and political aspects.

Table 1. Common Risk Factors that Cause Construction Non-Performance in Developing Countries

Risk Factors	Kuwait	Malaysia	Jordan	Ghana	Nigeria	Vietnam	Thailand	Indonesia	Lebanon	Zambia	India	Egypt	Uganda	Gaza	Palestine	Oman
Bureaucratic administrative system		x	x	x	x	x	x		x		x		x	x		
Corruption/Collusion						x	x									
Defective works and reworks				x		x				x	x	x	x	x	x	x
Financial difficulties of contractor	x		x	x	x	x	x			x	x			x	x	
Financial difficulties of owner	x		x	x	x	x	x			x		x		x	x	
Improper planning and scheduling	x	x	x	x	x	x	x	x			x		x	x	x	x
Inaccurate estimates	x			x		x			x			x		x		
Inadequate legal framework						x										
Ineffective designs and frequent design changes	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x
Ineffective project management	x	x		x		x	x		x	x	x		x			x
Interest and inflation rates				x	x		x	x			x		x	x	x	
Lack of accurate historical information		x		x	x		x	x	x		x	x	x			x
Lack of capable owners	x	x			x	x	x		x	x	x		x	x	x	x
Lack of experience in complex projects						x		x			x	x	x	x		x
Owners' site clearance difficulties			x			x					x	x		x	x	x
Poor contractor performance	x	x	x			x	x			x		x	x	x	x	x
Poor site management and supervision		x				x			x	x	x	x		x	x	x
Poor subcontractor performance		x	x		x	x	x		x	x	x	x	x	x	x	x
Poor tendering practices [Low bid practice]				x		x	x									x
Shortages of materials	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x
Slow payment of completed works		x	x	x			x		x	x	x		x	x	x	x
Slow site handover			x		x	x					x	x			x	
Unpredictable government policies and priorities		x	x		x	x	x		x		x				x	x
Total Counts	9	12	12	12	12	20	15	6	11	11	17	12	13	16	15	15

Success Factors in the VCI

Despite different perceptions of success among project participants, construction projects are widely acknowledged as successful when it is delivered on time, within budget, in accordance with specifications and to stakeholders' satisfaction (Sanvido et al., 1992). Critical Success Factors (CSFs) are certain conditions when achieved would lead to such success, defined by Rockart (1982) as: 'those few key areas of activity in which favorable results are necessary for a manager to reach his/her goals'. The CSF methodology attempts to identify the key areas that are essential for management success and has been utilized in financial services, information systems, manufacturing industry, and construction management (Li et al., 2005). Other functions of CSFs include: to guide an organization in strategic plans development, to form strategies, to identify critical issues and risks associated with a plan, and to help achieve high performance (Nguyen Duy et al., 2004).

To develop effective framework to manage those risks, the authors attempt to identify CSFs pertaining to them. The following CSFs have been found through extensive literature reviews and case analysis from published journals:

- CSFs related to procurement practices: more serious consideration during contractor selection stage (Le-Hoai et al., 2008; Koushki et al., 2007; Toor & Ogunlana, 2010), promote pre-qualification of tenders and selective bidding (Long et al., 2004), change tender selection philosophy from "lowest-price wins" to select the most responsive contractor based on preset criteria (Luu et al., 2009, Sambasivan & Soon, 2007, Lo et al., 2006), test contractors' experience and competency through successful projects in the past (Le-Hoai et al., 2008, Sambasivan & Soon, 2007), select designer based on experience and past performance (Thuyet et al., 2007, Yakubu & Sun, 2010), simplify bidding process (Thuyet et al., 2007), save time and cost during the bidding process (Long et al., 2004), and improve contracts to equitably allocate risks between parties (Le-Hoai et al., 2008, Faridi & El-Sayegh, 2006, Sambasivan & Soon, 2007).

- CSFs related to performance assessment: measurable projects performance (Khanh & Kim, 2014, Frimpong et al., 2003), create practical models to assess the changes of schedule and cost (Le-Hoai et al., 2008; Lo et al., 2006; Yakubu & Sun, 2010; Toor & Ogunlana, 2010), and measurable construction company's performance for improvement (Luu et al., 2008, Lo et al., 2006).
- CSFs related to management: introduce effective construction management (Long et al., 2004; Lo et al., 2006; Faridi & El-Sayegh, 2006; Frimpong et al., 2003; Yakubu & Sun, 2010), all project parties clearly understand their responsibilities (Khanh & Kim, 2014; Koushki et al., 2007; Lo et al., 2006; Faridi & El-Sayegh, 2006; Frimpong et al., 2003; Yakubu & Sun, 2010), project team members need to be well matched to particular projects (Thuyet et al., 2007), and adequate resources invested in the pre-construction phase (Lo et al., 2006, Sambasivan & Soon, 2007).
- CSFs related to other high impact issues: have a plan to assist inexperienced owners (Thuyet et al., 2007), effective communication between owner and

designer (Thuyet et al., 2007), select high performing consultants to evaluate design works (Thuyet et al., 2007; Koushki et al., 2007), owners understand their responsibility for timely payment to contractors (Le-Hoai et al., 2008; Sambasivan & Soon, 2007), all project parties, especially contractors, understand their responsibility to provide materials on time (Le-Hoai et al., 2008; Sambasivan & Soon, 2007; Yakubu & Sun, 2010), good relationships with both central and local governments (Thuyet et al., 2007), projects are inspected by government officials (Ling & Bui, 2010, Faridi & El-Sayegh, 2006), and foreign experts are involved (Ling & Bui, 2010).

While these CSFs were identified, their relative importance to one another has yet been determined. They could all be considered important, but some could have higher impact to success than others. Hence, it is prudent to attempt ranking them in terms of impact to project performance and attention should be given to them during project development. Additionally, the interrelationships among the CSFs should be revealed so the findings of this study could be readily and consistently applied for future projects (Nguyen Duy et al., 2004).

The Best Value Approach

The Best Value Approach (BVA), a procurement and project management philosophy, were first developed at Arizona State University in 1991 (Rivera, 2014). Throughout BVA's development, this method had undergone multiple names including: Performance Information Procurement System (PIPS), Performance Information Risk Management System (PIRMS), and Best Value Procurement (BVP) (Rivera, 2014). BVA uses the Construction Industry Structure chart (Figure 1) to describe the difference between the traditional procurement / project delivery practices and BVA methodology (Kashiwagi et al., 2005).

The environment of traditional procurement / project delivery practices is called price-based environment (Figure 1, Quadrant I). In the price-based environment, the owner directs project by developing the technical requirements, selecting contractor based on technical information, writing the contract, controlling and making decisions. Such practices do not differentiate contractors' capability as all contractors are required to bid on the same "hard" scope. In essence, contractors are to bid on the owner's requirement as directed, regardless of the correctness of the directions. They do not receive credits towards the award for proposing higher quality solutions. As a result, price becomes the dominant selecting criterion, profits become the contractor's sole objectives, and low-bid prevails. High quality contractors have to sacrifice quality and high performance to just meet the minimum standards to compete which increase risks to the project as illustrated in Figure 2. Other symptoms of the price-based environment include contractors sending inexperienced personnel, poor performance, higher overall costs, inefficiency, use of relationships to solve problems, and non-transparency (Kashiwagi & Kashiwagi, 2015). The price-based environment characteristics are similar to the conditions in the VCI as observed in previous studies (Long et al., 2004; Le-Hoai et al., 2008).

The BVA resolves the risks of price-based environment by creating the BVA environment (Figure 1, Quadrant II). The major difference between BVA environment and price-based environment is the replacement of owner's decision making and management, direction, and control (MDC) with the utilization of expertise. In addition to cost, the contractor is hired for his expertise. In the BVA environment, the owner utilizes the contractor to develop technical requirements for project. Technical information is only shared with the owner when a contractor is selected. The selected contractor develops the contract for the project and has total control of the project and the owner only approves the actions. The BVA owner outsources the project to the contractor and thus requires the contractor to be accountable for the project, send their high-performance team to minimize risks, and perform quality control. By observation, the BVA promotes high-performance and minimizes risks that originated from the price-based environment (Kashiwagi et al., 2005, Kashiwagi & Kashiwagi, 2015).

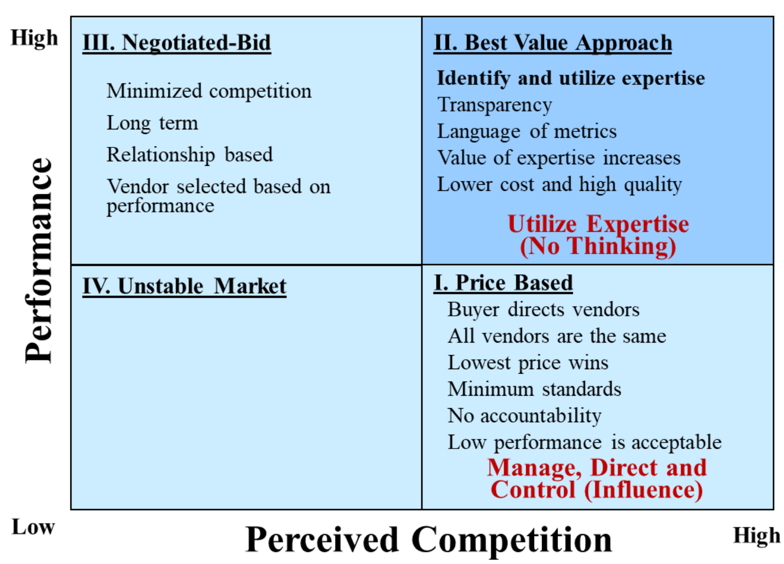

Figure 1. Industry Structure

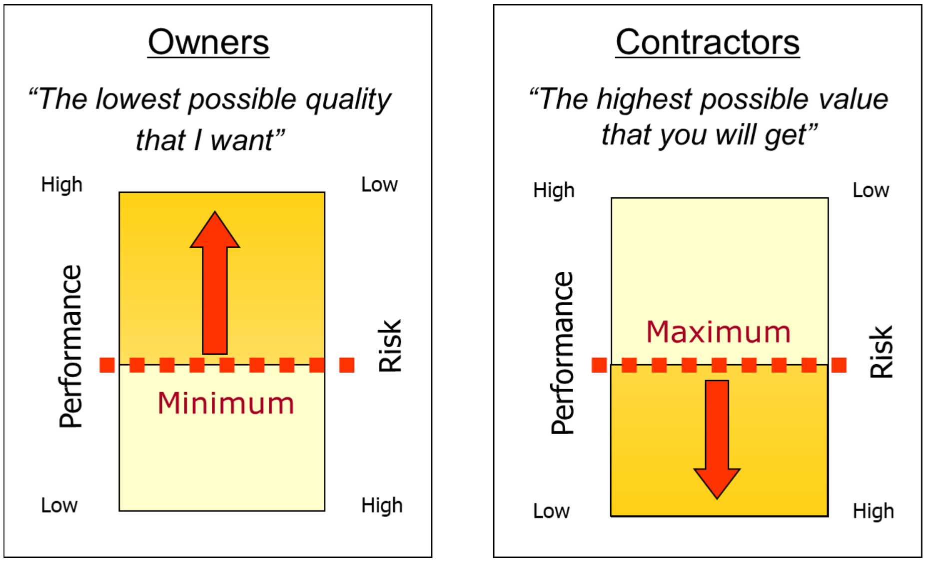

Figure 2. Minimum Standards and Risk

In practice, the BVA is implemented into a four-phase delivery process called Performance Information Procurement System (PIPS or BVA PIPS) (Figure 3) (Kashiwagi, 2019):

- Phase 1 – Preparation: In this case, the owner identifies their project team and develops the Request for Proposal (RFP) which includes their requirements and BVA price controls. Contractors who are interested in bidding will be educated in the BVA process and how they will be evaluated.
- Phase 2 – Selection: The contractors are ranked in this phase based upon their level of expertise specific to the subject project. All contractors compete and set themselves apart using non-technical performance metrics pertaining to their capability to meet the owner's requirements. In this phase, contractors are prioritized solely based on expertise and competitive pricing, not by the offered technical scope as often seen in traditional procurement. However, this

does not mean that the bidding contractors should not prepare a scope because their price should be based on a scope that they would be proposing if selected to proceed to the next phase.

- Phase 3 – Clarification: The top-rated contractor in Selection phase is invited to the Clarification phase. This contractor will present their scope of work and plan including detailed schedule, milestone schedule, cost, risk management plan, performance metrics to be kept through the project, and the Weekly Risk Report (WRR). The WRR is a BVA template that the selected contractor fills out during Clarification phase and submits to all stakeholders weekly throughout the project. The main functions of the WRR are to track progress and deviation of the contractor's plan; record change orders, project performance metrics, risk management plan; and allow stakeholders to follow and know the status of the project. The owner reviews, discusses, and approves the contractor's proposal before awarding the contract.
- Phase 4 – Execution: The awarded contractor executes their approved proposal. During project development, the contractor is responsible to perform quality control and risk management. All project actions are accomplished and recorded in the WRR.

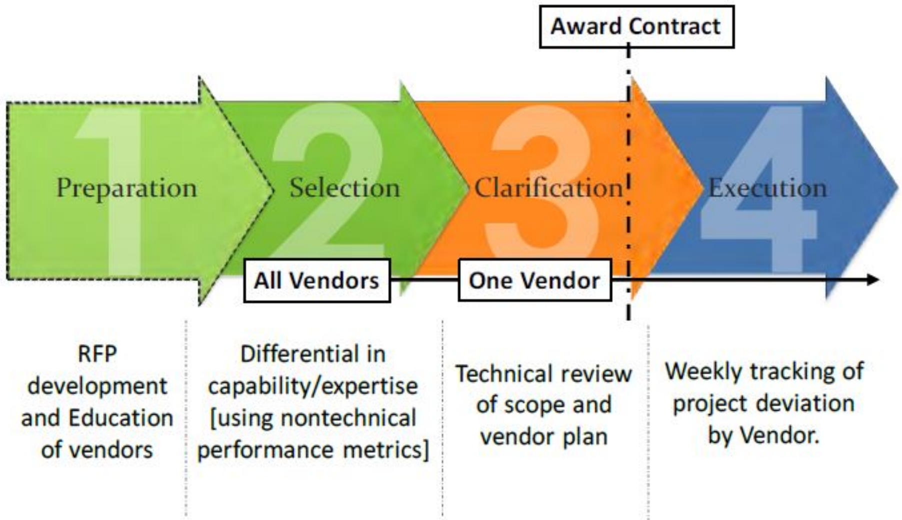

Figure 3. Performance Information Procurement System Process

The BVA and its application, PIPS, are continuously tested to deliver services, mainly in IT and construction industries. To date, BVA has been used in over 2,000 projects with total value of $6.6 billion in 32 US states and many countries with dominant results as shown in Table 2 (Kashiwagi, 2019; Alzara, 2016b). A review of BVA literature indicates that BVA has potential to improve the construction projects performance in Vietnam. However, an evaluation of BVA application in the VCI has yet to be performed.

Table 2. Examples of BVA case studies

Criteria	United Airlines	State of Utah	University of Hawaii	State of Minnesota
Duration	1996 - 1998	1999 - 2011	2000 - 2005	2005 - present
Number of projects	32	4	11	247
Awarded Cost	$13 million	$64.4 million	$1.7 million	$97.2 million
Satisfaction	100%	N/A	92%	100%
On time	98%	100%	100%	100%
Within budget	100%	100%	100%	100%
No change orders	100%	100%	N/A	100%

CHAPTER 3

RESEARCH METHODOLOGY

This research uses field survey as its key research method to collect data pertaining to the research objectives. The survey focuses on data collection from various construction stakeholders pertaining to the understanding of the VCI. The survey consists of five parts:

The first part collects respondent's general information such as role in the construction industry (Owner, Contractor, Design / Consultant), geographical area, year of experience, and main type of projects.

The second part collects respondents' project performance including average project budget, experience with delay issues, average project time extension, experience with budget overrun issues, average project cost growth, and satisfaction with the construction industry performance.

The third part is designed using the twenty-three (23) common risk factors from the literature research (shown on Table 1) with a goal to quantify the construction project and industry performances pertaining to time, cost, and customer satisfaction. It aims to identify the relative impacts that those risk factors had on construction projects and industry. The five-point Likert scale of 0 to 4 measures the respondents' experiences between the risk factors and their impacts on construction projects, based on their occurrences and severities. The numerical values assigned for the Likert Scale are as follow: '0 – Never Happen; 1 – Rarely; 2 – Sometimes; 3 – Often; 4 – Always' for frequency, and '0 – No Influence, 1 – Mild, 2 – Moderate, 3 – Very, 4 – Extremely' for severity. The respondents have the option to include additional risk factors they personally experienced but was not included in the 23 common risk factors.

The fourth part is designed using the twenty-three (23) CSFs identified from the literature. It also aims to identify the relative impacts that those CSFs had on construction projects performance. The five-point Likert scale of 0 to 4 measures the respondents' perception on the impact of each CSF on projects success. The numerical values assigned for the Likert Scale are as follow: '0 – No Impact, 1 – Mild, 2 – Moderate, 3 – Very, 4 – Extremely'. The respondents have the option to include additional CSF they personally pursued but was not included in the initial 23 CSFs.

The fifth part collects data from various VCI practitioners pertaining to their perspectives on the pre-established 16 BVA principles. It aims to identify the relative impacts that those BVA principles had on project performance in the VCI. The survey also asks the respondents on whether the presented 16 BVA principles would improve project performance, and if they are interested in learning more about BVA. The five-point Likert scale of 1 to 5 measured the respondents' agreement on each BVA principle. The numerical values assigned for the Likert Scale are as follow: '0 – Strongly Disagree, 1 – Disagree, 2 – Neutral, 3 – Agree, 4 – Strongly Agree'.

The questionnaire/survey was validated before it was sent out to the experts. Six (6) construction industry experts were identified and participated in the validation exercises. The experts included a civil engineering/construction engineering professor, a practicing contractor, two owner representatives, and two BVA certified trainers. These experts had at least 15 years of experience in the industry at the time of the validation test. The experts reviewed the structure and content of the questionnaire, and recommended changes to the originals. Their recommendations are incorporated into the final questionnaire. It was then sent to the selected survey participants in Vietnam. The stakeholders are divided into “Owners”, “Contractors” and “Consultants”, and they were either sent an email with a link connected to the survey or physical mail to their offices. The online survey was developed using Google Survey and printed copies of the survey forms were mailed out with return envelopes enclosed. Completed surveys were compiled online and physically from the returned mails. The surveys were returned within a month after they were mailed out.

CHAPTER 4

DATA COLLECTION AND CHARACTERISCTICS OF RESPONDENTS

Data Collection

The survey was sent to over 300 construction professionals from the three stakeholder groups only in Vietnam. These professionals were selected from companies that faced the highest risk factors, such as the type, complexity and size of the construction projects their companies are involved in. The research team avoided the companies that were involved in low-risk projects, such as renovation and structural repairs where cost and budget are less volatile. Large-size complex projects face increasing risks of budget, schedule and quality issues. They also faced greater scrutiny from the Vietnamese regulators and clients.

Nearly half of the surveys were returned (140 surveys were returned). To achieve research objectives, the data for risk factors (third part), success factors (fourth part), and BVA perception (fifth part) would be statistically analyzed. Before the analysis, incomplete surveys were eliminated from the responses to ensure liability of the findings. As a result, thirty-seven (37) surveys were removed from the analysis for risk factors, thirty-nine (39) surveys were removed from the analysis for success factors, and forty-two (42) surveys were removed from the analysis for BVA. While the total response rate was around 48%, a total of 32.7% to 34.2% of the invited survey were used for the analysis.

Characteristics of Respondents

Risk Factors Analysis

Among the 103 qualified questionnaire, 45 respondents worked for owners (43.7% of the responses), 36 for contractors (35%), and 22 for designers and/or consultants (21.4%) (Table 3). The participants held high level managerial positions, such as project managers, directors or associate directors, and should have at least ten (10) years of experience. The respondents' mean years of relevant experience in the construction industry is around 18 years. Such highly experienced profile and the management roles of the respondents would likely translate into highly reliable results and thus enhance the quality of the findings. These participants were asked to provide the projects' performance metrics that they experienced over the past five (5) years prior to the survey, and these are documented in Table 4. The participants did not add new risks to the questionnaire and concluded that the 23 risk factors accurately describe most of the risks they faced.

Table 3. Characteristics of Risk Factors Respondents

Demographic Characteristics	Responses	%
Groups		
Owners	45	43.7%
Contractors	36	35.0%
Consultants	22	21.4%
Industry Experience		
0 - 5 years	18	17.5%
6 - 10 years	18	17.5%
11 - 20 years	42	40.8%
Over 20 years	25	24.3%
Project Involvements		
Commercial / Residential	63	60.7%
Infrastructure / Heavy Civil	22	21.4%
Industrial	18	17.9%
Project Sizes		
< $1M	22	21.4%

$1M - 5M	46	44.6%
> $5M	35	33.9%

Table 4. Projects Performance of Risk Factors Respondents

Performance Metrics	Responses	%
Time		
Delayed	97	94.2%
On-Time	6	5.8%
Average Time Extension	-	30.0%
Cost		
Over-budget	84	81.6%
Under-budget	19	18.4%
Average Cost Growth	-	14.0%
Stakeholders' Satisfaction		
Unsatisfied	28	27.2%
Neutral	56	54.5%
Satisfied	19	18.4%

Success Factors Analysis

A total of 101 completed surveys qualified for success factors analysis. While the total response rate was around 47%, a total of 33.7% of the invited survey were used for the analysis.

Table 5. Characteristics of Success Factors Respondents

Demographic Characteristics	Responses	%
Groups		
Owners	44	43.6%
Contractors	35	34.7%
Consultants	22	21.8%
Industry Experience		
0 - 5 years	18	17.8%
6 - 10 years	17	16.8%
11 - 20 years	41	40.6%
Over 20 years	25	24.8%
Project Types		
Commercial / Residential	62	61.4%
Infrastructure / Heavy Civil	21	20.8%
Industrial	18	17.8%
Project Sizes		

< $1M	22	21.8%
$1M - 5M	45	44.6%
> $5M	34	33.7%

Among the 101 returned questionnaire, 44 respondents worked for owners (43.6% of the responses), 35 for contractors (34.7%), and 22 for designers and/or consultants (21.8%) (Table 5). The majority of participants held high level managerial positions, such as project managers, directors or associate directors. The respondents' mean years of relevant experience in the construction industry is around 16 years. Such highly experienced profile and the management roles of the respondents would likely translate into highly reliable results and thus enhance the quality of the findings. The participants did not make any significant contributions of new CSFs to the questionnaire and concluded that the initial 23 CSFs generally describe their risk management approach to success.

BVA Perception Analysis

A total of 98 completed surveys qualified for BVA perception analysis. While the total response rate was around 47%, a total of 32.7% of the invited survey were used for the analysis.

Table 6. Characteristics of BVA Respondents

Demographic Characteristics	Responses	%
Groups		
Owners	44	44.9%
Contractors	34	34.7%
Consultants	20	20.4%
Industry Experience		
0 - 5 years	18	18.4%
6 - 10 years	18	18.4%
11 - 20 years	37	37.8%
Over 20 years	25	25.5%
Project Types		
Commercial / Residential	59	60.4%
Infrastructure / Heavy Civil	22	22.3%

Industrial	17	17.3%
Project Sizes		
< $1M	16	16.3%
$1M - 5M	41	41.8%
> $5M	41	41.8%

Among the 98 returned questionnaire, 44 respondents worked for owners (44.9% of the responses), 34 for contractors (34.7%), and 20 for designers and/or consultants (20.4%) (Table 6). The majority of participants held high level managerial positions, such as project managers, directors or associate directors. The respondents' mean years of relevant experience in the construction industry is around 16 years. Such highly experienced profile and the management roles of the respondents would likely translate into highly reliable results and thus enhance the quality of the findings.

CHAPTER 5

RISK FACTORS ANALYSIS AND RESULTS

Data Analysis

The research team used the following techniques:

1. Cronbach's alpha coefficients to test internal consistency of the results,
2. Risk factor analysis to rank the risk factors in terms of degree of frequency, severity and importance,
3. Spearman's rank-order correlation coefficient was then utilized to determine the degree of agreement of risk rankings between each responded group,
4. Factor analysis was used to derive interrelationships among the risk factors

These are described in the following sections, and the analysis would follow.

Cronbach's Alpha Coefficients

The Cronbach's Alpha Coefficients of the internal consistency reliability tests for risk factors' frequency and severity ratings of the survey results are 0.928 and 0.942 respectively. Litwin & Fink (1995) suggested that consistency is high when Cronbach's alpha is above 0.7. This confirmed that there is high internal consistency among the answers.

Risk Factors Analysis

The survey results were analyzed using three indices that were previously used by Kaming et al. (1997), Le-Hoai (2008) and Doloi, et al. (2012). These indices are as following:

1. Frequency Index (FI): This index measures the frequency of occurrence for each risk factor. It is computed with the following formula:

$$FI = \frac{\sum_0^4 a_i n_i}{4N}$$

in which a = the weight assigned to each response (as in this research, a range of 0 for "Never Happen" to 4 for "Always"), n = frequency of occurrence for each response, and N = total number of responses.

2. Severity Index (SI): This index measures the severity of each risk factor to project performance. It is computed with the following formula:

$$SI = \frac{\sum_0^4 a_i n_i}{4N}$$

in which a = the weight assigned to each response (as in this research, a range of 0 for "No Influence" to 4 for "Extremely"), n = frequency of occurrence for each response, and N = total number of responses.

3. Relative Importance Index (RII): This index measures the relative importance of each risk factor pertaining to the frequency of occurrence and severity to project performance. It is computed with the following formula:

$$RII = FI \times SI$$

The calculations of FI, SI, and RII and the rankings of the twenty-three (23) risk factors identified in the questionnaire are presented in Table 7, 8, and 9. The following observations were made:

1. There are not many discrepancies between the FI, SI, and RII rankings. Seven (7) out of top ten (10) importance factors (Table 9) happened to be the top ten with regards to frequency (Table 7) and severity (Table 8).
2. Top risk - Bureaucracy: As shown in Table 6, the top risk is "Bureaucratic administrative system" and associated with the administrative nature of how the construction industry operates. Bureaucracy, or better known as red tape, hinders project progress through high level barriers that increase risks of project delays, cost overrun and affecting project quality. This is also the most highly ranked risks among the owners, contractors, and consultants. Further investigation also found that 'Bureaucratic administrative system' has become an increasingly critical hindrance of construction project performance in Vietnam as government and clients are increasing the amount of unnecessary procedures (red tape).
3. Risks pertaining to finance and cash flow: The analysis showed that three (3) of the top five (5) issues are tied to issues surrounding project financing, like slow payment, financial difficulties of owners and contractors, and improper planning. Cash flow is critical for any construction projects as profit is often "razor thin". Narrow profit margin forces contractors and owners to depend heavily on payment and financing every month. Contractors rely on monthly payment to pay their subcontractors and employees, and owners to secure financing to pay their contractors. Understanding cash flow is a critical knowledge especially in Vietnam.

4. Risks pertaining to experience and capability are also highly ranked risks - "Lack of experience in complex projects" and 'Ineffective designs and frequent design changes' were found to be critical risk factors surrounding the experience and capability of the construction professionals in Vietnam. The fast-paced development in Vietnam demand a significant number of construction workforce at all levels. This has resulted in the massive employment of professionals who may not have the necessary experience and skills in the first place. As a newly developing nation, Vietnam's young workforce offers the vigor and energy but not the experience and knowledge. Adding on to the lack of industry professional support, like the American Society for Civil Engineers (ASCE), the survey clearly indicated the lack of experience and capability to increase risks of the local projects. This has also caused frequent changes made to projects due to both inexperienced owners and professionals as they were unable to meet the exact requirements with their initial designs and plans. Frequent changes to projects are often costly and affect project quality and schedule.
5. Managerial and administrative risks: The ninth to sixteenth factors have an FI above 0.5 and an SI above 0.6. These risk factors are closely associated with the managerial and administrative aspect of construction project performance, particularly to the ability to make reliable decisions on project, schedule, bids, handover, supervision and eliminate mistakes. The survey clearly indicated the lack of solid foundation for management. Owners found various issues to manage their projects effectively as they lack the right knowledge to submit

accurate bids, determine the best approaches to manage projects, supervise workforce, ensure smooth handover, and manage their extremely ill-prepared subcontractors. They also highlighted that both contractors and consultants made frequent mistakes in their estimates and injected plenty of avoidable risks into their projects, and many of these mistakes are technical-related.

6. External risks: The seventeenth to twenty-third risk factors are mostly related to the external environment such as interest and inflation rates, legal framework, lack of accurate historical information, unpredictable government policies and priorities, and shortages of materials. The effects of these risks vary from countries to countries due to differences in socio-economic, cultural, and political aspects. The participants ranked the importance of these risks among the lowest. They found these factors were beyond their control. The participants rank the risks they were able to control higher than those they were unable to control.

7. "Not my problem" – An issue with personal accountability: The research also found an interesting phenomenon that the team identifies as "not my problem". The analysis found that the three groups of stakeholders rank the risks from the opposing stakeholders higher than those affected by them. For example, 'Financial difficulties of owner', 'Lack of capable owners', and 'Owners' site clearance difficulties' are lower ranked on the survey completed by the owners and higher on those completed by the contractors and consultants. Alternatively, the contractors ranked 'Poor contractor performance', 'Financial difficulties of contractor', 'Inaccurate estimates',

'Poor tendering practices' are ranked lower than the owners and consultants. 'Lack of experience in complex projects', 'Ineffective design and frequent design changes' were ranked lower by the consultants than owners and contractors at the same time. The survey found that the stakeholders often assumed their roles contributed to lower risks towards the projects. This might suggest self-accountability could be an issue.

Table 7. Frequency Index and Rankings of Risk Factors

Risk Factors	Overall		Owner		Contractor		Consultant	
	FI	Rank	FI	Rank	FI	Rank	FI	Rank
Bureaucratic administrative system	0.711	1	0.711	1	0.722	1	0.693	1
Slow payment of completed works	0.617	2	0.572	3	0.674	3	0.614	2
Ineffective designs and frequent design changes	0.609	3	0.580	2	0.681	2	0.548	7
Corruption/Collusion	0.569	4	0.545	6	0.639	5	0.500	13
Lack of experience in complex projects	0.568	5	0.556	5	0.611	8	0.523	12
Lack of accurate historical information	0.561	6	0.563	4	0.639	6	0.432	19
Financial difficulties of owner	0.559	7	0.506	14	0.646	4	0.523	11
Financial difficulties of contractor	0.558	8	0.528	9	0.604	10	0.545	9
Improper planning and scheduling	0.554	9	0.534	8	0.576	15	0.557	6
Poor contractor performance	0.551	10	0.517	12	0.569	16	0.591	3
Poor subcontractor performance	0.546	11	0.472	19	0.625	7	0.568	4
Slow site handover	0.544	12	0.506	16	0.586	13	0.557	5
Inaccurate estimates	0.541	13	0.522	10	0.596	12	0.545	10
Interest and inflation rates	0.540	14	0.534	7	0.611	9	0.409	22
Ineffective project management	0.527	15	0.472	18	0.583	14	0.545	8
Poor site management and supervision	0.527	16	0.517	13	0.604	11	0.420	20
Inadequate legal framework	0.527	17	0.522	11	0.569	17	0.466	17
Poor tendering practices [Low bid practice]	0.525	18	0.506	15	0.563	19	0.500	14
Unpredictable government policies and priorities	0.493	19	0.483	17	0.549	20	0.420	21
Lack of capable owners	0.483	20	0.422	22	0.563	18	0.477	15
Owners' site clearance difficulties	0.473	21	0.433	21	0.521	21	0.477	16
Defective works and reworks	0.465	22	0.455	20	0.486	22	0.455	18
Shortages of materials	0.392	23	0.372	23	0.429	23	0.375	23

Table 8. Severity Index and Rankings of Risk Factors

Risk Factors	Overall		Owner		Contractor		Consultant	
	SI	Rank	SI	Rank	SI	Rank	SI	Rank
Financial difficulties of owner	0.740	1	0.611	12	0.854	1	0.670	2
Poor contractor performance	0.694	2	0.661	2	0.757	2	0.655	4

Financial difficulties of contractor	0.680	3	0.656	3	0.701	5	0.693	1
Corruption/Collusion	0.659	4	0.683	1	0.694	7	0.352	23
Lack of experience in complex projects	0.658	5	0.656	4	0.736	3	0.580	9
Ineffective project management	0.657	6	0.633	7	0.722	4	0.523	17
Slow payment of completed works	0.636	7	0.648	5	0.674	11	0.670	3
Lack of capable owners	0.633	8	0.633	8	0.681	10	0.591	7
Bureaucratic administrative system	0.631	9	0.589	13	0.660	12	0.568	12
Poor site management and supervision	0.624	10	0.639	6	0.653	13	0.557	14
Poor subcontractor performance	0.621	11	0.533	22	0.688	9	0.591	6
Defective works and reworks	0.621	12	0.561	18	0.653	14	0.568	13
Improper planning and scheduling	0.621	13	0.544	21	0.653	15	0.580	10
Ineffective designs and frequent design changes	0.612	14	0.583	15	0.694	6	0.477	19
Shortages of materials	0.609	15	0.550	20	0.694	8	0.477	21
Poor tendering practices [Low bid practice]	0.604	16	0.622	10	0.639	16	0.591	8
Slow site handover	0.595	17	0.617	11	0.632	17	0.625	5
Inaccurate estimates	0.587	18	0.631	9	0.590	19	0.580	11
Inadequate legal framework	0.578	19	0.589	14	0.611	18	0.466	22
Unpredictable government policies and priorities	0.568	20	0.583	16	0.403	23	0.523	18
Interest and inflation rates	0.566	21	0.583	17	0.507	22	0.536	16
Lack of accurate historical information	0.527	22	0.489	23	0.549	21	0.477	20
Owners' site clearance difficulties	0.525	23	0.561	19	0.563	20	0.538	15

Table 9. Relative Importance Index and Rankings of Risk Factors

Risk Factors	Overall		Owner		Contractor		Consultant	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Bureaucratic administrative system	0.449	1	0.419	1	0.476	2	0.394	2
Financial difficulties of owner	0.414	2	0.309	13	0.552	1	0.350	5
Slow payment of completed works	0.392	3	0.371	3	0.454	4	0.411	1
Poor contractor performance	0.382	4	0.342	6	0.431	7	0.387	3
Financial difficulties of contractor	0.379	5	0.346	5	0.424	9	0.378	4
Corruption/Collusion	0.375	6	0.373	2	0.444	6	0.176	23
Lack of experience in complex projects	0.374	7	0.364	4	0.450	5	0.303	10
Ineffective designs and frequent design changes	0.372	8	0.338	7	0.473	3	0.261	14
Ineffective project management	0.346	9	0.299	15	0.421	10	0.285	12
Improper planning and scheduling	0.344	10	0.291	16	0.376	13	0.323	8
Poor subcontractor performance	0.339	11	0.252	21	0.430	8	0.336	7
Poor site management and supervision	0.329	12	0.330	8	0.394	11	0.234	17
Slow site handover	0.324	13	0.312	11	0.370	14	0.348	6
Inaccurate estimates	0.318	14	0.329	9	0.352	16	0.316	9
Poor tendering practices [Low bid practice]	0.317	15	0.315	10	0.359	15	0.295	11
Lack of capable owners	0.306	16	0.267	19	0.383	12	0.282	13
Interest and inflation rates	0.306	17	0.312	12	0.310	20	0.219	19
Inadequate legal framework	0.304	18	0.308	14	0.348	18	0.217	20
Lack of accurate historical information	0.296	19	0.275	18	0.351	17	0.206	21
Defective works and reworks	0.289	20	0.255	20	0.317	19	0.258	15

Unpredictable government policies and priorities	0.280	21	0.282	17	0.221	23	0.220	18
Owners' site clearance difficulties	0.248	22	0.243	22	0.293	22	0.257	16
Shortages of materials	0.239	23	0.205	23	0.298	21	0.179	22

Spearman's Rank-Order Correlation

The Spearman's Rank-Order Correlation (SRC) measures the implied degree of agreement on the ranking among groups of respondents. It is computed with the following formula:

$$\rho = 1 - \frac{6 \times \sum d^2}{n(n^2 - 1)}$$

in which ρ = level of consensus between two groups ($0 \leqslant \rho \leqslant 1$); d = the difference in ranking of a risk factor, and n = number of ranking places.

Table 10 shows the Spearman's Rank-Order Correlation among the survey returns from the stakeholders. The analysis shows that the owners and contractors generally agreed with each other on the types of risks affecting construction project performance with regards to the frequency (78%), severity (52%) and importance (67%). However, designers/consultants did not share similar sentiments as Table 10 clearly indicates. The survey shows that the consultants did not generally agree with the owners and contractors. Owners and contractors commonly share more similar project goals (i.e. on-time, on-budget) and their perception on project quality is mostly similar (quality generally means focusing on visible quality). The goals of designers and consultants focus are mainly on the technical aspects of projects, such as structural design, aesthetics and functional performances. The designers/consultants are also involved at the design and planning phases of the projects, rather than the actual construction process.

Table 10. Risk Factors Spearman's Rank-Order Correlation Among Parties – Differences between Groups

	Frequency Index		Severity Index		Importance Index	
Groups	SRC	Sig. level	SRC	Sig. level	SRC	Sig. level
Owners - Contractors	0.782	0.001	0.519	0.011	0.673	0.001
Contractors - Consultants	0.499	0.015	0.356	0.096	0.607	0.002
Owners - Consultants	0.361	0.001	0.336	0.117	0.42	0.046

Table 11 shows Spearman's Rank-Order Correlation between the three stakeholder types and overall rankings by all of them. The analysis found that the contractors' responses were highly correlated (92% on frequency, 90% on severity, and 94% on importance) with overall rankings. The results clearly indicate the contractors' clear perceptions on project risks, and how their involvement throughout the construction project delivery process could have led to such clarity. Contractors work closely with both owners and designers/consultants, and they would have perceived and partake risks more comprehensively than other stakeholders. The owners and designers/consultants had less consistent experiences.

Table 11. Risk Factors Spearman's Rank-Order Correlation Between Each Party and Overall Rankings – Differences within Group

	Frequency Index		Severity Index		Importance Index	
Groups	SRC	Sig. level	SRC	Sig. level	SRC	Sig. level
Overall - Owners	0.863	0.001	0.683	0.001	0.773	0.001
Overall - Contractors	0.915	0.001	0.898	0.001	0.941	0.001
Overall - Consultants	0.648	0.001	0.502	0.015	0.71	0.001

Factor Analysis

The relationships between each risk factors were further investigated in order to identify the most significant ones. Factor analysis was used to, first, measure the multivariate interrelationships between and within the risk factors, and second, analyze the structure and correlations between the variables by defining a set of common underlying dimensions (also known as factors or components) (Hair et al., 1998). The Kaiser-Meyer Olkin (KMO) and Bartlett's Test of Sphericity were conducted to verify the legitimacy of factor analysis. In this study, Bartlett's test approximate of Chi-square is 1481.631 with 253 degrees of freedom, which is significant at the 0.05 level of significance, suggesting that the population correlation matrix is not an identity matrix. The KMO statistic of 0.899 is also greater than 0.5 which is satisfactory for the factor analysis.

Table 12. Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	10.569	45.952	45.952	10.569	45.952	45.952	7.251
2	1.670	7.260	53.212	1.670	7.260	53.212	6.097
3	1.472	6.400	59.611	1.472	6.400	59.611	6.203
4	1.115	4.848	64.459	1.115	4.848	64.459	5.234

The Principal Component method was utilized for factor extraction. The Oblimin rotations with Kaiser Normalization rotation method was selected for this analysis. Four (4) components were identified with Eigenvalues to be greater than 1 (shown in Table

12). These four components account for 64.5% of the variance in construction non-performance.

Table 13. Factor Analysis Loading Results

Components	Eigenvalue	Variance (%)	Risk Factors	Factor Loading
1	10.569	45.952	Lack of accurate historical information	0.858
			Unpredictable government policies and priorities	0.819
			Inadequate legal framework	0.781
			Bureaucratic administrative system	0.592
			Interest and inflation rates	0.553
			Corruption/Collusion	0.508
2	1.670	7.260	Ineffective designs and frequent design changes	0.823
			Inaccurate estimates	0.604
			Ineffective project management	0.598
			Poor site management and supervision	0.593
			Poor contractor performance	0.571
			Improper planning and scheduling	0.543
3	1.472	6.400	Slow site handover	0.855
			Defective works and reworks	0.773
			Poor subcontractor performance	0.578
			Shortages of materials	0.564
			Financial difficulties of contractor	0.518
4	1.115	4.848	Financial difficulties of owner	0.764
			Slow payment of completed works	0.724

Table 13 shows the four (4) component loadings extracted from the factor analysis and these exclude the factors with loading values of less than 0.5. The four components are labeled as follow:

1. Component 1 – Lack of Site and Legal Information
2. Component 2 – Lack of Capable Managers
3. Component 3 – Poor Deliverables Quality
4. Component 4 – Owner's Financial Incapability

Component 1: Lack of Site and Legal Information

Component 1 consists of ‘lack of accurate historical information’, ‘unpredictable government policies and priorities’, ‘inadequate legal framework’, ‘bureaucratic administrative system’, ‘interest and inflation rates’, and ‘corruption/collusion’. This component implies the construction participants’ lack of information on site conditions and government legal framework, leading to projects being delayed and sometimes affected by inflation and interest rates, and the use of fraudulent practices to fasten the process.

‘Lack of accurate historical information’ has factor loading value of 0.858 (Table 13). Vietnam does not have accurate data on soil, weather, and traffic (Ling & Bui, 2010). The underground site condition in Vietnam is complex due to soft soil that change unexpectedly along the country (Le-Hoai et al., 2008). Despite inspection works strictly follow government standards, soil condition is always one of the biggest risks for most projects (Le-Hoai et al., 2013). Contractors also face the lack of accurate weather forecasts. As Vietnam is a tropical country, typhoons, heavy rain, and flood often occur and can lead to flooding on-site and subsequent remedial measures can lead to delay and cost overrun (Ling & Bui, 2010). On the other hand, designers rely on traffic volume provided by the government to design underpasses but sometimes the traffic information is found inaccurate only after construction began (Ling & Bui, 2010). As soil, weather, and traffic information are important input data for project activities, time and budget should be built into the master program to investigate site conditions during pre-construction phase (Ling & Bui, 2010). It is also necessary to consider the conditions of contract to adequately allocate risks between parties (Le-Hoai et al., 2008).

The legal system governing construction projects in Vietnam continues to change unexpectedly ('unpredictable government policies and priorities', Table 13, Factor loading value 0.819), is inconsistent on various levels ('inadequate legal framework', Table 13, Factor loading value 0.781), and requires excessive time and effort for approvals ('bureaucracy administrative system, Table 13, Factor loading value 0.592). Research has found that government funded projects in developing countries tend to be political in nature (Luu et al., 2008). These projects face the risk of being terminated even after the design has been well developed. In Vietnam and possibly other developing countries, due to high demand for infrastructure projects, it is possible that new government officials might abandon an ongoing project to channel funding elsewhere (Luu et al., 2008). Foreign firms in Vietnam have voiced their concerns of having to work in an environment where the legal code was inconsistent (Ling & Hoang, 2010). As building regulations are still primitive, there is no unified legal framework for the conduct of construction business. As shown in Table 1, Vietnam is not the only country that suffers from bureaucracy administrative system. Slow government permits, unstable regulatory framework, slow site clearance, unsatisfactory site compensation, incompetent staff of government regulatory agencies, unclear responsibility and power, relatively poor law implementation process, and complex approval procedures constitute into the bureaucracy administrative system that causes delays in Vietnam (Long et al., 2004; Thuyet et al., 2007). Master plan, zoning, and future plans for the land are frequently changed, or sometimes, even concealed by officials, making it difficult to plan for long-term development (Ling & Hoang, 2010). Not only this risk causes delays, it reduces Vietnam's image in the eyes of foreign investors as total foreign investment capital into Vietnam has decreased (Thuyet et al., 2007). Vietnamese government requires a proof of financial status and a deposit which would be held for 1 – 2 years for firms to obtain project approvals (Ling & Hoang, 2010). This requirement makes it difficult for small, medium, and foreign firms to compete with big and established firms in Vietnam. The government recognized this and has been trying to institute administrative reforms and openness in the operations of state agencies (Ling & Hoang, 2010). To manage this risk, in addition to being in good relationship with government, environment authority, and NGO's, construction owners and contractors should be familiar and conversant with approval processes and understand local laws and regulations. Building database of past projects approvals and forming templates of approval documentation are also recommended to reduce time and cost of project approval process (Long et al., 2004).

As bureaucracy is an issue, close and cooperative relations with local government and authorities are essential to obtain orders (Luu et al., 2008) and fraudulent practices ('corruption/collusion, Table 13, Factor loading value 0.508) seem to be the fastest way to build relationships. It has been estimated that 20 – 40% of capital investment in construction is lost due to poor management for which bureaucracy and briberies are mainly responsible (Long et al., 2004). The Vietnamese government has been introducing anticorruption law and enacting relevant regulations to combat corruption. An anticorruption strategy, and project to monitor incomes of public employees and government officials are in the pipeline for 2020. On the company level, antigraft training should be provided to staff to lessen or eradicate corruption and wastefulness within the company (Ling & Hoang, 2010).

'Interest and inflation rates' has factor loading value of 0.553 (Table 13). Projects that are affected by this risk the most are those that require special, non-local materials which are not readily available in Vietnam, and those that take too long to obtain approvals due to bureaucracy. Interest and inflation rates in Vietnam fluctuate wildly (Ling & Hoang, 2010). The average inflation rate of Vietnam is currently at 4% which is more than half the profit of construction projects for contractors (6%) (Kim et al., 2016). Due to high inflationary trend, price fluctuation is difficult to predict and would cause materials and labor costs to increase during construction phase (Le-Hoai et al., 2008, Ling & Hoang, 2010). Several measures have been recommended to manage this risk: introducing fluctuation clause in the contract (contractor to bear risk of cost increase for the original scope, owner to bear risk of cost increase for change orders) (Ling & Hoang, 2010), designers to conduct market surveys before specifying non-local materials and consider alternative materials (Ling & Bui, 2010), alternative materials should follow quality standards, owner to make advance payments for materials to lock in their prices, contractors to purchase materials in bulk, or enter into exclusive agreement with suppliers to fix costs of materials (Ling & Hoang, 2010).

Component 2: Lack of Capable Managers

Component 2 consists of 'ineffective designs and frequent design changes', 'inaccurate estimates', 'ineffective project management', 'poor site management and supervision', 'poor contractor performance', and 'improper planning and scheduling'. This component shows the lack of capable managers who can coordinate project activities from beginning to end using logical steps.

Managing project is quickly becoming a critical function as construction projects become increasingly complex. Developing countries are increasing the number of complex projects as these countries are beginning to ramp up the development of critical infrastructure to support their economic growth. However, the professional workforce, owners and government in the developing countries still lack the required knowledge and experience, and coupled with unsupportive government policies, these countries continue to face challenges starting with the design phase ('ineffective designs and frequent design changes', Table 13, Factor loading value 0.823; 'inaccurate estimates', Table 13, Factor loading 0.604). Vietnamese designers have been criticized for their incompetence, outdated skills, and lack experience to make good designs (Le-Hoai et al., 2008; Yean et al., 2009). For that reason, there is a dominance of foreign designers in complex projects in Vietnam (Thuyet et al., 2007). Despite being more skilled and experienced, these foreign designers still stumble on design issues such as owner's unclear scopes and unrealistic expectations, use of different standard design systems, poor inspection and approval of design process (Thuyet et al., 2007; Le-Hoai et al., 2008; Kim et al., 2016). Perhaps the lack of a management approach that could address and resolve the owners' lack of experience and uncertainty in what they want is the main cause of design issues (Kashiwagi, 2018). As design problems increase, change orders and inaccurate estimates would likely happen along the way (Long et al., 2004). A number of management strategies have been proposed to improve the design phase: selecting designer should be based on past and relevant performance and utilizing the designer's expertise, not owner's, to come up with the design (Thuyet et al., 2007; Kashiwagi, 2018), owner's ideas should be presented in simple, non-technical, and measurable metrics for the designer to translate into their own technical terms (Thuyet et al., 2007; Kashiwagi, 2018), the design office should establish a system to track and control changes with an effective risk management plan (Le-Hoai et al., 2008), conducting concurrent engineering activities to improve constructability (Thuyet et al., 2007), and employing expert consultants to evaluate the quality of designs and estimations (Thuyet et al., 2007; Long et al., 2004).

Construction phase also suffers from the lack of capable managers ('ineffective project management', Table 13, Factor loading value 0.598; 'poor site management and supervision', Table 13, Factor loading value 0.593; 'improper planning and scheduling', Table 13, Factor loading value 0.543). Strong project management capability is crucial in construction projects, though there has been a shortage of project managers who could handle large-scale projects in Vietnam (Yean et al., 2009). Despite project management has been professionalized, the works remain poor (Le-Hoai et al., 2013). Effective management and continuing professional development courses should be introduced at all levels (corporate, process, project, and activity) to improve performance (Yean et al., 2009). On the site level, poor site management and supervision has been a tough problem and emphasizing the weakness of contractors ('poor contractor performance', Table 13, Factor loading value 0.571). Contractors lack in skilled human resource, superintendents are often rated on years of experience not actual performance, the industry is not capable in adopt or adapt best practices already working in other countries are issues that should be addressed (Le-Hoai et al., 2008; Long et al., 2004). After the ‘Open Door’ policy has been applied, many foreign project management consultants and contractors have been joining the Vietnam construction market, so Vietnam is not lacking competent contractors (Le-Hoai et al., 2008). However, the right contractors still need to be identified and utilized for the right projects. Procurement and project delivery system have not been conducted properly (Long et al., 2004). Bidding processes have been criticized as being unfair, unhealthy, and costly due to excessive time required, even leading to contracts being awarded to incapable contractors (Long et al., 2004). Kashiwagi (2016) proposes the Best Value Approach that could accurately determine the qualification of contractors based on quantifiable past experience, risk management plan, and value-add. Contractors should be required to plan the project from start to finish and submit their high-level plan for review. The plan would provide enough details and shed lights on the potential success and failure of the project, thus allow stakeholders to better act and monitor risks through a project. The key challenge remains on how these ideas could be implemented and their effects could be observed in a developing country such as Vietnam without any prior knowledge.

Component 3: Poor Deliverables Quality

Component 3 consists of ‘slow site handover’, ‘defective works and reworks’, ‘poor subcontractor performance’, ‘shortage of materials’, and ‘financial difficulties of contractor’. This component resonates the effects of Component 1 and 2. The lack of information and capable managers to effectively look at projects from beginning to end, identify and manage risks, address the bureaucracy nature of the industry, select the right contractors, has resulted in poor deliverables from project team which emerge at the construction phase even though their causes are injected into the project much earlier.

Site handover is considered very serious and a big milestone in Vietnam (Luu et al., 2009). The Vietnamese Land Law separates the right of land use from land ownership. The government owns the land while the people own the right of land use. Before starting projects, owners have to negotiate with the communities for compensation to the right of land use, and then must receive approvals from the local government (Luu et al., 2009). Due to bureaucratic approval process, major delays have been caused by complex procedure for issuance of land use certificates (Luu et al., 2009). This risk ('slow site handover', Table 13, Factor loading value 0.855) is often overlooked by inexperienced owners and consultants (Kim et al., 2016). In addition to topographical surveys and geotechnical surveys, other tasks should be implemented in the comprehensive site investigation program to prepare the site well before commencing construction or mobilization: informing affected people near the site about the project, offering satisfactory compensation, conducting environmental and social impact assessments. These measures reduce the risk of slow site handover and interruptions during construction phase (Long et al., 2004).

Defective works and reworks (Table 13, Factor loading value 0.773) also affect the quality of final deliverables. Even though incapable designers may cause this risk due to impractical designs and lack of involvement throughout the project's life (Luu et al., 2009), contractors and subcontractors, especially, also share responsibilities (‘poor subcontractor performance’, Table 13, Factor loading value 0.578). Recently, the amount of subcontracting has increased through the use of specialist works and off-site production (Long et al., 2004). Vietnam has the advantage of a large population base that continuously supplies laborers at low cost. However, this advantage comes with low degree of mechanization, obsolete technology, and heavy reliance on unskilled workers observed in many subcontractors that ultimately cause defects and reworks (Yean et al., 2009). Defective works and reworks may cause of shortages of materials (Table 13, Factor loading value 0.564). Other causes of shortages of materials include high demand of fast development, price fluctuation, requirement of special materials (Le-Hoai et al., 2008, Ling & Bui, 2010). Consultants are recommended to conduct detailed market research on availability of materials, standard of quality, and suitable suppliers (Ling & Bui, 2010). Additional lead time should be built in the master program for imported materials, and suppliers should be evaluated on ability to deliver based on a specified time frame (Ling & Bui, 2010). Other measures to deal with materials price fluctuation have also been suggested in the ‘interest and inflation rates’ discussion in Component 1. As deliverables are not up to quality, contractors may encounter financial challenges (‘financial difficulties of contractors’, Table 13, Factor loading value 0.518) for having to pay for defects and reworks, extra materials, and time of subcontractors. Hence, financial capability of contractors should become one of the selection criteria during procurement phase.

Component 4: Owner's Financial Incapability

Component 4 consists of 'financial difficulties of owner' (Table 13, Factor loading value 0.764), and 'slow payment of completed works' (Table 13, Factor loading value 0.724). This component highlights financial incapability from owners. Money and resources ensure construction projects run smoothly and are obvious imperatives to carry out projects (Long et al., 2004). Since the majority of owners in Vietnam are medium-sized developers, they tend to have financial difficulties originating from land use compensation and monthly payments to contractors (Luu et al., 2009). Public owners on large projects suffer from bureaucracy in approving completed works and make late payments (Yean et al., 2009). Management of financial issues require efforts from both owner and contractor: owner should prepare an available fund for project and build financial plan to pay contractor as in contract agreement, contractor must prepare a detailed, feasible financial plan for project and it should be submitted and approved by owner before contract award (Le-Hoai et al., 2008; Kashiwagi, 2018).

CHAPTER 6

CRITICAL SUCCESS FACTORS ANALYSIS AND RESULTS

Data Analysis

The research team used the following techniques:

1. Cronbach's alpha coefficients to test internal consistency of the results,
2. Relative Importance Indexing to rank the CSFs based on response ratings data,
3. Spearman's rank-order correlation coefficient to determine the degree of agreement of rankings between each responded group,
4. Factor analysis to derive interrelationships among the CSFs.

These are described in the following sections, and the analysis would follow.

Cronbach's Alpha Coefficients

The Cronbach's Alpha Coefficients of the internal consistency reliability tests for impact ratings of the survey results are 0.940. Litwin & Fink (1995) suggested that consistency is high when Cronbach's alpha is above 0.7. This confirmed that there is high internal consistency among the answers.

Relative Importance Indexing

The survey results were analyzed using Relative Importance Index that were previously in several studies (Kaming et al. (1997); Le-Hoai (2008); Doloi, et al. (2012). This index measures the impact of each CSF to project performance. It is computed with the following formula:

$$RII = \frac{\sum_{0}^{4} a_i n_i}{4N}$$

in which a = the weight assigned to each response (as in this research, a range of 0 for “No Impact” to 4 for “Extremely”), n = frequency of occurrence for each response, and N = total number of responses.

The calculations of RII and the rankings of the twenty-three (23) CSFs identified in the questionnaire are presented in Table 14 which shows overall that 10 factors scored RII values higher than 0.7, 10 factors scored RII values between 0.6 and 0.5, and three factors scored RII values between 0.5 and 0.4. Each CSFs are then further investigated:

- The first ranked CSF emphasizes that ‘All project parties clearly understand their responsibilities’ (Table 14: RII value 0.745; ranked 1 by overall). This suggests that project stakeholders should be aware of what they are responsible for at all time to ensure timely actions and quality results. This applies to contracted parties such as contractors, suppliers, and consultants, as well as (but not limited to) owners for timely approvals and payments, and local government for permit approvals and inspections. The best time to achieve this CSF is before the project starts. Kashiwagi (2019) recommends a clarification period between contractor selection and project execution for this purpose. During clarification period, contractors will present their plans from beginning to end to all stakeholders along with expected responsibilities for each party. The contractors will also estimate the time and cost deviations to projects whenever a party fails to meet their responsibilities. The stakeholders will then provide feedback to adjust and finalize the plan before it becomes part of the contract. Such practices allow all project parties to understand their roles and responsibilities at the beginning to act and cooperate accordingly as the project develops.

- ‘More serious consideration during contractor selection stage’ is considered as second most important CSF (Table 14: RII value 0.738; ranked 2 by overall). Vietnam and other developing countries have been criticized for having inefficient bidding and low-bid practices. Selected contractors are often unable to deliver projects on-time and within budget. An innovative, strategic and proven tendering approach is therefore critical to ensure project success.
- One way to improve tendering quality is to ‘Test contractors’ experience and competency through successful projects in the past’ (Table 14: RII value 0.735; ranked 3 by overall). A contractor with inadequate experience is likely incapable to plan and manage projects properly, and that could lead to disastrous consequences (Sambasivan & Soon, 2007). As Vietnam is still in development, contracting and consultancy firms have been mushrooming the industry on a daily basis, but quantity does not always mean quality (Le-Hoai et al., 2008). Therefore, experience and success in past projects should be considered in selecting contractors.
- Workers that will be working on projects should also be tested to confirm that ‘Project team members need to be well matched to particular projects’ (Table 14: RII value 0.735; ranked 4 by overall). Competent project managers and competent project teams hold vital roles in successful projects, however, the

quantity and quality of such human resources are still very scarce in Vietnam and probably other developing countries (Le-Hoai et al., 2008). In order to win a project, companies may present their best teams while bidding but assign the project to less experienced groups after receiving the contract. Owners should request profiles of project team members and their time involvement during the project as part of the bidding submission. Those documents will be compared with project requirements to ensure that team members are qualified and capable to successfully deliver projects.

- 'Promote pre-qualification of tenders and selective bidding' is another important CSF (Table 14: RII value 0.728; ranked 5 by overall). In general, this term means that the owner is inviting short-listed contractors to bid on the project. This practice is an alternative to open competitive bidding and sometimes proves to save time and cost for the owner (Long et al., 2004). Since inexperienced owners do not have enough expertise to shortlist the contractors by themselves, they should consult an expert before considering selective bidding. Nevertheless, this practice has yet been taken full advantage of by Vietnamese owners (Long et al., 2004).
- Similar to selecting contractors, owners should consider 'Select designer based on experience and past performance' (Table 14 RII value 0.728; ranked 6 by overall). Le et al. (2019) observed that domestic and foreign design firms in Vietnam had been encountering design issues that led to change orders and inaccurate estimates throughout projects. Possible causes of those design issues are owners' lack of experience and uncertainty in what they want.

Those risks could be minimized and mitigated by an experienced designer with proven past performance.

- Other CSFs pertaining to design are 'Select high performing consultants to evaluate design works' (Table 14: RII value 0.703; ranked 10 by overall) and 'Effective communication between owner and designer' (Table 14: RII value 0.662; ranked 14 by overall). As design issues often surface much later after design is completed and bid out, changes to design could be costly, reduce project's profits, and increase time. Having a third party to evaluate design works to identify design flaws early on could save cost and time from design-related headache arising later (Le-Hoai et al., 2008). Having competent consultants to evaluate design works also ensure constructability, accurate translation of owner's ideas to design parties, and effective concurrent engineering (Thuyet et al., 2007).
- By nature, materials are crucial for construction success. Hence, it is essential that 'All project parties, especially contractors, understand their responsibility to provide materials on time' (Table 14: RII value 0.725; ranked 7 by overall). Due to fast development and high demands, material prices in Vietnam and other developing countries often fluctuate (Le-Hoai et al., 2008; Sambasivan & Soon, 2007). Additionally, scarcity of specialized, long-lead items, interest and inflation rates, and inaccurate estimates are common risks that cause delay in supplying materials (Le et al., 2019). Depends on project nature and material requirements, responsible parties should consider additional planning

and surveying, and development of strategies upfront to ensure timely delivery of materials (Le-Hoai et al., 2008).

- It is important that 'Owners understand their responsibility for timely payment to contractors' (Table 14: RII value 0.718; ranked 8 by overall). Money ensures construction projects run smoothly and is an obvious imperative to carry out projects (Long et al., 2004). Owners' financial capability in Vietnam is not strong. Most private owners are mid-sized developers who often struggle with land use compensation and payments to contractors (Luu et al., 2009), while on the other hand, public owners are mandated to follow excessive bureaucratic procedures that take a long time to approve completed works for payments. Hence, additional efforts are required for owners understand and manage the risks on late payments.
- 'Change tender selection philosophy from 'lowest price wins' to select the most responsive contractor based on preset criteria' in the procurement process is necessary to achieve success (Table 14: RII value 0.710; ranked 9 by overall). Construction projects, especially the complex ones, are not commodities that could be procured by just cost factor. Contract awarding to the lowest bidder has been criticized in the VCI as it attracts contractors with inadequate experience that may bring unfavorable consequences such as sub-standard work, change orders, and bankruptcy that make low-bid projects end up with high overall costs (Luu et al., 2009; Sambasivan & Soon, 2007; Lo et al., 2006). Hence, the practice of selecting the lowest bidder needs to change,

especially for public owners who tend to select the lowest bidders to justify with the citizens.

- ‘Adequate resources invested in the pre-construction phase’ (Table 14: RII value 0.693; ranked 11 by overall) is also important. The Cost of Change curve demonstrates that the longer a flaw is left unaddressed during a project, the more expensive it will be to fix (Griffiths, 2015). This concept applies to design flaws as mentioned earlier as well as other dominant risks in the VCI such as lack of site (soil, weather, traffic) and legal information (Le et al., 2019). Those risks are important input data for project activities and could be addressed with adequate time and budget built into the master program to investigate their conditions during pre-construction phase (Ling & Bui, 2010).
- ‘Have a plan to assist inexperienced owners’ (Table 14: RII value 0.691; ranked 12 by overall) is important but often overlooked as shown by relatively lower rankings from all parties. Despite not directly performing the works, the owner is revealed as the party that would often cause risks and deviations in a construction project (Elawi et al., 2016). Financial difficulties, slow payments, and site clearance difficulties are among the most common owners’ risks in the VCI and other developing countries (Le et al., 2019). In order to minimize those risks, it might be appropriate for owners to seek external skills and experience from competent contractors and consultants to complement their lack of experience and create a clear and simple project plan to execute.
- ‘Create practical models to assess the changes of schedule and cost’ (Table 14: RII value 0.673; ranked 13 by overall) is fundamental in achieving success

in construction. Constant changes such as those initiated by designers, client requirements, weather, site conditions, late deliveries, economic conditions, etc. that effect schedule and cost are inevitable in construction projects (Yakubu & Sun, 2010). Le et al. (2019) conducted a survey on 103 construction participants in Vietnam and revealed that 94.2% of them experienced delays and 81.6% of them experienced over-budget issues in the past five years. The VCI now needs practical models to manage changes of schedule and cost that fit Vietnam's conditions. There have been several efforts in the world pertaining to this domain such as mathematical models, artificial intelligence models, etc. However, the efforts are scattered and have not been tested widely within construction settings in Vietnam (Le-Hoai et al., 2008).

- 'Improve contracts to equitably allocate risks between parties' (Table 14: RII value 0.661; ranked 15 by overall) is a strategic approach for risk management that is essential during project development. Generally, this practice is meant to allocate each risk to the party best able to manage it. In theory, the party in the best position to manage a risk should be able to do so at the lowest cost. For example, to manage the risk from interest and inflation rates, a fluctuation cause should be introduced to require contractor to bear risk of cost increase for the original scope, while owner to bear risk of cost increase for change orders (Ling & Hoang, 2010). This practice could potentially lower each party's risk premiums and thus, the project's overall cost (Li et al., 2005).

- ‘Measurable construction company’s performance for improvement’ (Table 14: RII value 0.653; ranked 16 by overall) and ‘Measurable projects performance’ (Table 14: RII value 0.651; ranked 18 by overall) are indicators of project success. This practice utilizes metrics such as key performance indicators (KPIs), performance metrics (Kashiwagi, 2019) to benchmark performance, process, and strategy for improvement. Construction practitioners in Vietnam and other developing countries could benefit from this practice. For example, owners may use metrics to select potential contractors, construction companies may judge their own performance to reveal strongpoints and weaknesses to develop strategies for improvement, and contractors to compare their performance with competitors to learn and change from good practices of others (Luu et al., 2008).
- A further CSF is ‘Introduce effective construction management’ (Table 14: RII value 0.653; ranked 17 by overall). Project management tools and techniques play a vital role in the effective management of a project. It involves managing various resources (workers, machines, money, materials, methods used, etc.) and stakeholders (Sambasivan & Soon, 2007). Mismanaged projects often incur delay and cost overruns (Frimpong et al., 2003). Due to fast development and lack of support infrastructure, construction practitioners in development countries still lack the required knowledge and experience in project management (Le et al., 2019). There is a demand for the involvement of experienced construction managers at various

levels such as corporate, process, project, and activity to enhance the overall construction industry performance in Vietnam (Long et al., 2004).

- ‘Good relationships between both central and local governments’ (Table 14: RII value 0.643; ranked 19 by overall) and ‘Projects are inspected by government officials’ (Table 14: RII value 0.565; ranked 22 by overall) are two CSFs pertaining to dealing with the government. Good relationships with the government are important for the success of construction projects because they allow owners and contractors to understand, be familiar, and conversant with current approval processes, laws, and regulations. Similarly, having government officials to inspect projects helps identify and resolve existing legal issues that are common in Vietnam to avoid halts. With unresolved regulation and code issues, a project faces the risk of unexpected halt or termination even after design and construction have been well developed.
- Employment of innovative strategies to ‘Simplify the bidding process’ (Table 14: RII value 0.606; ranked 20 by overall) and ‘Save time and cost during the bidding process’ (Table 14: RII value 0.597; ranked 21 by overall) are other CSFs pertaining to tendering. Tendering practice in Vietnam has been criticized as time-consuming, complex, expensive, and based on relationships (Thuyet et al., 2007). Improving the quality of tendering system proves effective in shortening completion time, improving quality, and lowering costs of construction works (Thuyet et al., 2007).
- Ling & Bui (2010) suggested that as ‘Foreign experts are involved’ (Table 14: RII value 0.515; ranked 23 by overall), it would lead to better project

performance in the VCI. Benefits that foreign experts bring to the table include experience, sophisticated technologies, technology transfer, ethics, and professional work attitude. However, the limited access, high cost, and cultural differences to employ foreign experts are common concerns that need to be addressed before introducing the expertise of foreign professionals into projects. Those high barriers are probably the reasons why this CSF is ranked last by all parties.

Table 14. Relative Importance Index and Rankings of Success Factors

Success Factors	Overall		Owners		Contractors		Consultants	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
All project parties clearly understand their responsibilities	0.745	1	0.761	1	0.793	2	0.636	7
More serious consideration during contractor selection stage	0.738	2	0.733	4	0.807	1	0.636	6
Test contractors' experience and competency through successful projects in the past	0.735	3	0.722	8	0.786	3	0.682	2
Project team members need to be well matched to particular projects	0.735	4	0.756	2	0.786	4	0.614	11
Promote pre-qualification of tenders and selective bidding	0.728	5	0.721	7	0.764	7	0.682	1
Select designer based on experience and past performance	0.728	6	0.716	9	0.779	6	0.670	5
All project parties, especially contractors, understand their responsibility to provide materials on time	0.725	7	0.744	3	0.729	11	0.682	3
Owners understand their responsibility for timely payment to contractors	0.718	8	0.705	12	0.757	8	0.679	4
Change tender selection philosophy from "lowest-price wins" to select the most responsive contractor based on preset criteria	0.710	9	0.699	14	0.779	5	0.625	8
Select high performing consultants to evaluate design works	0.703	10	0.727	6	0.721	12	0.625	9
Adequate resources invested in the pre-construction phase	0.693	11	0.733	5	0.743	9	0.534	18
Have a plan to assist inexperienced owners	0.691	12	0.705	11	0.736	10	0.591	14
Create practical models to assess the changes of schedule and cost	0.673	13	0.716	10	0.686	16	0.568	16
Effective communication between owner and designer	0.662	14	0.680	15	0.671	18	0.607	12
Improve contracts to equitably allocate risks between parties	0.661	15	0.659	18	0.693	13	0.614	10
Measurable construction company's performance for improvement	0.653	16	0.670	16	0.693	14	0.523	19
Introduce effective construction management	0.653	17	0.670	17	0.686	17	0.560	17
Measurable projects performance	0.651	18	0.653	19	0.686	15	0.591	13
Good relationships between both central and local governments	0.643	19	0.705	13	0.600	21	0.583	15
Simplify the bidding process	0.606	20	0.642	21	0.621	19	0.511	20
Save time and cost during the bidding process	0.597	21	0.648	20	0.600	20	0.489	21
Projects are inspected by government officials	0.565	22	0.608	22	0.543	22	0.489	22

Foreign experts are involved	0.515	23	0.528	23	0.521	23	0.477	23

Spearman's Rank-Order Correlation

The Spearman's Rank-Order Correlation (SRC) measures the implied degree of agreement on the ranking among groups of respondents. It is computed with the following formula:

$$\rho = 1 - \frac{6 \times \sum d^2}{n(n^2 - 1)}$$

in which ρ = level of consensus between two groups ($0 \leqslant \rho \leqslant 1$); d = the difference in ranking of a risk factor, and n = number of ranking places.

Table 15 shows the results of Spearman's Rank-Order Correlation and significance level calculations among the respondents. The results show that there is generally good agreement between three groups of respondents in ranking the importance of these CSFs. The highest degree of agreement is between owners and contractors (79%) while the lowest degree of agreement is between owners and consultants (68%). Due to high degree of agreements, the data is considered acceptable for further analysis between all parties.

Table 15. Success Factors Spearman's Rank-Order Correlation Among Parties

Groups	SRC	Sig. level
Owners - Contractors	0.792	0.001
Contractors - Consultants	0.781	0.001
Owners - Consultants	0.676	0.001

Factor Analysis

The relationships between each CSFs were further investigated in order to identify the most significant ones. Factor analysis was used to, first, measure the multivariate interrelationships between and within the CSFs, and second, analyze the structure and correlations between the variables by defining a set of common underlying dimensions (also known as factors or components) (Hair et al., 1998). The Kaiser-Meyer Olkin (KMO) and Bartlett's Test of Sphericity were conducted to verify the legitimacy of factor analysis. In this study, Bartlett's test approximate of Chi-square is 1461.034 with 253 degrees of freedom, which is significant at the 0.001 level of significance, suggesting that the population correlation matrix is not an identity matrix. The KMO statistic of 0.857 is also greater than 0.5 which is satisfactory for the factor analysis.

The Principal Component method was utilized for factor extraction. The Oblimin rotations with Kaiser Normalization rotation method was selected for this analysis. Four (4) components were identified with Eigenvalues to be greater than 1 (shown in Table 16). These four components account for approximately 63.4% of the variances in construction success factors.

Table 16. Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	10.238	44.514	44.514	10.238	44.514	44.514	3.160
2	1.732	7.529	52.042	1.732	7.529	52.042	6.408
3	1.491	6.482	58.524	1.491	6.482	58.524	5.099
4	1.130	4.913	63.437	1.130	4.913	63.437	6.502

Table 17 shows the four (4) component loadings extracted from the factor analysis and exclude the factors with loading values of less than 0.5. The four components are interpreted and labeled as follow:

- Component 1 – Improving Management Capability
- Component 2 – Adequate Pre-Planning
- Component 3 – Stakeholders' Management
- Component 4 – Performance-based Procurement

Table 17. Factor Analysis Loading and Results

Components	Eigenvalue	Variance (%)	Success Factors	Factor Loading
1	10.238	44.514	Measurable construction company's performance for improvement	0.536
			Introduce effective construction management	0.527
2	1.732	7.529	Owners understand their responsibility for timely payment to contractors	0.800
			Have a plan to assist inexperienced owners	0.736
			Select high performing consultants to evaluate design works	0.631
			All project parties clearly understand their responsibilities	0.625
			Project team members need to be well matched to particular projects	0.595
			All project parties, especially contractors, understand their responsibility to provide materials on time	0.573
			Effective communication between owner and designer	0.555
3	1.491	6.482	Projects are inspected by government officials	0.834
			Foreign experts are involved	0.759
			Good relationships between both central and local governments	0.729
4	1.130	4.913	Promote pre-qualification of tenders and selective bidding	0.910
			More serious consideration during contractor selection stage	0.820
			Test contractors' experience and competency through successful projects in the past	0.731
			Select designer based on experience and past performance	0.522

Component 1: Improving Management Capability

Nowadays, there are many reputable and high-performance Vietnamese contractors such as CotecCons, Hoa Binh, Cofico etc. that could compete and win big projects against foreign competitors. Despite having high quality contractors, the

Vietnam construction industry is still lacking competent project managers (Le-Hoai et al., 2008) who can utilize the expertise of those contractors and perform necessary project management tasks to achieve success. This factor suggests that project managers should utilize performance metrics or indicators to improve their management capability. It is responsible for 44.5% of the total variance of critical success factors (Table 17). There are two CSFs in this group: ‘Measurable construction company’s performance for improvement’, and ‘Introduce effective construction management’.

In order to improve, one first has to be aware of their current performance. The first loading component ‘Measurable construction company’s performance for improvement’ (Table 17: Factor loading 0.536) suggests construction practitioners to benchmark their current performance with measurable metrics for improvement. Determined performance metrics would provide directions for project managers to develop or employ proper strategies to achieve success as indicated by the second loading component ‘Introduce effective construction management’ (Table 17: Factor loading 0.527). Metrics should not only include time, cost, and customer satisfaction, but also those that show the quality or value that the stakeholders are receiving (Kashiwagi, 2019). Chan (2004) also conducted a study on key performance indicators (such as those pertaining to time, cost, value and profit, environmental performance, quality, functionality, etc.) that could be utilized to measure success in construction projects. As different stakeholders have different views on success (Sanvido et al., 1992), the metrics pertaining to performance and success also vary from project to project. It is the project manager’s role to coordinate with all the stakeholders before the project starts to determine a set of performance metrics to be tracked throughout the project. Additionally, common metrics from multiple projects could be compiled in a report to reveal a company's strongpoints, weaknesses, past performance, and common risk encounters. Such report would be a useful tool for the project managers to develop long-term development strategic plan for their organizations.

Component 2: Adequate Pre-Planning

Pre-planning phase is important as it sets the right conditions such as money, resources, people, communication, etc. to ensure the project runs smoothly. This factor emphasizes on the importance of necessary preparation before construction starts and is responsible for 7.5% of the total variance of critical success factors (Table 17). There are seven CSFs components in this group:

- Owners understand their responsibility for timely payment to contractors,
- Have a plan to assist inexperienced owners,
- Select high performing consultants to evaluate design works,
- All project parties clearly understand their responsibilities,
- Project team members need to be well matched to particular projects,
- All project parties, especially contractors, understand their responsibility to provide materials on time,
- Effective communication between owner and designer.

The two highest loading components in this group are related to owners: 'Owners understand their responsibility for timely payment to contractors' (Table 17: Factor loading 0.800) and 'Have a plan to assist inexperienced owners' (Table 17: Factor loading 0.736). Owners keep projects going with their payments, however, they are also the party that cause most project risks and deviations (Elawi et al., 2016). Hence, having a plan to assist owners and ensure that they can fulfill their role comfortably are fundamental throughout the project and should be addressed upfront.

As discussed elsewhere, the design is critical for project success. As projects develop, the cost of changes for design increases, while the effect of those changes decreases. Hence, the design should be evaluated by high performing consultants during pre-construction to ensure quality, constructability, and accurate translation of owner's ideas to the designer. This is presented by the third and seventh loading components in this group (Table 17: Factor loading 0.631 and 0.555, respectively).

'All project parties clearly understand their responsibilities' (Table 17: Factor loading 0.625) is another important component that should be considered pre-construction. A stakeholder not fulfilling their role could slow, or even prevent, project development. That risk could be reduced by having clear and constantly updated project objectives, scope, and plans available to all stakeholders. A project also has higher chance of success when the plans are presented in simple formats with the right level of details (Nguyen Duy et al., 2004). This practice also creates uniform commitment, agreement, and clarity towards project goals. One of the most important responsibilities is timely delivery of materials (Table 17: Factor loading 0.573).

It should be emphasized that project teams, not project managers, implement and deliver projects (Nguyen Duy et al., 2004). In Vietnam, a developing country, it is relatively more difficult to assemble a team of necessary specialists, professionals, and experts to direct projects to success. Hence, additional efforts should be made during Pre-planning phase to ensure that project team members are well matched to project requirements (Table 17: Factor loading 0.595).

Component 3: Stakeholders' Management

This factor emphasizes on stakeholders' management and is responsible for 6.5% of the total variance of critical success factors (Table 17). There are three CSFs in this group: 'Project are inspected by government officials', 'Foreign experts are involved', and 'Good relationships between both central and local governments'.

The government is an important stakeholder as they provide permits, pass laws, and create development plans that have high impacts on construction industry and projects. However, construction projects in Vietnam have been facing high risks of delays and cost overruns due to bureaucratic administrative system (Le et al., 2019). The legal system governing construction projects in Vietnam is still primitive, continues to change unexpectedly, is consistent on various levels, and requires excessive time and effort to obtain permits. Thus, having projects inspected by government officials (Table 17: Factor loading 0.834) and maintaining good relationships with the governments (Table 17: Factor loading 0.729) are necessary measures to address potential legal issues that could delay, halt, or even terminate projects. Due to the complexity in managing different stakeholders, owners could choose to involve foreign experts (Table 17: Factor loading 0.759) as their representatives or construction managers. This is a potential, but temporary, solution for the lack of competent local project managers in Vietnam.

Component 4: Performance-based Procurement

The procurement process is important as it helps identifying the right designers, contractors, and other entities needed to successfully deliver projects. This factor emphasizes on prioritizing performance in tendering and is responsible for 4.9% of the total variance of critical success factors (Table 17). There are four CSFs in this group: ‘Promote pre-qualification of tenders and selective bidding’, ‘More serious consideration during contractor selection stage’, ‘Test contractors’ experience and competency through successful projects in the past’, and ‘Select designer based on experience and past performance’.

Compared to open competitive bidding, pre-qualification and selective bidding (Table 17: Factor loading 0.910) could quickly bring in high quality and reputable contractors to bid on projects. During selection phase, contractors should be considered more seriously (Table 17: Factor loading 0.820) based on criteria other than cost. Past experience and successful projects in the past closely relate to project success as they indicate a contractor’s competency (Nguyen Duy et al., 2004) (Table 17: Factor loading 0.731). However, it is a common misconception that only contractors should be selected based on performance. As construction is a dynamic environment that involves multiple parties, if one party fails to perform its role, the project is likely to fail. Therefore, not only the contractors, the remaining of project team including designers (Table 17: Factor loading 0.522), consultants, and sub-contractors should also be selected based on experience and past performance.

CHAPTER 7

BEST VALUE APPROACH ANALISYS AND RESULTS

Data Analysis

The research team conducted the following analysis:

1. Cronbach's alpha coefficients to test internal consistency of the results,
2. Relative Importance Indexing to rank the BVA principles based on response ratings data,
3. Spearman's rank-order correlation coefficient to determine the degree of agreement of rankings between each responded group.

Cronbach's Alpha Coefficients

The Cronbach's Alpha Coefficients of the internal consistency reliability tests for impact ratings of the survey results are 0.955. Litwin & Fink (1995) suggested that consistency is high when Cronbach's alpha is above 0.7. This confirmed that there is high internal consistency among the answers.

Relative Importance Indexing

The survey results were analyzed using Relative Importance Index that were previously employed in several studies (Kaming et al. (1997); Le-Hoai (2008); Doloi, et al. (2012). This index measures the degree of agreement on each BVA principle. It is computed with the following formula:

$$RII = \frac{\sum_0^4 a_i n_i}{4N}$$

in which a = the weight assigned to each response (as in this research, a range of 0 for "Strongly Disagree" to 4 for "Strongly Agree"), n = frequency of occurrence for each response, and N = total number of responses.

Ranking of BVA Principles

The calculations of RII and the ranking of the 16 BVA principles identified in the questionnaire are presented in Table 18. All 16 BVA principles have overall RII values between 0.8 and 0.6 (with 1.0 indicates absolute agreement and 0.0 indicates absolute disagreement). High RII values indicate that the respondents generally agreed with BVA principles. Six BVA principles namely, 'selection of contractors based on performance with price should be supported', 'existence of expert project manager with the contractor is essential', 'project milestone schedule should include all risks and activities of client and other stakeholders', 'interviewing the selected contractor's project manager performing the work is necessary', 'being transparent by updating all stakeholders weekly about all upcoming activities would help and motivate them to be accountable for their own activities', and 'contractors should be required to submit verifiable performance information' are highly ranked by all respondent groups. These BVA principle rankings would help establishing their relative impact to project performance and attention should be given to them during project development in the VCI. VCI practitioners could also choose to adopt certain BVA principles to their management strategies to improve and monitor project performance.

Table 18. Relative Importance Index and Rankings of BVA Principles

PIPS Phase	BVA Principles	Overall		Owners		Contractors		Consultants	
		RII	Rank	RII	Rank	RII	Rank	RII	Rank

Selection	Selection of contractors based on performance with price should be supported	0.791	1	0.801	1	0.824	1	0.713	1
All	Existence of expert project manager with the contractor is essential	0.755	2	0.767	2	0.809	2	0.638	9
Clarification	Project milestone schedule should include all risks and activities of client and other stakeholders	0.745	3	0.761	3	0.779	5	0.650	5
Selection	Interviewing the selected contractor’s project manager performing the work is necessary	0.740	4	0.750	4	0.779	5	0.650	5
Execution	Being transparent by updating all stakeholders weekly about all upcoming activities would help and motivate them to be accountable for their own activities	0.735	5	0.722	8	0.779	5	0.688	3
Selection	Contractors should be required to submit verifiable performance information	0.735	5	0.744	6	0.787	4	0.625	10
Execution	The contractor is the best party that can prepare project weekly reports; owner and consultants should review them	0.727	7	0.699	10	0.794	3	0.675	4
Selection	Contractors should be required to submit foreseeable risks on the project and how they will manage them	0.724	8	0.750	4	0.735	11	0.650	5
Execution	Tracking schedule and cost deviations and their responsible parties would help in measuring all parties’ performance	0.719	9	0.705	9	0.743	10	0.713	1
Execution	Reminding stakeholders about what, when, and how to manage their risks and activities would help them increase their performance	0.709	10	0.699	10	0.779	5	0.613	12

Clarification	Adding the requirement for contractor to plan the project from beginning to end, including scope of work, technical and milestone schedule, risks not in their control, and how they will measure their performance would improve the quality of procurement process	0.704	11	0.733	7	0.735	11	0.588	14
Execution	Weekly update of all stakeholders' performance would motivate them to be accountable for their tasks	0.696	12	0.665	13	0.765	9	0.650	5
Selection	The government documents and posts projects and contractors performance for comparison would be beneficial	0.678	13	0.688	12	0.721	14	0.579	15
Clarification	The contractor identifies and assists stakeholders in managing their own risks would reduce those risk impacts	0.676	14	0.665	13	0.721	14	0.625	10
Clarification	Disputes would be minimized if the contractor includes all activities and risks out of their control in the plan and measures all parties' performance during the project	0.661	15	0.665	13	0.691	16	0.600	13
Clarification	Project performance would increase if the contractor includes all stakeholders' risks and activities in milestone schedule and measure their performance during project development	0.658	16	0.648	16	0.728	13	0.563	16

Spearman's Rank-Order Correlation

The Spearman's Rank-Order Correlation (SRC) measures the implied degree of agreement on the ranking among groups of respondents. The value correlation coefficient ranges between +1 and -1, where +1 indicates absolute positive relationship (agreement), while -1 indicates absolute negative relationship (disagreement) (Tikote et al., 2017). It is computed with the following formula:

$$\rho = 1 - \frac{6 \times \sum d^2}{n(n^2 - 1)}$$

in which ρ = level of consensus between two groups ($0 \leqslant \rho \leqslant 1$); d = the difference in ranking of a risk factor, and n = number of ranking places.

Table 19 shows the results of Spearman's Rank-Order Correlation and significance level calculations among the respondents. The results show that there is generally good agreement between owners and contractors (69%). However, designers / consultants did not share similar views as Table 4 indicates. The survey shows that the consultants did not generally agree with the owners and contractors. Owners and contractors commonly share more similar project goals (i.e. on-time, on-budget) and their perception on project quality is mostly similar (quality generally means focusing on visible quality). The goals of designers and consultants focus are mainly on the technical aspects of projects, such as structural design, aesthetics and functional performances. The designers/consultants are also involved at the design and planning phases of the projects, rather than the actual construction process.

Table 19. BVA Principles Spearman's Rank-Order Correlation Among Responding Groups

Groups	SRC	Sig. level
Owners - Contractors	0.688	0.003
Contractors - Consultants	0.582	0.018
Owners - Consultants	0.489	0.055

Final Impressions and Interests

The respondents were asked about whether the presented 16 BVA principles would improve project performance, and if they are interested in learning more about BVA. As a result, 69.3% of the respondents agreed that the presented BVA principles would improve project performance, while 31.6% were neutral, and 6.1% disagreed. Last but not least, 64.3% of the respondents were interested in learning more about BVA, while 31.6% were neutral, and 4.1% were not interested (Table 20).

Table 20. Impressions and Interests about BVA

Claims	Responses	%
BVA would improve project performance		
Agree & Strongly Agree	68	69.4%
Neutral	24	24.5%
Disagree & Strongly Disagree	6	6.1%
To learn more about BVA		
Interested	63	64.3%
Neutral	31	31.6%
Not Interested	4	4.1%

CHAPTER 8

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Construction is a crucial industry for nearly every country. Despite being one of the oldest industries in human history, construction projects worldwide are still suffering from poor performance such as delays, cost overrun, and low satisfaction. It is crucial to identify new methodologies to improve construction performance because it highly impacts project participants, the community, and national development. Developing countries face different and unique challenges that developed countries do not. This research the aspects of managing construction project risks in the developing countries by identifying the relationships and correlations between and among current common risk factors, success factors, and the Best Value Approach project management philosophy. A questionnaire survey was developed, administered, and analyzed to assess current conditions from the Vietnam Construction Industry (VCI).

The first part of this research examines current dominant risks in the VCI. Twenty-three (23) risks were identified then ranked from the perspectives of three main project participating groups (owners, contractors, and consultants). ‘Bureaucratic administrative system’, ‘financial difficulties of owner’, ‘slow payment of completed works’, ‘poor contractor performance’, ‘financial difficulties of contractor’ were found to be the most dominant risks. There were no significant disagreements between each party in ranking these risks. Further analysis examines interrelationships among these risk factors and grouped them into four main components: ‘Lack of Site and Legal

Information', 'Lack of Capable Managers', 'Poor Deliverables Quality', and 'Owner's Financial Incapability'. Noticeable observations include:

- Vietnam, and possibly other developing countries, suffer from a continuously changing, inconsistent on different levels, and inefficient legal system governing construction projects, so construction participants should be aware of current processes to smoothly obtain approvals;
- Domestic designers have been criticized for design issues and changes, though the fact the foreign and experienced designers also encounter similar problems emphasize that it is probably the owner's lack of experience and uncertainty in what they want are the main causes of design issues;
- Vietnam is not lacking capable contractors; however, the right contractors still need to be identified and utilized for the right projects. Current procurement and project delivery system have not been effective. Innovative ideas to improve the supply chain face challenges of implementation in the industry without any prior knowledge;
- Site handover risks should be seriously considered and studied to avoid slow site handover and interruptions during construction phase;
- Financial issues and slow payments are common and should be cooperatively planned for by both owner and contractor even before the contract is awarded.

The second part of this research identifies twenty-three (23) Critical Success Factors (CSFs) pertaining to project risk management approach pertaining to common risk factors in the VCI. The relative importance of those CSFs was revealed from the response data of three main project participating groups (owners, contractors, and consultants). ‘All project parties clearly understand their responsibilities’, ‘More serious consideration during contractor selection stage’, ‘Test contractors’ experience and competency through successful projects in the past’, ‘Project team members need to be well matched to particular projects’, ‘Promote pre-qualification of tenders and selective bidding’ were found to be the most important CSFs. There were no significant disagreements between each party in ranking these CSFs. Further factor analysis examines the principal success factor groupings and results into four factors: ‘Improving Management Capability’, ‘Adequate Pre-Planning’, ‘Stakeholders’ Management’, and ‘Performance-based Procurement’. These four factors emphasize the basic elements of CSFs for project risk management in Vietnam. They should be constantly considered by VCI project managers throughout the development of projects.

The third part of this research studies the feasibility of utilizing the Best Value Approach (BVA), a project procurement and management philosophy, and its project delivery process, Performance Information Procurement System (PIPS), to analyze BVA’s potential to be applied in construction projects in the VCI and improve overall performance. Sixteen BVA principles were identified as a result of qualitative analysis of six experts and survey ratings by 98 construction practitioners in Vietnam. The BVA principles were ranked to help establishing their relative impact to project performance and attention should be given to them during project development. VCI practitioners indicated that they agreed with the BVA principles and that BVA would improve project performance in the industry. The majority of survey respondents were interested in learning more about BVA.

Recommendations

The findings could help construction practitioners in developing countries improve their understanding of the root causes of poor performance. Project managers could make better plans accordingly in their current and future projects if they could understand how to manage these risk factors. In the long run, it is important to improve the capability of managers, and engineers working in developing countries. The current education of focusing on technical skills while leaving a gap in planning, managing, and forecasting knowledge needs to change.

Other countries that face similar construction risks as Vietnam would also find these results useful. The findings could help construction practitioners in developing countries improve their understanding in project management. Project managers could make better plans and form strategies accordingly in their projects to ensure performance with the suggested CSFs and analyzed factors.

Further efforts are recommended to strengthen this research. Pilot tests using BVA on actual construction projects in Vietnam are necessary to accurately determine BVA's utility to the industry. Education of BVA is also important as it is a change from the traditional approach of the industry. Current students, owners, contractors, and consultants who have interests in performance information, performance procurement, project management, and risk management should seek opportunities to be educated in BVA. University environment is ideal to proliferate BVA education in terms of graduate degree program, research initiatives, workshops, and guest lectures. The approach in this research is general that it may be followed by researchers from other developing countries.

REFERENCES

Vietnam GDP Growth Rate | 2000-2017 | Data | Chart | Calendar | Forecast. (2017). Retrieved April 8, 2017, from http://www.tradingeconomics.com/vietnam/gdp-growth

Aibinu, A. A., & Odeyinka, H. A. (2006). Construction Delays and Their Causative Factors in Nigeria. *Journal of Construction Engineering and Management*, *132*(7), 667–677. https://doi.org/10.1061/(ASCE)0733-9364(2006)132:7(667)

Algahtany, M., Alhammadi, Y., & Kashiwagi, D. (2016). Introducing a New Risk Management Model to the Saudi Arabian Construction Industry. *Procedia Engineering*, *145*, 940–947. https://doi.org/10.1016/J.PROENG.2016.04.122

Alinaitwe, H., Apolot, R., & Tindiwensi, D. (2013). Investigation into the Causes of Delays and Cost Overruns in Uganda's Public Sector Construction Projects. *Journal of Construction in Developing Countries*, *18*(2), 33–47. https://doi.org/10.5121/ijcsit.2011.3406

Alzara, M. A. (2016). Measuring the Construction Performance in Saudi Arabia and Proposing New Procurement Model Based on BV PIPS (A University Case Study). Retrieved from https://repository.asu.edu/items/41230

Alzara, M., Kashiwagi, J., Kashiwagi, D., & Al-Tassand, A. (2016). Using PIPS to minimize causes of delay in Saudi Arabian construction projects: university case study. In: International Conference on Sustainable Design, Engineering and Construction. In *International Conference on Sustainable Design, Engineering and Construction* (pp. 932 – 939). Retrieved from https://www.sciencedirect.com/science/article/pii/S1877705816301278

Aziz, R. F., & Abdel-Hakam, A. A. (2016). Exploring delay causes of road construction projects in Egypt. *Alexandria Engineering Journal*, *55*(2), 1515–1539. https://doi.org/10.1016/j.aej.2016.03.006

Chan, A. P. C., & Chan, A. P. L. (2004). Key performance indicators for measuring construction success. *Benchmarking: An International Journal*, *11*(2), 203–221. https://doi.org/10.1108/14635770410532624

Doloi, H., Sawhney, A., & Iyer, K. C. (2012). Structural equation model for investigating factors affecting delay in Indian construction projects. *Construction Management and Economics*, *30*(10), 869–884. https://doi.org/10.1080/01446193.2012.717705

Duy Nguyen Stephen Ogunlana Do Thi Xuan Lan, L. O., Chan, A. P., Chan, A. P., Cheong Yong, Y., Emma Mustaffa, N., Duy Nguyen Stephen Ogunlana, L. O., & Thi Xuan Lan, D. (2004). A study on project success factors in large construction projects in

Vietnam. *Engineering, Construction and Architectural Management International Journal Construction Innovation*, *11*(2), 404–413. https://doi.org/10.1108/09699980410570166

Elawi, G. S. A., Algahtany, M., & Kashiwagi, D. (2016). Owners' Perspective of Factors Contributing to Project Delay: Case Studies of Road and Bridge Projects in Saudi Arabia. *Procedia Engineering*, *145*, 1402–1409. https://doi.org/10.1016/J.PROENG.2016.04.176

Enshassi, A., Al□Najjar, J., & Kumaraswamy, M. (2009). Delays and cost overruns in the construction projects in the Gaza Strip. *Journal of Financial Management of Property and Construction*, *14*(2), 126–151. https://doi.org/10.1108/13664380910977592

Faridi, A., & El-Sayegh, S. (2006). Significant factors causing delay in the UAE construction industry. *Construction Management and Economics*, *24*(11), 1167–1176. https://doi.org/10.1080/01446190600827033

Frimpong, Y., Oluwoye, J., & Crawford, L. (2003). Causes of delay and cost overruns in construction of groundwater projects in a developing countries; Ghana as a case study. *International Journal of Project Management*, *21*(5), 321–326. https://doi.org/10.1016/S0263-7863(02)00055-8

Griffiths, M. (2015). An Introduction to the Cost of Change and Technical Debt. Retrieved February 5, 2019, from https://www.projectmanagement.com/articles/308195/An-Introduction-to-the-Cost-of-Change-and-Technical-Debt

Hair, J. F. (1998). *Multivariate data analysis*. Prentice Hall. Retrieved from https://books.google.com/books/about/Multivariate_Data_Analysis.html?id=mSy3QgAACAAJ

Ibbs, C. W., Kwak, Y. H., Ng, T., & Odabasi, A. M. (2003). Project Delivery Systems and Project Change: Quantitative Analysis. *Journal of Construction Engineering and Management*. https://doi.org/10.1061/(ASCE)0733-9364(2003)129:4(382)

John F. Rockart. (1982). The Changing Role of the Information Systems Executive: A Critical Success Factors Perspective. *Sloan Management Review*, 3–13. Retrieved from http://www.sims.monash.edu.au/subjects/ims5042/stuff/readings/rockart_1982.pdf

Kaliba, C., Muya, M., & Mumba, K. (2009). Cost escalation and schedule delays in road construction projects in Zambia. *International Journal of Project Management*, *27*(5), 522–531. https://doi.org/10.1016/j.ijproman.2008.07.003

Kaming, P. F., Olomolaiye, P. O., Holt, G. D., & Harris, F. C. (1997). Factors influencing construction time and cost overruns on high-rise projects in Indonesia. *Construction Management and Economics*, *15*(1), 83–94. https://doi.org/10.1080/014461997373132

Kashiwagi, D. (2019). *How to Know Everything Without Knowing Anything Volume 3*. (I. Kashiwagi, J. Kashiwagi, & J. Kashiwagi, Eds.). Mesa: Kashiwagi Solution Model Inc.

Kashiwagi, D., Sullivan, K. T., Greenwood, D., Kovell, J., & Egbu, C. (2005). Source of Construction Industry Instability and Performance Problems. In *Construction Research Congress 2005* (pp. 1–10). Reston, VA: American Society of Civil Engineers. https://doi.org/10.1061/40754(183)79

Kashiwagi, I., & Kashiwagi, D. (2015). The Cause of Collusion in the IT and Construction Industries, *7*(1), 1–16. Retrieved from https://www.researchgate.net/publication/295854271

Kim, S. Y., Tuan, K. N., & Luu, V. T. (2016). Delay factor analysis for hospital projects in Vietnam. *KSCE Journal of Civil Engineering*. https://doi.org/10.1007/s12205-015-0316-1

Koushki, P. A., Al-Rashid, K., & Kartam, N. (2005). Delays and cost increases in the construction of private residential projects in Kuwait. *Construction Management and Economics*, *23*(3), 285–294. https://doi.org/10.1080/0144619042000326710

Koushki, P. A., Al-Rashid, K., & Kartam, N. (2005). Delays and cost increases in the construction of private residential projects in Kuwait. *Construction Management and Economics*, *23*(3), 285–294. https://doi.org/10.1080/0144619042000326710

Le, N., Chong, W. O., Sullivan, K. T., Kashiwagi, D. (2019a). Construction Risks in Developing Countries: A Vietnam Case Study. *Journal of Management in Engineering*, in press.

Le, N., Chong, W. O., Sullivan, K. T., Kashiwagi, D. (2019b). Success Factors for Project Risk Management in Construction Projects: A Vietnam Case Study. *Journal of Management in Engineering*, in press.

Le-Hoai, L., Lee, Y. D., & Lee, J. Y. (2008). Delay and cost overruns in Vietnam large construction projects: A comparison with other selected countries. *KSCE Journal of Civil Engineering*, *12*(6), 367–377. https://doi.org/10.1007/s12205-008-0367-7

Le-Hoai, L., Lee, Y. D., & Nguyen, A. T. (2013). Estimating time performance for building construction projects in Vietnam. *KSCE Journal of Civil Engineering*, *17*(1), 1–8. https://doi.org/10.1007/s12205-013-0862-3

Li, B., Akintoye, A., Edwards, P. J., & Hardcastle, C. (2005). Critical success factors for PPP/PFI projects in the UK construction industry. *Construction Management and Economics*, *23*(5), 459–471. https://doi.org/10.1080/01446190500041537

Ling, F. Y. Y., & Bui, T. T. D. (2010). Factors affecting construction project outcomes: case study of Vietnam. *Journal of Professional Issues in Engineering Education and Practice*, *136*(3), 148–155. https://doi.org/10.1061/(ASCE)EI.1943-5541.0000013

Ling, F. Y. Y., & Hoang, V. T. P. (2010). Political, Economic, and Legal Risks Faced in International Projects: Case Study of Vietnam. *Journal of Professional Issues in Engineering Education and Practice*, *136*(3), 156–164. https://doi.org/10.1061/(ASCE)EI.1943-5541.0000015

Litwin, M. (1995). *How to Measure Survey Reliability and Validity*. SAGE Publications. https://doi.org/10.4135/9781483348957

Lo, T. Y., Fung, I. W., & Tung, K. C. (2006). Construction Delays in Hong Kong Civil Engineering Projects. *Journal of Construction Engineering and Management*, *132*(6), 636–649. https://doi.org/10.1061/(ASCE)0733-9364(2006)132:6(636)

Long, N. D., Ogunlana, S., Quang, T., & Lam, K. C. (2004). Large construction projects in developing countries: A case study from Vietnam. *International Journal of Project Management*, *22*(7), 553–561. https://doi.org/10.1016/j.ijproman.2004.03.004

Luu, T.-V., Kim, S.-Y., Cao, H.-L., & Park, Y.-M. (2008). Performance measurement of construction firms in developing countries. *Construction Management and Economics*, *26*(4), 373–386. https://doi.org/10.1080/01446190801918706

Luu, V. T., Kim, S. Y., & Huynh, T. A. (2008). Improving project management performance of large contractors using benchmarking approach. *International Journal of Project Management*, *26*(7), 758–769. https://doi.org/10.1016/j.ijproman.2007.10.002

Luu, V. T., Kim, S.-Y., Tuan, N. Van, & Ogunlana, S. O. (2009). Quantifying schedule risk in construction projects using Bayesian belief networks. *International Journal of Project Management*, *27*(1), 39–50. https://doi.org/10.1016/j.ijproman.2008.03.003

Mahamid, I., Bruland, A., & Dmaidi, N. (2012). Causes of Delay in Road Construction Projects. *Journal of Management in Engineering*, *28*(July), 300–310. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000096

Mezher, T. M., & Tawil, W. (1998). Causes of delays in the construction industry in Lebanon. *Engineering, Construction and Architectural Management*. https://doi.org/10.1108/eb021079

Ngowi, A. (2002). Challenges facing construction industries in developing countries. *Building Research and Information*. https://doi.org/10.1080/09613210110113993

Rivera, A., Le, N., Kapsikar, K., Kashiwagi, J., & Ph, D. (2017). Identifying the Global Performance of the Construction Industry, 567–575.

Rivera, A. (2014). *Impact of a Non-Traditional Research Approach: Case Study on the Performance Based Studies Research Group (PBSRG)*. Retrieved from https://repository.asu.edu/attachments/143378/content/Rivera_asu_0010N_14488.pdf

Ruqaishi, M., & Bashir, H. A. (2015). Causes of Delay in Construction Projects in the Oil and Gas Industry in the Gulf Cooperation Council Countries: A Case Study. *Journal of Management in Engineering*, *31*(3), 05014017. https://doi.org/10.1061/(ASCE)ME.1943-5479.0000248

Sambasivan, M., & Soon, Y. W. (2007). Causes and effects of delays in Malaysian construction industry. *International Journal of Project Management*, *25*(5), 517–526. https://doi.org/10.1016/j.ijproman.2006.11.007

Sambasivan, M., & Soon, Y. W. (2007). Causes and effects of delays in Malaysian construction industry. *International Journal of Project Management*, *25*(5), 517–526. https://doi.org/10.1016/j.ijproman.2006.11.007

Sanvido, V., Grobler, F., Parfitt, K., Guvenis, M., & Coyle, M. (1992). Critical Success Factors for Construction Projects. *Journal of Construction Engineering and Management*, *118*(1), 94–111. https://doi.org/10.1061/(ASCE)0733-9364(1992)118:1(94)

Sweis, G., Sweis, R., Abu Hammad, A., & Shboul, A. (2008). Delays in construction projects: The case of Jordan. *International Journal of Project Management*, *26*(6), 665–674. https://doi.org/10.1016/j.ijproman.2007.09.009

Thuyet, N. V., 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. https://doi.org/10.1108/17506220710761582

Tikote, R. H., Magdum, M. M., & Khandare, M. A. (2017). Delay Analysis in Industrial Projects by using Relative Importance Index Method. Retrieved from https://www.semanticscholar.org/paper/Delay-Analysis-in-Industrial-Projects-by-using-Tikote-Magdum/87974ebc032c34fa4c69f3e6d97b435ef7854bda

Toor, S. U. R., & Ogunlana, S. (2008). Problems causing delays in major construction projects in Thailand. *Construction Management and Economics*, *26*(4), 395–408. https://doi.org/10.1080/01446190801905406

Toor, S.-U.-R., & Ogunlana, S. (2008). Problems causing delays in major construction projects in Thailand. *Construction Management and Economics*, *26*(4), 395–408. https://doi.org/10.1080/01446190801905406

Yakubu, O., & Sun, M. (2010). Cost and time control of construction projects: Inhibiting factors and mitigating measures in practice. *Construction Management and Economics*, *28*(5), 509–526. https://doi.org/10.1080/01446191003674519

Yean, F., Ling, Y., Min, V., Pham, C., & Hoang, T. P. (2009). Strengths , Weaknesses , Opportunities , and Threats for Architectural , Engineering , and Construction Firms : Case Study of Vietnam. *October*, (October), 1105–1113. https://doi.org/10.1061/ASCÊCO.1943-7862.0000069