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# HOLISTIC EVALUATION OF CORRUPTION ISSUES IN THE CHINESE PUBLIC CONSTRUCTION SECTOR

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**Ph.D**

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This programme is jointly offered by

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# HOLISTIC EVALUATION OF CORRUPTION ISSUES IN THE CHINESE PUBLIC CONSTRUCTION SECTOR

**SHAN Ming**

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

January 2015

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# ABSTRACT

The social image of the public construction sector has deteriorated because of a growing incidence of corrupt practices worldwide over the past decade, particularly in developing countries such as China. Such corrupt practices are a by-product of continual economic growth and rapid urbanization. According to the National Bureau of Statistics of China, total investment in public infrastructure and construction projects in the country increased by almost 15 times from USD 0.16 trillion in 1993 to USD 2.33 trillion in 2012. However, such huge investments have caused serious corruption in the Chinese public construction sector. The National Bureau of Corruption Prevention of China reported 15,010 recorded cases of corruption in the public construction sector between 2009 and 2011; these incidences of corruption caused an estimated loss of USD 490 million. Given this severe situation, this study focuses on corruption issues in the Chinese public construction sector and aims to address a set of key issues related to the topic, including corruption indicators, causes of corruption, and the prevailing anti-corruption strategies.

Qualitative and quantitative research methods were combined to facilitate this study. First, a comprehensive literature review and a series of structured interviews were sequentially conducted to establish and refine the frameworks of corruption indicators, causes of corruption, and prevailing anti-corruption

strategies in the context of the Chinese public construction sector. Second, based on the interview results, a questionnaire survey was administered to solicit opinion-based data of corruption indicators, causes of corruption, and prevailing anti-corruption strategies from target respondents. A total of 188 valid replies were obtained. Third, based on the data collected from the questionnaire survey, factor analysis was conducted to consolidate the aforementioned frameworks. Fourth, partial least squares structural equation modeling was applied to investigate the underlying corruption indicators, principal causes of corruption, and the effectiveness of the prevailing anti-corruption strategies. Lastly, an evaluation model was developed by using fuzzy set theory to assess the vulnerability of Chinese public construction projects to corruption.

This study revealed five underlying corruption indicators, namely, immorality, opacity, unfairness, procedural violation, and contractual violation. Immorality was found to be the most influential underlying corruption indicator. This study consolidated two principal causes of corruption in the Chinese public construction sector, namely, flawed regulation systems and lack of a positive industrial climate. The former was found to contribute more to corruption than the latter. With respect to the four prevailing anti-corruption strategies, this study found that only leadership received a marginal acceptable evaluation on its effectiveness. The remaining three strategies, namely, rules and regulations, sanctions, and training, were found to be ineffective. The newly developed evaluation model for predicting vulnerability to corruption was also applied in two real-life public projects. Generally, the predicted results conform to reality.

# LIST OF PUBLICATIONS

## Journal Papers (Published and Accepted)

**Shan, M.**, Chan, A.P.C., Le, Y.*, Xia, B., and Hu, Y. (2014). Measuring Corruption in Public Construction Projects in China. *Journal of Professional Issues in Engineering Education and Practice,* Doi: 10.1061/(ASCE)EI.1943-5541.0000241, 05015001.

**Shan, M.**, Chan, A.P.C., Le, Y.*, and Hu, Y. (2014). Investigating the effectiveness of response strategies for vulnerabilities to corruption in the Chinese public construction sector. *Science Engineering and Ethics*, 21(3), 683-705, Doi: 10.1007/s11948-014-9560-x.

Le, Y., **Shan, M.***, Chan, A.P.C., and Hu, Y. (2014). Overview of corruption research in construction. *Journal of Management in Engineering*. 30(4), 02514001. Doi: 10.1061/(ASCE)ME.1943-5479.0000300.

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## Journal Papers (Under Review)

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Hu, Y., Chan, A.P.C., Ma, L., **Shan, M.**, and Le, Y. Improving the outcomes of public drainage projects through relational contracts: A Hong Kong case study. *Journal of Professional Issues in Engineering Education and Practice.*

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Hu, Y.*, Chan, A.P.C., Le, Y., Xu, Y., & **Shan, M.** Development of a program organizational performance index for construction megaprojects: A fuzzy synthetic evaluation analysis. *Building and Environment*.

## Conference Paper (Published and Accepted)

**<u>Shan, M.</u>***, Chan, A.P.C., Le, Y., and Hu Y. (2014). Analyses of the anti-corruption strategies in the construction sector of China. *The Third World Construction Symposium 2014: Sustainability and Development in Built and Environment*, 20-22 June, 2014, Colombo, Sri Lanka. 56-62.

Chan, A.P.C., Le, Y., Hu, Y.*, and **<u>Shan, M.</u>** (2014). A research framework for evaluating the maturity of relationship management in Chinese mega construction and infrastructure megaprojects: A relational contracting perspective. *The 2014 International Conference on Construction and Real Estate Management*, 27-28 September, Kunming, China. (Accepted)

Le, Y., and **<u>Shan, M.</u>*** (2012). Research trend of collusion in top construction journals. *Proceedings of the 17th International Symposium on Advancement of Construction Management and Real Estate*, 17-18 November, Shenzhen, China. 1133-1140.

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# CHAPTER 1 INTRODUCTION

# CHAPTER 1 INTRODUCTION

## 1.1 RESEARCH BACKGROUND

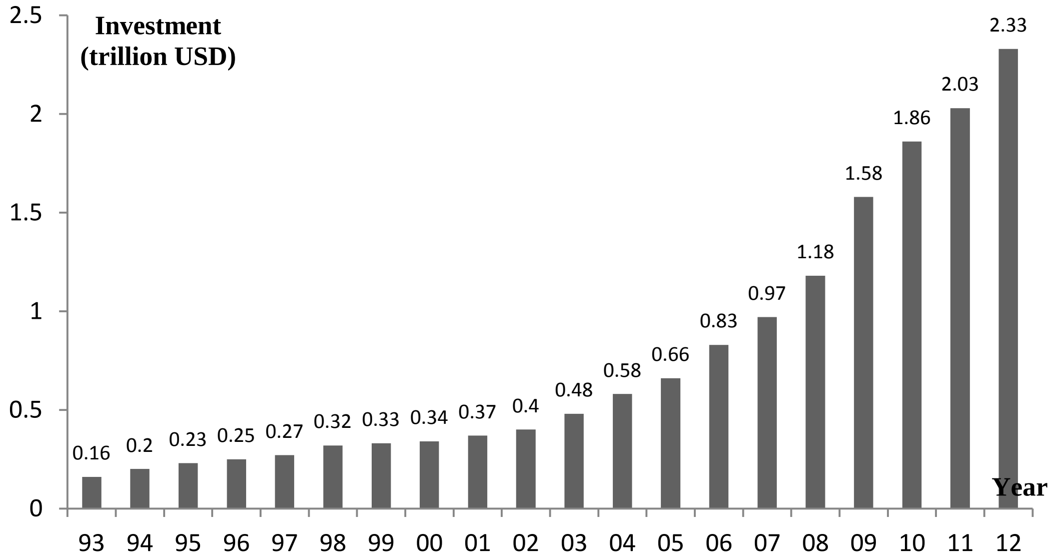
Corruption exists in both developed and developing countries of various political and economic systems, and its occurrence is highly associated with economic growth and development stages (Bardhan 1997; Ehrlich and Francis 1999; Jain 2001; Svensson 2005; Le et al. 2014a). As a result of the continued economic growth and rapid urbanization worldwide (Mo 2001; Ahmad et al. 2012), significant investments have been generated for infrastructure and urban construction projects, thereby triggering increased vulnerabilities to corruption in managing these projects around the world (Goldie-Scot 2008). Corruption can reduce economic efficiency and growth, inhibit provisions of public services, and result in income inequality (Tanzi 1998). This wrong doing has been identified as the greatest obstacle to economic and social development (Marquette 2001; Le et al. 2014a).

As a core industrial sector, the construction industry plays a vital role in national economies and constantly contributes to improvements to the built environment of human societies (de Jong et al. 2009). However, these positive social images have been increasingly diminished by corruption issues in recent years (Bowen et al. 2012; Le et al. 2014a). Corruption can damage the industry at multiple levels and lead to underperformance of construction projects, such as quality defects and cost overruns (Kenny 2009a). Sohail and Cavill (2008) estimated that the annual loss from corruption in the global construction market reaches about USD 340 billion, which accounts for 1% of the global construction market value (about USD 3.2 trillion).

Compared with the private construction sector, the public construction sector is particularly important from a development perspective, as it requires decisions to be made with respect to the use and ownership of a country‟s core resources and infrastructure. These decisions have significant consequences for the well-being of future generations. However, based on the Bribe Payers Index published by Transparency International (1999; 2002; 2006; 2008; 2011), the public construction sector has consistently been regarded as the most corrupt sector around the world in the past decade.

This study examines corruption issues in the Chinese public construction sector. Since the establishment of the socialist market economy in 1992, considerable investments have been made in public projects in China to facilitate the economic growth of the country. As shown in Figure 1.1, such investment increased steadily from USD 0.16 trillion in 1993 to USD 2.33 trillion in 2012 (National Bureau of Statistics of China 1993; 1994; 1995; 1996; 1997; 1998; 1999; 2000; 2001; 2002; 2003; 2004; 2005; 2006; 2007; 2008; 2009; 2010; 2011; 2012; 2013). However, these great investments have also caused numerous corruption cases in this domain.

According to Legal Evening News (2014), among the 164 minister-level officials who were accused of corruption between 1986 and 2014, more than 40% of them were connected to the public construction sector. The National Bureau of Corruption Prevention of China (2011) recorded 13,006 cases of corruption in the public construction sector between 2007 and 2009. Moreover, since 2009, the Chinese central government sponsored a campaign that specifically targets corruption in the construction sector. Through this campaign, more than 260,000 corruption cases in public projects have been prosecuted (China National Radio 2012). These statistics vividly reflect the severity of corrupt practices in the Chinese public construction sector.




Source: China Statical Yearbooks issued by National Bureau of Statistics of China

Figure 1.1 Investment trend of Chinese public construction sector

## 1.2 PROBLEM STATEMENT

A comprehensive understanding of vulnerabilities to corruption is necessary to prevent corruption and to achieve integrity and transparency in the Chinese public construction sector. Only by understanding the baseline of corruption, that is, how much corruption, in what forms, and what causes it, could effective policy responses be formulated (Sampford et al. 2006). The following research problems are to be addressed in this study:

(1) What are the underlying corruption indicators in the Chinese public construction sector?

(2) What are the principal causes of corruption in the Chinese public construction sector?

(3) What are the prevailing anti-corruption strategies in the Chinese public construction sector? What is their effectiveness?

(4) How can we measure corruption in Chinese public projects?

## 1.3 SIGNIFICANCE AND VALUE

Corruption should be studied not only because it is a moral issue that negatively affects the construction industry, but also because people everywhere, particularly those in developing countries that are undergoing transition economies, pay the price of corruption in one way or another

(Sampford et al. 2006). Although corruption has been widely discussed in the social science domain (Bardhan 1997; Ades and Di Tella 1999; Treisman 2000; Jain 2001; Svensson 2005), the topic has been given little attention in the construction domain (Tabish and Jha 2011a; Le et al. 2014a).

Public projects pertain to the work performed by a government to fulfill a public purpose, and commonly, these projects are closely related to both work and life of the entire society in a country (Flyvbjerg et al. 2002). Corruption in the public construction sector can incur particularly serious consequences and thus deserve more systematic research input (Sohail and Cavill 2006; 2008; Tabish and Jha 2011a; 2012). This study performs a comprehensive empirical investigation into corruption issues in the Chinese public construction sector, including corruption indicators, causes of corruption, as well as the prevailing anti-corruption strategies. Through this research, a good and clear understanding of vulnerabilities to corruption in the Chinese public construction sector is expected to be provided for both the industry and the academia, thereby helping to develop effective countermeasures.

## 1.4 RESEARCH OBJECTIVES

Accordingly, eight research objectives have been established to address the aforementioned research problems. These objectives are:

**Objective 1** Identify the corruption indicators in the Chinese public construction sector;

**Objective 2** Identify the causes of corruption in the Chinese public construction sector;

**Objective 3** Identify the prevailing anti-corruption strategies in the Chinese public construction sector;

**Objective 4** Evaluate the perceived level of corruption in the Chinese public construction sector;

**Objective 5** Explore the underlying corruption indicators in the Chinese public construction sector;

**Objective 6** Explore the principal causes of corruption in the Chinese public construction sector;

**Objective 7** Investigate the effectiveness of the prevailing anti-corruption strategies in the Chinese public construction sector;

**Objective 8** Develop an evaluation model to measure the vulnerability to corruption in the Chinese public projects.

As depicted in Figure 1.2, the study begins by examining corruption indicators (Objective 1), causes of corruption (Objective 2), prevailing anti-corruption strategies (Objective 3), and the perceived level of corruption (Objective 4) in the Chinese public construction sector. Then underlying corruption indicators (Objective 5) are obtained by investigating the relationships between corruption indicators and the perceived level of corruption in the Chinese public construction sector. Subsequently, principal causes of corruption (Objective 6) are obtained by investigating the causal relationships between causes of corruption and corruption indicators. Effectiveness of the prevailing anti-corruption strategies (Objective 7) is obtained by investigating the relationships between the prevailing anti-corruption strategies and corruption indicators. Finally, a fuzzy model to assess the vulnerability to corruption (Objective 8) is developed based on the underlying corruption indicators in the Chinese public construction sector.

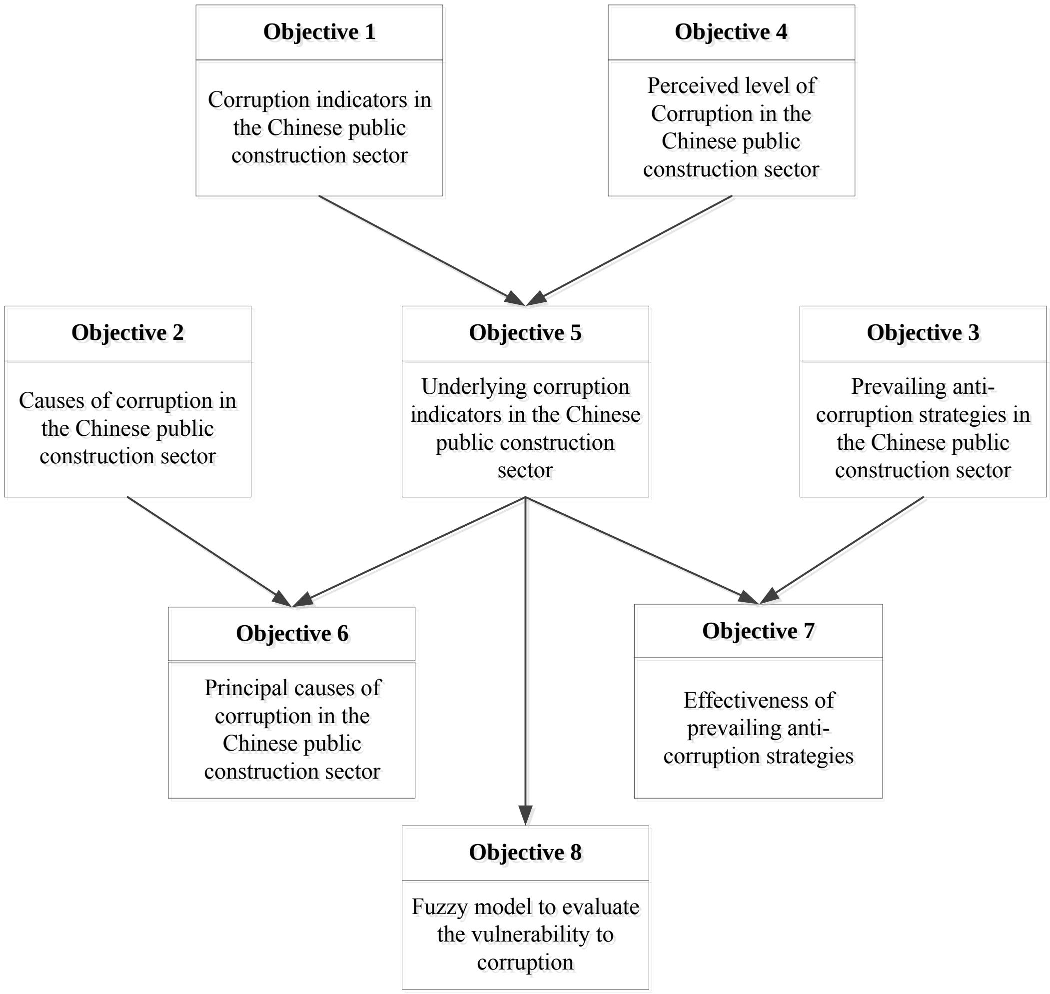



Figure 1.2 Relationships between the objectives

## 1.5 RESEARCH APPROACH

This study employs six qualitative and quantitative research methods throughout the research process: (1) literature review, (2) structured interview, (3) questionnaire survey, (4) factor analysis, (5) partial least squares structural equation modeling (PLS-SEM), and (6) fuzzy set theory. The corruption indicators, causes of corruption, and prevailing anti-corruption strategies in the Chinese public construction sector were first identified through a comprehensive literature review and a series of structured interviews.

Additional data were then collected by conducting a questionnaire survey with target respondents having public project experiences. Diverse underlying factors of corruption indicators, causes of corruption, and anti-corruption strategies were obtained through factor analysis. The underlying corruption indicators, principal causes of corruption, and the effectiveness of the prevailing anti-corruption strategies were obtained by using PLS-SEM. An evaluation model was lastly developed by using fuzzy set theory to measure the vulnerability to corruption in Chinese public projects. Table 1.1 summarizes the research methods applied for each research objective. More details regarding the research methods can be found in Chapter 3. Figure 1.3 shows the overall flow of the study.

Table 1.1 Research objectives and corresponding research methods

| **Research Objectives** | **Research Methods** |
|---|---|
| **Objective 1** Identify the corruption indicators in the Chinese public construction sector | ● Literature review<br>● Structured interview |
| **Objective 2** Identify the causes of corruption in the Chinese public construction sector | ● Literature review<br>● Structured interview |
| **Objective 3** Identify the prevailing anti-corruption strategies in the Chinese public construction sector | ● Literature review<br>● Structured interview |
| **Objective 4** Evaluate the perceived level of corruption in the Chinese public construction sector | ● Questionnaire survey |
| **Objective 5** Explore the underlying corruption | ● Questionnaire survey |

| Research Objectives | Research Methods |
|---|---|
| indicators in the Chinese public construction sector | • Factor analysis<br>• PLS-SEM |
| **Objective 6** Explore the principal causes of corruption in the Chinese public construction sector | • Questionnaire survey<br>• Factor analysis<br>• PLS-SEM |
| **Objective 7** Investigate the effectiveness of the prevailing anti-corruption strategies in the Chinese public construction sector | • Questionnaire survey<br>• Factor analysis<br>• PLS-SEM |
| **Objective 8** Develop an evaluation model to measure the vulnerability to corruption in the Chinese public projects | • Questionnaire survey<br>• Factor analysis<br>• Fuzzy set theory |

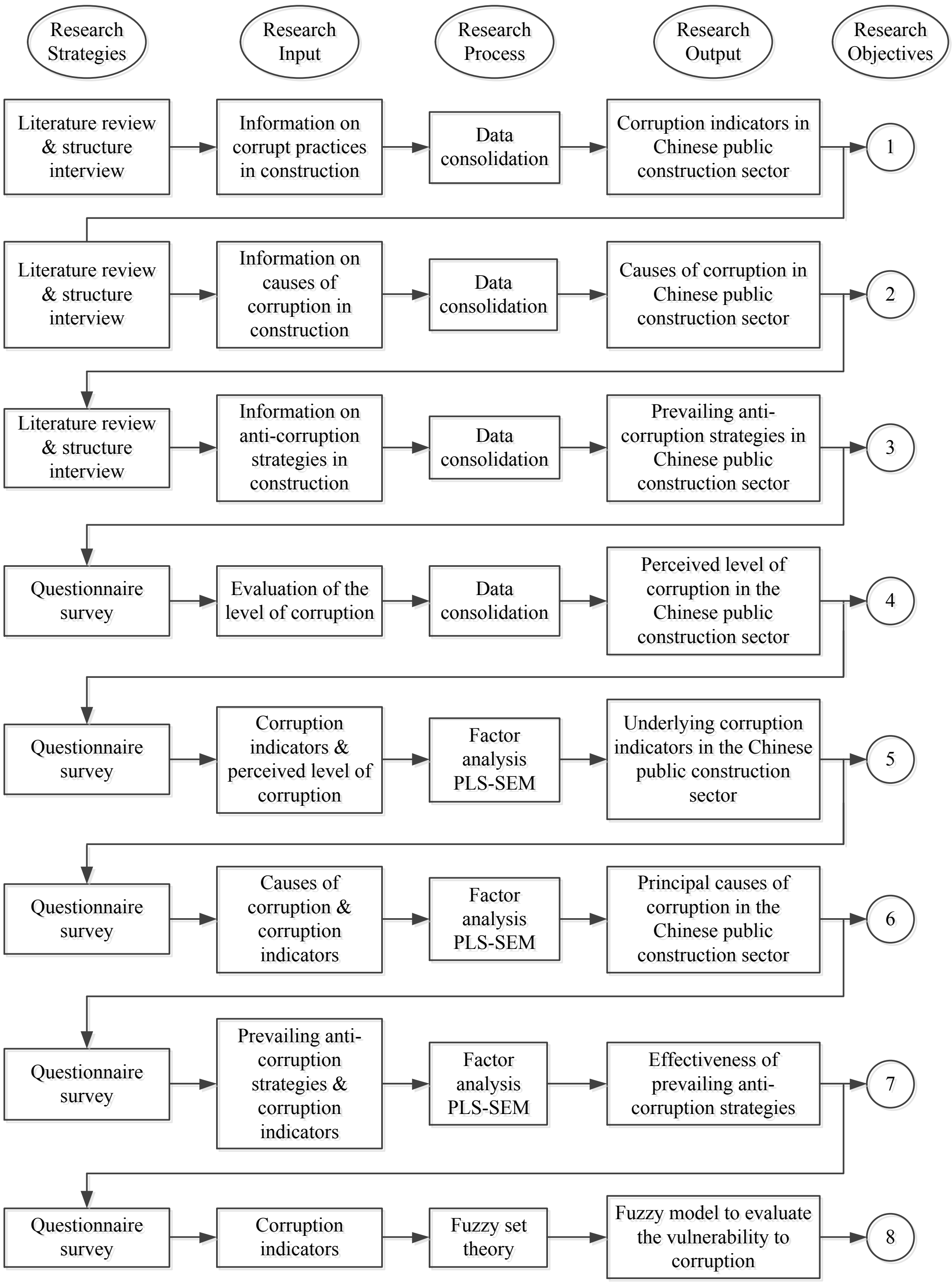



Figure 1.3 Overall flow of research

## 1.6 STRUCTURE OF THE THESIS

The structure of the thesis is as follows:

**Chapter 1** introduces the study by discussing the research background, research problems, the significance and value of research, research objectives, research process of the study, as well as the structure of the thesis.

**Chapter 2** presents a comprehensive literature review of corruption research in the field of construction engineering and management. The definitions, forms, causes, and impacts of corruption, as well as the prevailing anti-corruption strategies being implemented in the Chinese public construction sector are systematically reviewed.

**Chapter 3** introduces the research methodologies applied in this study. Data collection methods (i.e., structured interview and questionnaire survey) and data analysis methods (i.e., factor analysis, partial least squares structural equation modeling, and fuzzy set theory) are explained.

**Chapter 4** shows the findings of the structured interviews, including the identification of corruption indicators, the causes of corruption, as well as the prevailing anti-corruption strategies in the Chinese public construction sector. This chapter also presents the questionnaire survey results, including the perceived level of corruption in the Chinese public construction sector, the demographic backgrounds of respondents, data examination results, as well as the factor analysis results of corruption indicators, causes of corruption, and the prevailing anti-corruption strategies.

**Chapter 5** explores the underlying corruption indicators in the Chinese public construction sector by investigating the relationships between corruption indicators and the perceived level of corruption.

**Chapter 6** explores the principal causes of corruption in the Chinese public construction sector by investigating the causal relationship between causes of corruption and corruption indicators.

**Chapter 7** evaluates the effectiveness of prevailing anti-corruption strategies in the Chinese public construction sector by investigating the relationships between the prevailing anti-corruption strategies and corruption indicators.

**Chapter 8** develops an evaluation model to measure the vulnerability to corruption in Chinese public projects. Two illustrative applications of the model in real Chinese public projects are also provided in this chapter.

**Chapter 9** validates the current study by investigating the content, construct, internal, face, and external validity of the whole study.

**Chapter 10** concludes the findings of this study. The limitations and future research directions of this study are also presented in this chapter.

## 1.7 CHAPTER SUMMARY

This chapter outlined the framework of this thesis, including the research background, the statement of the research problems, research significance and value, research objectives, research process, and the detailed structure of the thesis.

# CHAPTER 2 LITERATURE REVIEW

# CHAPTER 2 LITERATURE REVIEW[1]

## 2.1 INTRODUCTION

This chapter presents a comprehensive review of corruption research in construction. First, various definitions of corruption in current literature are introduced. After that, review process and four review scopes, namely, forms of, causes of, and impacts of corruption, as well as anti-corruption strategies, are introduced in details respectively.

## 2.2 DEFINITION OF CORRUPTION IN CONSTRUCTION

The focus of this study is corrupt practices in construction and thus, providing an accurate definition of corruption in the context of construction sector is necessary to ensure identification of the actions of individuals and institutions as corrupt or incorrupt. Currently, the most widely used definition of corruption is the misuse of public power, office, or authority for private benefit through bribery, extortion, influence peddling, nepotism, fraud, speed money, or embezzlement (Gray and Kaufman 1998). This definition has been endorsed by a number of international organizations, such as the United Nations, the African Development Bank, the Asian Development Bank, the European Investment Bank, the International Monetary Fund, the American Development

[1] Major part of this chapter has been published in the following paper:
Le, Y., **Shan, M.***, Chan, A.P.C., & Hu, Y. (2014). Overview of corruption research in construction. *ASCE Journal of Management in Engineering*, 30(4), 02514001.

Bank, and the World Bank (Tabish and Jha 2011a; Bowen et al. 2012). However, such a definition is advocated by researchers from the public management field and refers more to corrupt practices of government officials or public servants. No literature has ever provided a particular definition of corruption in construction, let alone corruption in the public construction sector. Therefore, filling this gap is necessary by offering an accurate definition of corruption in construction before the research commences. Hence, to define corruption in construction, some modifications to the classic definition of corruption, namely, ***misuse of public power for private benefit***, were created from the following two perspectives.

First, public power was replaced by entrusted power. The classic definition restricts corruption to the misuse of public power, which is specified for corruptionists working as governmental officials or public servants. However, in the context of the construction sector, corruptionists are mainly industrial professionals instead of governmental officials or public servants. Thus, using the term public power in the definition of corruption in construction would be inappropriate. Nevertheless, corruptionists in the construction sector would inevitably deviate from their formal duties when they engage in corruption, which stains their entrusted power. Thus, the term entrusted power appears to be more reasonable.

Second, the classic definition notes that people engage in corruption for private benefit. However, in the context of the construction sector, people may conduct corrupt practices for their institutions" benefit rather than for their private benefit, thereby emphasizing the incorrectness of the claim that only individuals benefit from corruption. However, whether corrupt practices are conducted for private or institutional benefit, such practices would absolutely be at the cost of the interest of construction projects. Based on the two modifications, the particular definition of corruption in the construction sector was proposed as "***the misuse of entrusted power at the expense of construction projects***." Considering that this study focuses on vulnerabilities to corruption in the public construction sector, the definition of corruption in this study can be specified as "***the misuse of entrusted power at the expense of public projects.***"

Another key point is that corrupt practices must be differentiated from unethical, unprofessional, and criminal practices. This distinction is especially important in identifying whether a practice is corrupt or incorrupt. Objectively, corrupt practices are a subset conception of unethical, unprofessional, and criminal practices; however, they do have boundaries between them. The critical boundary lies in whether related parties have actively sought economic benefits from their actions. If economic benefits are actively sought from the unethical, unprofessional, and criminal practices, these would be considered as corrupt practices, if not, then these are not corrupt practices. For example, the finance department in a client organization may negatively verify and approve the payment application proposed by the engineering department because of the contradictions between the two departments, during which unethical practices rather than corrupt practices have been performed by the finance department. A poorly trained frontline worker would inevitably conduct unprofessional practices, which could not be considered as corrupt practices. Finally, a fight occurring between frontline workers because of personal dispute that leads to injury or fatality could be categorized as a criminal practice rather than a corrupt practice.

## 2.3 REVIEW PROCESS

Literature review is usually conducted to establish a theoretical foundation for research. As this study concentrates on corruption issues in the public construction sector, the scope of the literature review is limited to those related to construction engineering and management (CEM) publications. This study adopts a structured literature review approach advocated by Ke et al. (2009), Hong et al. (2011), Hu et al. (2013), and Yi and Chan (2014). The review process consists of the following steps.

In Step 1, a list of peer-reviewed CEM journals was formulated as the source for identifying related papers according to the CEM journal ranking list by Chau (1997). Selected journals included the top six journals in the ranking list of Chau, namely, *Construction Management and Economics (CME), Journal of*

*Construction Engineering and Management (JCEM), Engineering, Construction and Architectural Management (ECAM), Journal of Management in Engineering (JME), Proceedings of the Institution of Civil Engineers: Civil Engineering (PICE-CE),* and *International Journal of Project Management (IJPM)*. A full search of related papers in each of the six journals was conducted using Scopus with a full collection of reports from 1990 to 2013. The keyword "corruption" was used in the Title/Abstract/Keywords field of search engines. Search results by frequency were as follows: CME (9), JCEM (5), ECAM (1), JME (2), PICE-CE (2), and IJPM (1). These identified papers were then reviewed to examine their relevance to the topic of corruption. All the identified papers were found to be highly correlated. A total of 20 corruption papers were identified in Step 1.

In Step 2, a separate research was conducted to identify more papers on corruption in the construction industry by using the Web of Science (WoS). A code *TOPIC: (corruption) AND TOPIC: (construction industry) AND YEAR PUBLISHED: (1990-2013) Refined by: LANGUAGES: (ENGLISH) AND DOCUMENT TYPES: (ARTICLE OR REVIEW)* was searched within the database WoS. A total of 20 papers were obtained. After reviewing the topics of these 20 papers, 14 papers were regarded as valid. Among the 14 papers, 3 papers, namely, Alutu and Udhawuve (2009), Ling et al. (2009), and Kenny (2012) have been identified in Step 1. Therefore, 11 new corruption papers were actually identified in Step 2.

In Step 3, a further search was conducted within three CEM journals published by the ASCE but not included in Chau‟s list. These journals are: *Leadership and Management in Engineering (LME), Journal of Professional Issues in Engineering Education and Practice (JPIEEP),* and *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction (JLADREC).* A full search of related papers in each of the three journals was conducted using Scopus with a full collection of reports from 1990 to 2013. The keyword "corruption" was used in the Title/Abstract/Keywords field of search engines. Search results by frequency were as follows: LME (14), JPIEEP (4), and JLADREC (0). These identified papers were then reviewed to examine their relevance to the topic of corruption. The results were refined and trimmed down as follows: LME (14) and JPIEEP (3). Among these 17 papers, one paper, namely, Ameh and Odusami (2010), has also been identified in Step 2. Therefore, a total of 16 new corruption papers were actually identified in Step 3.

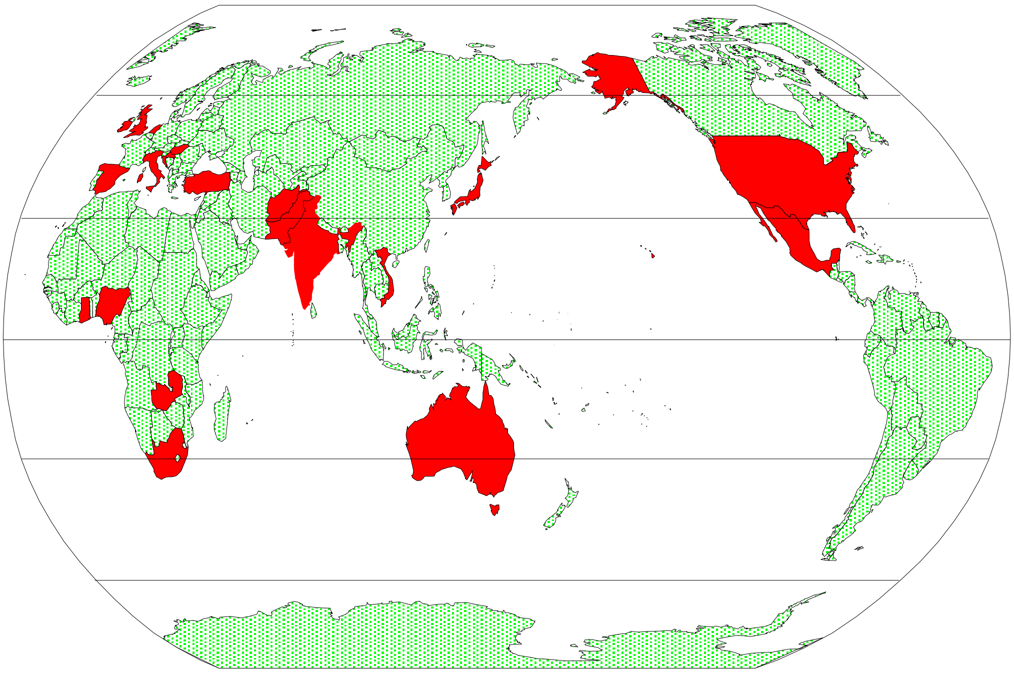
In Step 4, an additional search was performed to identify corruption studies published in top Chinese academic journals. The search scope was limited to the journal list advocated by the Department of Management Science, National Natural Science Foundation of China (2014), in which the journals have earned quite a good reputation in the Chinese academia. The keyword of "腐败" (i.e. corruption) was used in the Topic field of the search engine in the China Knowledge Resource Integrated Database for the limit to the targeted journals.

The initial search result contained 61 papers. After reviewing research topics of these papers, 26 papers that are correlated with corruption in the construction sector were regarded as valid. Thus, a total of 26 Chinese corruption papers were identified in Step 4.

Finally, a total of 73 corruption papers were identified through this review process. Among these papers, 47 are English corruption papers and 26 are Chinese corruption papers. The detailed information of English corruption papers is shown in Appendix A. Detailed information of Chinese corruption papers and their translations is shown in Appendix B and Appendix C, respectively.

## 2.4 CORRUPTION RESEARCH IN CONSTRUCTION

The identified English corruption studies in construction were from a wide range of countries including Afghanistan (Unruh and Shalaby 2012), Australia (Zarkada-Fraser 2000; Zarkada-Fraser and Skitmore 2000; Vee and Skitmore 2003; Hartley 2009), Croatia (Badun 2011), Ghana (Frimpong et al. 2003), Hungary (Jancsics and Jávor 2012), India (Tabish and Jha 2011a; 2011b; 2012; Meduri and Annamalai 2013), Italy (Bologna and Del Nord 2000), Japan (Black 2004), the Netherlands (Graafland 2004; Dorée 2004; Van den Heuvel 2005), Mexico (Fernandez-Dengo et al. 2013), Nigeria (Sonuga et al. 2002; Alutu 2007; Alutu and Udhawuve 2009; Ameh and Odusami 2010), Pakistan (Choudhry and Iqbal 2013), South Africa (Bowen et al. 2007a; 2007b; 2012), Spain (Jiménez 2009; Romero et al. 2012), Turkey (Gunduz and Önder 2013), the United Kingdom (Crosthwaite 1998; Stansbury 2009a; Amaee 2011; Tang et al. 2012; Jones 2012), the United States (Brooks 1992; Barco 1994; Crist Jr 2009), Vietnam (Ling et al. 2009; Ling and Hoang 2010; Ling and Tran 2012), and Zambia (Sichombo et al. 2009) (see Figure 2.1). However, no English corruption literature was found from China. This also reinforces the research need on corruption issues in the Chinese construction sector, which can help establish a global body of knowledge on corruption.



Note: countries where corruption research has been carried out

Figure 2.1 Corruption research in construction around the world

According to the literature review, the majority of current corruption research in construction mainly focuses on four areas, namely, the forms of, causes of, impacts of corruption, and anti-corruption strategies. These four areas will be fully discussed in the following sections.

### 2.4.1 Forms of Corruption in Construction

A total of 12 forms of corruption in the construction industry were identified from literature as follows: bribery, fraud, collusion, bid rigging, embezzlement, kickback, conflict of interest, dishonesty and unfair conduct, extortion, negligence, front companies, and nepotism.

Bribery is the most common and serious form of corruption in the construction industry, particularly in developing countries (Barco 1994; Sonuga et al. 2002; Alutu 2007; Bowen et al. 2007a; 2007b; Goldie-Scot 2008; Alutu and Udhawuve 2009; Sichombo et al. 2009; Krishnan 2009; de Jong et al. 2009; Stansbury 2009b; Ameh and Odusami 2010; Tabish and Jha 2011a; Bowen et al. 2012; Tabish and Jha 2012; Unruh and Shalaby 2012; Li et al. 2013; Meduri and Annamalai 2013). This misconduct refers to offer, give, receive or solicit of anything of value to influence the action of an official in the procurement or selection process or in contract execution (Hartley 2009). Based on an empirical survey in South Africa, Bowen et al. (2007a; 2007b) examined the process of bribery and found that it could take various forms, such as gifts, cash, overseas and holiday trips, special favors/privileges, and affirmative appointments.

Fraud is another common form of corruption in construction (Gunduz and Önder 2013). This misconduct primarily takes the forms of misinformation (e.g., alteration of documents and deliberate intention to mislead and withhold information), deceit (e.g., making invoices and payment for materials without being received), and theft (e.g., materials and equipment) (Vee and Skitmore 2003; Van den Heuvel 2005; Bowen et al. 2007a; 2007b; Sohail and Cavill 2008; de Jong et al. 2009; Tabish and Jha 2011a; Bowen et al. 2012). According to the two questionnaire surveys conducted in Australia and South Africa (Vee and Skitmore 2003; Bowen et al. 2007a; 2007b), deceit and misinformation are regarded as the most common forms of fraud.

Collusion is a form of corruption in which a secret agreement is reached between two or more parties for a fraudulent or deceitful purpose (Bajari and Ye 2003; Besfamille 2004; Van den Heuvel 2005; Sichombo et al. 2009; de Jong et al. 2009; Tabish and Jha 2011a; Chotibhongs and Arditi 2012a; 2012b; Le et al. 2013; Wu et al. 2013). Collusion can benefit the involved parties by sacrificing the normal benefits of the project or the public (Dorée 2004; Graafland 2004; Bowen et al. 2007a; 2007b). Zarkada-Fraser and Skitmore (2000) stated that most collusive practices are conducted by tenderers during project biddings to win contracts. Zarkada-Fraser (2000) emphasized that collusion seriously corrodes the foundation of the competitive principle in the construction industry.

Bid rigging is a major form of corruption that usually occurs between a tenderee and a tenderer (Vee and Skitmore 2003; Sichombo et al. 2009; Krishnan 2009; Hartley 2009; de Jong et al. 2009; Bowen et al. 2012). In this case, a tenderee may intentionally set up some constraints (e.g., a short time limit and inappropriate qualification requests) in bidding documents to help its favored tenderer attend the tendering and win the contract (de Jong et al. 2009). Bowen et al. (2007a; 2007b) further identified several common forms of bid rigging, such as cover pricing, bid cutting, hidden fees and commissions, and compensation for tendering costs of unsuccessful tenderers.

Embezzlement is a crime in which a person fraudulently misuses the power or resources in their position to intentionally procure personal, illegal benefits (Green 1993; Hartley 2009; de Jong et al. 2009; Stansbury 2009b). In the construction industry, a typical example of embezzlement is the misappropriation of project funds (Tow and Loosemore 2009; Ling and Hoang 2010). Embezzlement can seriously affect the cost management of construction projects (Sohail and Cavill 2008). For example, payment for a contractor can be defaulted by the client"s embezzlement of the project funds, which may delay project delivery or even result in project failure.

Kickback refers to illegal economic incentives that a person uses to seek a favorable decision from a person in power (Barco 1994; Sohail and Cavill 2008; de Jong et al. 2009; Bowen et al. 2012). For instance, a client"s staff may receive an economic reward from a tenderer by helping them win the contract. A recent questionnaire survey in Nigeria revealed that the contractor that wins a contract usually includes a kickback into the price quotation for bidding (Alutu 2007).

Conflict of interest refers to a situation in which a professional in a position of trust, such as a site supervisor, an auditor, or a cost consultant cannot impartially fulfill their duty because of am bivalent professional or personal interests (Bowen et al. 2007a; 2007b; Hartley 2009; de Jong et al. 2009). Despite the lack of improper activity evidence, a conflict of interest can cause an appearance of impropriety and thus undermine confidence in the professional opinions or actions, which may negatively affect the performances of projects (Bowen et al. 2007a; 2007b).

Dishonesty and unfair conduct mostly occur in the bidding, contract negotiation and signing, and project construction phases (Vee and Skitmore 2003; Alutu 2007). Bowen et al. (2007a; 2007b) analyzed primary opinions on dishonesty and unfair conduct from key stakeholders in construction projects: (1) architects believe that contractors are not always honest when following contractual specifications, and that they commonly use cheap and inferior alternatives; (2) contractors believe that the tendering adjudication process is unfair, and that there exist a bias in professionals‟ acts when clients greatly intervene in the process; and (3) quantity surveyors believe that contractors always repeatedly over claim in the project construction phase.

Extortion refers to corrupt conduct motivated by personal desire for extra income, which usually take the form of forcing extraction of bribes and asking for favors from vulnerable project parties (Sohail and Cavill 2008; Sichombo et al. 2009; Stansbury 2009b; Tabish and Jha 2011a; Bowen et al. 2012). Extortion usually occurs from a party to another party involved in a project, such as (1) from client staff to contractors or material suppliers, (2) from a major contractor to their subcontractor, (3) from a potential subcontractor to a material/equipment supplier, and (4) from regulatory/permitting agencies to clients, contractors, or material/equipment suppliers. Extortion can result in the misuse of project funds and provide some individuals with illegal incomes (de Jong et al. 2009).

Negligence is a common form of corruption in construction projects that is characterized by failure to exercise the due care of a responsible professional (Richard 1972). Specific forms of negligence include inadequate quality specifications, poor workmanship, insufficient safety specifications, low-quality materials, poor process supervision, and lack of project management and skills (Vee and Skitmore 2003). Bowen et al. (2007a; 2007b) observed that more than 90% of architects and cost consultants have committed negligence in the South African construction industry.

Front companies refer to corporate entities that are established by persons who hold senior positions in the government or client organizations to obtain illegal benefits in awarding construction contracts (de Jong et al. 2009). Although these companies are not familiar to the public, they can secure contracts because of the power of their owners and delegate them to other contractors or suppliers at a lower price (Hartley 2009). The price difference exactly represents illegal income for these corruptions.

Nepotism refers to corrupt conduct by which a person may provide assistance to a tenderer who has some kinds of relational links, such as common race, same origins, or good friendship (Kadembo 2008; Hartley 2009; Bowen et al. 2012; Ling and Tran 2012). Nepotism, which is also called the "good old boys" network" (Singh and Shoura 1999), can have multiple negative impacts on performances of construction projects, such as low construction productivity and low managerial efficiency (Kale and Arditi 1998).

Although the contemporary corruption studies have identified various forms of corruption, few studies have identified specific corruption indicators. Therefore, this study aims to identify the specific corruption indicators in the Chinese public construction sector, which is expected to help both industry and academia gain a better understanding of corruption in the sector.

### 2.4.2 Causes of Corruption in Construction

Some efforts have been made to investigate causes of corruption in the construction industry. Tanzi (1998) identified the regulations and authorizations, spending decisions, and discretionary decisions of project managers or other decision makers as the direct causes of corruption. Tanzi (1998) further listed the level of public sector wages, penalty systems, institutional controls, transparency, and leadership practices as the indirect causes of corruption. Neelankavil (2002) considered three variables that contribute to vulnerabilities to corruption in the construction industry: environmental, individual, and international firm variables. Environmental variables include power concentration, lack of transparency, inappropriate regulations, lack of competition, uneven income, and poverty. Individual variables refer to personal behaviors and attitudes, such as greed, integrity, and honesty; living wages; and power. International firm variables include market expansion, competitive advantage, and profit maximization.

Sohail and Cavill (2008) observed that corruption often results from the deregulation of the infrastructure sector, the substantial inflow of public funds, the highly competitive nature of the tendering process, the lack of transparent selection criteria for projects, the political interference and caution in investment decisions, the monopolistic nature of service delivery, the tight margins, the close relationships among contractors, subcontractors, and project owners, and the complexity of institutional roles and functions in the construction industry.

In some cases, corruption is regarded as the result of an unethical decision (Zarkada-Fraser and Skitmore 2000; Zarkada-Fraser 2000; Liu et al. 2004; Moodley et al. 2008). For developing countries in societal transition and which may lack mature law systems, corruption may be worsened by insufficient legal punishments and penalties (Bologna and Del Nord 2000; Perng and Chang 2004). Bowen et al. (2012) regarded the lack of positive role models of public officials as a key cause of corruption in construction. Tabish and Jha (2011a) emphasized that corruption in construction can be attributed to the lack of standardized execution in construction projects. Ling and Tran (2012) reported that intimate interpersonal relationships among public owners, private contractors, and consultants could lead to corruption. Based on this review, ten causes of corruption were gathered from literature and are shown in Table 2.1.

Although current corruption research has identified a set of diverse causes of corruption in the construction sector, they seldom investigate the effect of these causes on the vulnerabilities to corruption. This study aims to address this point by investigating the causal relationships between causes of corruption and the corruption indicators in the Chinese public construction sector.

Table 2.1 Causes of corruption gathered from literature review

| No. | Causes of corruption | Definition | Source I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | XIII |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Multifarious licenses or permits | Some construction-related companies choose to bribe government officials to obtain multifarious licenses or permits in a limited time. | | | √ | √ | | | | | | | | | |
| 2 | Deficiencies in rules and laws | Deficiencies in rules and laws foster an environment that is conducive to corruption. | | | √ | | | | | | √ | √ | | | |
| 3 | Excessive competition in the construction market | Excessive competition in the construction market drives contractors to buy off some client staff members to acquire competitive advantage in securing contracts. | | √ | | | | | | | | | | | |
| 4 | Lack of rigorous supervision | Corrupt practices are encouraged without due rigorous supervision from supervisors. | | | √ | √ | | | | | | | | | √ |
| 5 | Low wage level | The wage level in the construction industry is low, thus motivating the industrial practitioners to maintain corrupt practices to gain extra profit. | | | √ | √ | | | | | | | | | |
| 6 | Inadequate sanctions | The sanctions imposed on individuals who commit corruption are significantly moderate; hence, these sanctions are not effective in discouraging delinquents from continuing their corruption activities. | √ | | √ | | | | | | | √ | √ | √ | |

| No. | Causes of corruption | Definition | Source | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | XIII |
| 7 | Poor professional ethical standards | Low integrity due to poor professional ethical standards. | √ | | | √ | | √ | √ | √ | | √ | | | |
| 8 | Negative leader roles | Negative leaders encourage corruption, especially those who are not punished, influence other people to commit such crime. | √ | | √ | | | | | | | | | | |
| 9 | Over-close relationships among contracting parties | Over-close relationships among contracting parties effectively facilitate illegal trade, thereby contributing to the occurrence of corruption. | | √ | | | √ | | | | | | | | |
| 10 | Great project complexity | A highly complex public construction project is more vulnerable to corruption due to information asymmetry brought about by the involvement of numerous practitioners. | | √ | | | | | | | | | | | |

Note: I = Bowen et al. (2012); II = Sohail and Cavill (2008); III = Tanzi (1998); IV = Neelankavil (2002); V = Ling and Tran (2012); VI = Liu et al. (2004); VII = Moodley et al. (2008); VIII = Zarkada-Fraser and Skitmore (2000); IX = Bologna and Del Nord (2000); X = Zarkada-Fraser (2000); XI = Sha (2004); XII = Perng and Chang (2004); XIII = Tabish and Jha (2011a)

### 2.4.3 Impacts of Corruption in Construction

With regard to the impacts of corruption, previous studies focused on three areas, namely, the corruption risks in construction projects (micro), the expansion strategies of global companies in the international construction market (moderate), and social and economic impacts (macro).

Corruption is an extremely significant risk that greatly impacts core management tasks in construction projects, particularly in developing countries lacking mature legislative and administrative system (Ofori 2000; Choudhry and Iqbal 2013; Fernandez-Dengo et al. 2013; Deng et al. 2013). Wang et al. (1999; 2000) identified corruption as a major risk in managing build-operate-transfer (BOT) projects and found that bribing governmental officials is a major corruption risk in Chinese BOT projects. Numerous researchers stated that public-private partnership projects in China and Turkey also face a high risk in corruption prevention (Xu et al. 2010; Chan et al. 2011; Ke et al. 2011; Gurgun and Touran 2013). Meduri and Annamalai (2013) added that corruption risks can lead to an increase in project costs and a waste of public funds in India because of extra bribe expenditure.

Corruption can also affect global companies‟ expansion strategies in the international construction market (Barco 1994; Crosthwaite 1998; Gunhan and Arditi 2005; Ling and Hoang 2010; Tang et al. 2012). Crosthwaite (1998) stated that, despite the great construction demand and enormous latent profits in some developing countries, the level of corruption in a country may be a key consideration for global companies to decide whether to enter the market in the country. Gunhan and Arditi (2005) and Tang et al. (2012) also stated that corruption combined with political and physical factors is critical for an overseas company to successfully enter the Chinese construction market. However, Barco (1994) pointed out that bribery is commonly used as a strategy by global companies to gain competitive advantages in winning overseas construction contracts.

Corruption can hinder the social and economic development of human societies worldwide (Snaith and Khan 2008). Empirical studies have revealed that corruption causes economic problems and worsens current fiscal crises in some European countries. For instance, Jiménez (2009) noted that corruption in the construction industry gave rise to the speculative bubble in Spain. Romero et al. (2012) stated that corruption has resulted in many unsuccessful urban expansion cases in Spain. Skorupka (2008) and Badun (2011) reported that the slow development of infrastructure in Poland and Croatia is attributable to corrupt practices. Developing countries in Asia and Africa face more severe situations. For instance, many global contractors abandoned water and irrigation projects in Nigeria (Sonuga et al. 2002) and road projects in Afghanistan (Unruh and Shalaby 2012) because of serious corruption in these two countries.

### 2.4.4 Prevailing Anti-Corruption Strategies in Construction

Anti-corruption strategies in construction have been receiving considerable research attention. Compared with English corruption studies, more Chinese corruption studies seem to focus on anti-corruption strategies.

Leadership is a significant anti-corruption strategy (He 2004; Tabish and Jha 2012). Leaders can facilitate fair performance, develop values of integrity for long-term success, and implement such values through appropriate actions and behaviors (Tabish and Jha 2012). An eligible leader always communicates values of integrity to the rest of the organization and creates conditions that motivate people to behave in an upright manner (Wang and Ni 2004; Xia and Zhang 2005; Tan et al. 2011). Therefore, first-rate leaders must be selected to prevent corruption effectively (He 2004; Zhou and Liu 2004). Hu and Guo

(2001) also stated that the role of leaders needs to be emphasized in the fight against corruption.

Many researchers have argued that rules and regulations are critical to corruption prevention (Lv and Liu 1999; He 2004; Tabish and Jha 2012), particularly in developing countries that are undergoing economic transition (Ofori 2000; Videos 2002; Goldie-Scot 2008). Rules and regulations can be used not only in identifying corrupt practices, but also in determining the scale of punishment for verified corrupt practices (Stapenhurst and Langseth 1997; Li and Li 2004; Schwartz 2004). Rules and regulations that address corruption issues generally contain all or some of the following elements: an anti-corruption law, a national anti-corruption program, a ministerial commission, a specialized unit or agency dedicated to corruption reform (e.g., a ministerial commission and an agency), an implementation action plan, and a monitoring mechanism (Deng and Tian 2002; Tisné and Smilov 2004; Nan and Meng 2008). Nonetheless, Xiang (1989) and Ge (1994) reported that rules and regulations would be useless if they are not rigorously executed.

Transparency mechanism is a key strategy for preventing corruption in construction projects (Hu and Guo 2001; Deng et al. 2003; He 2004; Li and Li 2004). Sohail and Cavill (2008) observed that transparency mechanisms can provide the public with access to information on construction projects to ensure that project performance can be monitored and decision makers can be held accountable for their decisions. Kenny (2012) further indicated that regular exposure to contract and implementation details is a common method for improving project transparency. Goldie-Scot (2008) noted that some developing countries such as Tanzania, Zambia, the Philippines, and Vietnam have already made considerable efforts in introducing transparency initiatives to prevent corruption in construction projects.

A proper incentive system for industry practitioners is considered effective in preventing corruption (An et al. 1999; Zhang and Shen 1999; Hu and Guo 2001; Zhou 2004; Zhou and Liu 2004; Wu et al. 2008). However, Zhou and Liu (2004) argued that high wages could only help restrain corruption if the potential corruptor is risk averse. If a potential corruptor is risk loving, high wages cannot restrain the occurrence of corruption. Long and Tian (2008) concluded that high wages could not help fight corruption in developing countries that are undergoing economic transitions.

Establishing an ethical code is another important proactive strategy that is commonly used to prevent corrupt practices (Xiang 1989; Ge 1994; Fan et al. 2001; Hu and Guo 2001; Xia and Zhang 2005). For instance, a National Code of Practice for the Construction Industry has been encouraged in Australia to discipline all industry professionals (Hartley 2009). Sohail and Cavill (2008) noted that ethical training programs can help prevent corruption and that developing an ethical code for a particular stakeholder may be useful because the universal industry ethical code cannot include exhaustive guidelines for all situations that different stakeholders face in their work. Goldie-Scot (2008) added that ethical behavior should be rewarded to create a positive industrial atmosphere.

Imposing sanctions can also help fight corruption effectively (Tabish and Jha 2012). Sanctions on corruption in the construction industry are usually divided into three categories, namely, administrative, economic, and penal sanctions. The effectiveness of sanctions in preventing corruption has been supported by many studies, which have all stated that harsh punishments could discourage industry practitioners from engaging in corrupt practices (An et al. 1999; Zhang and Shen 1999; Hu and Guo 2001; Wang and Ni 2004; Wu et al. 2008; Xie and Kang 2010; 2011).

Several international organizations and industry associations have made substantial efforts to promote the mixed use of two or two above of the preceding strategies for preventing corruption in the construction industry. For instance, Transparency International issued a special report on corruption in construction in 2005 and consequently developed Project Anti-Corruption System in 2007 to assist various stakeholders to prevent corruption (Krishnan 2009). Similarly, the International Federation of Consulting Engineers developed some corruption prevention information systems for its members, such as the Business Integrity Management System and the Government Procurement Integrity Management System (Boyd and Padilla 2009). The Global Infrastructure Anti-Corruption Center (GIACC) established the GIACC Resource Centre and provided industry professionals the free access to advice and tools on corruption identification and prevention (Stansbury 2009b). The American Society of Civil Engineers has established a Committee of Global Principles for Professional Conduct and an Engineer"s Charter in the organization, which has developed related policies, such as Statement 510 Combating Corruption, and reviewed anti-corruption issues in annual meetings (Crist Jr 2009). In the United Kingdom, the Anti-Corruption Forum that involves the Institution of Civil Engineers, the Chartered Institute of Building, the Royal Institution of Chartered Surveyors, and the Association of Consulting Engineers and other local institutions, has been held annually since 2003 and many useful guidelines have been provided on corruption prevention in the construction industry (Goldie-Scot 2008; Stansbury 2009a).

Table 2.2 shows the ten prevailing anti-corruption strategies that were collected from current literature. Although the current corruption research has already identified various anti-corruption strategies, they seldom evaluate the effectiveness of these strategies. Therefore, this study aims to continue to bridge the knowledge gap by evaluating the effectiveness of anti-corruption strategies in the Chinese public construction sector.

Table 2.2 Anti-corruption strategies gathered from the literature

| No. | Anti-corruption strategy | Definition | Sources |
|---|---|---|---|
| 1 | Positive leadership | Leadership with integrity helps prevent corruption in organizations. | Hu and Guo (2001); He (2004); Zhou and Liu (2004); Tan et al. (2011); Tabish and Jha (2012) |
| 2 | A completed legal framework | A thorough legal framework can provide remarkable support in fighting corruption. | Xiang (1989); Ge (1994); Lv and Liu (1999);Hu and Guo (2001); He (2004); Li and Li (2004); Zhang (2005a); Long and Tian (2008); Wu and Yao (2008); Tabish and Jha (2012) |
| 3 | Sound institutional systems | Sound institutional systems can eliminate the leaks that can be exploited by corrupt practitioners. | Ge (1994); Hu and Guo (2001); Deng and Tian (2002); He (2004); Li and Li (2004); Wang and Ni (2004); Xia and Zhang (2005); Nan and Meng (2008); Wu and Yao (2008) |

| No. | Anti-corruption strategy | Definition | Sources |
|---|---|---|---|
| 4 | Rigorous execution of laws, rules, and systems | The rigorous execution of laws, rules, and systems impedes the incidence of corruption. | Lv and Liu (1999); Nan and Meng (2008) |
| 5 | Transparency | Information on the projects should be publicized to ensure wider public supervision. | Mo et al. (1998); Hu and Guo (2001); Deng et al. (2003); He (2004); Li and Li (2004); Zhang (2005a); Goldie-Scot (2008); Sohail and Cavill (2008); Wu and Yao (2008); Kenny (2012) |
| 6 | Raising wage level | Increasing the wage level of industrial practitioners may reduce corruption. | An et al. (1999); Lv and Liu (1999); Zhang and Shen (1999); Hu and Guo (2001); Zhou (2004); Zhou and Liu (2004); Long and Tian (2008); Wu et al. (2008) |
| 7 | Education and training | Providing education and training for industrial practitioners can increase their morality levels, thereby restraining the incidence of corruption in public construction projects. | Xiang (1989); Ge (1994); Lv and Liu (1999); Hu and Guo (2001); Li and Li (2004); Wang and Ni (2004); Zhou (2004); Xia and Zhang (2005); Zhang (2005a) |
| 8 | Administrative sanctions | Administrative sanctions on corrupt practices, such as degradation of certificates and | An et al. (1999); Zhou and Liu (2004); Wang and Ni (2004); Wu et al. (2008); Xie and Kang |

| No. | Anti-corruption strategy | Definition | Sources |
|---|---|---|---|
| | | banning entities from bidding for new projects, can help curtail corruption. | (2011); Tabish and Jha (2012); Wu et al. (2013) |
| 9 | Economic sanctions | Economic sanctions, such as fines can prevent corruption in public construction projects. | An et al. (1999); Zhang and Shen (1999); Hu and Guo (2001); Wang and Ni (2004); Zhou and Liu (2004); Wu et al. (2008); Tabish and Jha (2012); Wu et al. (2013) |
| 10 | Penal sanctions | Penal sanctions inflict great fear to corrupt practitioners, deterring them from further committing such crime. | An et al. (1999); Zhang and Shen (1999); Hu and Guo (2001); Wang and Ni (2004); Zhou and Liu (2004); Wu et al. (2008); Xie and Kang (2010; 2011); Tabish and Jha (2012); Wu et al. (2013) |

## 2.5 CHAPTER SUMMARY

This chapter conducted a systematic literature review on corruption studies that have been published in the past two decades. The literature search scope contains not only the top English construction engineering and management journals, but also the Chinese top management journals which have good reputations in Chinese academia. The definition of, forms of, causes of, and impacts of corruption as well as the prevailing anti-corruption strategies were sequentially scrutinized. This chapter also identified three knowledge gaps, namely, identifying corruption indicators in the Chinese public construction sector, examining the causal relationships between causes of corruption and the corruption indicators, and evaluating the effectiveness of various anti-corruption strategies in the Chinese public construction sector. The identified knowledge gaps exactly echoes the research objectives of this study.

# CHAPTER 3RESEARCH METHODOLOGY

# CHAPTER 3 RESEARCH METHODOLOGY[2]

## 3.1 INTRODUCTION

This chapter introduces the research methodologies adopted in this study. Qualitative and quantitative data collection methods, namely, structured interviews and a questionnaire survey are introduced respectively. Diverse quantitative methods adopted for data analysis, such as factor analysis, partial least squares structural equation modeling, and fuzzy set theory, are also fully discussed in this chapter.

## 3.2 RESEARCH DESIGN

To operationalize the research framework of the study, a rigorous research design must be established as a guide for the entire research process and to ensure the achievement of the research objectives. According to Creswell (2003), research design refers to logically linked plans and procedures that address the topic under investigation. Research design specifically addresses four aspects: the questions to study, the relevant data, the data collection methods, and the analysis of the gathered data. A proper research design is dependent on the issue that is being addressed, the personal experiences of the

[2] Parts of this chapter has been published in the following paper:
Le, Y., Shan, M.*, Chan, A.P.C., & Hu, Y. (2014). Investigating the causal relationships between causes of and vulnerabilities to corruption in the Chinese public construction sector. *ASCE Journal of Construction Engineering and Management*, 140(9), 05014007.

researcher, and the target audience of the study. The formulation of a research design involves integrating decisions on the aforementioned issues (Creswell 2003).

Research methods are proposed to carry out the various procedures included in a research design. Research methods can be qualitative, quantitative, or mixed. Qualitative methods ask open-ended questions and use interview, observation, and document data that involve text and image analysis (Shank 2002; Patton 2005; Grbich 2012). Quantitative methods ask instrument-based questions, use performance and attitude data, and conduct statistical analysis and interpretation (Creswell 2003; Neuman 2005). The mixed method combines the qualitative and quantitative methods, and allows triangulation of data sources to determine the convergence of the employed qualitative and quantitative methods (Cavana et al. 2001; Creswell 2003). The quantitative and qualitative results can be used side by side to complement each other.

To provide a clear and systematic picture of corruption issues in the Chinese public construction sector, a mixed method approach combining both qualitative and quantitative methods was adopted in this study. The following steps were performed: Step 1, from a comprehensive literature review and a series of face-to-face structured interviews, this study identified corruption indicators, causes of corruption, and prevailing anti-corruption strategies in the Chinese public construction sector. Step 2, a questionnaire survey was administered to solicit target respondents‟ assessment of corruption indicators, causes of corruption, prevailing anti-corruption strategies, and the perceived level of corruption in the Chinese public construction sector. Step 3, by using factor analysis and partial least squares structural equation modeling on the data collected from the questionnaire survey, this study explores the underlying corruption indicators, the principal causes of corruption, and the effectiveness of prevailing anti-corruption strategies in the Chinese public construction sector. In addition, the study develops an evaluation model to measure the risk of corruption in Chinese public construction projects. Lastly, Step 4, a series of interviews was conducted to validate the entire study. The research design of the study is shown in Figure 3.1.

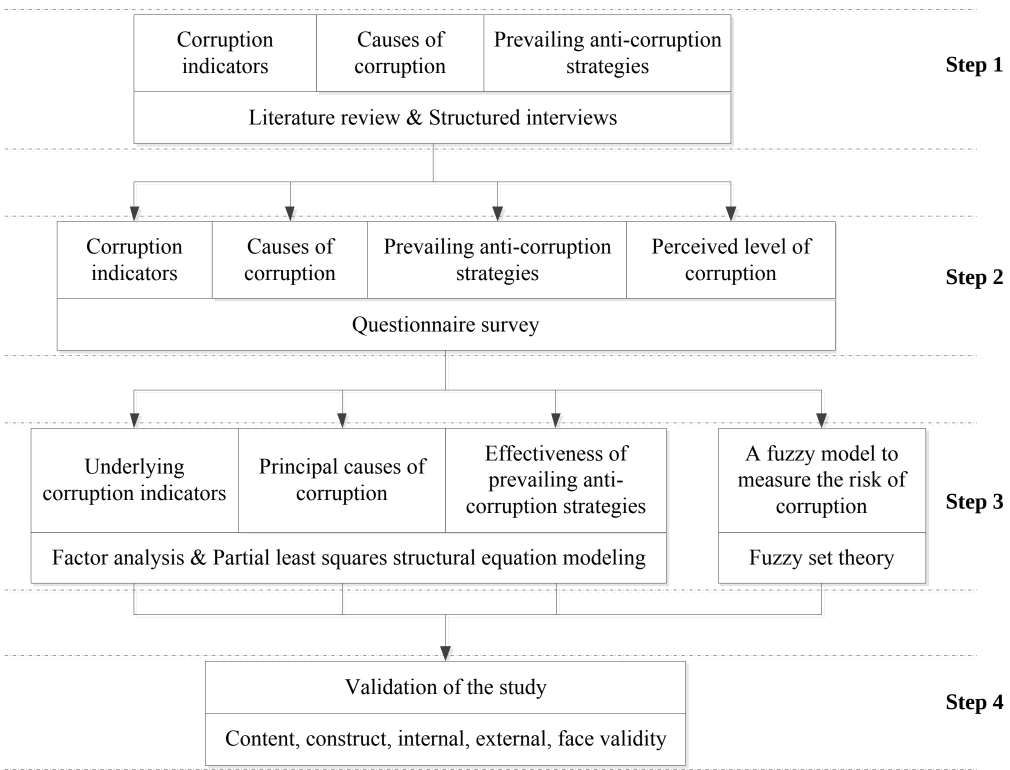



Figure 3.1 Research design of this study

## 3.3 RESEARCH STRATEGIES FOR OBJECTIVES 1 TO 3: STRUCTURED INTERVIEW

An interview is a qualitative method that aims to define the central themes of the real world of the subjects by recording and analyzing the underlying meanings in the statements of the interviewees (Kvale and Brinkmann 2009). The interview has been widely used in construction engineering and management studies (Fellows and Liu 2009), and can come in the form of structured (Chan et al. 2004; Lam et al. 2007), semi-structured (Xia and Chan 2010; Hon et al. 2010), and unstructured interviews (Rooke et al. 2004; Luu et al. 2008). Structured interviews are particularly ideal for studies that are backed by a highly developed body of research (Cohen and Crabtree 2006). Considering the extensive corruption research on construction as mentioned in Section 2.4, a structured interview approach was adopted in this study.

To identify corruption indicators, causes of corruption, and the prevailing anti-corruption strategies in the Chinese public construction sector, a series of face-to-face structured interviews was conducted between July and August 2013. Each interview contains four parts. In Part A, the personal information of each interviewee was collected. In Parts B, C, and D, each interviewee was asked to provide his/her assessment of a set of initial corruption indicators, a set of causes of corruption gathered in Section 2.4.2, and a set of anti-corruption strategies gathered in Section 2.4.4 according to a five-point Likert scale. A threshold of 2.5 points was employed to refine the interview results, as recommended by Hsueh et al. (2009). The interviewee panel was encouraged to supplement the items that were not recorded in the interview. Appendix D shows a sample of the interview document developed for this study. To facilitate the interviews in the Chinese context, the interview document was translated into Chinese, which is the official language of the interviewees (Appendix E).

The initial corruption indicators used in the structured interviews were based on the questionnaire of Tabish and Jha (2011a), which investigated vulnerabilities to corruption in Indian public project procurement. Their framework was adopted for the following reasons: First, few researchers, apart from Tabish and Jha (2011a), have examined specific corruption indicators in the public construction sectors of developing countries. Second, China and India have several similar aspects, such as locations, economy, population, and industrial structures (Cheng et al. 2007). Most importantly, both China and India have a booming public construction sector and are faced with the challenge of preventing corruption in the sector (Le et al. 2014b).

A total of 14 experienced industrial and academic experts were invited to attend the interviews. A purposive interviewee selection approach was adopted to ensure the reliability and quality of interviews. All the interviewees were expected to have at least ten years of experience in the Chinese public construction sector and to hold senior positions within their organizations. The selection of interviewees considered the diversity of the professional expertise of the experts. The selected interviewees were from government departments, clients, contractors, consultants, and academics. In addition, the selected interviewees were from different geographic areas of China. This approach helps to increase the heterogeneity of the interview panel and thus improve the validity of the interviews. Table 3.1 shows the backgrounds of the interviewees.

Table 3.1 Backgrounds of interviewees

| **No.** | **Employer** | **Position** | **Years of experience** | **Largest project ever managed/consulted** | **Working place*** |
|---|---|---|---|---|---|
| A | Government | Director | 20 | USD 363 million | Eastern China |
| B | Government | Deputy Director | 16 | USD 308 million | Central China |
| C | Client | Project Manager | 19 | USD 363 million | Western China |
| D | Client | Project Manager | 17 | USD 308 million | Eastern China |
| E | Client | Director | 13 | USD 167 million | Northeastern China |
| F | Contractor | General Manager | 25 | USD 363 million | Eastern China |
| G | Contractor | Project Manager | 20 | USD 122 million | Western China |
| H | Contractor | Director | 15 | USD 85 million | Central China |
| I | Consultant | General Manager | 20 | USD 363 million | Eastern China |

| No. | Employer | Position | Years of experience | Largest project ever managed/consulted | Working place* |
|---|---|---|---|---|---|
| J | Consultant | Project Manager | 16 | USD 122 million | Western China |
| K | Consultant | Project Manager | 15 | USD 85 million | Northeastern China |
| L | Academic | Professor | 22 | USD 197 million | Central China |
| M | Academic | Professor | 17 | USD 73 million | Western China |
| N | Academic | Associate Professor | 13 | USD 363 million | Northeastern China |

Note: *Working places are divided into eastern China with GDP per capita about USD 8,600, central China with GDP per capita about USD 4,700, western China with GDP per capita about USD 4,400, and northeastern China with GDP per capita about USD 6,600, according to the National Bureau of Statistics of China (2012).

## 3.4 RESEARCH STRATEGIES FOR OBJECTIVES 4 TO 7: QUESTIONNAIRE SURVEY

### 3.4.1 Questionnaire Development

A questionnaire survey was used in this study to solicit target respondents‟ perceptions on corruption indicators, causes of corruption, and the prevailing anti-corruption strategies in the Chinese public construction sector, because this instrument is particularly effective in large sample sizes for quantitative data analysis, and its results are likely to be generalizable (Oppenheim 2000).

The adopted questionnaire is structured in six parts. Part A is a self-explanatory letter that introduces the survey. Part B asks for the personal particulars of the respondent. Part C comprises 24 questions that measure the probability and severity of corruption indicators that have been verified by the structured interviews. Part D comprises 10 questions that measure the causes of corruption. Part E comprises 17 questions that measure the effectiveness of the prevailing anti-corruption strategies. Part F comprises one question that measures the perceived level of corruption in the Chinese public construction sector. Appendix F shows the sample questionnaire developed for this study. To facilitate the questionnaire survey in the Chinese context, the questionnaire was translated into Chinese, which is the official language of the target respondents (Appendix G).

#### 3.4.1.1 Personal Particulars

Part B of the questionnaire comprises five questions about the personal particulars of the respondents. The questions pertain to the following: (1) current professional affiliation, (2) previous professional affiliation (if any), (3) current position in the organization, (4) years of working experience, and (5) working place(s) in the past three years.

#### 3.4.1.2 Measurement of Corruption Indicators

As mentioned previously, the corruption indicators involved in the questionnaire were sequentially derived from the findings of Tabish and Jha (2011a) and structured interviews. Compared with the measurement in Tabish and Jha (2011a), which merely focused on each indicator‟s probability, this study measures each indicator in both probability and severity using a five-point rating scale (i.e., 1 = very low, 2 = low, 3 = neutral, 4 = high, and 5 = very high). This measuring approach can be expected to provide a good understanding of corruption indicators in the Chinese public construction sector. Additionally, this measuring approach has been widely adopted in risk management studies in the construction engineering and management field (Shen et al. 2001; Molenaar 2005; Sun et al. 2008; Zou and Zhang 2009; Xu et al. 2010; Ke et al. 2011), which is similar to the corruption research of this study to a certain extent.

### 3.4.1.3 Measurement of Causes of Corruption

Although the causes of corruption in the construction sector have been investigated in previous studies (Tanzi 1998; Zarkada-Fraser 2000; Zarkada-Fraser and Skitmore 2000; Bologna and Del Nord 2000; Liu et al. 2004; Sha 2004; Sohail and Cavill 2008; Bowen et al. 2012), few have measured the effect of such causes on the vulnerabilities to corruption. Therefore, given their huge potential significance in corruption prevention in construction, the cause-and-effect between causes of and vulnerabilities to corruption was examined in this study. Based on the interview results, a set of diverse causes of corruption was consolidated to form the questionnaire. The respondents are required to provide their endorsements on each corruption cause‟s effect on the corruption vulnerabilities in terms of a five-point rating scale (i.e., 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree).

#### 3.4.1.4 Measurement of the Prevailing Anti-Corruption Strategies

The framework that measures the prevailing anti-corruption strategies in the Chinese public construction sector follows Tabish and Jha (2012), which investigated the anti-corruption strategies in Indian public project procurement. The major reasons for using their framework are similar to those that had justified the usage of Tabish and Jha‟s (2011a) earlier framework to measure corruption indicators in the Chinese public construction sector (see Section 3.3 of this study). Additionally, based on interview feedback, the prevailing anti-corruption strategies in the Chinese public construction sector were found to be exactly the same as those in Tabish and Jha (2012). Given this finding, the framework of Tabish and Jha (2012) was adopted in this study and expected to be appropriate to measure the anti-corruption strategies in the Chinese context. The respondents were asked in the questionnaire to provide their perceptions based on a five-point rating scale (i.e., 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree).

#### 3.4.1.5 Measurement of Perceived Level of Corruption

One question was developed to assess the perceived level of corruption in the Chinese public construction sector. This question asked the respondent to indicate their perception using a five-point rating scale (i.e., 1 = not serious at all, 2 = not serious, 3 = neutral, 4 = serious, and 5 = very serious).

### 3.4.2 Questionnaire Survey

The pilot questionnaire was reviewed by 12 advisers prior to the survey. Stakeholders of public construction projects, including government officials, clients, contractors, consultants, designers, suppliers, and academics, were chosen as the target respondents of the pilot survey. Considering that no major negative feedback was received from the advisers, the pilot questionnaire was slightly modified and used as the final empirical questionnaire.

Survey sampling affects the generalizability of research findings. Sampling error can be controlled by setting a sufficient sample size (de Leeuw et al. 2008). According to Kline (2014), factor analysis can only be applied for surveys with a minimum sample size of 100 and a minimum subject-to-variable ratio of 2. Among all the items of the questionnaire, 24 items measured corruption indicators, 10 items measured causes of corruption, and 17 items measured prevailing anti-corruption strategies. Therefore, a minimum sample size of 104 was targeted.

To maximize the number of target respondents, a number of government agencies, research institutions, and companies within the public construction sector were contacted. In the end, eight institutions, namely, (1) Research Institute of Complex Engineering & Management, Tongji University, (2) Shanghai Construction Consultants Association, (3) Shanghai Xian Dai Architectural Design (Group) Co., Ltd., (4) School of Civil Engineering and Transportation, South China University of Technology, (5) College of Civil Engineering, Shenzhen University, (6) Construction Commission of Zhengzhou Municipality, (7) Zhengzhou Metro Group Co., Ltd., and (8) China Construction Eighth Engineering Division, agreed to facilitate the survey. They are all active players in the Chinese public construction sector. Each of them represents a huge number of governmental officials or industry professionals or researchers from a broad range of the entire sector.

The questionnaire was distributed between September and October 2013 via three channels. First, an online version of the questionnaire was prepared and disseminated to the staff of the aforementioned supporting institutions. Second, hard copies of the questionnaire were distributed in an industry forum held in Shanghai in September, 2013. Some qualified attendants of this forum were invited to attend this survey. Third, field surveys were conducted on sites in Shanghai (in the eastern China), Jinan City (in the eastern China), and Zhengzhou City (in the central China), respectively. These three survey channels enhanced the number of valid returns.

## 3.5 DATA ANALYSIS

### 3.5.1 Factor Analysis

Factor analysis was adopted in this study to create a clearer picture of corruption indicators, causes of corruption, and the prevailing anti-corruption strategies. Factor analysis is a multivariate statistical technique that is used to reduce a number of variables into underlying factors (Kim and Mueller 1978; Gorsuch 1997; Chan et al. 2010). This technique can also be used to identify the latent structure of variables, to identify the variables that are to be subjected to further multivariate statistical analysis, and to create new sets of variables based on factor scores for subsequent statistical analysis (Hair et al. 2010).

The data matrix must have sufficient correlations to justify the application of factor analysis (Dziuban and Shirkey 1974). Factor analysis cannot be applied if the correlations in the matrix are less than 0.3 (Ngai and Cheng 1997). Furthermore, both Kaiser-Meyer-Olkin (KMO) and Bartlett"s Test of Sphericity should be examined to check the appropriateness of employing factor analysis before it is conducted. According to Norušis (2008) and Hair et al. (2010), KMO value should be higher than the 0.5 threshold; meanwhile the significance level of Bartlett"s Test for Sphericity should also be small (e.g., p-value = 0.000).

An important decision is the number of factors to retain. Various options include eigenvalues (i.e., greater than one), scree test, parallel analysis, priori theory, and retaining the number of factors that gives a high proportion of variance accounted for or that gives the most interpretable solution (O Connor 2000; Conway and Huffcutt 2003; Pallant 2010; Hon et al. 2013). Different techniques often lead to different numbers of factors being retained (Zwick and Velicer 1986; Fabrigar et al. 1999). According to Ford et al. (1986) and Fabrigar et al. (1999), the best practice is to use a combination of these techniques because no single technique has been shown to be highly accurate in pinpointing the number of factors over a wide range of conditions. Thus this study used a combination of the eigenvalues-greater-than-one rule, scree test, and Horn"s parallel analysis to determine the number of factors.

When more than one factor is retained, these factors are usually rotated to identify a more interpretable solution. Researchers may adopt orthogonal rotations that prohibit correlation among the factors or oblique rotations that allow correlation among the factors, when attempting to identify an interpretable solution (Conway and Huffcutt 2003). The most popular orthogonal rotation is varimax, whereas the most popular oblique rotations are direct oblimin and promax (Kim and Mueller 1978). Although an orthogonal rotation may seem conceptually simple because of the lack of factor correlations, an oblique rotation is in fact the most likely to give a straightforward, interpretable solution (Conway and Huffcutt 2003). This conclusion has been obtained by various researchers (Gorsuch 1970; Ford et al. 1986; Gorsuch 1997; Fabrigar et al. 1999; Conway and Huffcutt 2003; Gorsuch 2013).

Factor loading indicates the correlation of the variables to the underlying factor (Kim and Mueller 1978; Comrey and Lee 1992; Conway and Huffcutt 2003; Kline 2014). According to Hair et al. (2010), a threshold of 0.5 is established to determine if a variable is capable of formulating the corresponding factor.

### 3.5.2 Partial Least Squares Structural Equation Modeling

#### *3.5.2.1 Purpose of Using PLS-SEM*

Partial least squares structural equation modeling (PLS-SEM) is a structural path estimation approach that is becoming a popular tool in social sciences as a multivariate technique for non-experimental and experimental data (Hulland 1999; Wetzels et al. 2009; Aibinu and Al-Lawati 2010; Hair et al. 2011). PLS-SEM was adopted in this study to investigate underlying corruption indicators, principal causes of corruption, and the effectiveness of the prevailing anti-corruption strategies in the Chinese public construction sector. PLS-SEM comprises a set of measurement models and a structural model. The measurement models pertain to the relations between measurement items and the corresponding latent variable. The structural model refers to relations among latent variables (Ning and Ling 2013).

Preference for PLS-SEM could be attributed to its many advantages. These include its effectiveness in exploring key driving constructs, theory testing, and theory development (Aibinu and Al-Lawati 2010; Hair et al. 2011; 2012), its capability of dealing with non-normality data sets (Hair et al. 2011; 2012; Ning and Ling 2013), its applicability in formative mode (Hair et al. 2011; 2012), and its minimum requirements for sample size (Reinartz et al. 2009; Zhao et al. 2013a; Le et al. 2014b).

#### *3.5.2.2 Application Procedures*

PLS-SEM is mainly conducted by (1) examining data characteristics, (2) model specification, (3) model estimation, (4) model interpretation, and (5) model validation.

Step 1: Data characteristics

Sample size and data distribution are examined at this stage. No distributional requirements are needed for PLS-SEM because it can handle highly skewed data distributions (Fornell and Bookstein 1982; Hair et al. 2011; 2012). PLS-SEM is also capable of achieving robust results even with a small sample size, even as low as 20, as indicated by the Monte Carlo simulation result by Chin and Newsted (1999).

Step 2: Model specification

Model specification refers to the process of building the measurement models and accordingly a structural model. This stage may be achieved based on experience in the particular field, review of the theory, and literature (Aibinu and Al-Lawati 2010).

Step 3: Model estimation

This step involves estimating the parameters of the theoretical model. Structural equation modeling analysis estimates the parameters for the links between the measurement items and their respective latent variables (i.e., loadings) and the links between the different latent variables (i.e., path coefficients) (Kline 2010). PLS-SEM uses a combination of principal component analysis, path analysis, and regression to simultaneously evaluate theory and data (Pedhazur 1997; Aibinu and Al-Lawati 2010). PLS-SEM takes each latent variable as an approximation of its respective block of measurement items. Hence, in the first stage of PLS-SEM estimation, an iterative scheme of simple and or multiple regressions that are contingent on the particular model is performed until a solution converges on a set of weights used for estimating the latent variable scores. Once scores for all the latent variables are obtained, the second and third stages are simple non-iterative applications of ordinary least square regression for obtaining loadings, path coefficients, and mean scores and location parameters for the latent variables and measurement items (Chin 1998a).

Step 4: Model evaluation

The PLS-SEM model evaluation may be described as a two-step approach. First, four types of validity of the measurement models (internal consistency reliability, indicator reliability, convergent validity, and discriminating validity), are assessed by three indicators (composite reliability, loadings of observed variables on the corresponding latent variables, and average variance extracted (AVE)) (Wetzels et al. 2009; Hair et al. 2011; Ning and Ling 2013; Zhao et al. 2013a). Second, after adjustment of items and acceptance of the measurement model, the structural model is evaluated to assess the relationships between the various latent variables (Aibinu and Al-Lawati 2010).

The composite reliability is adopted to assess internal consistency reliability. Instead of assuming that all measurements are equally reliable, composite reliability prioritizes the measurements based on their reliability during the estimation of the model and is thus suitable for PLS-SEM (Hair et al. 2011). A threshold of 0.7 was established (Bagozzi and Yi 1988; Hair et al. 2011).

The factor loading of each observed variable on their respective latent variable was used to evaluate indicator reliability. Churchill Jr (1979) suggested that measurement with loadings less than 0.4 should be eliminated. Measurements with loadings between 0.40 and 0.70 can also be eliminated if such removal can increase the composite reliability above the threshold value (Hair et al. 2011). Weak measurements with loadings less than 0.7 may be retained if they significantly contribute to content validity (Hair et al. 2011).

The convergent validity of each latent variable is confirmed if the AVE value of a particular construct is greater than 0.5 (Bagozzi and Yi 1988; Hair et al. 2011).

The discriminating validity of each latent variable can be confirmed by either of two methods. First, if the AVE of a particular latent variable is greater than this latent variable‟s highest squared correlation with any other latent variable (Fornell-Larcker criterion), or second, if the loading of the observed variable is higher than all of its cross loadings (Cenfetelli and Bassellier 2009; Hair et al. 2011).

The results of the structural model can be evaluated by using the coefficient of determination (R2) (Chin 1998b; Hair et al. 2011; Ning and Ling 2013) and the path coefficients (Chin 1998b; Henseler et al. 2009; Ning and Ling 2013).

According to Hair et al. (2011), the appropriate level of R2 may vary depending on the research discipline. For instance, $R^2$ results of 0.20 are considered high in disciplines such as consumer behavior, whereas $R^2$ values of 0.75 would be perceived as high in success driver studies. In marketing research studies, $R^2$ values of 0.75, 0.50, or 0.25 for endogenous latent variables in the structural model can, as a rule of thumb, be described as substantial, moderate, or weak, respectively. Nonetheless, in construction engineering and management research, many studies do not report the R2 value if the structural equation modeling is mainly used to test the hypotheses instead of making a prediction (Jin et al. 2007; Eriksson and Pesämaa 2007; Wong et al. 2008; Doloi 2009; Maurer 2010; Ning and Ling 2013).

The individual path coefficients of the PLS-SEM model can be interpreted as standardized beta coefficients of ordinary least squares regressions (Chin 1998b). Just as with the indicators" weights and loadings, each path coefficient"s significance can be assessed via a bootstrapping procedure (Hair et al. 2011), as detailed below. Paths that are non-significant or show signs contrary to the hypothesized direction do not support a prior hypothesis, whereas significant paths showing the hypothesized direction empirically support the proposed causal relationship (Hair et al. 2011).

Step 5: Model validation

In PLS-SEM, the estimated structural model of the interrelationships between various latent variables is validated to ascertain whether the predicted values from the model are likely to accurately predict the responses of future sample (Fornell and Bookstein 1982; Hair et al. 2011). Model validation may be achieved by resampling method to test the significance of the t-value of the path coefficients of the structural model using nonparametric tests of significance known as bootstrapping (Chin 1998a; Hair et al. 2010).

Bootstrapping is an inferential statistical method for estimating sampling distribution by drawing randomly with replacement from the original sample to derive a robust estimate of confidence intervals of a population parameter (Nevitt and Hancock 2001; Hair et al. 2011). The population parameter in this study is the path coefficient for the estimated theoretical model. Bootstrapping is useful for conducting hypothesis tests, and it is a robust alternative to statistical inference based on parametric assumptions when those assumptions are in doubt. Such cases include small samples and when traditional distributional assumptions are violated, such as in data with non-normal distribution (Mooney and Duval 1993). According to Kleijnen et al. (2001), bootstrapping is a versatile tool that enables estimation of the distribution of any statistic for any type of distribution.

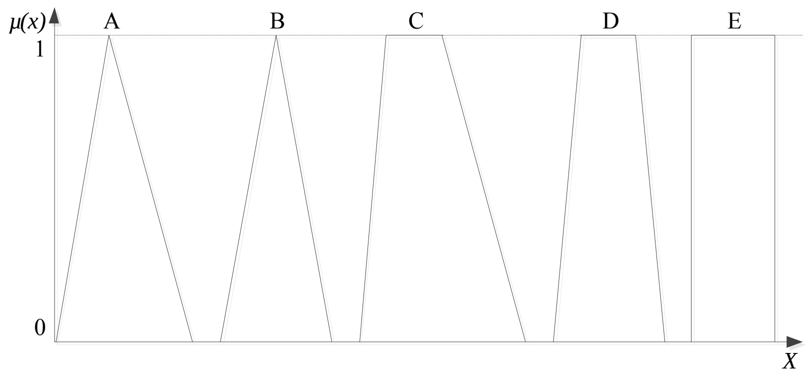
Hair et al. (2011) and Aibinu and Al-Lawati (2010) stated that the higher the path coefficient the stronger the effect of a predictor latent construct on the dependent construct. The critical t-values for a two-tailed test are 1.65 (0.1 significance level), 1.96 (0.05 significance level), and 2.58 (0.01 significance level) (Hair et al. 2011; Ning and Ling 2013).

### 3.5.3 Fuzzy Set Theory

Fuzzy set theory was adopted in this study to facilitate developing an evaluation model to measure potential corruption. Fuzzy set theory was first introduced by Zadeh (1965) to address subjectivity and uncertainties. Based on linguistic variables and membership functions with varying grades, fuzzy set theory allows for the development of strong and significant instruments for the measurement of ambiguities and provides the opportunity to represent meaningfully ambiguous concepts expressed in natural language (Zimmermann 2001). This approach is appropriate to address complex problems due to the imprecise, uncertain, or unreliable information that characterize real world systems (Baloi and Price 2003; Chan et al. 2009; Xia et al. 2011; Zhao et al. 2013b).

A fuzzy set is a set whose elements have varying degrees of membership (Zimmermann 2001). The degrees of membership of an element are expressed by a membership function, which enables quantitative calculations in fuzzy decision making (Xia et al. 2011). Baloi and Price (2003) viewed that membership functions in fuzzy set theory play a similar role to that of probability distribution functions in Probability Theory, that is, membership functions are used to represent uncertainty. A membership function is a function that maps a universal set of objects, X, into the unit interval [0, 1]. The universal set of objects represents all the elements of the set and the interval corresponds to the set of grades. The grades of membership in fuzzy sets may fall anywhere in the interval [0, 1], meaning that an element is not a member of the set if the grade of membership falls on the degree of 0. Conversely, in term of degree 1, it means that an element absolutely belongs to the set (Hadipriono 1988).

Unlike crisp sets that have only one membership function, fuzzy sets have a large number of membership functions. Membership functions composed of straight segments are very often adopted in practice for their simplicity. As shown in Figure 3.2, the common forms of membership functions are triangular asymmetrical/symmetrical membership functions, trapezoidal asymmetrical/symmetrical membership functions, and rectangular membership function (Piegat 2001).




A- triangular asymmetrical membership function
B- triangular symmetrical membership function
C- trapezoidal asymmetrical membership function
D- trapezoidal symmetrical membership function
E- rectangular membership function

Figure 3.2 Shapes of common membership functions
Source: Piegat (2001)

The grades of membership in fuzzy sets are actually the values of the linguistic variables (Zhao et al. 2013b). Baloi and Price (2003) stated that the concept of linguistic variables lies at the core of fuzzy set theory because the basis of fuzzy set theory is the manipulation of linguistic expressions rather than numbers. The values assumed by linguistic variables are words. Considering that words are generally less precise than numbers, the concept of linguistic variables serves the purpose of providing a means of approximate characterization of phenomena that are too complicated or too ill-defined to be amendable to description in quantitative terms (Gottwald 1993). Linguistic variables often assume different values, such as “very high”, “high”, “moderate”, “low”, and “very low”, which represent the perception of a decision-maker or an assessor.

Each fuzzy set has to overlap its neighboring sets to some degree in its membership functions. In most cases, there is an overlap averaging between 25 and 50% of the fuzzy set base between two neighboring fuzzy regions (Earl 1999). Driankov et al. (2010) also argued that the crossing point for two overlapping membership functions should be 50% for control applications and slightly lower for classifiers and others. Figure 3.3 shows triangular membership functions that have 50% of overlap between two neighboring fuzzy regions.

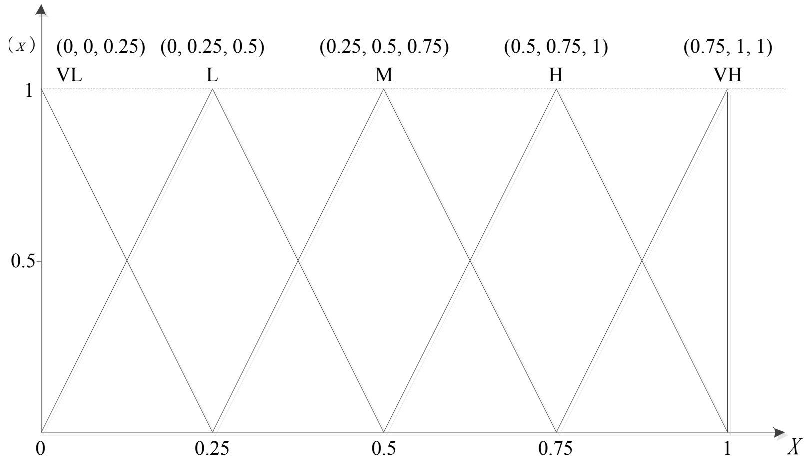



Figure 3.3 Membership functions of varying linguistic values
Source: Zhao et al.(2013b).

Defuzzification is the last step of fuzzy set theory which produces a crisp number that adequately represents the fuzzy number (Zhao et al. 2013b). Several defuzzification methods are used: the centroid method, center of sums method, means of maximal method, alpha-cut method, and signed distance method, and each has its strengths and weaknesses (Klir and Yuan 1995). However, the centroid method is one of the most popular methods that have been widely applied for its several desirable properties: (1) the defuzzified values tend to move smoothly around the output fuzzy region, (2) it is relatively easy to calculate, and (3) it can be applied to both fuzzy and singleton output set geometries (Negnevitsky 2011).

## 3.6 CHAPTER SUMMARY

This chapter first introduced the research design of the study. Then two different research strategies, namely, structured interview and questionnaire survey, which have been employed to address different research objectives, are explained in details. Lastly, this chapter fully discussed the adopted data analysis techniques, such as factor analysis, partial least squares structural equation modeling, and fuzzy set theory.

# CHAPTER 4 INTERVIEWS & QUESTIONNAIRE SURVEY RESULTS

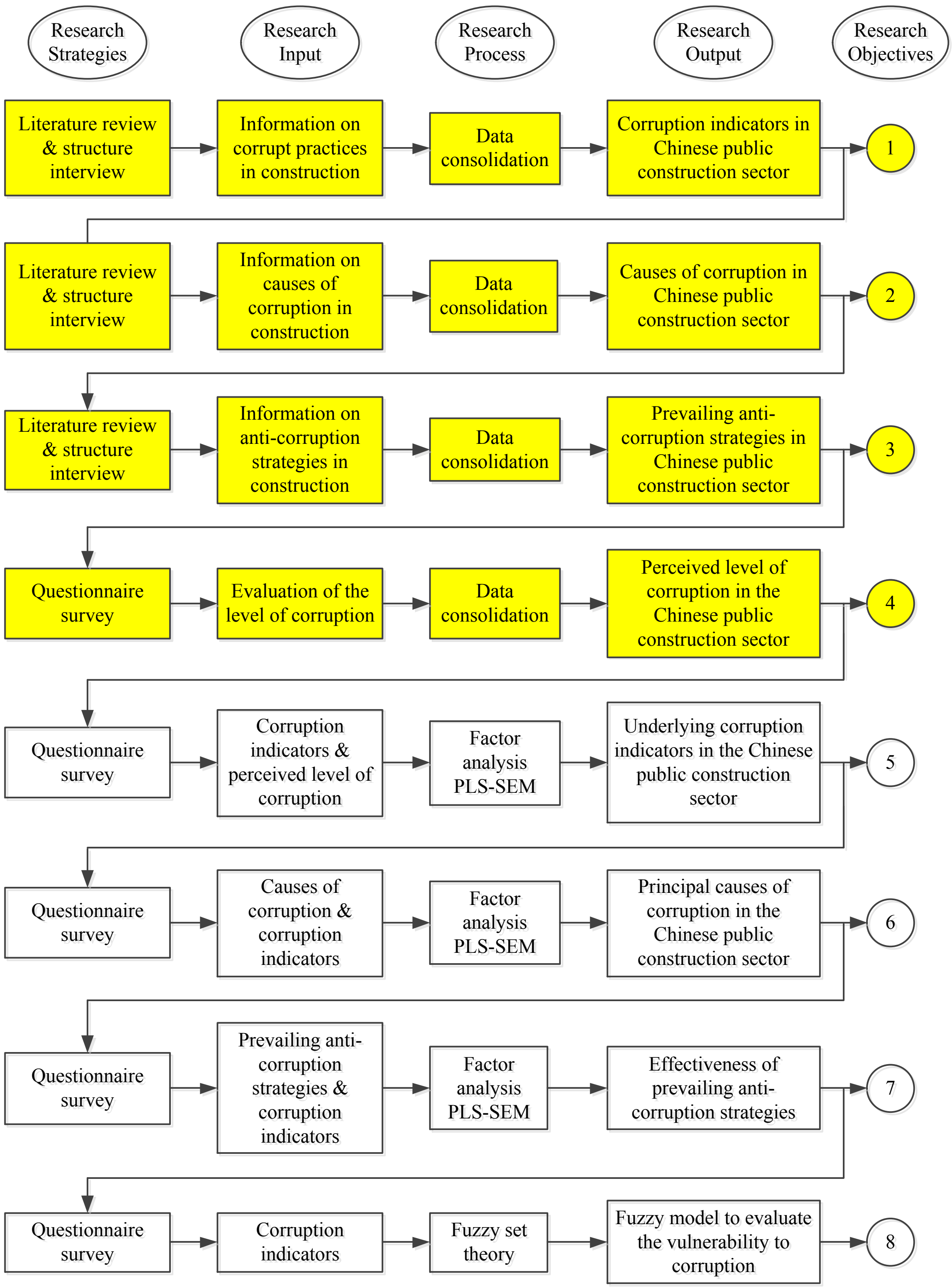



Figure 4.1 Overall flow of research

# CHAPTER 4 INTERVIEWS & QUESTIONNAIRE SURVEY RESULTS

## 4.1 INTRODUCTION

This chapter first presents the structured interview results, namely, the refined frameworks of corruption indicators, causes of corruption, and prevailing anti-corruption strategies. Then this chapter presents the data collected from the questionnaire survey, as well as its statistical analysis results. Lastly, this chapter presents the factor analysis results of the frameworks of corruption indicators, causes of corruption, and the prevailing anti-corruption strategies.

## 4.2 RESULTS OF STRUCTURED INTERVIEWS

### 4.2.1 Identification of Corruption Indicators

As indicated earlier in Section 3.3, the initial corruption indicators adopted in this study were derived from the questionnaire by Tabish and Jha (2011a). However, these indicators primarily refer to Indian public construction projects. To identify the corruption indicators in the context of China, a set of structured interviews with 14 experienced experts was conducted. These experts were invited to evaluate the applicability of each initial indicator of Tabish and Jha (2011a) in measuring the Chinese corruption vulnerability, through a five-point rating scale (i.e., 1 = very inapplicable, 2 = in applicable, 3 = medium, 4 =

applicable, and 5 = very applicable). The interviewees were also encouraged to supplement any corruption indicators that they had in mind but had not been included in the list.

Table 4.1 and Table 4.2 show the assessment provided by the interviewees, as well as the relevant statistical analysis results. The Cronbach‟s alpha coefficient of the data collected from the interviews was 0.920, which indicates good internal reliability among the interviewees (Santos 1999). The computed chi-square value ($x^2$) 533.559 is larger than the critical chi-square value 79.08, suggesting that the assessments of interviewees are consistent (Hon et al. 2012). In addition, the asymptotic significance value of each corruption indicator of Kruskal-Wallis test is larger than 0.05, indicating no significant differences among the evaluations of interviewees of different backgrounds (Hon et al. 2012).

Table 4.1 Interviewees‟ evaluations of initial corruption indicators derived from Tabish and Jha (2011a)

| No. | Initial corruption indicators derived from Tabish and Jha (2011a) | Evaluation | Kruskal-Wallis Asymp. Sig. |
|---|---|---|---|
| 1. | Administrative approval and financial sanction not taken to execute work | 2.79 | 0.245 |
| 2. | The provisions are not as per laid down yardstick | 3.86 | 0.156 |
| 3. | Work is not executed for the same purpose for which the sanction was accorded | 2.93 | 0.138 |
| 4. | Realistic technically sound estimates are not prepared | 2.43 | 0.750 |
| 5. | Some components are repeated in more than one item | 2.07 | 0.881 |

| No. | Initial corruption indicators derived from Tabish and Jha (2011a) | Evaluation | Kruskal-Wallis Asymp. Sig. |
|---|---|---|---|
| 6. | The consultant is not appointed after proper publicity and open competition | 3.64 | 0.283 |
| 7. | The credentials of all consultants have not been verified | 1.07 | 0.453 |
| 8. | The criteria adopted in prequalification of consultant are restrictive and benefit only few consultants | 3.43 | 0.341 |
| 9. | The offer of lowest consultant is ignored on flimsy grounds | 1.71 | 0.444 |
| 10. | The selection of consultant not done by appropriate authority | 3.57 | 0.345 |
| 11. | The role of consultant is not clearly defined | 2.36 | 0.788 |
| 12. | The provisions are not made for payment to consultant for part performance or repetitive work | 2.14 | 0.196 |
| 13. | The upper ceiling limit for payments to consultant is not fixed | 2.36 | 0.842 |
| 14. | The detailed project report is not prepared as per actual site requirement | 1.21 | 0.741 |
| 15. | Consultant does not submit performance guarantee in time | 1.00 | 1.000 |
| 16. | Performance guarantee submitted by consultant is not renewed from time to time | 1.07 | 0.453 |
| 17. | The reimbursement of service tax, excise duty, etc. is not done after obtaining the actual proof of depositing the same | 1.00 | 1.000 |
| 18. | The updated standard bidding document is not used for tendering process | 2.21 | 0.314 |
| 19. | The tender documents are not approved by competent authority | 1.64 | 0.566 |

| No. | Initial corruption indicators derived from Tabish and Jha (2011a) | Evaluation | Kruskal-Wallis Asymp. Sig. |
|---|---|---|---|
| 20. | Stipulated conditions in the contract are not feasible to be operated | 1.07 | 0.453 |
| 21. | The performance guarantee clause is not stipulated | 1.71 | 0.509 |
| 22. | The condition regarding splitting of quantities, if required, is not stipulated in the tender document | 2.14 | 0.290 |
| 23. | The nomenclature of the items, drawings and specifications do not conform to each other | 1.93 | 0.453 |
| 24. | Adequate & wide publicity is not given to tender | 2.71 | 0.475 |
| 25. | Adequate time for submission of tender/offer not given | 2.64 | 0.518 |
| 26. | Complete address of place of tender submission not notified | 1.00 | 1.000 |
| 27. | Documents for sale and opening of tender are not properly maintained in transparent manner | 1.93 | 0.577 |
| 28. | Unduly restrictive criteria stipulated, creating entry barrier for potential bidders | 2.07 | 0.453 |
| 29. | The objective evaluation criteria for contractor not clearly notified in the tender document | 1.50 | 0.234 |
| 30. | Prequalification criteria for selection of contractor are stringent | 3.00 | 0.351 |
| 31. | Prequalification criteria are not kept same during evaluation of bidders as notified | 1.79 | 0.158 |
| 32. | The evaluation criteria are not notified to the bidders | 2.21 | 0.608 |
| 33. | The prequalification is not carried out as per notified criteria | 2.43 | 0.426 |
| 34. | The credentials of the bidders are not matched and verified with the notified criteria | 1.14 | 0.577 |
| 35. | The evaluation of tenders is not done exactly as per the | 2.57 | 0.149 |

| No. | Initial corruption indicators derived from Tabish and Jha (2011a) | Evaluation | Kruskal-Wallis Asymp. Sig. |
|---|---|---|---|
| | notified criteria | | |
| 36. | The bids/tenders are not opened in presence of bidders | 1.07 | 0.453 |
| 37. | All corrections, omissions, insertions, overwriting are not attested and accounted for | 1.71 | 0.228 |
| 38. | „On the spot summary‟ is not prepared in tender opening register and signed by the person present | 1.00 | 1.000 |
| 39. | Decision on tender is not given by appropriate authority within validity period | 1.93 | 0.743 |
| 40. | Some items are deleted after opening of tender | 2.36 | 0.566 |
| 41. | The negotiation on tender not done as per laid down guidelines | 3.00 | 0.765 |
| 42. | The conditions/specifications are relaxed in favor of contractor to whom the work is being awarded | 3.50 | 0.138 |
| 43. | The offer of lowest bidder is ignored on flimsy grounds | 1.64 | 0.232 |
| 44. | The work order/supply order is not placed within justified rates | 2.71 | 0.145 |
| 45. | Work is executed without the availability of funds for the said purpose | 3.93 | 0.187 |
| 46. | The work is not executed as per original sanction accorded | 3.93 | 0.563 |
| 47. | The bank guarantees submitted by bidder not verified | 1.29 | 0.420 |
| 48. | Compliance with conditions regarding obtaining licenses, insurance policies and deployment of technical staff not being followed by contractor | 3.71 | 0.622 |
| 49. | The compliance with agreement conditions not fulfilled | 2.36 | 0.114 |
| 50. | All the mandatory tests not being carried out | 2.43 | 0.340 |
| 51. | Proper record of hindrances is not being maintained | 2.93 | 0.309 |

| No. | Initial corruption indicators derived from Tabish and Jha (2011a) | Evaluation | Kruskal-Wallis Asymp. Sig. |
|---|---|---|---|
| | from the beginning | | |
| 52. | The technical staff as per tender stipulation is not provided at site | 1.93 | 0.453 |
| 53. | Contractors are paid for that part of the work which was not done by them | 1.64 | 0.232 |
| 54. | Contractors are not paid for that part of the work which was done by them | 2.36 | 0.323 |
| 55. | All the recoveries as per contract are not effected | 2.14 | 0.252 |
| 56. | The deviations, especially in abnormally high rated and high value items are not properly monitored and verified | 3.29 | 0.679 |
| 57. | Duplicate payment for the same activity under two different items is released | 2.29 | 0.892 |
| 58. | Recoveries for the land rent or equipment given to contractor not effected | 1.00 | 1.000 |
| 59. | Recoveries for statutory taxes/duties not made before releasing payment | 1.00 | 1.000 |
| 60. | Escalation clause is not applied correctly for admissible payment | 3.57 | 0.136 |
| 61. | The required guarantees for water tightness of roof/ basements, etc. and termite proofing are not obtained | 1.36 | 0.144 |

Table 4.2 Reliability and consistency checking

| Statistical techniques | Value |
|---|---|
| Cronbach"s alpha coefficient ($a$) | 0.920 |
| Kendall"s coefficient of concordance ($W$) | 0.635 |
| Actual calculated chi-square value ($x^2$) | 533.559 |

| Statistical techniques | Value |
|---|---|
| Critical value of chi-square from table | 79.08 |
| Degree of freedom ($df$) | 60 |
| Asymptotic level of significance | 0.000 |

Based on the threshold of 2.5 points suggested by Hsueh et al. (2009), 19 out of 61 initial corruption indicators were finalized and considered applicable in measuring corruption in the Chinese public construction sector. Such a sharp trim rate, namely 68.9%, suggests an objective difference of corruption in the construction sectors of the two countries. To compare the research results obtained from the two countries, a simple comparison analysis was conducted. However, the comparison was mainly conducted based on the top 15 corruption indicators in Indian public construction sector because they are the only corruption indicators Tabish and Jha (2011a) had provided the evaluation results.

Comparison results (as shown in Table 4.3) indicate only four overlapped corruption indicator between the top 15 corruption indicators in India and the identified corruption indicators in the context of Chinese public construction sector. Such a result also proves a significant difference of corruption issue in the construction sectors of the two countries. What is noteworthy is that the majority of the top 15 corruption indicators in India refer to the rude violation of legal regulations in the public construction sector, indicating the extremely severe corruption situation in the country. The detailed analysis of the corruption indicators in the Chinese public constructions sector would be discussed in Chapter 5.

Table 4.3 Comparison of corruption indicators in India and China

| Ranking in India | Corruption indicator | Ranking in China |
|---|---|---|
| 1 | Realistic technically sound estimates are not prepared | Trimmed down |
| 2 | The consultant is not appointed after proper publicity and open competition | 5 |
| 3 | The provisions are not made for payment to consultant for part performance or repetitive work | Trimmed down |
| 4 | Compliance with conditions regarding obtaining licences, insurance policies and deployment of technical staff not being followed by contractor | 4 |
| 5 | The upper ceiling for payments to consultant is not fixed | Trimmed down |
| 6 | The compliance with agreement conditions not fulfilled | Trimmed down |
| 7 | The role of consultant is not clearly defined | Trimmed down |
| 8 | All the mandatory tests not being carried out | Trimmed down |
| 9 | The proper record of hindrances is not being maintained from the beginning | 13 |
| 10 | The detailed project report (DPR) is not prepared as per actual site requirement | Trimmed down |
| 11 | The credentials of all consultants have not been verified | Trimmed |

| **Ranking in India** | **Corruption indicator** | **Ranking in China** |
|---|---|---|
| | | down |
| 12 | „On the spot summary‟ is not prepared in tender opening register | Trimmed down |
| 13 | Adequate & wide publicity not given to tender | 16 |
| 14 | The prequalification is not carried out as per notified criteria | Trimmed down |
| 15 | The technical staff as per tender stipulation not deployed at site | Trimmed down |

Except for the 19 corruption indicaotrs derived from Tabish and Jha‟s (2011a) framework, five additional corruption indicators were also supplemented by the interviewees, as shown in Table 4.4. Thus, a total of 24 corruption indicators were identified via the structured interviews, as shown in Table 4.5.

Table 4.4 Corruption indicators supplemented by the interviewees

| No. | Supplemented corruption indicators | Interviewee | | | | | | | | | | | | | | Evaluation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **A** | **B** | **C** | **D** | **E** | **F** | **G** | **H** | **I** | **J** | **K** | **L** | **M** | **N** | |
| 1. | A large project should have called for bids is split into several small projects and contracted without bidding | | | | √ | √ | √ | | √ | | √ | √ | √ | | √ | 3.40 |
| 2. | Bidding documents submitted do not match the real condition of the contractor | √ | √ | √ | | | | √ | √ | | √ | | √ | √ | | 3.96 |
| 3. | Supervision on the project construction is not adequate | | √ | √ | √ | √ | | | | √ | √ | | √ | √ | √ | 3.91 |
| 4. | Confidential information of bidding is disclosed to a specific bidder | √ | | | √ | | | √ | | √ | | √ | √ | | √ | 3.76 |
| 5. | Substitution of unqualified materials in construction | √ | √ | | √ | √ | | | | √ | √ | √ | √ | √ | √ | 3.54 |

Table 4.5 Identified corruption indicators

| Code | Corruption indicators (CIs) |
|---|---|
| **CI1** | Administrative approval and financial sanction not taken to execute the work |
| **CI2** | The provisions are not as per laid down yardstick |
| **CI3** | Work is not executed for the same purpose for which the sanction was accorded |
| **CI4** | The consultant is not appointed after proper publicity and open competition |
| **CI5** | The criteria adopted in prequalification of consultant are restrictive and benefit only few consultants |
| **CI6** | The selection of consultant not done by appropriate authority |
| **CI7** | Adequate & wide publicity is not given to tender |
| **CI8** | Adequate time for submission of tender/offer not given |
| **CI9** | Prequalification criteria for selection of contractor are stringent |
| **CI10** | The evaluation of tenders is not done exactly as per the notified criteria |
| **CI11** | The negotiation on tender not done as per laid down guidelines |
| **CI12** | The conditions/specifications are relaxed in favor of contractor to whom the work is being awarded |
| **CI13** | The work order/supply order is not placed within justified rates |
| **CI14** | Work is executed without the availability of funds for the said purpose |
| **CI15** | The work is not executed as per original sanction accorded |
| **CI16** | Compliance with conditions regarding obtaining licenses, insurance policies and deployment of technical staff not being followed by contractor |
| **CI17** | The proper record of hindrances is not being maintained from the beginning |
| **CI18** | The deviations, especially in abnormally high rated and high value items are not properly monitored and verified |
| **CI19** | Escalation clause is not applied correctly for admissible payment |
| **CI20** | A large project should have called for bids is split into several small projects and contracted without bidding |
| **CI21** | Contractors provide false certificates in bidding |

| Code | Corruption indicators (CIs) |
|---|---|
| **CI22** | Confidential information of bidding is disclosed to a specific bidder |
| **CI23** | Substitution of unqualified materials in construction |
| **CI24** | Site supervisor neglects his duties for taking bribe from contractor |

### 4.2.2 Identification of Causes of Corruption

As mentioned in Section 2.4.2, on the basis of the systematic literature review, ten initial causes of corruption were identified. These initial causes were refined in the Chinese context through structured interviews. The interviewees were requested to provide their endorsement on the initial causes based on a five-point rating system (i.e., 1 = very disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = very agree). The interviewees were also encouraged to supplement any causes that they had in mind but had not been included in the list.

Table 4.6 and Table 4.7 show the evaluation results of ten initial causes of corruption and the relevant statistical analysis results. The Cronbach‟s alpha coefficient of the data collected from the interviews was 0.727, indicating a marginal but acceptable consistency or reliability among the interviewees‟ responses (Santos 1999). The computed chi-square value ($x^2$) 56.610 is larger than the critical chi-square value 18.31, suggesting that the assessments of interviewees are consistent (Hon et al. 2012). In addition, the asymptotic significance value of each initial cause in the Kruskal-Wallis test is larger than

0.05, indicating no significant differences among the interviewees that have different backgrounds (Hon et al. 2012).

According to Table 4.6, the initial cause of the low wage level was excluded due to an evaluation score below 2.5. This result indicates that the interviewees did not consider low wage level as a cause of corruption in construction. An additional cause of corruption, interpersonal connections, was suggested by interviewees (Table 4.8). Interviewees stated that interpersonal connections, such as relatives, friends, and colleagues may push industry practitioners who could have been incorrupt to perform corrupt practices passively. Thus, ten causes of corruption in the Chinese public construction sector were identified via the structured interviews (Table 4.9).

Table 4.6 Interviewees‟ evaluations of the initial causes of corruption

| No. | Initial causes of corruption | Evaluation | Kruskal-Wallis Asymp. Sig. |
|---|---|---|---|
| 1 | Multifarious licenses or permits | 4.50 | 0.684 |
| 2 | Deficiencies in rules and laws | 3.93 | 0.577 |
| 3 | Excessive competition in the construction market | 3.29 | 0.158 |
| 4 | Lack of rigorous supervision | 3.50 | 0.821 |
| 5 | Low wage level | 2.21 | 0.446 |
| 6 | Inadequate sanctions | 3.07 | 0.703 |
| 7 | Poor professional ethical standards | 3.57 | 0.169 |
| 8 | Negative leader roles | 3.79 | 0.607 |
| 9 | Over-close relationships among contracting | 3.36 | 0.305 |

| No. | Initial causes of corruption | Evaluation | Kruskal-Wallis Asymp. Sig. |
|---|---|---|---|
| | parties | | |
| 10 | Great project complexity | 3.21 | 0.372 |

Table 4.7 Reliability and consistency checking

| Statistical techniques | Value |
|---|---|
| Cronbach‟s alpha coefficient ($a$) | 0.727 |
| Kendall‟s coefficient of concordance ($W$) | 0.404 |
| Actual calculated chi-square value ($x^2$) | 56.610 |
| Critical value of chi-square from table | 18.31 |
| Degree of freedom ($df$) | 10 |
| Asymptotic level of significance | 0.000 |

Table 4.8 Added causes of corruption

| Item | Interviewee | | | | | | | | | | | | | | Evaluation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | |
| Interpersonal connections | | | | √ | √ | √ | | √ | | √ | √ | √ | | √ | 3.96 |

Table 4.9 Identified causes of corruption

| Code | Causes of corruption (COC) |
|---|---|
| COC1 | Multifarious licenses or permits |
| COC2 | Deficiencies in rules and laws |
| COC3 | Excessive competition in the construction market |
| COC4 | Lack of rigorous supervision |
| COC5 | Inadequate sanctions |
| COC6 | Poor professional ethical standards |
| COC7 | Negative leader roles |

| Code | Causes of corruption (COC) |
|---|---|
| COC8 | Over-close relationships among contracting parties |
| COC9 | Great project complexity |
| COC10 | Interpersonal connections |

### 4.2.3 Identification of the Prevailing Anti-Corruption Strategies

As have been mentioned in Section 2.4.4, ten prevailing anti-corruption strategies in the Chinese public construction sector were collected from the systematic literature review. The strategies were refined by the same 14 interviewees. The interviewees were requested to evaluate the effectiveness of these strategies using a five-point rating system (i.e., 1 = very ineffective, 2 = ineffective, 3 = medium, 4 = effective, and 5 = very effective). The interviewees were also encouraged to supplement any strategies that had not been included in the list.

Table 4.10 and Table 4.11 show the evaluation results of the ten anti-corruption strategies and the relevant statistical analysis results. The Cronbach‟s alpha coefficient of the data collected from the interviews is 0.710, indicating a marginal but acceptable reliability among the interviewees‟ responses (Santos 1999). The computed chi-square value ($x^2$) 45.851 is larger than the critical chi-square value 16.92, suggesting that the assessments of interviewees are consistent (Hon et al. 2012). In addition, the asymptotic significance value of each strategy in the Kruskal-Wallis test is larger than 0.05, indicating no significant differences among the interviewees of different backgrounds (Hon et al. 2012).

According to Table 4.10, the strategy raising wage level scores below 2.5 and is thus removed from the list of prevailing anti-corruption strategies. This result is consistent with the findings obtained in Section 4.2.2. Thus, nine prevailing anti-corruption strategies in the Chinese public construction sector are finalized via the interviews, as shown in Table 4.12.

Table 4.10 Interviewees‟ evaluations of prevailing anti-corruption strategies

| No. | Anti-corruption strategy | Evaluation | Kruscal-Wallis Asymp. Sig. |
|---|---|---|---|
| 1 | Positive Leadership | 3.93 | 0.511 |
| 2 | A completed legal framework | 4.29 | 0.996 |
| 3 | Sound systems | 3.93 | 0.430 |
| 4 | A rigorous execution of laws, rules, and systems | 4.21 | 0.446 |
| 5 | Transparency | 3.79 | 0.269 |
| 6 | Raising wage level | 2.14 | 0.269 |
| 7 | Education and training | 2.71 | 0.773 |
| 8 | Administrative sanction | 3.64 | 0.538 |
| 9 | Economic sanction | 3.64 | 0.710 |
| 10 | Penal sanction | 4.21 | 0.876 |

Table 4.11 Reliability and consistency checking

| Statistical techniques | Value |
|---|---|
| Cronbach‟s alpha coefficient (*a*) | 0.710 |
| Kendall‟s coefficient of concordance (*W*) | 0.364 |

| Statistical techniques | Value |
|---|---|
| Actual calculated chi-square value ($x^2$) | 45.851 |
| Critical value of chi-square from table | 16.92 |
| Degree of freedom (*df* ) | 9 |
| Asymptotic level of significance | 0.000 |

Table 4.12 Identified prevailing anti-corruption strategies

| No. | Anti-corruption strategy |
|---|---|
| 1 | Positive Leadership |
| 2 | A completed legal framework |
| 3 | Sound systems |
| 4 | A rigorous execution of laws, rules, and systems |
| 5 | Transparency |
| 6 | Education and training |
| 7 | Administrative sanction |
| 8 | Economic sanction |
| 9 | Penal sanction |

In addition, the nine identified prevailing anti-corruption strategies could be congenitally categorized into four constructs, as shown in Table 4.13, which is in line with Tabish and Jha"s (2012) finding. Therefore, the framework of Tabish and Jha (2012) was adopted in this study to measure the Chinese anti-corruption strategies. The reasons for using the framework of Tabish and Jha (2012) instead of developing a new framework have been discussed previously in Section 3.3.

The framework of Tabish and Jha (2012) consists of four constructs, namely, leadership, rules and regulations, training, and sanctions. Tabish and Jha (2012) also developed 17 items to measure the four constructs. Table 4.14 shows the details of the framework.

Table 4.13 Categorization of nine identified anti-corruption strategies

| No. | Anti-corruption strategy | Category |
|---|---|---|
| 1 | Positive Leadership | Leadership |
| 2 | A completed legal framework | Rules and regulations |
| 3 | Sound systems | |
| 4 | A rigorous execution of laws, rules, and systems | |
| 5 | Transparency | |
| 6 | Education and training | Training |
| 7 | Administrative sanction | Sanctions |
| 8 | Economic sanction | |
| 9 | Penal sanction | |

Table 4.14 The framework measuring anti-corruption strategies

| Code | Anti-corruption strategy | Construct |
|---|---|---|
| ACS1 | I clearly consider anticorruption measures to be equally as important as construction | Leadership |
| ACS2 | I act positively and cooperate with anticorruption agencies | |
| ACS3 | I act decisively when an anticorruption issue is raised | |
| ACS4 | I praise staff members for working honestly | |
| ACS5 | We often remind each other on how to work fairly and honestly | |
| ACS6 | As a group we maintain good working relationship and offer help when needed to perform job honestly | |
| ACS7 | As a group we maintain corruption free workplace environment | |

| Code | Anti-corruption strategy | Construct |
|---|---|---|
| ACS8 | I believe that anticorruption rules and regulations are adequate source of information on anticorruption | Rules and regulations |
| ACS9 | I believe that anticorruption rules and regulations are there to protect me from vigilance cases/ disciplinary action | |
| ACS10 | I believe that anticorruption rules and regulation should be consulted by all recruits | |
| ACS11 | I believe that anticorruption rules and regulations do not put rigid restriction in the adoption of new products and technological processes | |
| ACS12 | I believe adequate training is necessary to perform my job honestly | Training |
| ACS13 | I believe adequate training help me in taking action to prevent corruption | |
| ACS14 | I believe adequate training helps me to prevent workplace corrupt practices and help me to follow fair and transparent practices | |
| ACS15 | I recognize I have complied with the anticorruption measures like rules and regulations etc of my job for fear of administrative sanction from my boss | Sanctions |
| ACS16 | I recognize I have complied with the anticorruption measures like rules and regulations etc of my job for fear of economic sanction | |
| ACS17 | I recognize I have complied with the anticorruption measures like rules and regulations etc of my job for fear of penal sanction | |

Source: Tabish and Jha (2012)

## 4.3 RESULTS OF QUESTIONNAIRE SURVEY

### 4.3.1 Survey Response and Sample Demographic Characteristics

The questionnaire, as introduced in Section 3.4.2, was distributed via three channels between September and October 2013. First, an online version of the questionnaire was delivered to the staff of eight organizations that promised to support this study. Second, hard copies of the questionnaire were distributed in an industry forum held in September, 2013, in Shanghai, China. Selected qualified attendants of this forum were invited to participate in this survey. Third, field surveys were performed in sites of three public construction projects in Shanghai, Jinan (i.e., the capital city of Shandong Province in eastern China), and Zhengzhou (i.e., the capital city of Henan Province in central China), respectively.

At the end, 216 replies were received. Due to incomplete information, 28 replies were regarded as invalid and excluded. Thus, 188 valid replies were obtained in this study. Among the 188 valid replies, 87 were from the online survey, 20 from the industry forum, and 81 from the field survey. Sample demographic characteristics are introduced, as detailed below.

Figure 4.2 shows that the majority of respondents were consultants (46 replies), contractors (43 replies), and clients (43 replies). Additionally, 26 replies were collected from designers, 20 replies were collected from respondents working for the government, and ten replies were collected from academicians from research institutions. This distribution of occupations of respondents basically matches the constitutions of professionals related to the Chinese construction industry.

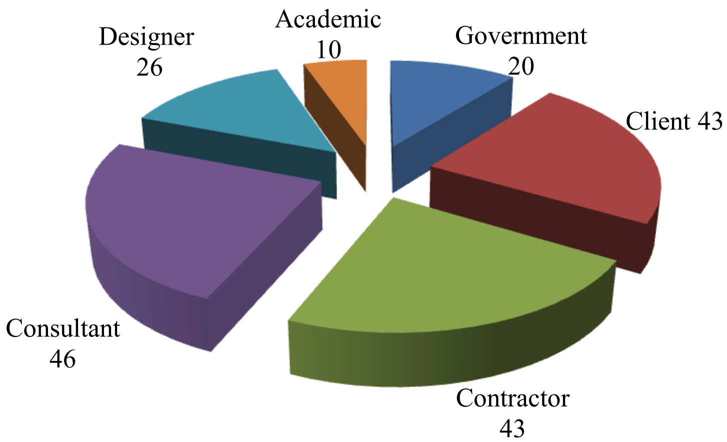



Figure 4.2 Occupations of respondents

Figure 4.3 shows that 49 respondents were in top management posts such as president, general manager, and professor. A total of 88 respondents were in middle management positions such as director, project manager, and associate professor. A total of 51 respondents were working as technical professionals such as civil engineer, quantity surveyor, and junior academicians like assistant professor and lecturer. In this study, nearly 73 percent of respondents were in middle management or above in their organizations, which suggests a high quality panel of respondents.

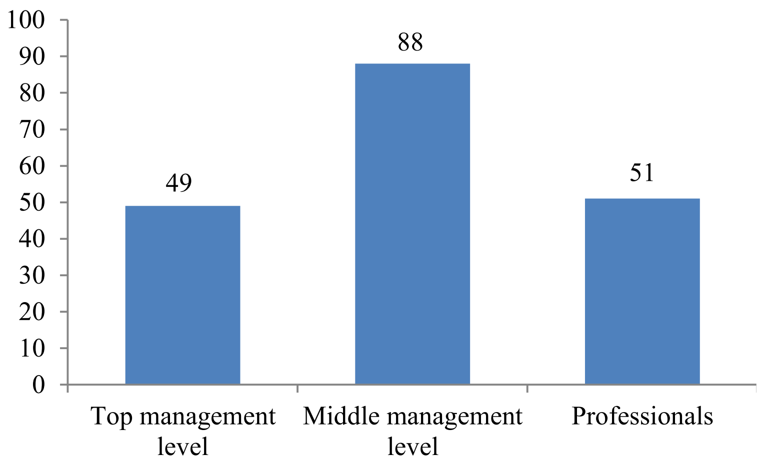



Figure 4.3 Positions of respondents

Years of working experience of respondents (Figure 4.4) can be summarized as: 74% with from 6 to over 20 years" experience, and 26% with less than 5 years" experience. This proportion indicates that these respondents had good experience and were able to provide sensible answers.

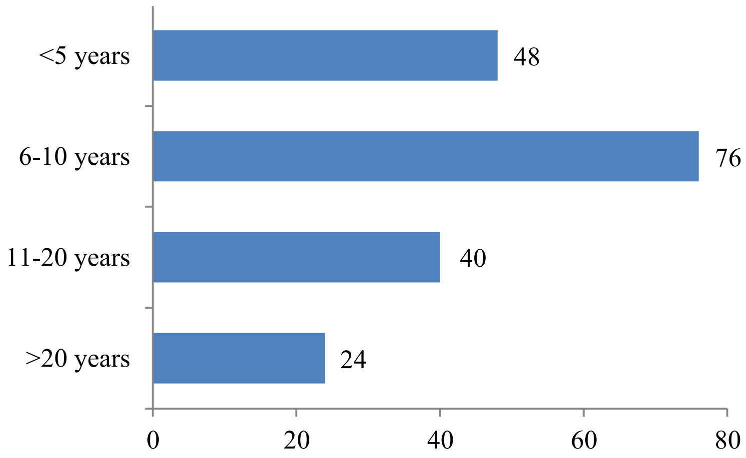



Figure 4.4 Years of working experience of respondents

China is a large developing country with uneven development (Wei 2013). For instance, eastern areas of China have a more developed economy than northeastern, central, and western areas (National Bureau of Statistics of China

2012). Considering the possible difference in managing public construction projects in such different areas, respondents‟ work locations in the past three years were also inquired into in the questionnaire design. Figure 4.5 shows that, in the past three years, 63 respondents worked in eastern China, 55 respondents worked in central China, 37 respondents worked in western China, and 33 respondents worked in northeastern China. This distribution of sampling proportion also ensures that the findings derived from the survey cover all variations across the country.

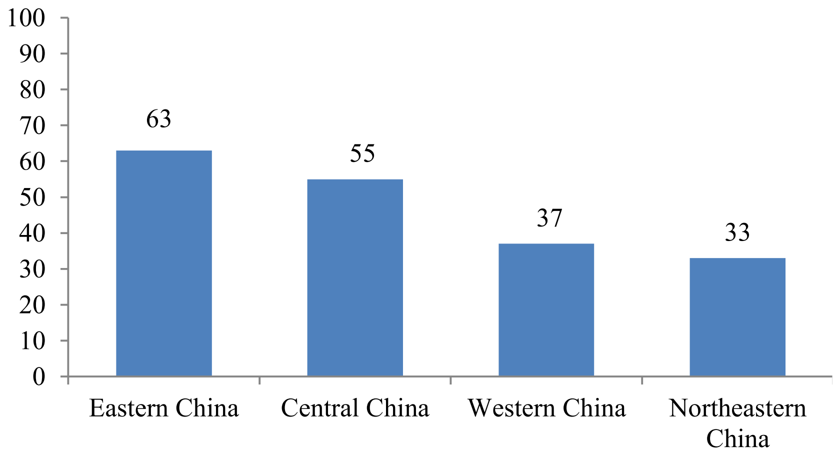



Figure 4.5 Working places of respondents in the past three years

### 4.3.2 Data Examination

A series of statistical analysis tests were conducted on the collected data before they were further analyzed. The below sections introduce the process of data examination.

#### 4.3.2.1 Reliability Checking

Reliability refers to the property of a measurement instrument that similar results are given for similar inputs, which means that if a survey is repeated using the same instrument, similar results can be obtained (Landis and Koch 1977). This study uses Cronbach‟s alpha, the most common technique that has been applied to measure the reliability of data collected from the questionnaire survey (Spiliotopoulou 2009). According to Netemeyer et al. (2003) and Stone (1978), a Cronbach‟s coefficient alpha less than 0.7 is questionable, between 0.7 and 0.8 is marginal, and between 0.8 and 1.0 is acceptable.

Table 4.15 shows the reliability checking results of data. Cronbach‟s alpha values of 0.902, 0.785, and 0.884 were obtained from the perceptions of the respondents on corruption indicators, causes of corruption, and the prevailing anti-corruption strategies, respectively. These results indicate acceptable to high levels of internal consistency reliability among the respondents (Stone 1978; Netemeyer et al. 2003).

Table 4.15 Reliability checking on data collected from questionnaire survey

| Measured object | Number of items | Cronbach's alpha | Level of acceptance |
|---|---|---|---|
| Risk factors to corruption | 24 | 0.902 | High |
| Causes of corruption | 11 | 0.785 | Marginal |
| Anti-corruption strategies | 17 | 0.884 | Acceptable |

#### 4.3.2.2 Standard Deviation and Standard Errors of Means

Standard deviation, in any analysis, is used to measure how well the mean represents the observed data; whereas the standard error of the mean is an indication of how well a particular sample represents the respondents (Field 2009). The cases with scores more than three standard deviations beyond the mean should be considered outliers and dropped, because they cause data to be skewed and non-normally distributed (Kline 2010). A large standard deviation indicates that the score cluster is more widely around the mean and, as a result, the mean is not the right representation of the data. On the contrary, a small standard deviation indicates fewer dispersed data points about the mean, which adequately represents the data. Table 4.16 shows that the standard deviation values of data are relatively small. Thus, using the mean value as a representative score for the data is appropriate.

The standard error is the variability of the sample mean. A large standard error indicates considerable variation between the means of the different samples, which suggests that the samples are a poor representative of the respondents. By contrast, a small standard error represents a situation in which most sample means are similar to the means provided by all the respondents. The sample is then an accurate reflection of the population (Field 2009). Table 4.16 shows that the standard error values of all the observed variables contained in the questionnaire are trivial compared with the actual means. Thus, the sample used throughout this study is sufficiently representative of the population.

#### 4.3.2.3 ANOVA Test of Data

This study involved a wide range of respondents, in terms of their occupations (e.g., governmental official, client, contractor, consultant, designer, and academic), positions (e.g., top management, middle management, and professionals), years of working experience (e.g., below 5 years, between 6 and 10 years, between 11 and 20 years, and above 20 years), and working places (e.g., eastern China, central China, western China, and northeastern China). Each respondent may have a different point of view. This diversity is expected to be present in the rating of observed variables of the questionnaire. Therefore, one-way analysis of variance (ANOVA) was employed to test whether the differences in the opinions of the respondents from different subgroups are statistically significant and meaningful (Bewick et al. 2004).

A key assumption of conducting an ANOVA test is that the data must be normally distributed. Thus, the assessment of data normality was conducted. The most common statistical test for data normality is based on skewness (a measure of symmetry) and kurtosis (a measure of the peakedness) values (Hair et al. 2010). For a distribution to be considered normal, both the skewness and kurtosis values should be between +2.58 and -2.58 (Hair et al. 2010). Table 4.16 shows that all the skewness and kurtosis values of the observed variables are between +2.58 and -2.58, suggesting that the data collected from the questionnaire survey are normally distributed.

Table 4.16 Descriptive statistics of the observed variables

| Item | Mean | Skewness | Kurtosis | Standard deviation | Standard error of the mean |
|---|---|---|---|---|---|
| CI1 | 2.83 | 0.275 | -0.084 | 0.727 | 0.053 |
| CI2 | 3.29 | -0.231 | 0.383 | 0.710 | 0.052 |
| CI3 | 2.77 | 0.083 | -0.579 | 0.684 | 0.050 |
| CI4 | 3.27 | -0.109 | 0.053 | 0.796 | 0.058 |
| CI5 | 3.08 | -0.120 | -0.004 | 0.680 | 0.050 |
| CI6 | 2.97 | -0.291 | .022 | 0.698 | 0.051 |
| CI7 | 2.84 | -0.058 | -0.182 | 0.838 | 0.061 |
| CI8 | 2.82 | -0.014 | -0.144 | 0.793 | 0.058 |
| CI9 | 3.23 | -0.157 | 0.310 | 0.726 | 0.053 |
| CI10 | 2.90 | -0.127 | -0.051 | 0.734 | 0.054 |
| CI11 | 2.72 | 0.205 | -0.147 | 0.785 | 0.057 |
| CI12 | 3.15 | 0.003 | 0.532 | 0.688 | 0.050 |
| CI13 | 3.28 | 0.074 | -0.392 | 0.777 | 0.057 |
| CI14 | 3.05 | -0.002 | 0.215 | 0.757 | 0.055 |
| CI15 | 3.27 | -0.295 | -0.337 | 0.885 | 0.065 |
| CI16 | 3.31 | -0.087 | -0.366 | 0.793 | 0.058 |
| CI17 | 3.71 | -0.431 | 0.544 | 0.735 | 0.054 |
| CI18 | 3.51 | -0.398 | 0.055 | 0.747 | 0.055 |
| CI19 | 3.53 | -0.589 | 1.116 | 0.715 | 0.052 |
| CI20 | 3.05 | -0.373 | 0.855 | 0.670 | 0.049 |
| CI21 | 3.27 | -0.020 | -0.312 | 0.717 | 0.052 |
| CI22 | 3.14 | 0.119 | 0.726 | 0.656 | 0.048 |
| CI23 | 3.44 | -0.436 | 0.115 | 0.805 | 0.059 |

| Item | Mean | Skewness | Kurtosis | Standard deviation | Standard error of the mean |
|---|---|---|---|---|---|
| CI24 | 3.53 | -0.427 | 0.438 | 0.816 | 0.060 |
| COC1 | 3.84 | -0.700 | 0.550 | 0.859 | 0.063 |
| COC2 | 3.49 | -0.356 | -0.457 | 0.956 | 0.070 |
| COC3 | 3.37 | -0.392 | -0.343 | 0.991 | 0.072 |
| COC4 | 3.86 | -0.802 | 0.744 | 0.885 | 0.065 |
| COC5 | 3.84 | -0.348 | -0.704 | 0.913 | 0.067 |
| COC6 | 3.63 | -0.481 | -0.362 | 0.980 | 0.071 |
| COC7 | 3.82 | -0.321 | -0.177 | 0.838 | 0.061 |
| COC8 | 3.65 | -0.486 | -0.403 | 0.961 | 0.070 |
| COC9 | 3.59 | -0.330 | -0.401 | 0.889 | 0.065 |
| COC10 | 3.41 | -0.379 | -0.312 | 0.929 | 0.068 |
| ACS1 | 3.37 | -0.157 | -0.143 | 0.907 | 0.066 |
| ACS2 | 3.12 | -0.117 | -0.064 | 0.935 | 0.068 |
| ACS3 | 3.06 | 0.003 | -0.034 | 0.932 | 0.068 |
| ACS4 | 3.09 | -0.037 | -0.272 | 0.963 | 0.070 |
| ACS5 | 3.30 | -0.341 | -0.220 | 0.953 | 0.069 |
| ACS6 | 3.11 | -0.185 | -0.179 | 0.933 | 0.068 |
| ACS7 | 3.16 | -0.216 | -0.306 | 0.962 | 0.070 |
| ACS8 | 2.59 | 0.299 | -0.579 | 1.03 | 0.075 |
| ACS9 | 2.68 | 0.215 | -0.365 | 0.994 | 0.073 |
| ACS10 | 2.87 | 0.005 | -0.326 | 0.907 | 0.066 |
| ACS11 | 3.14 | -0.119 | -0.419 | 0.789 | 0.058 |
| ACS12 | 3.85 | -0.691 | 0.720 | 0.867 | 0.063 |
| ACS13 | 3.51 | -0.332 | 0.146 | 0.916 | 0.067 |
| ACS14 | 2.83 | -0.041 | -0.283 | 0.972 | 0.071 |
| ACS15 | 3.13 | -0.259 | -0.232 | 0.984 | 0.072 |
| ACS16 | 3.31 | -0.258 | -0.275 | 0.926 | 0.068 |
| ACS17 | 3.45 | -0.368 | -0.376 | 0.955 | 0.070 |

By convention, if ANOVA‟s F statistic is significant (i.e., significant value <0.05), it will lead to a significant difference in means among respondents who are being compared (Vasey and Thayer 1987). However, Cohen (1988) suggested that the effect size of the difference ($\eta^2$), which can be calculated by dividing the sum of squares between groups by the total sum of squares, should also be considered. Cohen (1988) further stated that if the effect size is not large (e.g., less than 0.14), then the significance between the means, as indicated by the F statistic, may be of little practical importance. The results of the ANOVA test (Tables 4.17 - 4.20) show that the data distribution of all the observed variables was not distorted significantly by the different opinions of the specific subgroups. Therefore, all the observed variables were retained in the data file for further analysis.

Table 4.17 ANOVA testing results for occupations of respondents

| **Item** | **Mean** | | | | | | ***F*** | **Sig.** | **$\eta^2$** |
|---|---|---|---|---|---|---|---|---|---|
| | **Client** | **Contr-actor** | **Consult-ant** | **Design-er** | **Gover-nment** | **Acad-emic** | | | |
| CI1 | 2.80 | 2.81 | 2.94 | 2.71 | 2.78 | 3.12 | 0.710 | 0.617 | 0.019 |
| CI2 | 3.24 | 3.39 | 3.39 | 2.95 | 3.38 | 3.40 | 1.776 | 0.120 | 0.047 |
| CI3 | 2.80 | 2.70 | 2.84 | 2.91 | 2.47 | 2.97 | 1.378 | 0.235 | 0.036 |
| CI4 | 3.21 | 3.23 | 3.35 | 3.09 | 3.40 | 3.56 | 0.785 | 0.562 | 0.021 |
| CI5 | 3.14 | 3.12 | 3.02 | 2.96 | 2.87 | 3.72 | 2.554 | 0.029 | 0.066 |
| CI6 | 3.09 | 2.93 | 2.89 | 2.83 | 3.01 | 3.25 | 0.932 | 0.462 | 0.025 |
| CI7 | 2.91 | 2.93 | 2.72 | 3.08 | 2.60 | 2.55 | 1.327 | 0.255 | 0.035 |
| CI8 | 3.10 | 2.63 | 2.70 | 2.93 | 2.62 | 3.05 | 2.402 | 0.039 | 0.062 |
| CI9 | 3.28 | 3.20 | 3.22 | 3.25 | 3.04 | 3.60 | 0.845 | 0.519 | 0.023 |

| Item | Mean | | | | | | $F$ | Sig. | $\eta^2$ |
|---|---|---|---|---|---|---|---|---|---|
| | Client | Contr-actor | Consult-ant | Design-er | Gover-nment | Acad-emic | | | |
| CI10 | 2.95 | 3.02 | 2.81 | 2.82 | 2.76 | 3.12 | 0.790 | 0.558 | 0.021 |
| CI11 | 2.78 | 2.61 | 2.94 | 2.67 | 2.43 | 2.65 | 1.514 | 0.187 | 0.040 |
| CI12 | 3.16 | 3.22 | 3.14 | 3.12 | 2.96 | 3.28 | 0.455 | 0.810 | 0.012 |
| CI13 | 3.12 | 3.60 | 3.21 | 3.12 | 3.24 | 3.50 | 2.368 | 0.041 | 0.061 |
| CI14 | 3.19 | 3.14 | 3.03 | 2.66 | 3.02 | 3.19 | 1.971 | 0.085 | 0.051 |
| CI15 | 3.58 | 3.01 | 3.36 | 3.02 | 3.31 | 3.19 | 2.417 | 0.038 | 0.062 |
| CI16 | 3.39 | 3.42 | 3.33 | 3.04 | 2.94 | 3.88 | 2.890 | 0.015 | 0.074 |
| CI17 | 3.50 | 3.93 | 3.71 | 3.66 | 3.71 | 3.81 | 1.556 | 0.175 | 0.041 |
| CI18 | 3.61 | 3.43 | 3.62 | 3.35 | 3.48 | 3.45 | 0.691 | 0.631 | 0.019 |
| CI19 | 3.70 | 3.34 | 3.53 | 3.43 | 3.51 | 3.87 | 1.668 | 0.144 | 0.044 |
| CI20 | 3.05 | 2.79 | 3.13 | 3.12 | 3.14 | 3.38 | 2.078 | 0.070 | 0.054 |
| CI21 | 3.22 | 3.19 | 3.35 | 3.22 | 3.38 | 3.40 | 0.443 | 0.818 | 0.012 |
| CI22 | 3.03 | 3.20 | 3.22 | 3.12 | 3.06 | 3.11 | 0.524 | 0.758 | 0.014 |
| CI23 | 3.54 | 3.08 | 3.59 | 3.44 | 3.47 | 3.75 | 2.531 | 0.030 | 0.065 |
| CI24 | 3.56 | 3.38 | 3.61 | 3.47 | 3.60 | 3.73 | 0.572 | 0.721 | 0.015 |
| COC1 | 3.98 | 3.95 | 3.78 | 3.81 | 3.55 | 3.60 | 1.029 | 0.402 | 0.027 |
| COC2 | 3.56 | 3.44 | 3.46 | 3.65 | 3.30 | 3.60 | 0.406 | 0.844 | 0.011 |
| COC3 | 3.53 | 3.28 | 3.35 | 3.35 | 3.45 | 3.00 | 0.616 | 0.688 | 0.017 |
| COC4 | 3.74 | 4.00 | 3.89 | 3.77 | 3.80 | 4.00 | 0.490 | 0.783 | 0.013 |
| COC5 | 3.67 | 4.09 | 3.78 | 3.77 | 3.85 | 3.80 | 1.015 | 0.411 | 0.027 |
| COC6 | 3.65 | 3.91 | 3.41 | 3.38 | 3.95 | 3.40 | 2.060 | 0.072 | 0.054 |
| COC7 | 3.81 | 3.95 | 3.74 | 3.54 | 3.90 | 4.30 | 1.610 | 0.159 | 0.042 |
| COC8 | 3.30 | 4.09 | 3.52 | 3.58 | 4.00 | 3.30 | 4.286 | 0.001 | 0.105 |
| COC9 | 3.49 | 3.58 | 3.67 | 3.62 | 3.80 | 3.10 | 1.031 | 0.401 | 0.028 |
| COC10 | 3.14 | 3.58 | 3.52 | 3.54 | 3.40 | 3.00 | 1.673 | 0.143 | 0.044 |
| ACS1 | 3.72 | 3.07 | 3.33 | 3.23 | 3.75 | 3.00 | 2.977 | 0.060 | 0.101 |
| ACS2 | 3.47 | 2.95 | 3.04 | 2.85 | 3.50 | 2.60 | 3.881 | 0.027 | 0.128 |

| Item | Mean | | | | | | $F$ | Sig. | $\eta^2$ |
|---|---|---|---|---|---|---|---|---|---|
| | Client | Contr-actor | Consult-ant | Design-er | Gover-nment | Acad-emic | | | |
| ACS3 | 3.37 | 2.84 | 2.98 | 2.92 | 3.45 | 2.60 | 3.309 | 0.044 | 0.111 |
| ACS4 | 3.33 | 2.95 | 3.00 | 3.08 | 3.25 | 2.80 | 0.505 | 0.606 | 0.019 |
| ACS5 | 3.47 | 3.14 | 3.35 | 3.12 | 3.45 | 3.30 | 0.460 | 0.634 | 0.017 |
| ACS6 | 3.30 | 3.00 | 3.09 | 3.12 | 3.15 | 2.80 | 0.397 | 0.674 | 0.015 |
| ACS7 | 3.44 | 2.98 | 3.15 | 2.92 | 3.40 | 2.90 | 1.435 | 0.247 | 0.051 |
| ACS8 | 2.79 | 2.35 | 2.54 | 2.65 | 2.85 | 2.30 | 0.884 | 0.419 | 0.032 |
| ACS9 | 2.91 | 2.60 | 2.74 | 2.54 | 2.55 | 2.40 | 0.084 | 0.920 | 0.003 |
| ACS10 | 3.19 | 2.58 | 2.80 | 2.81 | 3.25 | 2.40 | 3.785 | 0.029 | 0.125 |
| ACS11 | 3.21 | 3.07 | 3.20 | 3.00 | 3.20 | 3.10 | 0.399 | 0.673 | 0.015 |
| ACS12 | 3.93 | 3.72 | 3.91 | 3.69 | 4.00 | 3.80 | 0.580 | 0.563 | 0.021 |
| ACS13 | 3.51 | 3.51 | 3.59 | 3.31 | 3.55 | 3.50 | 0.338 | 0.715 | 0.013 |
| ACS14 | 2.95 | 2.86 | 2.76 | 2.88 | 2.85 | 2.30 | 1.639 | 0.204 | 0.058 |
| ACS15 | 3.47 | 2.95 | 3.07 | 2.92 | 3.35 | 2.80 | 1.712 | 0.190 | 0.061 |
| ACS16 | 3.56 | 3.07 | 3.35 | 3.15 | 3.55 | 3.10 | 1.135 | 0.329 | 0.041 |
| ACS17 | 3.56 | 3.30 | 3.57 | 3.12 | 3.90 | 3.00 | 4.554 | 0.015 | 0.137 |

Table 4.18 ANOVA testing results for management levels of respondents

| Item | Mean | | | $F$ | Sig. | $\eta^2$ |
|---|---|---|---|---|---|---|
| | Top management level | Middle management level | Professionals | | | |
| CI1 | 2.69 | 2.86 | 2.96 | 1.828 | 0.164 | 0.019 |
| CI2 | 3.23 | 3.24 | 3.43 | 1.391 | 0.251 | 0.015 |
| CI3 | 2.74 | 2.82 | 2.73 | 0.381 | 0.683 | 0.004 |
| CI4 | 3.28 | 3.19 | 3.40 | 1.063 | 0.347 | 0.011 |
| CI5 | 3.15 | 3.04 | 3.10 | 0.439 | 0.646 | 0.005 |
| CI6 | 2.99 | 2.96 | 2.97 | 0.026 | 0.975 | 0.000 |

| Item | Mean | | | $F$ | Sig. | $\eta^2$ |
|---|---|---|---|---|---|---|
| | Top management level | Middle management level | Professionals | | | |
| CI7 | 2.68 | 2.94 | 2.80 | 1.581 | 0.208 | 0.017 |
| CI8 | 2.67 | 2.91 | 2.82 | 1.468 | 0.233 | 0.016 |
| CI9 | 3.27 | 3.18 | 3.30 | 0.544 | 0.582 | 0.006 |
| CI10 | 2.80 | 2.96 | 2.89 | 0.778 | 0.461 | 0.008 |
| CI11 | 2.64 | 2.78 | 2.69 | 0.508 | 0.603 | 0.005 |
| CI12 | 3.23 | 3.15 | 3.07 | 0.674 | 0.511 | 0.007 |
| CI13 | 3.36 | 3.26 | 3.24 | 0.365 | 0.695 | 0.004 |
| CI14 | 3.00 | 3.06 | 3.08 | 0.162 | 0.851 | 0.002 |
| CI15 | 3.39 | 3.24 | 3.20 | 0.626 | 0.536 | 0.007 |
| CI16 | 3.37 | 3.29 | 3.31 | 0.174 | 0.841 | 0.002 |
| CI17 | 3.71 | 3.73 | 3.67 | 0.113 | 0.893 | 0.001 |
| CI18 | 3.47 | 3.57 | 3.45 | 0.540 | 0.584 | 0.006 |
| CI19 | 3.57 | 3.52 | 3.50 | 0.122 | 0.885 | 0.001 |
| CI20 | 3.05 | 3.04 | 3.06 | 0.018 | 0.982 | 0.000 |
| CI21 | 3.42 | 3.24 | 3.17 | 1.763 | 0.174 | 0.019 |
| CI22 | 3.03 | 3.18 | 3.16 | 0.973 | 0.380 | 0.010 |
| CI23 | 3.47 | 3.36 | 3.53 | 0.702 | 0.497 | 0.008 |
| CI24 | 3.69 | 3.51 | 3.41 | 1.595 | 0.206 | 0.017 |
| COC1 | 3.84 | 3.93 | 3.67 | 1.548 | 0.215 | 0.016 |
| COC2 | 3.35 | 3.60 | 3.45 | 1.198 | 0.304 | 0.013 |
| COC3 | 3.33 | 3.44 | 3.27 | 0.520 | 0.595 | 0.006 |
| COC4 | 3.76 | 3.93 | 3.84 | 0.641 | 0.528 | 0.007 |
| COC5 | 3.86 | 3.94 | 3.63 | 1.970 | 0.142 | 0.021 |
| COC6 | 3.82 | 3.58 | 3.55 | 1.177 | 0.310 | 0.013 |
| COC7 | 3.90 | 3.84 | 3.73 | 0.559 | 0.573 | 0.006 |
| COC8 | 4.02 | 3.57 | 3.43 | 5.530 | 0.005 | 0.056 |

| Item | Mean | | | $F$ | Sig. | $\eta^2$ |
|---|---|---|---|---|---|---|
| | Top management level | Middle management level | Professionals | | | |
| COC9 | 3.59 | 3.58 | 3.59 | 0.003 | 0.997 | 0.000 |
| COC10 | 3.57 | 3.31 | 3.43 | 1.300 | 0.275 | 0.014 |
| ACS1 | 3.16 | 3.48 | 3.39 | 1.920 | 0.149 | 0.020 |
| ACS2 | 2.98 | 3.28 | 2.96 | 2.695 | 0.070 | 0.028 |
| ACS3 | 2.82 | 3.18 | 3.08 | 2.476 | 0.087 | 0.026 |
| ACS4 | 3.02 | 3.19 | 2.98 | 0.963 | 0.384 | 0.010 |
| ACS5 | 3.31 | 3.32 | 3.27 | 0.034 | 0.967 | 0.000 |
| ACS6 | 2.96 | 3.19 | 3.12 | 0.992 | 0.373 | 0.011 |
| ACS7 | 2.96 | 3.20 | 3.27 | 1.531 | 0.219 | 0.016 |
| ACS8 | 2.63 | 2.58 | 2.57 | 0.057 | 0.945 | 0.001 |
| ACS9 | 2.69 | 2.67 | 2.69 | 0.010 | 0.990 | 0.000 |
| ACS10 | 2.82 | 2.90 | 2.86 | 0.126 | 0.881 | 0.001 |
| ACS11 | 3.12 | 3.13 | 3.18 | 0.081 | 0.922 | 0.001 |
| ACS12 | 3.92 | 3.84 | 3.78 | 0.299 | 0.742 | 0.003 |
| ACS13 | 3.47 | 3.60 | 3.37 | 1.067 | 0.346 | 0.011 |
| ACS14 | 2.86 | 2.85 | 2.76 | 0.156 | 0.856 | 0.002 |
| ACS15 | 2.76 | 3.28 | 3.22 | 5.040 | 0.007 | 0.052 |
| ACS16 | 3.02 | 3.41 | 3.43 | 3.420 | 0.035 | 0.036 |
| ACS17 | 3.22 | 3.52 | 3.53 | 1.813 | 0.166 | 0.019 |

Table 4.19 ANOVA testing results for years of working experience of respondents

| Item | Mean | | | | $F$ | Sig. | $\eta^2$ |
|---|---|---|---|---|---|---|---|
| | <5 years | 6 – 10 years | 11 – 20 years | > 20 years | | | |
| CI1 | 2.95 | 2.84 | 2.75 | 2.78 | 0.597 | 0.618 | 0.010 |
| CI2 | 3.36 | 3.32 | 3.22 | 3.18 | 0.523 | 0.667 | 0.008 |

| Item | Mean | | | | $F$ | Sig. | $\eta^2$ |
|---|---|---|---|---|---|---|---|
| | <5 years | 6 – 10 years | 11 – 20 years | > 20 years | | | |
| CI3 | 2.72 | 2.79 | 2.84 | 2.75 | 0.244 | 0.866 | 0.004 |
| CI4 | 3.30 | 3.23 | 3.32 | 3.25 | 0.137 | 0.938 | 0.002 |
| CI5 | 3.04 | 3.04 | 3.20 | 3.11 | 0.530 | 0.662 | 0.009 |
| CI6 | 2.91 | 2.93 | 3.09 | 3.01 | 0.598 | 0.617 | 0.010 |
| CI7 | 2.79 | 2.93 | 2.76 | 2.77 | 0.526 | 0.665 | 0.009 |
| CI8 | 2.75 | 2.89 | 2.71 | 2.93 | 0.702 | 0.552 | 0.011 |
| CI9 | 3.26 | 3.12 | 3.27 | 3.47 | 1.551 | 0.203 | 0.025 |
| CI10 | 2.80 | 2.93 | 2.89 | 3.03 | 0.586 | 0.625 | 0.009 |
| CI11 | 2.68 | 2.75 | 2.71 | 2.71 | 0.094 | 0.963 | 0.002 |
| CI12 | 3.04 | 3.12 | 3.28 | 3.23 | 1.027 | 0.382 | 0.016 |
| CI13 | 3.17 | 3.27 | 3.45 | 3.26 | 0.908 | 0.438 | 0.015 |
| CI14 | 3.04 | 2.99 | 3.23 | 2.96 | 1.003 | 0.393 | 0.016 |
| CI15 | 3.23 | 3.22 | 3.31 | 3.45 | 0.460 | 0.710 | 0.007 |
| CI16 | 3.29 | 3.25 | 3.37 | 3.46 | 0.493 | 0.688 | 0.008 |
| CI17 | 3.61 | 3.82 | 3.72 | 3.55 | 1.286 | 0.281 | 0.021 |
| CI18 | 3.45 | 3.58 | 3.50 | 3.47 | 0.326 | 0.806 | 0.005 |
| CI19 | 3.43 | 3.54 | 3.50 | 3.73 | 0.994 | 0.397 | 0.016 |
| CI20 | 3.05 | 3.04 | 2.98 | 3.20 | 0.534 | 0.659 | 0.009 |
| CI21 | 3.17 | 3.24 | 3.35 | 3.45 | 1.045 | 0.374 | 0.017 |
| CI22 | 3.11 | 3.21 | 3.10 | 3.00 | 0.716 | 0.544 | 0.012 |
| CI23 | 3.48 | 3.38 | 3.40 | 3.58 | 0.438 | 0.726 | 0.007 |
| CI24 | 3.37 | 3.53 | 3.65 | 3.65 | 1.054 | 0.370 | 0.017 |
| COC1 | 3.63 | 3.80 | 4.05 | 4.00 | 2.164 | 0.094 | 0.034 |
| COC2 | 3.50 | 3.42 | 3.58 | 3.58 | 0.310 | 0.818 | 0.005 |
| COC3 | 3.31 | 3.33 | 3.50 | 3.38 | 0.323 | 0.809 | 0.005 |
| COC4 | 3.81 | 3.83 | 4.03 | 3.79 | 0.585 | 0.626 | 0.009 |
| COC5 | 3.56 | 3.91 | 4.05 | 3.79 | 2.397 | 0.070 | 0.038 |

| Item | Mean <5 years | 6 – 10 years | 11 – 20 years | > 20 years | *F* | Sig. | η² |
|---|---|---|---|---|---|---|---|
| COC6 | 3.60 | 3.45 | 3.88 | 3.88 | 2.268 | 0.082 | 0.036 |
| COC7 | 3.71 | 3.74 | 4.10 | 3.88 | 2.093 | 0.103 | 0.033 |
| COC8 | 3.48 | 3.54 | 3.93 | 3.88 | 2.423 | 0.067 | 0.038 |
| COC9 | 3.63 | 3.54 | 3.68 | 3.50 | 0.305 | 0.821 | 0.005 |
| COC10 | 3.50 | 3.26 | 3.60 | 3.38 | 1.359 | 0.257 | 0.022 |
| ACS1 | 3.35 | 3.49 | 3.38 | 3.04 | 1.484 | 0.220 | 0.024 |
| ACS2 | 2.94 | 3.29 | 3.13 | 2.92 | 1.845 | 0.141 | 0.029 |
| ACS3 | 3.04 | 3.17 | 3.10 | 2.67 | 1.840 | 0.141 | 0.029 |
| ACS4 | 2.98 | 3.21 | 3.13 | 2.88 | 1.025 | 0.383 | 0.016 |
| ACS5 | 3.27 | 3.39 | 3.33 | 3.04 | 0.860 | 0.463 | 0.014 |
| ACS6 | 3.10 | 3.20 | 3.10 | 2.88 | 0.729 | 0.536 | 0.012 |
| ACS7 | 3.27 | 3.20 | 3.08 | 2.96 | 0.702 | 0.552 | 0.011 |
| ACS8 | 2.56 | 2.55 | 2.73 | 2.54 | 0.287 | 0.835 | 0.005 |
| ACS9 | 2.60 | 2.71 | 2.80 | 2.54 | 0.462 | 0.709 | 0.007 |
| ACS10 | 2.88 | 2.91 | 2.83 | 2.79 | 0.135 | 0.939 | 0.002 |
| ACS11 | 3.15 | 3.11 | 3.20 | 3.13 | 0.128 | 0.943 | 0.002 |
| ACS12 | 3.73 | 3.76 | 3.98 | 4.13 | 1.663 | 0.176 | 0.026 |
| ACS13 | 3.35 | 3.50 | 3.73 | 3.46 | 1.228 | 0.301 | 0.020 |
| ACS14 | 2.73 | 2.82 | 2.85 | 3.04 | 0.559 | 0.643 | 0.009 |
| ACS15 | 3.19 | 3.36 | 2.83 | 2.79 | 3.772 | 0.012 | 0.058 |
| ACS16 | 3.48 | 3.45 | 3.05 | 3.00 | 3.140 | 0.027 | 0.049 |
| ACS17 | 3.56 | 3.55 | 3.28 | 3.17 | 1.685 | 0.172 | 0.027 |

Table 4.20 ANOVA testing results for working places of respondents

| Item | Mean Eastern areas | Central and western areas | *F* | Sig. | η² |
|---|---|---|---|---|---|

| Item | Mean | | $F$ | Sig. | $\eta^2$ |
| --- | --- | --- | --- | --- | --- |
| | Eastern areas | Central and western areas | | | |
| CI1 | 2.78 | 2.90 | 1.206 | 0.274 | 0.006 |
| CI2 | 3.32 | 3.27 | 0.188 | 0.665 | 0.001 |
| CI3 | 2.80 | 2.74 | 0.365 | 0.546 | 0.002 |
| CI4 | 3.25 | 3.29 | 0.094 | 0.759 | 0.001 |
| CI5 | 3.04 | 3.13 | 0.691 | 0.407 | 0.004 |
| CI6 | 2.96 | 2.97 | 0.005 | 0.942 | 0.000 |
| CI7 | 2.74 | 2.94 | 2.829 | 0.094 | 0.015 |
| CI8 | 2.82 | 2.82 | 0.001 | 0.974 | 0.000 |
| CI9 | 3.16 | 3.31 | 2.210 | 0.139 | 0.012 |
| CI10 | 2.91 | 2.90 | 0.007 | 0.932 | 0.000 |
| CI11 | 2.71 | 2.73 | 0.049 | 0.825 | 0.000 |
| CI12 | 3.10 | 3.20 | 0.925 | 0.337 | 0.005 |
| CI13 | 3.28 | 3.28 | 0.002 | 0.968 | 0.000 |
| CI14 | 3.08 | 3.01 | 0.371 | 0.543 | 0.002 |
| CI15 | 3.34 | 3.19 | 1.396 | 0.239 | 0.007 |
| CI16 | 3.36 | 3.27 | 0.541 | 0.463 | 0.003 |
| CI17 | 3.69 | 3.73 | 0.153 | 0.696 | 0.001 |
| CI18 | 3.69 | 3.33 | 11.793 | 0.001 | 0.060 |
| CI19 | 3.63 | 3.42 | 4.363 | 0.038 | 0.023 |
| CI20 | 3.04 | 3.05 | 0.019 | 0.892 | 0.000 |
| CI21 | 3.32 | 3.21 | 1.048 | 0.307 | 0.006 |
| CI22 | 3.10 | 3.18 | 0.723 | 0.396 | 0.004 |
| CI23 | 3.60 | 3.27 | 8.058 | 0.005 | 0.042 |
| CI24 | 3.65 | 3.41 | 4.202 | 0.042 | 0.022 |
| COC1 | 3.91 | 3.76 | 1.349 | 0.247 | 0.007 |
| COC2 | 3.57 | 3.41 | 1.315 | 0.253 | 0.007 |
| COC3 | 3.48 | 3.25 | 2.532 | 0.113 | 0.013 |

| Item | Mean | | $F$ | Sig. | $\eta^2$ |
|---|---|---|---|---|---|
| | Eastern areas | Central and western areas | | | |
| COC4 | 3.91 | 3.82 | 0.496 | 0.482 | 0.003 |
| COC5 | 3.91 | 3.76 | 1.192 | 0.276 | 0.006 |
| COC6 | 3.69 | 3.58 | 0.606 | 0.437 | 0.003 |
| COC7 | 3.95 | 3.70 | 4.337 | 0.039 | 0.023 |
| COC8 | 3.60 | 3.70 | 0.424 | 0.516 | 0.002 |
| COC9 | 3.63 | 3.54 | 0.394 | 0.531 | 0.002 |
| COC10 | 3.43 | 3.39 | 0.069 | 0.793 | 0.000 |
| ACS1 | 3.45 | 3.29 | 1.364 | 0.244 | 0.007 |
| ACS2 | 3.19 | 3.04 | 1.116 | 0.292 | 0.006 |
| ACS3 | 3.11 | 3.00 | 0.709 | 0.401 | 0.004 |
| ACS4 | 3.02 | 3.16 | 1.024 | 0.313 | 0.005 |
| ACS5 | 3.28 | 3.33 | 0.104 | 0.748 | 0.001 |
| ACS6 | 3.07 | 3.15 | 0.338 | 0.562 | 0.002 |
| ACS7 | 3.24 | 3.08 | 1.358 | 0.245 | 0.007 |
| ACS8 | 2.52 | 2.66 | 0.890 | 0.347 | 0.005 |
| ACS9 | 2.71 | 2.65 | 0.149 | 0.700 | 0.001 |
| ACS10 | 2.80 | 2.93 | 1.007 | 0.317 | 0.005 |
| ACS11 | 3.19 | 3.09 | 0.762 | 0.384 | 0.004 |
| ACS12 | 3.97 | 3.72 | 4.013 | 0.047 | 0.021 |
| ACS13 | 3.52 | 3.49 | 0.056 | 0.813 | 0.000 |
| ACS14 | 2.76 | 2.90 | 1.000 | 0.319 | 0.005 |
| ACS15 | 3.13 | 3.13 | 0.001 | 0.970 | 0.000 |
| ACS16 | 3.40 | 3.23 | 1.542 | 0.216 | 0.008 |
| ACS17 | 3.50 | 3.39 | 0.608 | 0.437 | 0.003 |

### 4.3.3 Framework Consolidation: Factor Analysis

In order to obtain a clearer picture of corruption indicators, causes of corruption, and prevailing anti-corruption strategies, factor analysis was employed to condense the various observed variables into several more meaningful constructs (Hair et al. 2010). Given its simplicity and distinctive data-reduction capacity, principal component analysis was conducted to extract these constructs (Chan et al. 2010). With regard to the assumption that correlations occur among constructs, factor extraction with promax rotation was conducted as recommended by Conway and Huffcutt (2003). The data collected from the questionnaire survey were tested for factorability via the Kaiser-Meyer-Olkin (KMO) value, the Bartlett‟s test of sphericity statistic, and anti-image correlation values (Tobias and Carlson 1969; Kaiser 1976; Hair et al. 2010). Table 4.21 shows the testing results. KMO values of corruption indicators, causes of corruption, and the prevailing anti-corruption strategies range from 0.789 to 0.863, which is considered middling and meritorious to conduct factor analysis (Hair et al. 2010). The Bartlett‟s test of sphericity statistics for corruption indicators, causes of corruption, and prevailing anti-corruption strategies are highly significant at $p<0.001$, indicating adequate relationships between the included observed variables in the analysis (Tobias and Carlson 1969). Lastly, all anti-image correlation values are greater than 0.500, which confirms the factorability of factor analysis being conducted (Kaiser 1976).

Table 4.21 Factorability test results

| Measured object | KMO* | Bartlett test of sphericity (Sig.) | Anti-image correlation |
|---|---|---|---|
| Corruption indicators | 0.863 | 1308.051 (0.000) | 0.798 – 0.923 |
| Causes of corruption | 0.789 | 486.044 (0.000) | 0.721 – 0.856 |
| Prevailing anti-corruption strategies | 0.821 | 1787.405 (0.000) | 0.562 – 0.900 |

Note: KMO* represents for Kaiser-Meyer-Olkin measure of sampling adequacy

#### 4.3.3.1 Factor Analysis Results of Corruption Indicators

The 24 specific corruption indicators were subjected to factor analysis with the principal component analysis extraction method. Before performing principal component analysis, the suitability of data for factor analysis was assessed. The Kaiser-Meyer-Olkin (KMO) value was 0.863, indicating good sampling adequacy (Field 2009; Hair et al. 2010). Bartlett"s test of sphericity produced an approximation of $x^2$ = 1308.051 ($p<0.001$); the inspection of the correlation matrix revealed the presence of numerous coefficients of 0.3 and above (see Table 4.22), indicating correlations between the specific corruption indicators to be sufficiently large for principal component analysis (Tobias and Carlson 1969; Ngai and Cheng 1997). All anti-image correlation values of corruption indicators are greater than 0.5, confirming the factorability of factor analysis to be conducted (Kaiser 1976). The factor loading cutoff was fixed at 0.5 as suggested by Hair et al. (2010). Five corruption indicators, namely CI6, CI8, CI13, CI14, and CI17 were thus removed.

Principal component analysis revealed the presence of five components with eigenvalues exceeding 1 (see Table 4.23). Scree plot showed that the line is almost flat from the sixth component on, indicating that five components should be retained (see Figure 4.6) (Zhang 2005b). Actual eigenvalues for the first five components obtained from actual data were larger than those from the random data, suggesting that the number of components extracted were five (O Connor 2000) (see Table 4.23). The five components explained 61.623% of the total variance for the corruption indicators (see Table 4.23). Structure matrix of factor analysis of corruption indicators has been listed in Table 4.24. The five components were named immorality, unfairness, opacity, procedural violation, and contractual violation respectively according to their related specific corruption indicators. The final factor analysis result of corruption indicators has been listed in Table 4.25.

Table 4.22 Total correlations of corruption indicators

| | CI14 | CI15 | CI18 | CI21 | CI23 | CI24 | CI4 | CI5 | CI6 | CI9 | CI12 | CI22 | CI7 | CI8 | CI10 | CI11 | CI20 | CI1 | CI2 | CI3 | CI17 | CI13 | CI16 | CI19 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CI14 | 1 | | | | | | | | | | | | | | | | | | | | | | | |
| CI15 | .394** | 1 | | | | | | | | | | | | | | | | | | | | | | |
| CI18 | .400** | .381** | 1 | | | | | | | | | | | | | | | | | | | | | |
| CI21 | .381** | .395** | .462** | 1 | | | | | | | | | | | | | | | | | | | | |
| CI23 | .369** | .409** | .374** | .450** | 1 | | | | | | | | | | | | | | | | | | | |
| CI24 | .306** | .427** | .391** | .455** | .605** | 1 | | | | | | | | | | | | | | | | | | |
| CI4 | .290** | .261** | .164* | .210** | .208** | .210** | 1 | | | | | | | | | | | | | | | | | |
| CI5 | .204** | .247** | .138 | .107 | .256** | .214** | .594** | 1 | | | | | | | | | | | | | | | | |
| CI6 | .273** | .242** | .232** | .139 | .278** | .274** | .388** | .514** | 1 | | | | | | | | | | | | | | | |
| CI9 | .335** | .421** | .184* | .222** | .278** | .210** | .449** | .516** | .449** | 1 | | | | | | | | | | | | | | |
| CI12 | .414** | .337** | .305** | .319** | .274** | .293** | .401** | .487** | .336** | .464** | 1 | | | | | | | | | | | | | |
| CI22 | .090 | .215** | .302** | .466** | .216** | .285** | .302** | .371** | .304** | .331** | .346** | 1 | | | | | | | | | | | | |
| CI7 | .267** | .158* | .034 | .109 | .109 | .104 | .136 | .152* | .314** | .374** | .270** | .123 | 1 | | | | | | | | | | | |
| CI8 | .318** | .296** | .235** | .193** | .143* | .194** | .198** | .218** | .314** | .338** | .220** | .247** | .487** | 1 | | | | | | | | | | |
| CI10 | .421** | .291** | .198** | .206** | .302** | .252** | .361** | .305** | .348** | .346** | .372** | .224** | .414** | .430** | 1 | | | | | | | | | |
| CI11 | .453** | .313** | .279** | .192** | .308** | .207** | .265** | .234** | .331** | .301** | .362** | .187* | .357** | .388** | .501** | 1 | | | | | | | | |
| CI20 | .179* | .222** | .306** | .367** | .399** | .298** | .040 | .026 | .189** | .220** | .164* | .186* | .365** | .385* | .382* | .365* | 1 | | | | | | | |
| CI1 | .285** | .217** | .213** | .156* | .206** | .241** | .206** | .261** | .294** | .290** | .162* | .239** | .256** | .277** | .286** | .241** | .165* | 1 | | | | | | |
| CI2 | .231** | .185* | .118 | .061 | .182* | .179* | .289** | .284** | .279** | .259** | .082 | .201** | .155* | .224** | .238** | .259** | .089 | .356** | 1 | | | | | |
| CI3 | .244** | .257** | .211** | .286** | .220** | .214** | .296** | .290** | .270** | .299** | .156* | .272** | .188** | .216** | .158* | .262** | .175* | .384** | .316** | 1 | | | | |
| CI17 | .257** | .251** | .284** | .217** | .210** | .241** | .178* | .200** | .145* | .212** | .267** | .309** | .289** | .239** | .201** | .263** | .143 | .355** | .347** | .360** | 1 | | | |
| CI13 | .309** | .221** | .218** | .247** | .220** | .179* | .184* | .270** | .189** | .232** | .272** | .325** | .234** | .274** | .225** | .275** | .195** | .136 | .180* | .219** | .301** | 1 | | |
| CI16 | .313** | .357** | .308** | .334** | .319** | .339** | .350** | .333** | .267** | .210** | .285** | .310** | .230** | .277** | .296** | .288** | .201** | .264** | .301** | .359** | .348** | .331** | 1 | |
| CI19 | .053 | .342** | .329** | .341** | .391** | .313** | .228** | .265** | .143 | .219** | .213** | .338** | .086 | .203** | .246** | .110 | .224** | .186* | .183* | .260** | .298** | .379** | .480** | 1 |

The correlations between these items and others are >0.3, however the cross loadings are <0.5

**Correlation is significant at the 0.01 level (2-tailed)
*Correlation is significant at the 0.05 level (2-tailed)

Table 4.23 Corruption indicator components extracted from principal component analysis

| Component number | Eigenvalue from actual data | Eigenvalue from random data by parallel analysis | Accumulated variance explained |
|---|---|---|---|
| 1 | 6.399 | 1.723 | 33.679% |
| 2 | 1.847 | 1.575 | 43.398% |
| 3 | 1.262 | 1.236 | 50.042% |
| 4 | 1.197 | 1.119 | 56.342% |
| 5 | 1.067 | 1.003 | 61.623% |
| 6 | 0.932 | 0.963 | |

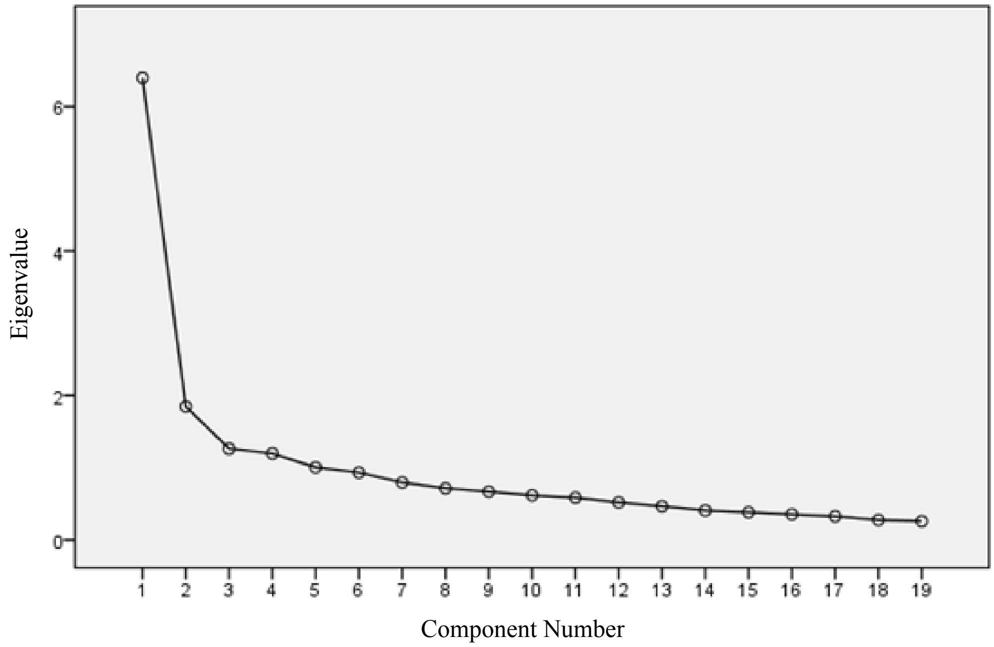



Figure 4.6 Scree plot of factor analysis of corruption indicators

Table 4.24 Factor analysis results of corruption indicators

| Items | Structure Matrix | | | | |
|---|---|---|---|---|---|
| | 1-CI | 2-CI | 3-CI | 4-CI | 5-CI |
| CI14 | 0.474 | 0.277 | 0.325 | 0.210 | 0.414 |
| CI15 | 0.727 | 0.573 | 0.314 | 0.297 | 0.196 |
| CI18 | 0.696 | 0.258 | 0.210 | 0.414 | 0.182 |
| CI21 | 0.673 | 0.260 | 0.200 | 0.480 | 0.072 |
| CI23 | 0.735 | 0.374 | 0.262 | 0.206 | 0.274 |
| CI24 | 0.750 | 0.452 | 0.179 | 0.273 | 0.362 |
| CI4 | 0.291 | 0.797 | 0.241 | 0.237 | 0.354 |
| CI5 | 0.275 | 0.849 | 0.284 | 0.254 | 0.339 |
| CI6 | 0.330 | 0.451 | 0.316 | 0.193 | 0.339 |
| CI9 | 0.393 | 0.708 | 0.609 | 0.194 | 0.417 |
| CI12 | 0.398 | 0.636 | 0.466 | 0.323 | -0.051 |
| CI22 | 0.290 | 0.654 | 0.398 | 0.188 | 0.324 |
| CI7 | 0.175 | 0.205 | 0.720 | 0.189 | 0.209 |
| CI8 | 0.275 | 0.298 | 0.482 | 0.324 | 0.279 |
| CI10 | 0.338 | 0.509 | 0.752 | 0.293 | 0.188 |
| CI11 | 0.345 | 0.399 | 0.759 | 0.212 | 0.303 |
| CI20 | 0.036 | 0.383 | 0.616 | 0.126 | 0.119 |
| CI1 | 0.290 | 0.317 | 0.377 | 0.742 | 0.226 |
| CI2 | 0.162 | 0.354 | 0.260 | 0.707 | 0.218 |
| CI3 | 0.480 | 0.341 | 0.204 | 0.640 | 0.267 |
| CI17 | 0.375 | 0.256 | 0.289 | 0.440 | 0.344 |
| CI13 | 0.277 | 0.325 | 0.376 | 0.066 | 0.443 |
| CI16 | 0.568 | 0.301 | 0.489 | 0.369 | 0.573 |
| CI19 | 0.362 | 0.135 | 0.531 | 0.237 | 0.746 |

Note: Factor extraction, principle component analysis; Factor rotation, promax

Table 4.25 Consolidated framework of corruption indicators

| Underlying factor | Code | | Corruption indicator |
|---|---|---|---|
| | Previous | Current | |
| Immorality | CI15 | IMM1 | The work is not executed as per original design accorded |
| | CI18 | IMM2 | The deviations, especially in abnormally high rated and high value items are not properly monitored and verified |
| | CI21 | IMM3 | Contractors provide false certificates in bidding |
| | CI23 | IMM4 | Substitution of unqualified materials in construction |
| | CI24 | IMM5 | Site supervisor neglects his duties for taking bribe from contractor |
| Unfairness | CI4 | UNF1 | The consultant is not appointed after proper publicity and open competition |
| | CI5 | UNF2 | The criteria adopted in prequalification of consultant are restrictive and benefit only few consultants |
| | CI9 | UNF3 | Prequalification criteria for selection of contractor are stringent |
| | CI12 | UNF4 | The conditions/specifications are relaxed in favor of contractor to whom the work is being awarded |
| | CI22 | UNF5 | Confidential information of bidding is disclosed to a specific bidder |
| Opacity | CI7 | OPA1 | Adequate & wide publicity is not given to tender |
| | CI10 | OPA2 | The evaluation of tenders is not done exactly as per the notified criteria |
| | CI11 | OPA3 | The negotiation on tender not done as per laid down guidelines |
| | CI20 | OPA4 | A large project should have called for bids is split into several small projects and contracted without bidding |

| Underlying factor | Code | | Corruption indicator |
|---|---|---|---|
| | **Previous** | **Current** | |
| Procedural violation | CI1 | PRV1 | Administrative approval and financial sanction not taken to execute the work |
| | CI2 | PRV2 | Lack of the sanctioned financial provisions from the government |
| | CI3 | PRV3 | Work is not executed for the same purpose for which the sanction was accorded |
| Contractual violation | CI16 | COV1 | Compliance with conditions regarding deployment of technical staff not being followed by contractor |
| | CI19 | COV2 | Escalation clause is not applied correctly for admissible payment |

#### 4.3.3.2 Factor Analysis Results of Causes of Corruption

Regarding causes of corruption, its KMO value was 0.789, indicating acceptable sampling adequacy (Field 2009; Hair et al. 2010). Bartlett‟s test of sphericity produced an approximation of $x^2$ = 486.044 ($p<0.001$); the inspection of the correlation matrix revealed the presence of numerous coefficients of 0.3 and above (see Table 4.26), indicating correlations between the specific causes of corruption to be sufficiently large for principal component analysis (Tobias and Carlson 1969; Ngai and Cheng 1997). All anti-image correlation values of causes of corruption are greater than 0.5, confirming the factorability of factor analysis to be conducted (Kaiser 1976). Two causes of corruption, namely COC2 and COC3 were deleted from the list of causes of corruption due to their factor loadings less than the cut-off criterion of 0.5 suggested by Hair et al. (2010).

Table 4.26 Total correlations of causes of corruption

| | COC1 | COC2 | COC4 | COC5 | COC7 | COC3 | COC6 | COC8 | COC9 | COC10 |
|---|---|---|---|---|---|---|---|---|---|---|
| COC1 | 1 | | | | | | | | | |
| COC2 | .341** | 1 | | | | | | | | |
| COC4 | .395** | .477** | 1 | | | | | | | |
| COC5 | .458** | .370** | .342** | 1 | | | | | | |
| COC7 | .398** | .476** | .400** | .486** | 1 | | | | | |
| COC3 | .109 | .208** | .241** | .091 | .078 | 1 | | | | |
| COC6 | .175* | .143* | .311** | .249** | .423** | .416** | 1 | | | |
| COC8 | .053 | .021 | .106 | .257** | .202** | .302** | .322** | 1 | | |
| COC9 | .148* | .117 | .240** | .199** | .311** | .495** | .352** | .411** | 1 | |
| COC10 | .078 | .150* | .186* | .206** | .100 | .402** | .595** | .485** | .421** | 1 |

The correlations between these items and others are >0.3, however the cross loadings are <0.5

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

*Correlation is significant at the 0.05 level (2-tailed)

Principal component analysis revealed the presence of two components with eigenvalues exceeding 1 (see Table 4.27). Scree plot showed that the line is almost flat from the third component on, indicating that two components should be retained (Zhang 2005b) (see Figure 4.7). Actual eigenvalues for the first two components obtained from actual data were larger than those from the random data, suggesting that the number of components extracted were two (O Connor 2000) (see Table 4.27). The two components explained 54.160% of the total variance for causes of corruption (see Table 4.27). Structure matrix of factor analysis of causes of corruption has been listed in Table 4.28. The two components were named flawed regulation systems and lack of a positive industrial climate according to their related specific casuses of corruption. The final factor analysis result of causes of corruption has been listed in Table 4.29.

Table 4.27 Cause of corruption components extracted from principal component analysis

| Component number | Eigenvalue from actual data | Eigenvalue from random data by parallel analysis | Accumulated variance explained |
|---|---|---|---|
| 1 | 3.093 | 1.315 | 38.668% |
| 2 | 1.239 | 1.196 | 54.160% |
| 3 | 0.825 | 1.107 | |

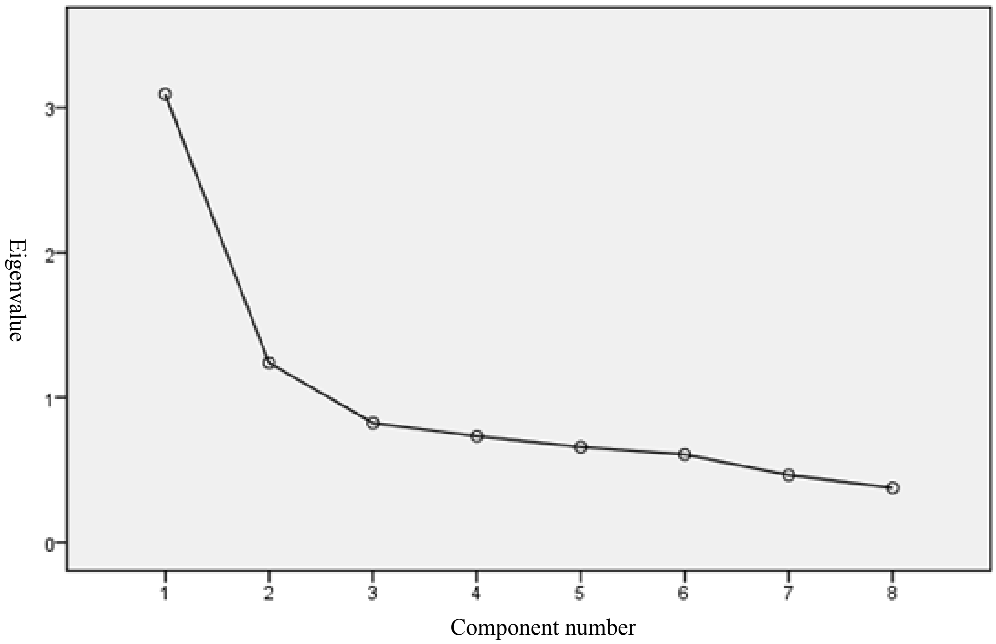



Figure 4.7 Scree plot of factor analysis of causes of corruption

Table 4.28 Factor analysis results of causes of corruption

| Items | Structure Matrix | |
|---|---|---|
| | 1-COC | 2-COC |
| COC3 | 0.471 | 0.165 |
| COC6 | 0.568 | 0.454 |
| COC8 | 0.764 | 0.156 |
| COC9 | 0.792 | 0.299 |
| COC10 | 0.777 | 0.160 |
| COC1 | 0.108 | 0.631 |
| COC2 | 0.058 | 0.474 |
| COC4 | 0.303 | 0.630 |
| COC5 | 0.347 | 0.707 |
| COC7 | 0.381 | 0.840 |

Note: Factor extraction, principle component analysis; Factor rotation, promax

Table 4.29 Consolidated framework of causes of corruption

| Underlying factor | Code | | Specific cause |
|---|---|---|---|
| | Previous | Current | |
| Flawed regulation systems | COC1 | FRS1 | Multifarious licenses or permits |
| | COC4 | FRS2 | Lack of rigorous supervision |
| | COC5 | FRS3 | Inadequate sanctions |
| | COC7 | FRS4 | Negative leader roles |
| Lack of a positive industrial climate | COC6 | LPIC1 | Poor professional ethical standards |
| | COC8 | LPIC2 | Over-close relationships among contract parties |
| | COC9 | LPIC3 | Great project complexity |
| | COC10 | LPIC4 | Interpersonal connections |

### 4.3.3.3 Factor Analysis Results of the Prevailing Anti-Corruption Strategies

With specific to prevailing anti-corruption strategies, its KMO value was 0.821, indicating good sampling adequacy (Field 2009; Hair et al. 2010). Bartlett‟s test of sphericity produced an approximation of $x^2$ = 1787.405 (p<0.001); the inspection of the correlation matrix revealed the presence of numerous coefficients of 0.3 and above (see Table 4.30), indicating correlations between the specific items of prevailing anti-corruption strategies sufficiently large for principal component analysis (Tobias and Carlson 1969; Ngai and Cheng 1997). All anti-image correlation values of prevailing anti-corruption strategies are greater than 0.5, confirming the factorability of factor analysis to be conducted (Kaiser 1976).

Table 4.30 Total correlations of the prevailing anti-corruption strategies

| | ACS1 | ACS2 | ACS3 | ACS4 | ACS5 | ACS6 | ACS7 | ACS8 | ACS9 | ACS10 | ACS11 | ACS15 | ACS16 | ACS17 | ACS12 | ACS13 | ACS14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ACS1 | 1 | | | | | | | | | | | | | | | | |
| ACS2 | .705** | 1 | | | | | | | | | | | | | | | |
| ACS3 | .619** | .753** | 1 | | | | | | | | | | | | | | |
| ACS4 | .481** | .499** | .530** | 1 | | | | | | | | | | | | | |
| ACS5 | .401** | .416** | .408** | .763** | 1 | | | | | | | | | | | | |
| ACS 6 | .469** | .525** | .602** | .596** | .552** | 1 | | | | | | | | | | | |
| ACS 7 | .550** | .603** | .616** | .515** | .373** | .659** | 1 | | | | | | | | | | |
| ACS 8 | .329** | .366** | .386** | .226** | .192** | .414** | .443** | 1 | | | | | | | | | |
| ACS 9 | .358** | .403** | .361** | .321** | .295** | .425** | .417** | .632** | 1 | | | | | | | | |
| ACS10 | .340** | .366** | .345** | .222** | .227** | .321** | .362** | .587** | .540** | 1 | | | | | | | |
| ACS11 | .182* | .137 | .113 | -.017 | -.006 | .052 | .091 | .346** | .397** | .317** | 1 | | | | | | |
| ACS15 | .372** | .391** | .330** | .281** | .255** | .381** | .329** | .262** | .299** | .247** | .184* | 1 | | | | | |
| ACS16 | .331** | .303** | .313** | .166* | .110 | .269** | .363** | .185* | .220** | .184* | .138 | .754** | 1 | | | | |
| ACS17 | .295** | .283** | .271** | .165* | .144* | .268** | .335** | .149* | .185* | .162* | .088 | .599** | .814** | 1 | | | |
| ACS12 | .209** | .128 | -.009 | .094 | .089 | .061 | -.002 | -.011 | .036 | .110 | .102 | .136 | .047 | .058 | 1 | | |
| ACS13 | .165* | .212** | .122 | .227** | .203** | .215** | .139 | .118 | .225** | .217** | .088 | .254** | .171* | .162* | .664** | 1 | |
| ACS14 | .203** | .252** | .283** | .291** | .212** | .298** | .212** | .330** | .359** | .266** | .163* | .347** | .214** | .198** | .324** | .548** | 1 |

The correlations between these items and others are >0.3, however the cross loadings are <0.5

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

*Correlation is significant at the 0.05 level (2-tailed)

Principal component analysis revealed the presence of four components with eigenvalues exceeding 1 (see Table 4.31). Scree plot showed that four components should be retained (see Figure 4.8). Actual eigenvalues for the first four components obtained from actual data were larger than those from the random data, suggesting that the number of components extracted were four (O Connor 2000) (see Table 4.31). The four components explained 68.391% of the total variance for prevailing anti-corruption strategies (see Table 4.31). Structure matrix of factor analysis of prevailing anti-corruption strategies has been listed in Table 4.32. The four components were named leadership, rules and regulations, training, and sanctions according to their related specific items. The final factor analysis result of prevailing anti-corruption strategies has been listed in Table 4.33.

Table 4.31 Prevailing anti-corruption strategy components extracted from principal component analysis

| **Component number** | **Eigenvalue from actual data** | **Eigenvalue from random data by parallel analysis** | **Accumulated variance explained** |
|---|---|---|---|
| 1 | 6.218 | 1.675 | 36.578% |
| 2 | 1.931 | 1.525 | 47.938% |
| 3 | 1.793 | 1.424 | 58.485% |
| 4 | 1.684 | 1.334 | 68.391% |
| 5 | 0.909 | 1.257 | |

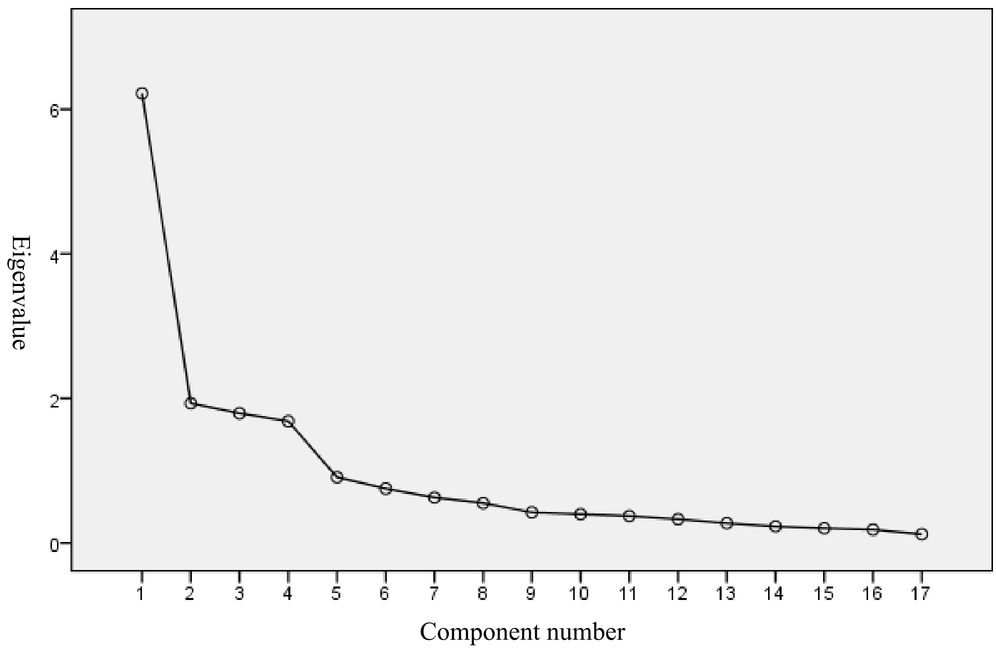



Figure 4.8 Scree plot of factor analysis of prevailing anti-corruption strategies

Table 4.32 Factor analysis results of prevailing anti-corruption strategies

| Items | Structure Matrix | | | |
|---|---|---|---|---|
| | 1-ACS | 2-ACS | 3-ACS | 4-ACS |
| ACS1 | .732 | .440 | .417 | .221 |
| ACS2 | .793 | .466 | .407 | .168 |
| ACS3 | .806 | .452 | .385 | .055 |
| ACS4 | .823 | .205 | .187 | .240 |
| ACS5 | .739 | .162 | .127 | .229 |
| ACS6 | .808 | .416 | .342 | .164 |
| ACS7 | .772 | .515 | .424 | .030 |
| ACS8 | .443 | .836 | .237 | .077 |
| ACS9 | .503 | .820 | .272 | .178 |
| ACS10 | .407 | .765 | .225 | .195 |
| ACS11 | .040 | .641 | .184 | .131 |

| | | | | |
|---|---|---|---|---|
| ACS15 | .420 | .354 | .843 | .273 |
| ACS16 | .317 | .276 | .951 | .123 |
| ACS17 | .303 | .216 | .891 | .119 |
| ACS12 | .088 | .054 | .079 | .850 |
| ACS13 | .243 | .204 | .206 | .902 |
| ACS14 | .356 | .412 | .290 | .670 |

Note: Factor extraction, principle component analysis; Factor rotation, Promax

Table 4.33 Consolidated framework of the prevailing anti-corruption strategies

| **Underlying factor** | **Code** | | **Observed variables** |
|---|---|---|---|
| | **Previous** | **Current** | |
| Leadership | ACS1 | LEA1 | Anti-Corruption issues are important |
| | ACS2 | LEA2 | Act positively and cooperate |
| | ACS3 | LEA3 | Act decisively when anti-corruption issues are important |
| | ACS4 | LEA4 | Praise for working honestly |
| | ACS5 | LEA5 | Remind each other to work fairly and honestly |
| | ACS6 | LEA6 | Provide help to work honestly |
| | ACS7 | LEA7 | Corruption free environment is provided |
| Rules and regulations | ACS8 | RAR1 | Adequate source of information |
| | ACS9 | RAR2 | Rules protect us from vigilance cases |
| | ACS10 | RAR3 | Rules should be consulted by all |
| | ACS11 | RAR4 | Rules do not impose restrictions |
| Training | ACS12 | TRA1 | Training is necessary |
| | ACS13 | TRA2 | Training helps me |
| | ACS14 | TRA3 | Training helps in prevention of corrupt practices |
| Sanctions | ACS15 | SAN1 | Fear of administrative sanction |
| | ACS16 | SAN2 | Fear of economic sanction |

| Underlying factor | Code | | Observed variables |
|---|---|---|---|
| | Previous | Current | |
| | ACS17 | SAN3 | Fear of penal sanction |

## 4.4 CHAPTER SUMMARY

Based on the results of structured interviews, 24 corruption indicators, ten causes of corruption, and nine anti-corruption strategies in the Chinese public construction sector were identified. A questionnaire was then developed based on the interview results and distributed via three channels, namely, online survey, interview survey in a forum, and field survey in construction sites. Lastly, 188 valid replies were collected. Various statistical analysis techniques, such as Cronbach‟s alpha, standard deviation, standard error, and one way analysis of variance, were used to test the collected data. All the statistical parameters were found to be acceptable for the further data analysis. By doing factor analysis of the collected data, corruption indicators were categorized into five underlying factors, namely, immorality, unfairness, opacity, procedural violation, and contractual violation; the causes of corruption were categorized into two underlying factors, namely, flawed regulation systems, and the lack of a positive industrial environment; the anti-corruption strategies were categorized into four underlying factors, namely, leadership, rules and regulations, training, and sanctions.

# CHAPTER 5 INVESTIGATING THE UNDERLYING CORRUPTION INDICATORS IN THE CHINESE PUBLIC CONSTRUCTION SECTOR

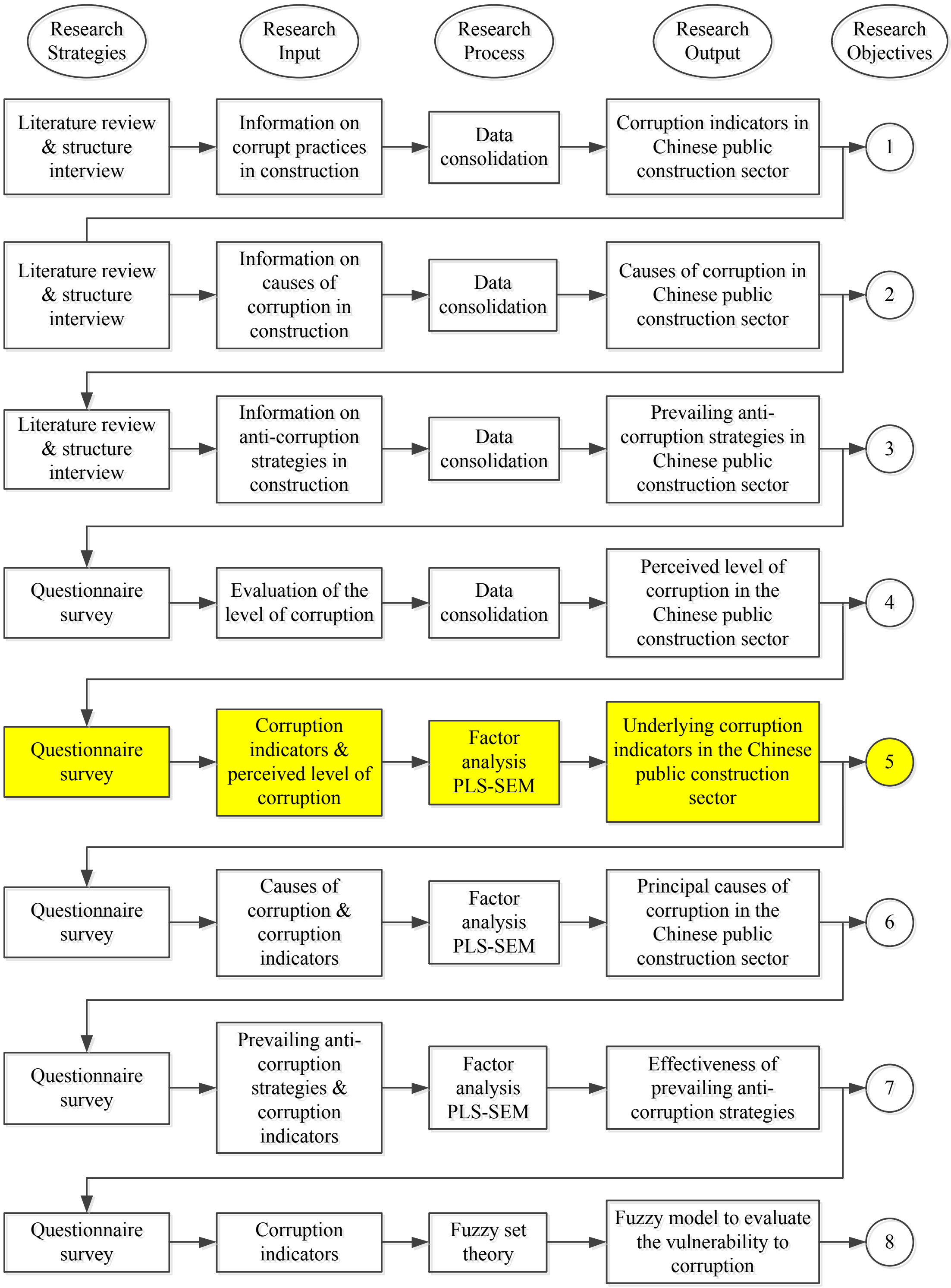



Figure 5.1 Overall flow of research

# CHAPTER 5 INVESTIGATING THE UNDERLYING CORRUPTION INDICATORS IN THE CHINESE PUBLIC CONSTRUCTION SECTOR

## 5.1 INTRODUCTION

This chapter first investigates the prioritization of corruption indicators in the Chinese public construction sector, and then explores the underlying corruption indicators by investigating the influences of corruption indicators to the perceived level of corruption using the means of structural equation modeling analysis.

## 5.2 PRIORITIZATION OF CORRUPTION INDICATORS

To prioritize corruption indicators, this study adopted a formula developed by Ke et al. (2011) to calculate the significance index of each corruption indicator. The formula is as follows:

$$CI_{si} = \frac{\sum_{m=1}^{n} \sqrt{CI_{mpi} \times CI_{msi}}}{n} \quad \text{(Formula 5.1)}$$

where $CI_{si}$ = the significance index of the *i*th corruption indicator

$CI_{mpi}$ = the probability assessment of the *i*th corruption indicator, by the *m*th respondent

$CI_{msi}$ = the severity assessment of the *i*th corruption indicator, by the *m*th respondent

$n$ = the number of respondents

Table 5.1 shows the prioritization results of the entire corruption indicators.

The survey results reveal that the top five corruption indicators under the assessment of probability are as follows: (1) proper record of hindrances is not being maintained from the beginning; (2) the conditions/specifications are relaxed in favor of contractor to whom the work is being awarded; (3) compliance with conditions regarding obtaining licenses, insurance policies and deployment of technical staff not being followed by contractor; (4) the work is not executed as per original sanction accorded; and (5) the consultant is not appointed after proper publicity and open competition.

The top five corruption indicators under the assessment of severity are as follows: (1) site supervisor neglects his duties for taking bribe from contractor; (2) substitution of unqualified materials in construction; (3) proper record of hindrances is not being maintained from the beginning; (4) confidential information of bidding is disclosed to a specific bidder; and (5) contractors provide false certificates in bidding.

Considering the probability and severity simultaneously, the top five corruption indicators are as follows: (1) proper record of hindrances is not being maintained from the beginning; (2) site supervisor neglects his duties for taking bribe from contractor; (3) the work is not executed as per original sanction accorded; (4) compliance with conditions regarding obtaining licenses, insurance policies and deployment of technical staff not being followed by contractor; and (5) substitution of unqualified materials in construction.

Table 5.1 Prioritization of corruption indicators

| **Rank** | **Corruption indicator** | **Significance index** | **Probability** | | **Severity** | |
|---|---|---|---|---|---|---|
| | | | **Mean** | **Rank** | **Mean** | **Rank** |
| 1 | CI17 | 3.75 | 3.71 | 1 | 3.80 | 3 |
| 2 | CI24 | 3.59 | 3.23 | 6 | 4.00 | 1 |
| 3 | CI15 | 3.57 | 3.45 | 4 | 3.69 | 6 |
| 4 | CI16 | 3.56 | 3.52 | 3 | 3.61 | 7 |
| 5 | CI23 | 3.50 | 3.01 | 16 | 4.06 | 1 |
| 6 | CI22 | 3.37 | 3.05 | 14 | 3.73 | 4 |
| 7 | CI2 | 3.35 | 3.20 | 8 | 3.50 | 12 |
| 8 | CI21 | 3.35 | 3.04 | 15 | 3.70 | 5 |
| 9 | CI4 | 3.34 | 3.43 | 5 | 3.26 | 19 |
| 10 | CI13 | 3.33 | 3.16 | 9 | 3.51 | 9 |
| 11 | CI18 | 3.32 | 3.06 | 13 | 3.60 | 8 |
| 12 | CI9 | 3.27 | 3.21 | 7 | 3.34 | 15 |
| 13 | CI12 | 3.22 | 3.54 | 2 | 2.92 | 24 |
| 14 | CI19 | 3.18 | 3.08 | 11 | 3.28 | 18 |
| 15 | CI5 | 3.14 | 3.14 | 10 | 3.14 | 20 |
| 16 | CI14 | 3.13 | 2.79 | 17 | 3.51 | 10 |
| 17 | CI20 | 3.13 | 2.79 | 18 | 3.51 | 11 |
| 18 | CI6 | 3.03 | 3.06 | 12 | 3.00 | 23 |
| 19 | CI10 | 2.97 | 2.62 | 22 | 3.37 | 14 |
| 20 | CI1 | 2.95 | 2.63 | 21 | 3.30 | 17 |

| Rank | Corruption indicator | Significance index | Probability | | Severity | |
|---|---|---|---|---|---|---|
| | | | Mean | Rank | Mean | Rank |
| 21 | CI7 | 2.89 | 2.74 | 19 | 3.05 | 22 |
| 22 | CI8 | 2.87 | 2.70 | 20 | 3.06 | 21 |
| 23 | CI3 | 2.86 | 2.47 | 23 | 3.31 | 16 |
| 24 | CI11 | 2.82 | 2.28 | 24 | 3.50 | 13 |

## 5.3 A HYPOTHESIZED MODEL OF CORRUPTION INDICATORS AND THE PERCEIVED LEVEL OF CORRUPTION

Based on the factor analysis results of corruption indicators, and the respondents‟ perceived level of corruption, a hypothesized structural equation model (as shown in Figure 5.2) was proposed to investigate the underlying corruption indicators in the Chinese public construction sector. Theoretically, a structural equation model comprises several measurement models and a structural model. The measurement model describes how well the various observed variables measure the latent variables. The structural model describes the relationships among the latent variables (Molenaar et al. 2000; Wong and Cheung 2005; Molenaar et al. 2009; Eybpoosh et al. 2011). This hypothesized structural equation model contains six measurement models, including one measurement model measuring the perceived level of corruption and five measurement models measuring the five underlying factors of corruption indicators (immorality, unfairness, opacity, procedural violation, and contractual violation). The hypothesized structural model contains one structural model, which measures the influences of the diverse underlying factors of corruption indicators on the perceived level of corruption. The underlying corruption indicators can be obtained by testing the hypothesized structural equation model. The hypothesized structural equation model consists of five hypotheses as follows.

*H1: The underlying factor immorality is positively correlated with the perceived level of corruption in the Chinese public construction sector*

*H2: The underlying factor unfairness is positively correlated with the perceived level of corruption in the Chinese public construction sector*

*H3: The underlying factor opacity is positively correlated with the perceived level of corruption in the Chinese public construction sector*

*H4: The underlying factor procedural violation is positively correlated with the perceived level of corruption in the Chinese public construction sector*

*H5: The underlying factor contractual violation is positively correlated with the perceived level of corruption in the Chinese public construction sector*

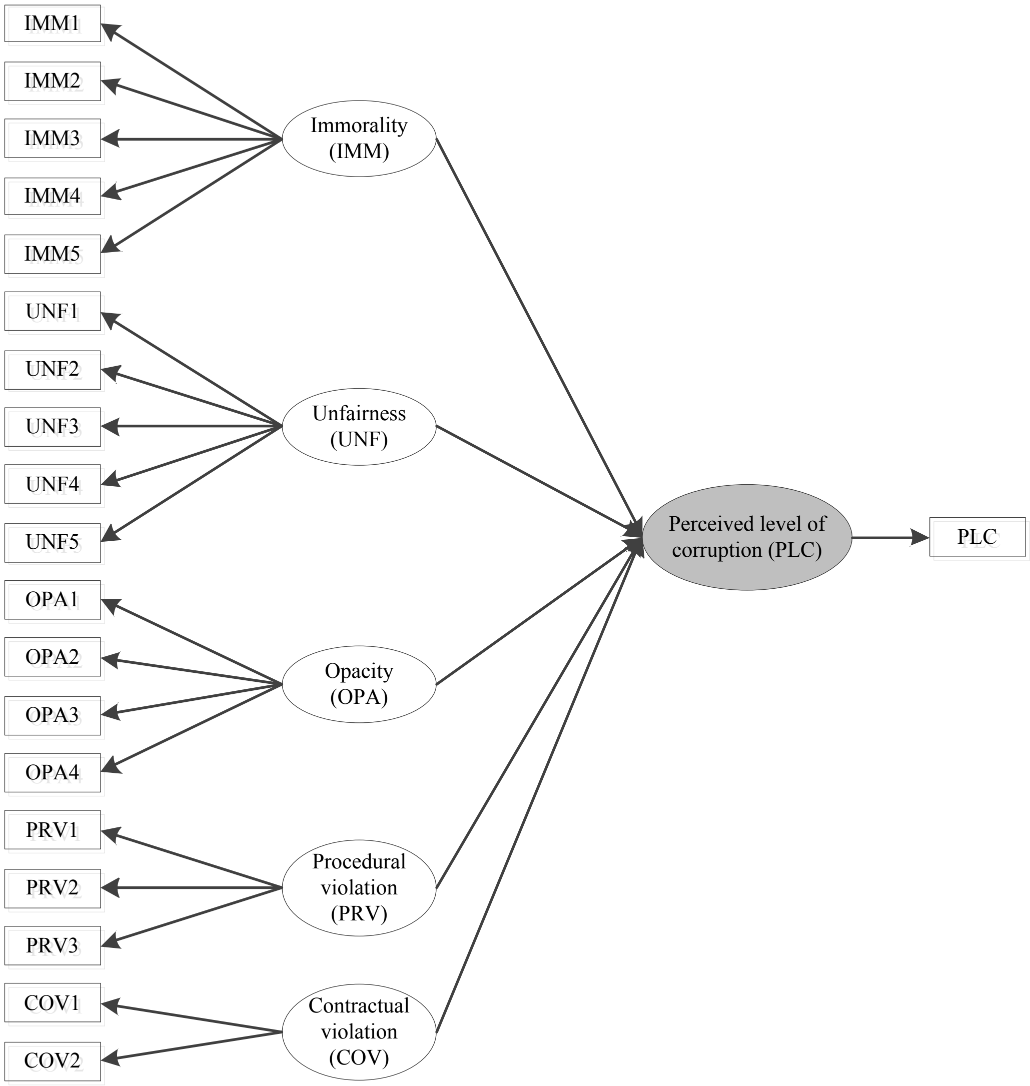



Figure 5.2 Hypothesized structural equation model of corruption indicators and the perceived level of corruption

## 5.4 MODEL EVALUATION

As previously mentioned in Section 3.5.2, partial least squares structural equation modeling (PLS-SEM) was adopted to test the hypothesized structural equation model. Data gathered from the questionnaire were entered into the Smart PLS 2.0M3 software to test the model. As a structural equation model is composed of several measurement models and a structural model, its model evaluation process consists of two separate sections, namely, the evaluation of the measurement models and the evaluation of the structural model.

### 5.4.1 Evaluation of the Measurement Models

As mentioned in Section 3.5.2, three indicators, namely, composite reliability (CR), loadings of measurement items on the corresponding construct, and average variance extracted (AVE), were examined to evaluate four kinds of validity of the measurement models, namely, (1) indicator reliability, (2) internal consistency reliability, (3) convergent validity, and (4) discriminating validity (Hair et al. 2011). Tables 5.2 to 5.4 show the evaluation results of the measurement models. Table 5.2 shows that (1) the loadings of all the corruption indicators are greater than 0.4, indicating an acceptable indicator reliability (Hulland 1999; Ning and Ling 2013); the CR values are over 0.7, suggesting a satisfactory level of reliability of internal corruption indicators with each construct (i.e. the underlying factor of corruption indicators) (Hair et al. 2011); and the AVE values are higher than 0.5, showing a satisfactory level of convergent validity of the constructs (Hair et al. 2011). Table 5.3 shows that the AVE of each construct is higher than its squared correlation with any other construct. Table 5.4 indicates that each corruption indicator has the highest loading on its corresponding construct. These results suggest the high discriminate validity of the constructs (Hair et al. 2011; Ning and Ling 2013).

Table 5.2 Evaluation results of measurement models

| Construct | Code | Loading | T-value | AVE | CR |
|---|---|---|---|---|---|
| IMM | IMM1 | 0.666 | 12.312 | 0.5479 | 0.7242 |
| | IMM3 | 0.495 | 8.766 | | |
| | IMM4 | 0.500 | 8.838 | | |
| | IMM5 | 0.621 | 11.111 | | |
| | IMM6 | 0.644 | 10.528 | | |
| UNF | UNF1 | 0.617 | 10.720 | 0.5665 | 0.7352 |
| | UNF2 | 0.544 | 11.377 | | |
| | UNF4 | 0.564 | 11.083 | | |
| | UNF5 | 0.491 | 8.733 | | |
| | UNF6 | 0.442 | 4.886 | | |
| OPA | OPA1 | 0.619 | 8.842 | 0.5940 | 0.7111 |
| | OPA3 | 0.574 | 10.640 | | |
| | OPA4 | 0.608 | 11.641 | | |
| | OPA5 | 0.405 | 4.503 | | |
| PRV | PRV1 | 0.588 | 11.646 | 0.5735 | 0.7282 |
| | PRV2 | 0.477 | 7.933 | | |
| | PRV3 | 0.497 | 8.483 | | |
| COV | COV1 | 0.729 | 16.922 | 0.5706 | 0.7892 |
| | COV2 | 0.559 | 8.279 | | |
| PLC | PLC | 0.821 | 17.261 | 0.6901 | 0.7722 |

Table 5.3 Correlation matrix and the square root of each construct‟s AVE

| | COV | PLC | IMM | OPA | PRV | UNF |
|---|---|---|---|---|---|---|
| COV | **0.7554*** | | | | | |
| PLC | 0.7233 | **0.8307*** | | | | |
| IMM | 0.6361 | 0.7986 | **0.7402*** | | | |
| OPA | 0.3912 | 0.7426 | 0.4258 | **0.7707*** | | |

| | COV | PLC | IMM | OPA | PRV | UNF |
|---|---|---|---|---|---|---|
| PRV | 0.4184 | 0.6753 | 0.4160 | 0.4258 | **0.7573*** | |
| UNF | 0.5412 | 0.8055 | 0.5194 | 0.5072 | 0.5070 | **0.7527*** |

Note: *square root of each construct"s AVE

Table 5.4 Cross loadings for individual corruption indicators

| | COV | PLC | IMM | OPA | PRV | UNF |
|---|---|---|---|---|---|---|
| COV1 | **0.7288** | 0.5445 | 0.4564 | 0.3170 | 0.3273 | 0.4207 |
| COV2 | **0.5591** | 0.3793 | 0.3659 | 0.1729 | 0.2018 | 0.2649 |
| PLC | 0.3001 | **0.8210** | 0.3314 | 0.3081 | 0.2802 | 0.3342 |
| IMM1 | 0.4816 | 0.5552 | **0.6664** | 0.3080 | 0.2626 | 0.4219 |
| IMM3 | 0.3044 | 0.4052 | **0.4948** | 0.2016 | 0.2185 | 0.2156 |
| IMM4 | 0.2772 | 0.3855 | **0.4996** | 0.1996 | 0.1653 | 0.2477 |
| IMM5 | 0.3778 | 0.4808 | **0.6211** | 0.2980 | 0.2567 | 0.2730 |
| IMM6 | 0.4022 | 0.5057 | **0.6442** | 0.2332 | 0.3079 | 0.3406 |
| OPA1 | 0.1680 | 0.3883 | 0.1223 | **0.6195** | 0.2290 | 0.2523 |
| OPA3 | 0.2852 | 0.4471 | 0.2530 | **0.5742** | 0.2258 | 0.3561 |
| OPA4 | 0.1974 | 0.4578 | 0.2790 | **0.6080** | 0.3060 | 0.3218 |
| OPA5 | 0.1911 | 0.2820 | 0.2786 | **0.4054** | 0.1310 | 0.1154 |
| PRV1 | 0.1956 | 0.3768 | 0.2052 | 0.2780 | **0.5883** | 0.2957 |
| PRV2 | 0.2087 | 0.3109 | 0.1467 | 0.1956 | **0.4766** | 0.2474 |
| PRV3 | 0.2521 | 0.3662 | 0.2913 | 0.1897 | **0.4972** | 0.2498 |
| UNF1 | 0.3331 | 0.4480 | 0.2815 | 0.2438 | 0.3179 | **0.6167** |
| UNF2 | 0.2879 | 0.3931 | 0.2295 | 0.1875 | 0.2538 | **0.5439** |
| UNF4 | 0.3127 | 0.4862 | 0.2913 | 0.3808 | 0.3416 | **0.5635** |
| UNF5 | 0.2031 | 0.3940 | 0.2827 | 0.2943 | 0.1260 | **0.4912** |
| UNF6 | 0.2417 | 0.3263 | 0.2478 | 0.1634 | 0.2427 | **0.4421** |

### 5.4.2 Evaluation of the Structural Model

Table 5.5 shows the path coefficients and corresponding *t*-statistics of the structural model. All five paths have *t*-values greater than 2.58, indicating that they are statistically significant at the 0.01 level (Hair et al. 2011). Therefore, the five hypotheses (*H1, H2, H3, H4,* and *H5*) are supported in the hypothesized sign. Figure 5.3 shows the test results of the hypothesized structural equation model.

Table 5.5 Evaluation results of the Structural Model

| **Paths** | **Hypothesized sign** | **Path coefficient** | ***t*-value** | **Inference** |
|---|---|---|---|---|
| IMM→PLC | + | 0.342 | 15.527 | Supported |
| UNF→PLC | + | 0.296 | 15.187 | Supported |
| OPA→PLC | + | 0.309 | 15.089 | Supported |
| PRV→PLC | + | 0.191 | 11.393 | Supported |
| COV→PLC | + | 0.145 | 8.077 | Supported |

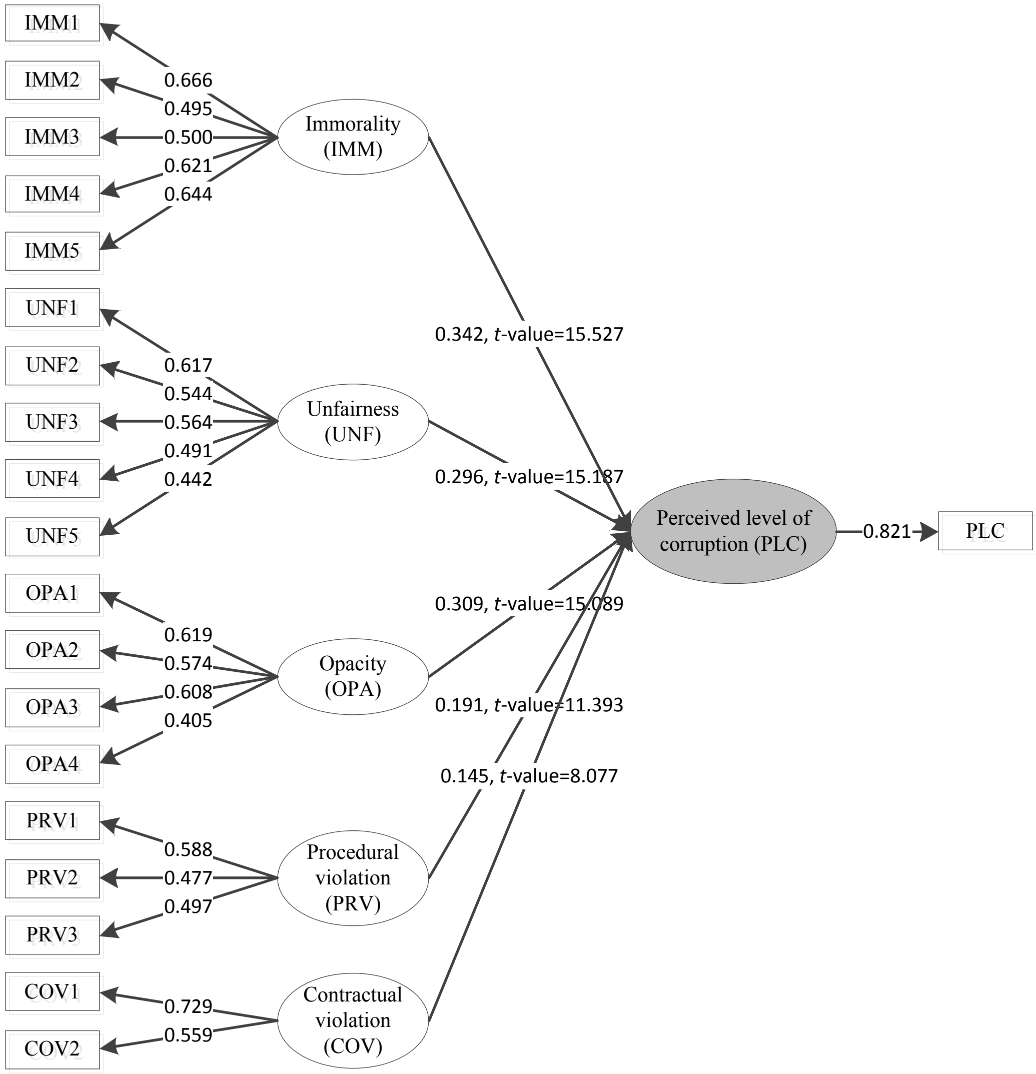



Figure 5.3 Testing results of the hypothesized structural equation model

## 5.5 THE UNDERLYING CORRUPTION INDICATORS IN THE CHINESE PUBLIC CONSTRUCTION SECTOR

Based on the PLS-SEM results, all the statistical indicators were found to be acceptable, which validated the five hypotheses proposed in this chapter (Hair et al. 2011). The PLS-SEM results suggest that the construct of immorality has the highest influence on the perceived level of corruption in the Chinese public construction sector with a path coefficient of 0.342, which can be regarded as the most influential underlying corruption indicator. Following immorality are opacity (0.309), unfairness (0.296), procedural violation (0.191), and contractual violation (0.145). The five underlying corruption indicators are discussed as follows.

## 5.5.1 Immorality

Immorality was regarded in this study as the most influential corruption indicator in the Chinese public construction sector. It mainly refers to the corruption indicators that can be attributed to the immoral initiatives of industry practitioners.

Immorality can be explained as a kind of behavior that is in active opposition to a body of standards or principles considered good and right (Olivier De Sardan 1999; Letki 2006). Corruptors inevitably perform immoral conducts when they engage in corruption. This study reveals that a large number of corrupt practices performed by various industry practitioners in the Chinese public construction sector have a high correlation with immoral initiatives. Examples of specific scenarios are as follows:

- Many immoral contractors are reluctant to construct the project rigorously based on the original design sanctioned and are inclined to propose many construction changes as possible to reap an extra profit. To obtain the approval of these proposed changes, they bribe the client or consultant staff.

Previous research has validated the close relationships between corruption and excessive construction change orders in a project (Love et al. 2002; Wu et al. 2005; Fernie et al. 2006; Hwang and Low 2012).

- To secure a project, a contractor who does not meet due qualified requirements may cheat in project biddings by using the qualification certificates of others. However, before doing this, the contractor usually has already established a corrupt relationship with immoral client staff who allows them to do so (Jaselskis and Talukhaba 1998; Zarkada-Fraser 2000; Oo et al. 2010).

- An immoral contractor may substitute qualified materials with substandard materials during the construction process. It is a common corrupt practice in projects in which corruption was verified. Through this substitution, the corrupt contractor can compensate for their previous loss in paying bribes (Zou 2006; Deng et al. 2014).

- Immoral site supervisor staff members who take bribes from a contractor may neglect their duties by exercising looser supervision on the contractor‟s works so that the contractor can reap a higher profit with their substandard works performed during the construction stage (Zou 2006; Deng et al. 2014).

### 5.5.2 Opacity

Opacity was regarded in this study as the second most influential corruption indicator in the Chinese public construction sector. It is mainly related to specific corruption indicators with opacity characteristics.

Considerable research efforts have proved that opacity provides a fertile soil for corruption to flourish in the construction sector because it hinders the public from accessing project information and disallows the monitoring of corrupt practices (Wang et al. 1999; Fan 2002a; 2002b; Zhang and Zhu 2007; Tabish and Jha 2011a; Le et al. 2014b). Opacity is a crucial issue in the Chinese public construction sector as evidenced in this study, particularly in project awarding. Examples of specific cases are listed as follows:

- A large public project calling for bids may be clandestinely split into several small projects by corrupt government officials or client staff, and then contracted directly to the companies they prefer. This misconduct is notorious in China, even in national-level public project such as the Three Gorges Project (Xinhua Net 2014a).

- Some clients refuse to provide adequate publicity to project bidding information to ensure that their preferred companies win the contract. For example, they may set a short time for the bidding call announcement or advertise the bidding call announcement on a local newspaper which has a limited audience.

- The potential for opacity is large in the evaluation of tenders and in the subsequent contract awarding (Oo et al. 2010). Although the client is the one to select which tenderer to contract a project, a panel responsible for evaluating diverse tenderers should be established to facilitate the tenderer selection in the Chinese public construction sector (Ma 2007). The evaluating process by the evaluation panel is not usually accessible to the tenderers (Cao and Li 2008). Therefore, the corrupt members of the evaluation panel can give tenderers who bribed them favorable evaluations. Although the evaluation panel recommends a list of qualified tenderers based on their competence, corrupt client staff may still choose the unqualified contractor who bribed them. This process is also opaque to all the tenderers (Jiang and Feng 2007).

### 5.5.3 Unfairness

This section discusses unfairness, the third most influential corruption indicator in the Chinese public construction sector. It refers to specific corruption indicators with unfair characteristics.

Inevitably, corruption causes unfairness because corruptors provide unequal treatment between reputable companies and corrupt companies (Andersson and

Heywood 2009; Tabish and Jha 2011a). Similar to opacity, unfairness is also found in this study to be particularly prominent in the project awarding phase. For instance, the client could set some extreme requirements to exclude qualified tenderers from the bidders‟ list and only allow the "favored" tenderer to participate in the bidding. This method runs counter to the rule of fair competition. In another case, the client may relax the conditions and requirements for the unqualified companies who gave them bribes. The client may also intentionally disclose some underlying confidential information to a specific tenderer to ensure that the "favored" tenderer would win the contract. Moreover, the corruption indicators encapsulated by this underlying factor were also considered by previous studies as the misconducts most related to corruption and most easily perceived by industry practitioners (Deng et al. 2003; Krishnan 2009; Tabish and Jha 2011a).

### 5.5.4 Procedural Violation

The corruption indicators involved in procedural violation mainly refer to misconducts that are non-compliant with the routine principles and procedures of project procurement and construction. This study reveals that procedural violation is an essential part of corruption vulnerabilities in the Chinese public construction sector, consistent with the findings of previous studies on corruption in other countries, such as Nigeria (Alutu and Udhawuve 2009), South Africa (Bowen et al. 2012), India (Tabish and Jha 2011a; 2012), and

Turkey (Gunduz and Önder 2013). The main specific corruption indicators under procedural violation in the Chinese context are as follows:

- Some projects do not receive administrative approvals from the construction-related government department because of insufficient preparation for the project construction, for instance, insufficient environmental protection measures. However, the reality is that these projects may still be constructed even without inspection from the government department (Xinhua Net 2011a). To a certain extent, this situation could be attributed to the corrupt relationship between the client of the project and the government department.

- A situation exists in the Chinese public construction sector in which project funds may be embezzled by corrupt governmental officials (Deng et al. 2003), which leads to projects being limited in the sanctioned financial provisions. This misconduct causes different adverse consequences for public projects, such as contract dispute, and project delivery delay (Barros et al. 2013; Xie et al. 2014).

- Some projects are not rigorously constructed on the basis of the sanctioned purpose. For instance, some corrupt officials who took bribes from a company could allow parts of a project, which is originally designed as a public utility, to be changed into a commercial center and then lease the commercial center to the company. These misconducts have been reported many times by the Chinese media (Zhongzheng Net 2009; Hebei News 2013).

### 5.5.5 Contractual Violation

The specific corruption indicators involved in contractual violation mainly refer to the non-compliance with or the misuse of contract provisions. This study demonstrates two specific corruption indicators encapsulated in this underlying corruption indicator as follows:

- Contractors may not deploy sufficient technical staff and equipment as they promised in the contract. However, only a few contractors were reported to be blamed or fined for this violation (Meng 2006; Shen et al. 2006; Meng 2007; Ye et al. 2013), which could be attributed to the corrupt relationship between contractors and clients.

- The escalation clause has been widely misused by corrupt client staff and contractors to gain improper profits (Lan 1999; Li 2010; China News 2012; Ye et al. 2013). For instance, a client staff may actively approve of a material inflation claim proposed at an unreasonably high price by a contractor for the promised kickback to be provided by the contractor.

## 5.6 CASE STUDY

In this section, a prosecuted corruption case is scrutinized in detail to triangulate the research findings obtained from the model validation in the chapter. On 15 November 2010 a renovated energy saving residential building in Jingan District, Shanghai was burnt down, resulting in the loss of 58 lives, 71 people injured, and economic loss of CNY 158 million (approximately USD 25.5 million). The case appeared to have been referred to as a construction safety accident. However, the investigation report revealed that the root cause of the accident was corruption in construction. The case and the details related to corruption are discussed as follows.

The case pertains to a renovated energy saving project funded by the Jingan District Construction and Traffic Committee (JDCTC). The implementation of the project was arbitrarily proposed by the chief director of JDCTC and thus, the project received no legal administrative approval and legal financial sanctions from the government. The general manager of Shanghai Jiayi Construction and Decoration Co. Ltd. (SJCD) has an intimate relationship with the chief director of JDCTC, who suggested the project to be awarded to SJCD even when the project was still at its conception stage. Nevertheless, SJCD did not meet any of the qualification requirements of contracting the project. Under such a circumstance, the chief director of JDCTC brought forward that the project be awarded first to Jingan General Construction Company (JGCC), who met the contracting qualification requirements, which would then eventually subcontract the project to SJCD. However, JGCC was not in the shortlist of eligible candidate companies that could contract renovated energy saving projects in Jingan District. Thus, the chief director of JDCTC decided arbitrarily to update the shortlist to include JGCC.

As a recommended consulting company of JDCTC, Shanghai Fuda Engineering Management Consulting Co. Ltd. (SFEMC) secured the bidding consultancy contract for the project. Based on the contract, SFEMC was responsible for administering the bidding procedures for the project in behalf of JDCTC. Considering that the project would be eventually awarded to SJCD, which was not qualified to contract the entire project, SFEMC proposed an illegal bidding mode that would help SJCD secure the project in a speciously legal manner. Under the proposed bidding model, the entire renovated energy saving project was split into three small projects to enable SJCD to undertake each project legally. A small project was selected to call for bids and would be awarded to SJCD, as planned. Subsequently, the other two small projects were awarded directly to SJCD based on the consideration that the two other projects were highly similar to the project that had openly called for bids.

SJCD was not a qualified candidate contractor that can undertake a renovated energy saving project in Jingan District, and thus, JGCC participated in the project bidding in behalf of SJCD. Based on the arrangement of a staff member from JDCTC, two construction companies together with JGCC submitted the bidding documents. However, all bidding documents were prepared by SJCD and the representatives of the three companies in the bidding meeting were all from SJCD. Finally, the project was awarded to JGCC and then subcontracted to SJCD, as planned. Although SJCD secured the project, it could not undertake it because the company only has ten employees. SJCD divided the project into three parts, namely, energy saving branch, scaffolding branch, and aluminum window branch. SJCD then subcontracted these parts to different contractors. However, such subcontracting violates the construction law in China.

Utilizing Shanghai Dimu Property Management Co. Ltd. (SDPM) as a front company, two local merchants secured the scaffolding branch by bribing a deputy general manager of SJCD. Subsequently, SDPM illegally subcontracted the scaffolding branch further to a welding foreman. The welding foreman hired two frontline workers to implement the welding operation. For the two frontline workers, one had an outdated welding operation certificate, while the other one did not possess a welding operation certificate.

Meanwhile, with the help of a staff member from JDCTC, Shanghai Zhengjie Energy Saving Engineering Co. Ltd. (SZESE) secured the energy saving branch from SJCD and took charge of supplying insulation materials for the project.

On 15 November 2010, a splash spark from the illegal welding operation of the two unqualified frontline workers ignited the insulation materials, which were supplied by SZESE and should have been flame–retardant materials. The network of the related parties in this case is depicted in Figure 5.4.

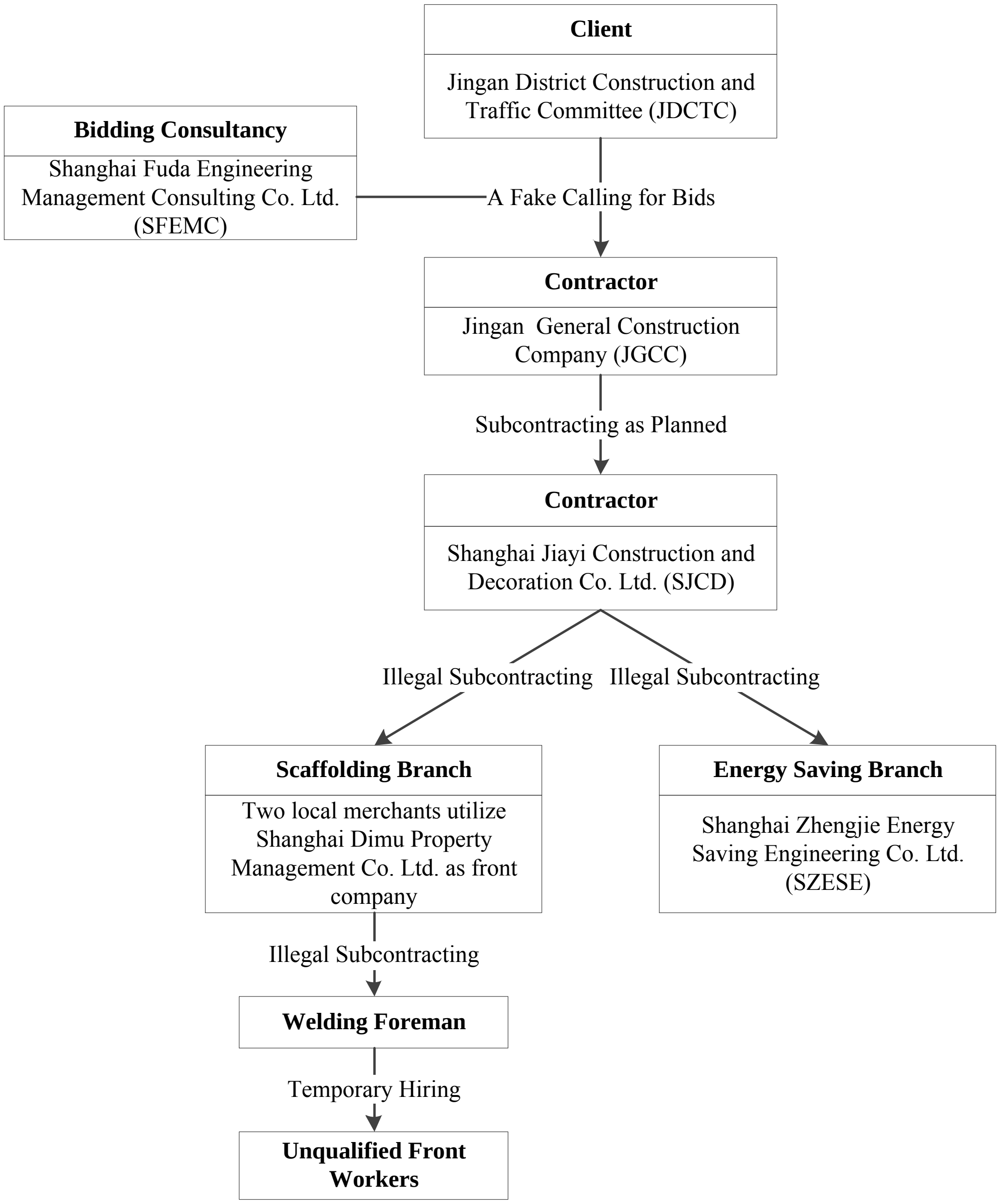



Figure 5.4 Overview of the Corruption Case

After scrutinizing the case, a total of 21 specific corruption indicators were identified and categorized under different underlying corruption indicators, as shown in Table 5.6. Among these specific corruption indicators, seven refered to immorality, this had the highest frequency, followed by opacity (5), unfairness (4), procedural violation (3), and contractual violation (2). Such results echo the findings obtained in previous sections in the chapter that immorality is the most siginificant underlying corruption indicator in public construction projects, followed by opacity, unfairness, procedural violation, and contractual violation.

Table 5.6 Specific Corruption Indicators Involved in the Case

| **No.** | **Corruption indicator** | **Underlying corruption indicator** |
|---|---|---|
| 1 | Being organized by the staff of JDCTC, a fake biddingwas conducted and the project was awarded to JGCC as have planned. | Immorality |
| 2 | JGCC, the company serving as the front contractor of the project, was affiliated with JDCTC, namely the client of the project. | |
| 3 | The Chief Director of JDCTC actively recommended the project to be awarded to SJCD even it has poor records in construction safety. | |
| 4 | An official of JDCTC helped SZESE secure the subcontract of insulation materials branch. | |
| 5 | The insulation materials provided by SZESE are unqualified that they are not flame retarded as they should be. | |
| 6 | The two local merchants secured the subcontract of scaffolding branch by utilizing SDPM as a front company. | |

| No. | Corruption indicator | Underlying corruption indicator |
|---|---|---|
| 7 | The chief site supervisor neglects his duties that he did not halt construction work even he had found the project was undergoing without due administrative approval as well as a detailed construction scheme. | |
| 1 | The chief director of the government designated SJCD to undertake the project even before the project was started. | Opacity |
| 2 | When he was told that SJCD could not undertake the project subject to the fact that it dissatisfied the due qualification requirement, the chief director of JDCTC proposed to award the project to JGCC first and then subcontract it to SJCD. | |
| 3 | SFEMC proposed to split the entire project into three small projects to make sure SJCD undertake the project legally. | |
| 4 | To award the project to JGCC, the chief director of JDCTC made JGCC an eligible candidate company who could undertake renovated energy saving project in Jingan District by updating the candidate shortlist optionally. | |
| 5 | The supplier of insulation materials was determined in advance under the influence from the government officials. | |
| 1 | SFEMC, the bidding consultancy for the project, was not appointed after an open competition. | Unfairness |
| 2 | The site supervisor was not appointed after proper publicity and open competition. In reality the appointed site supervisor has direct interest relationship with the client of the project. | |
| 3 | An invited bidding was conducted to determine the suppliers of insulation materials, which should have been an open bidding based on the regulations. | |

| No. | Corruption indicator | Underlying corruption indicator |
|---|---|---|
| 4 | Bid evaluation panel provided biased evaluation to the favored supplier of insulation materials. | |
| 1 | The proect received neither legal administrative approval nor legal financial sanctions from the government. | Procedural violation |
| 2 | The chief director of the government department, namely JDCTC, sanctioned the project illegaly. | |
| 3 | The project was in lack of financial provisions. | |
| 1 | SJCD subcontracted the project to different subcontractors illegally because in reality SJCD has no adequate technical staffs to implement the project. | Contractual violation |
| 2 | The majority contracts were signed in the name of JGCC but using the stamp of SJCD. | |

## 5.7 CHAPTER SUMMARY

This chapter first investigated the prioritization of corruption indicators from various perspectives, such as the assessment of its probability, severity, as well as the simultaneous consideration of probability and severity. Subsequently, following a partial least squares structural equation modeling analysis, five underlying corruption indicators in the Chinese public construction sector, namely, immorality, opacity, unfairness, procedural violation, and contractual violation, were consolidated and discussed. Finally, a prosecuted construction corruption case was scrutinized in detailes, the findings of which also echoed the results obtained from the partial least squares structural equation modeling analysis.

# CHAPTER 6 INVESTIGATING THE PRINCIPAL CAUSES OF CORRUPTION IN THE CHINESE PUBLIC CONSTRUCTION SECTOR

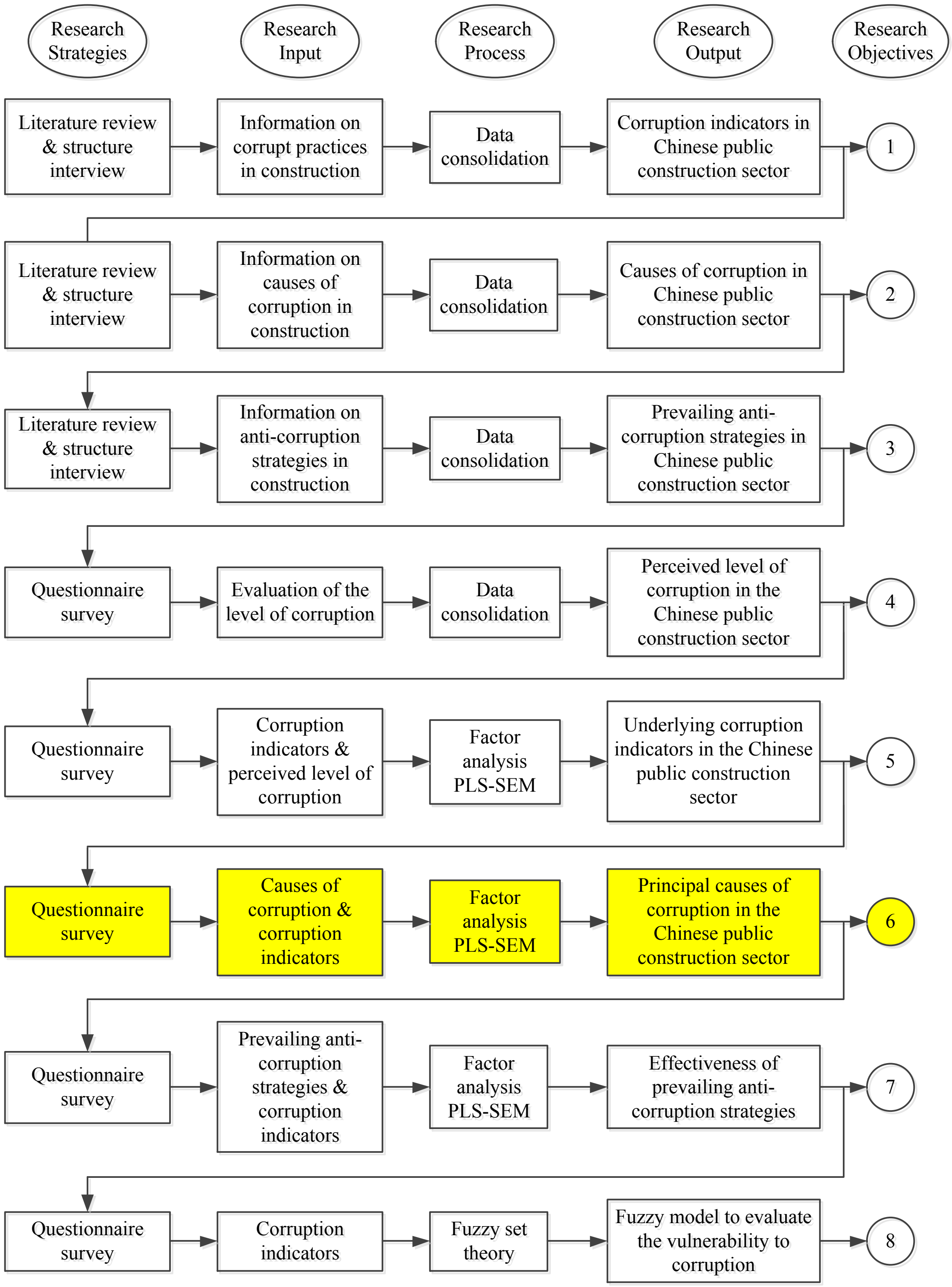



Figure 6.1 Overall flow of research

# CHAPTER 6 INVESTIGATING THE PRINCIPAL CAUSES OF CORRUPTION IN THE CHINESE PUBLIC CONSTRUCTION SECTOR[3]

## 6.1 INTRODUCTION

This chapter explores the principal causes of corruption by testing a hypothesis that causes of corruption are positively correlated with corruption indicators in the Chinese public construction sector, by using PLS-SEM method. The principal causes of corruption including other relevant specific causes that have a significant contribution to corruption are investigated in this chapter.

## 6.2 A HYPOTHESIZED MODEL OF CAUSES OF CORRUPTION AND CORRUPTION INDICATORS

Sustained efforts have been made to investigate causes of corruption in the construction sector, particularly in the public sector. Because corruption is regarded as a result of an unethical decision (Zarkada-Fraser and Skitmore 2000; Liu et al. 2004; Moodley et al. 2008), prior studies have revealed several explanations at the macro level. First, a defective law system may provide

[3] Major part of this chapter has been published in the following paper:
Le, Y., Shan, M.*, Chan, A.P.C., & Hu, Y. (2014). Investigating the causal relationships between causes of and vulnerabilities to corruption in the Chinese public construction sector. *ASCE Journal of Construction Engineering and Management*, 140(9), 05014007.

opportunity for corruption (Bologna and Del Nord 2000; Sha 2004). Ling and Tran (2012) observed that over-close relationships among contracting parties could lead to corruption. Bowen et al. (2012) stated that the negative role models of public officials and absence of deterrents and sanctions are key causes of corruption in construction. Apart from these cause, Sohail and Cavill (2008) and Tabish and Jha (2011a) emphasized that the occurrence of corruption is due to deregulation in the public construction sector, excess competition of the construction market, and inappropriate political interference in investment decision making. Tanzi (1998) further examined the causes of corruption at multiple levels and aspects, such as regulations and authorizations, discretionary decisions, wage level of public servants, penalty systems, institutional controls, transparency, as well as role models of leadership.

Based on the findings of Section 4.3.3, a hypothesized structural equation model was constructed as shown in Figure 6.2. Different from the hypothesized model of Chapter 5, the hypothesized model of causes of corruption and corruption indicators comprises two second-order hierarchical models except for the common measurement model and structural model. To be specific, this hypothesized model contains seven measurement models, including two measurement models measuring the two constructs of causes of corruption, namely, flawed regulation systems and the lack of a positive industrial climate, and five measurement models measuring the five constructs of corruption indicators, namely, immorality, unfairness, opacity, procedural violation, and contractual violation. Meanwhile, this hypothesized model contains two second-order hierarchical models which measure the causes of corruption and corruption indicators, respectively. With respect to these hierarchical models, causes of corruption were considered as a two-dimensional and second-order construct, and corruption indicators were considered as a five-dimensional and second-order construct. The development of second-order hierarchical model followed the approach advocated by Wetzels et al. (2009) because it maximizes the interpretability of both measurement and the hierarchical models. Additionally, the hypothesized model contains one structural model which measures the causal relationships between causes of corruption and corruption indicators. The hypothesis that causes of corruption are positively correlated with corruption indicators is to be tested within this hypothesized structural equation model.

## 6.3 MODEL EVALUATION

Data of causes of corruption and corruption indicators were collected from the questionnaire survey and input the software Smart PLS 2.0M3 to test the hypothesized structural equation model. Given that the hypothesized structural equation model contains three types of components, namely, measurement models, hierarchical models, and the structural model; its evaluation was also conducted in three steps, which focused on each type of component respectively.

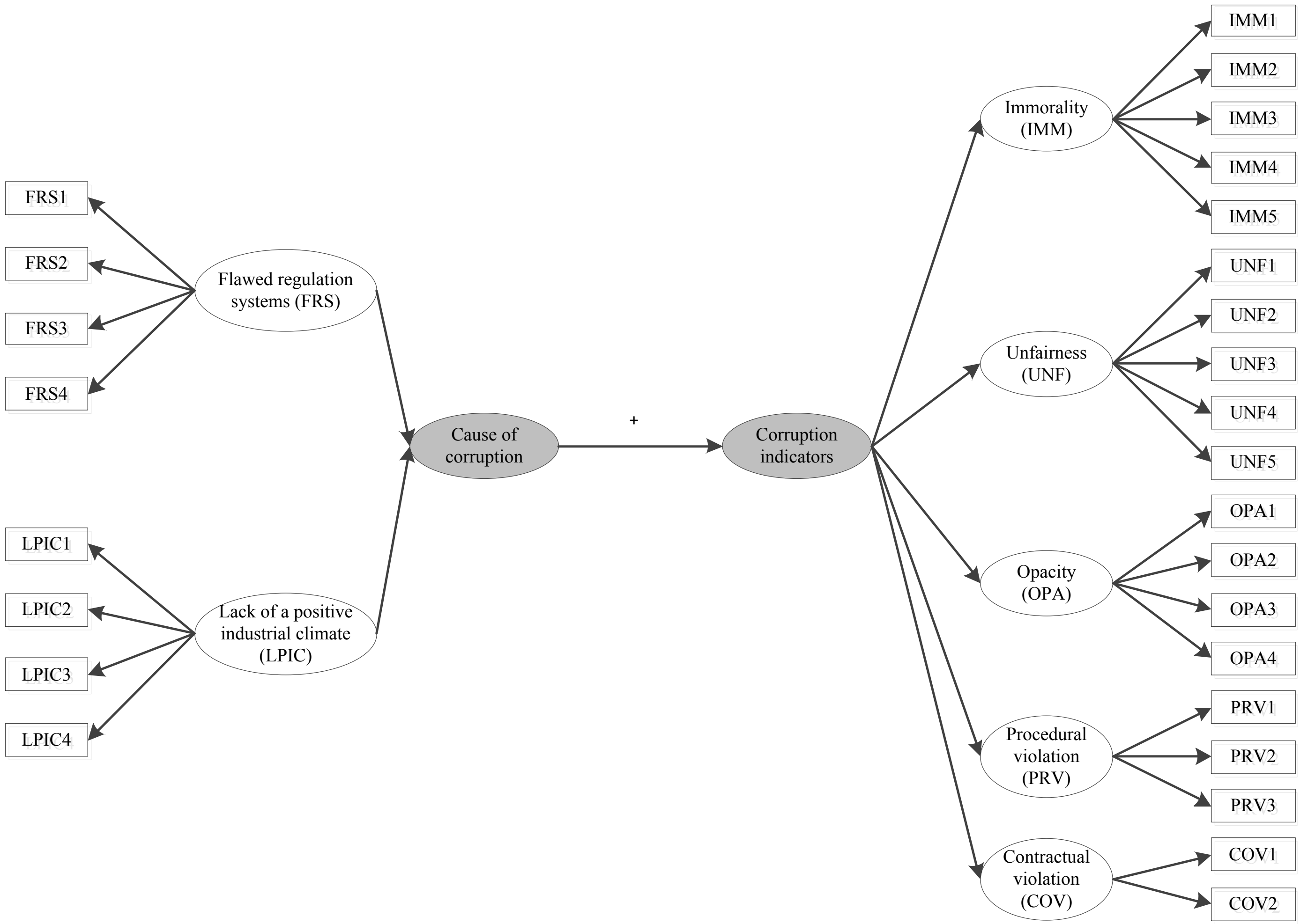



Figure 6.2 A hypothesized structural equation model of causes of corruption and corruption indicators

### 6.3.1 Evaluation of Measurement Models

The evaluation criteria for the measurement models specific to key underlying causes of corruption and underlying factors of corruption indicators are exactly the same as those have previously been introduced in Section 5.4.1, which would not be repeated in this section. As shown in Tables 6.1 to 6.3, the results of four kinds of validity evaluating the measurement models (i.e. internal consistency reliability, indicator reliability, convergent validity, and discriminating validity), were all found to be satisfactory.

Table 6.1 Evaluation results of measurement models

| **Direction** | **Loading** | **Weight** | **T-value** | **AVE** | **CR** |
|---|---|---|---|---|---|
| FRS1←FRS | 0.600 | 0.2789 | 8.3170 | 0.5143 | 0.8069 |
| FRS2←FRS | 0.683 | 0.3447 | 10.1444 | | |
| FRS3←FRS | 0.737 | 0.3462 | 10.9578 | | |
| FRS4←FRS | 0.830 | 0.4124 | 14.0376 | | |
| LPIC1←LPIC | 0.669 | 0.3437 | 9.9917 | 0.5403 | 0.8238 |
| LPIC2←LPIC | 0.783 | 0.3502 | 13.0040 | | |
| LPIC3←LPIC | 0.691 | 0.2768 | 7.7230 | | |
| LPIC4←LPIC | 0.789 | 0.3858 | 13.4034 | | |
| PRV1←PRV | 0.794 | 0.4670 | 11.2432 | 0.5461 | 0.7820 |
| PRV2←PRV | 0.658 | 0.3851 | 8.9278 | | |
| PRV3←PRV | 0.758 | 0.4957 | 10.791 | | |
| UNF1←UNF | 0.767 | 0.2557 | 15.3066 | 0.5600 | 0.8638 |
| UNF2←UNF | 0.801 | 0.2531 | 14.1633 | | |
| UNF3←UNF | 0.767 | 0.2839 | 13.2561 | | |

| Direction | Loading | Weight | T-value | AVE | CR |
|---|---|---|---|---|---|
| UNF4←UNF | 0.689 | 0.2457 | 11.5474 | | |
| UNF5←UNF | 0.712 | 0.3007 | 15.58 | | |
| OPA1←OPA | 0.615 | 0.2371 | 5.8088 | 0.5523 | 0.8301 |
| OPA2←OPA | 0.801 | 0.3699 | 12.6199 | | |
| OPA3←OPA | 0.789 | 0.3495 | 12.174 | | |
| OPA4←OPA | 0.752 | 0.3748 | 11.4131 | | |
| IMM1←IMM | 0.687 | 0.2455 | 11.9562 | 0.5485 | 0.8584 |
| IMM2←IMM | 0.732 | 0.2484 | 11.4736 | | |
| IMM3←IMM | 0.719 | 0.2921 | 11.3353 | | |
| IMM4←IMM | 0.772 | 0.2731 | 14.248 | | |
| IMM5←IMM | 0.789 | 0.2899 | 14.1749 | | |
| COV1←COV | 0.799 | 0.5828 | 9.4346 | 0.6686 | 0.8013 |
| COV2←COV | 0.836 | 0.6391 | 10.4413 | | |

Table 6.2 Correlation matrix and square root of AVE values of underlying factors

| | COV | FRS | IMM | LPIC | OPA | PRV | UNF |
|---|---|---|---|---|---|---|---|
| **COV** | **0.8177*** | | | | | | |
| **FRS** | 0.4069 | **0.7171*** | | | | | |
| **IMM** | 0.5599 | 0.4882 | **0.7406*** | | | | |
| **LPIC** | 0.1854 | 0.4726 | 0.3092 | **0.7351*** | | | |
| **OPA** | 0.2316 | 0.2465 | 0.4492 | 0.1674 | **0.7432*** | | |
| **PRV** | 0.3990 | 0.3329 | 0.4210 | 0.1167 | 0.4601 | **0.7390*** | |
| **UNF** | 0.4615 | 0.3836 | 0.5508 | 0.2310 | 0.5941 | 0.5012 | **0.7483*** |

**Note: *Square root of each underlying factor's AVE**

Table 6.3 Cross loadings for specific causes of and corruption indicators

| | COV | FRS | IMM | LPIC | OPA | PRV | UNF |
|---|---|---|---|---|---|---|---|
| **COV1** | **0.7989** | 0.3114 | 0.3944 | 0.1566 | 0.2110 | 0.3704 | 0.3396 |
| **COV2** | **0.8361** | 0.3527 | 0.5164 | 0.1472 | 0.1699 | 0.2864 | 0.4125 |
| **FRS1** | 0.3553 | **0.5999** | 0.3808 | 0.2287 | 0.2085 | 0.2156 | 0.2624 |
| **FRS2** | 0.2882 | **0.6826** | 0.3130 | 0.3633 | 0.1534 | 0.2878 | 0.3102 |
| **FRS3** | 0.1967 | **0.7369** | 0.2412 | 0.3204 | 0.1419 | 0.2351 | 0.1974 |
| **FRS4** | 0.3403 | **0.8298** | 0.4621 | 0.4186 | 0.2093 | 0.2235 | 0.3277 |
| **IMM1** | 0.4503 | 0.3510 | **0.6870** | 0.1693 | 0.3286 | 0.2989 | 0.2964 |
| **IMM2** | 0.4893 | 0.3108 | **0.7319** | 0.2437 | 0.2742 | 0.2383 | 0.3226 |
| **IMM3** | 0.3435 | 0.3348 | **0.7194** | 0.1615 | 0.4024 | 0.2999 | 0.5502 |
| **IMM4** | 0.3764 | 0.3796 | **0.7716** | 0.2522 | 0.3459 | 0.3250 | 0.3899 |
| **IMM5** | 0.4301 | 0.4254 | **0.7888** | 0.314 | 0.3051 | 0.3867 | 0.4508 |
| **LPIC1** | 0.1199 | 0.4166 | 0.1964 | **0.6691** | 0.0905 | 0.0095 | 0.1492 |
| **LPIC2** | 0.1280 | 0.3210 | 0.2865 | **0.7833** | 0.1571 | 0.1131 | 0.1869 |
| **LPIC3** | 0.0285 | 0.1986 | 0.1138 | **0.6908** | 0.0878 | 0.0241 | 0.0753 |
| **LPIC4** | 0.2371 | 0.4200 | 0.2846 | **0.7891** | 0.1477 | 0.1742 | 0.2420 |
| **OPA1** | 0.1268 | -0.0063 | 0.1417 | 0.0982 | **0.6153** | 0.2725 | 0.3146 |
| **OPA2** | 0.2881 | 0.2573 | 0.3402 | 0.1277 | **0.8010** | 0.3038 | 0.5066 |
| **OPA3** | 0.1791 | 0.1216 | 0.3517 | 0.0750 | **0.7894** | 0.3891 | 0.4164 |
| **OPA4** | 0.0864 | 0.2944 | 0.4454 | 0.1887 | **0.7523** | 0.3926 | 0.4977 |
| **PRV1** | 0.3164 | 0.2091 | 0.2806 | 0.0146 | 0.3927 | **0.7941** | 0.3743 |
| **PRV2** | 0.2344 | 0.2282 | 0.1999 | 0.1595 | 0.3021 | **0.6582** | 0.3585 |
| **PRV3** | 0.3247 | 0.2974 | 0.4298 | 0.0979 | 0.3236 | **0.7580** | 0.3801 |
| **UNF1** | 0.2632 | 0.2484 | 0.3445 | 0.1671 | 0.4047 | 0.4006 | **0.7673** |
| **UNF2** | 0.3276 | 0.1954 | 0.3227 | 0.0974 | 0.3448 | 0.3751 | **0.8014** |
| **UNF3** | 0.3383 | 0.2326 | 0.3891 | 0.1850 | 0.5197 | 0.4684 | **0.7667** |
| **UNF4** | 0.2793 | 0.2171 | 0.4125 | 0.1707 | 0.4829 | 0.1846 | **0.6888** |
| **UNF5** | 0.4877 | 0.5031 | 0.5629 | 0.2299 | 0.4561 | 0.4174 | **0.7118** |

## 6.3.2 Evaluation of Hierarchical Models

The key evaluation criteria for the hierarchical models lie in its internal paths" T-values and composite reliability (CR) values. Table 6.4 shows that all path coefficients for the hierarchical models are significant with t-values greater than 2.58. Values of CRs are also over 0.7, suggesting a satisfactory reliability of the hierarchical models (Bagozzi and Yi 1988; Ling et al. 2013).

Table 6.4 Evaluation results of hierarchical models

| **Paths** | **Path coefficient** | **T-value** | **CR** |
|---|---|---|---|
| FRS→Causes of corruption | 0.605 | 15.330 | 0.8320 |
| LPIC→Causes of corruption | 0.560 | 14.306 | |
| Corruption indicators→PRV | 0.685 | 16.841 | 0.9045 |
| Corruption indicators→UNF | 0.861 | 51.096 | |
| Corruption indicators→OPA | 0.738 | 17.325 | |
| Corruption indicators→IMM | 0.820 | 22.166 | |
| Corruption indicators→COV | 0.640 | 12.106 | |

## 6.3.3 Evaluation of the Structural Model

The path coefficient between causes of corruption and corruption indicators has a t-value higher than 2.58, indicating its statistical significance at the 0.01 level (Henseler et al. 2009; Hair et al. 2011). The hypothesis that causes of corruption are positively correlated with corruption indicators is supported in the hypothesized sign. Figure 6.3 shows the testing results of the hypothesized model.

## 6.4 DISCUSSIONS OF PRINCIPAL CAUSES OF CORRUPTION

According to the PLS-SEM results, all the statistical indicators were found to be acceptable, which validated the hypothesis proposed in the chapter. The PLS-SEM results suggest that the causes of corruption have a positive correlation with the corruption indicators in the Chinese public construction sector. The results also show that flawed regulation systems and the lack of a positive industrial climate have a significant correlation with the causes of corruption. Moreover, flawed regulation systems emerged as the most principal cause of corruption with a path coefficient of 0.605, followed by the lack of a positive industrial climate, with a path coefficient of 0.560. The specific causes under the two principal causes of corruption are discussed as follows.

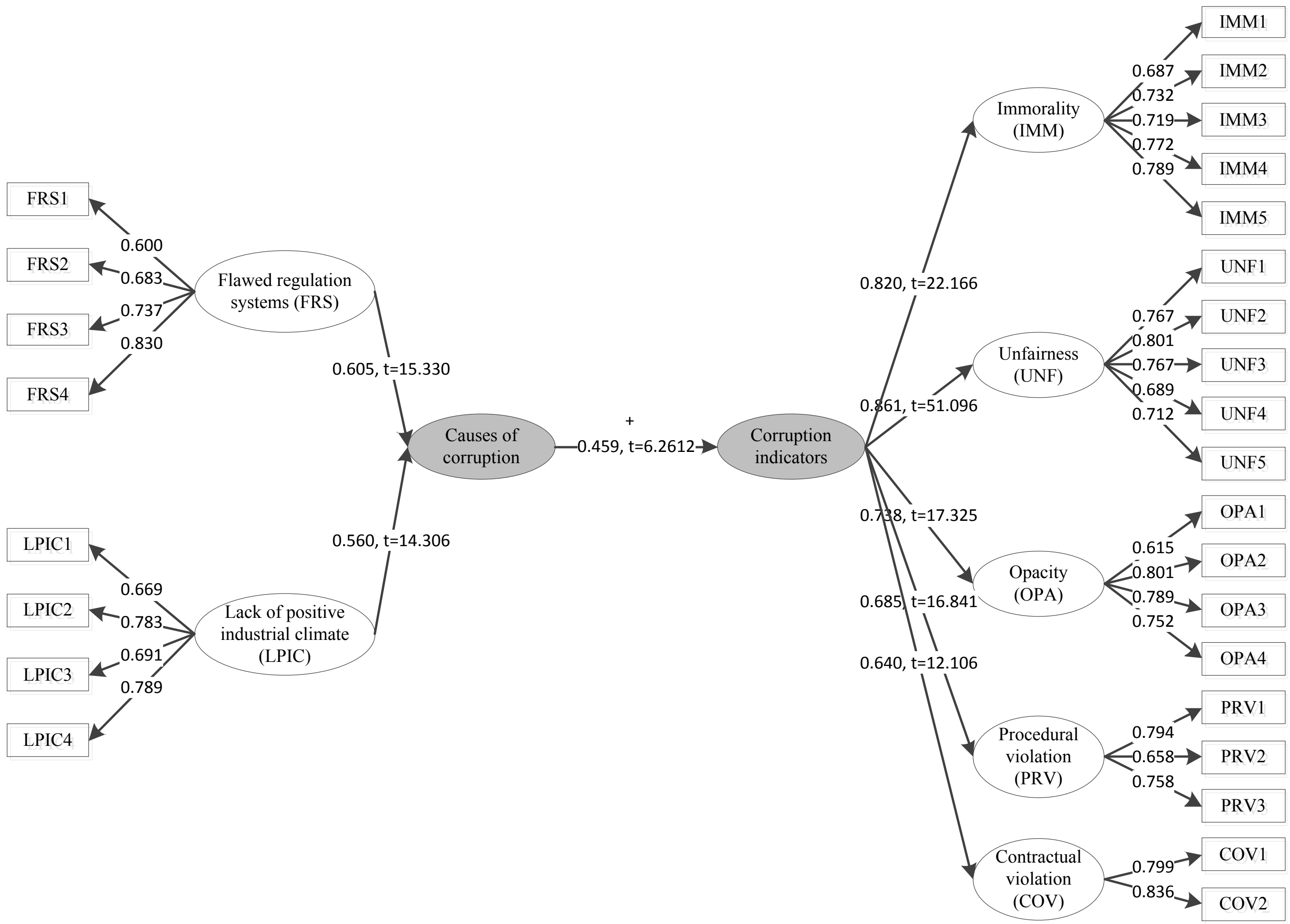



Figure 6.3 Testing result of the hypothesized structural equation model of causes of corruption and corruption indicators

### 6.4.1 Flawed Regulation Systems

Negative leader roles have the highest factor loading (0.830) on flawed regulation systems. Leadership plays a vital role in the formation of an organization‟s ethically oriented culture (Sims 1992; 2000; Schein 2006). Positive leader role can facilitate the achievement of a mission through fair and honest actions (Tabish and Jha 2012). Conversely, negative leader role can lead to corruption if leaders engage in corrupt practices themselves or if they overlook such practices performed by their friends, relatives, or colleagues. Under these circumstances, their subordinates may not behave differently (Tanzi 1998). According to Li et al. (2013), in most cases, corruption is undertaken in the Chinese context by a collective involving executives and staff within an organization. In a recent survey in South Africa, Bowen et al. (2012) reported similar findings that corrupt practices by an organization‟s leaders could have negative effects on their subordinates, who would follow these corrupt practices.

The inadequate sanctions item has the second highest factor loading (0.737) on flawed regulation systems. Theoretically, imposing significant sanctions on corrupt crimes largely reduces the occurrence of corruption (Tanzi 1998; Zarkada-Fraser 2000). However, the Chinese public believes that only a few suspects receive sanctions for their corrupt crimes (He 2000). Although the suspects may be sentenced to jail for their corrupt crimes, their terms of imprisonment are usually commuted by bribing the judicial department (Xinhua Net 2014b). Therefore, potential corruptors are not intimidated by inadequate sanctions, thus contributing to the occurrence of corruption.

Lack of rigorous supervision ranks third in flawed regulation systems. Rigorous supervision is usually regarded as one of the most effective anti-corruption measures (Tanzi 1998). However, a significant gap exists between the specification of supervising rules and its execution in the Chinese context (Ko and Weng 2011). This gap may be due to the high social cost that supervisors are reluctant to shoulder, such as losing a friend (Guo and Yang 2008). Moreover, supervisors themselves may be susceptible to corruption, which can also lead to the lack of rigorous supervision (Li et al. 2013). Under such circumstances, minor corrupt practices could evolve into major ones.

The item multifarious licenses and permits has the fourth highest factor loading (0.600) on flawed regulation systems. Obtaining several compulsory licenses and permits from government agencies is indispensable for a company to enter the public construction sector (Zou et al. 2007). However, in reality, the quantity of these licenses and permits appears to be so large that many companies find themselves rushing to obtain them all the time. A company is estimated to obtain 108 licenses and permits to enter the public construction market of Guangdong Province (Southern Metropolis Daily 2013). A lack of access to information and procedures on obtaining related licenses and permits in developing countries also exists (Tanzi 1998; Neelankavil 2002). To accelerate the process of obtaining licenses and permits, some companies choose to bribe government officials (Tanzi 1998; Argandona 2001).

### 6.4.2 Lack of a Positive Industrial Climate

The interpersonal connections item has the highest factor loading (0.789) on the lack of a positive industrial climate. Previous studies indicated that interpersonal connections are regarded as a critical factor for conducting business in China (Alston 1989). In a transitional society that lacks mature legislative and administrative systems, a company can gain competitive advantages and achieve business success by developing good interpersonal connections with governmental officials (Chan et al. 1999). Although interpersonal connections can make a company competitive and achieve business benefits, these benefits are usually obtained by exchanging favors with various parties, specifically by exchanging money and power (Fan 2002b). In China, interpersonal connections are synonymous with corrupt acts such as bribery, nepotism, and fraud to a certain extent (Yang 1994). Although corruption is common in every country, interpersonal connection provides a more fertile soil in China than in any other country for corruption to flourish (Fan 2002b).

Over-close relationships among contracting parties have the second highest factor loading (0.783) on the lack of a positive industrial climate. Although close relationships among contracting parties are regarded as a critical factor for the success of public construction projects (Ning and Ling 2013), over-close relationships can also trigger a risk in collusion, which is a form of corruption. Zarkada-Fraser and Skitmore (2000) defined collusion as a corrupt act in which various parties coordinate their behaviors surreptitiously and gain benefits by bringing loss to project benefits. In practice, identifying collusion is extremely difficult. Such misconduct is a common type of corrupt practice that refers to various contracting parties including clients, contractors, designers, consultants, and suppliers in the Chinese public construction sector (Legal Daily 2012).

Great project complexity has the third highest factor loading (0.691) on the lack of a positive industrial climate. Project complexity may impose pressure on the parties involved in a construction project, thus triggering corruption vulnerabilities (El-Sayegh 2008). According to Tanzi and Davoodi (1998), project complexity may increase difficulties in project management tasks such as contractual design, engineering design, project construction, and site supervision. Task uncertainty caused by project complexity also provides opportunities for potential corruptors (e.g., contractors) to reap personal benefits (Tanzi and Davoodi 1998). Le et al. (2013) and Li et al. (2013) reported that the complex and nonstandard production process of construction projects in the Chinese context could foster asymmetric information stocks among contracting parties, thus providing the opportunity for corruption to occur.

Poor professional ethical standards rank fourth in the factor loadings on the lack of a positive industrial climate. Professionals refer to a group of well-trained people organized to serve a body of specialized knowledge in the interests of society (Appelbaum and Lawton 1990). Professional ethics is a set of moral principles that govern the conduct for these professionals. Sohail and Cavill (2008) highlighted the seven principles for being an ethical professional, namely, fair reward, integrity, honesty, objectivity, accountability, reliability, and fairness. However, previous studies revealed the lack of professional and public morality in the construction sector of developing countries (Vee and Skitmore 2003; Bowen et al. 2007a; 2007b). Poor professional ethical standards are a root cause of corruption in developing countries.

## 6.5 CHAPTER SUMMARY

This chapter explored the principal causes of corruption by investigating the causal relationships between causes of corruption and corruption indicators in the public construction sector of China using PLS-SEM method. The results revealed that the causes of corruption are positively correlated with corruption indicators. Additionally, with respect to the two principal causes of corruption, namely, flawed regulation systems and the lack of a positive industrial climate, the former one was found to have a higher influence on corruption indicators in the public construction sector than the latter one. The results also indicated that the most influential cause of corruption under the flawed regulation systems was negative leader roles, followed by inadequate sanctions, the lack of rigorous supervision, and multifarious licenses or permits. The most influential cause of corruption under the lack of a positive industrial climate was interpersonal connections, followed by over-close relationships among contracting parties, great project complexity, and poor professional ethical standards.

# CHAPTER 7 INVESTIGATING THE EFFECTIVENESS OF THE PREVAILING ANTI-CORRUPTION STRATEGIES

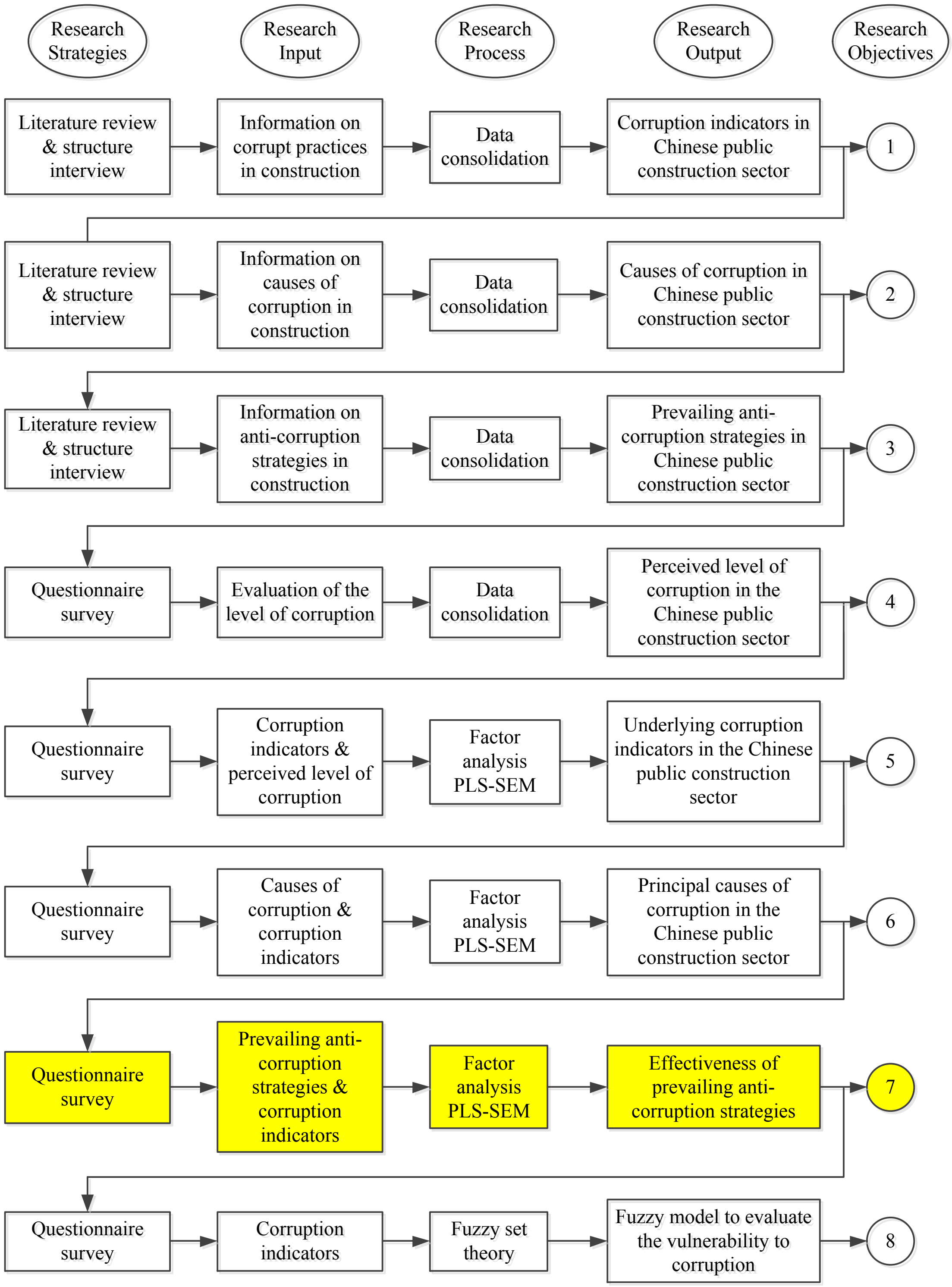



Figure 7.1 Overall flow of research

# CHAPTER 7 INVESTIGATING THE EFFECTIVENESS OF PREVAILING ANTI-CORRUPTION STRATEGIES[4]

## 7.1 INTRODUCTION

This chapter investigates the effectiveness of prevailing anti-corruption strategies by testing a hypothesis that prevailing anti-corruption strategies are negatively correlated with corruption indicators in the Chinese public construction sector, utilizing of the PLS-SEM method.

## 7.2 A HYPOTHESIZED MODEL OF PREVAILING ANTI-CORRUPTION STRATEGIES AND CORRUPTION INDICATORS

As mentioned in Section 4.2.3, the interview results revealed four major types of anti-corruption strategies, namely, leadership, rules and regulations, training, and sanctions, are being implemented in the Chinese public construction sector.

Leadership can develop and facilitate values of integrity in an organization which is manifested by appropriate actions (Tabish and Jha 2012). An eligible

[4] Major part of this chapter has been published in the following paper:
Shan, M., Chan, A.P.C., Le, Y.*, & Hu, Y. (2014). Investigating the effectiveness of response strategies for vulnerabilities to corruption in the Chinese public construction sector. *Science and Engineering Ethics*, 21(3), 683-705, doi: 10.1007/s11948-014-9560-x.

leader always communicates values of integrity to the rest of the organization and creates conditions that motivate people to behave in an upright way (Sööt 2012). Meanwhile, openness and strictness of leaders are also found to have a direct impact on the frequency of integrity violations by employees (Huberts et al. 2007). Therefore, selecting suitable leaders is vital for an organization to fight against corruption (Mumford et al. 2003).

Harboring the belief that corruption can be completely curbed without rules and regulations is perhaps naive given the long history of corruption in business and the understanding of human behavior that cannot be disciplined under a circumstance without any constraint (Ashforth et al. 2008). Rules and regulations have been deemed as the core component of anti-corruption strategies, because an organization must implement its mission and vision of anti-corruption policies with the aid of relevant rules and regulations (Klitgaard 1988; Ivancevich et al. 2003; Tabish and Jha 2012). A thorough regulation system is usually developed to increase transparency and accountability and to enforce penal codes against corruption, and can thus aid the "good guys" in controlling unsavory competitors and creating an impartial playing field (Ashforth et al. 2008; Misangyi et al. 2008).

Imposing training on industry practitioners is indispensable to corruption prevention in the construction industry (Smith 2009). This is because training can help practitioners to acquire knowledge of the damaging effects of corruption on society and teach them about the risks of corruption in the project execution and concrete skills coping with these risks (Schwartz 2004; Boehm and Nell 2007; Schwartz 2009). Many international associations, such as the International Federation of Consulting Engineers, the American Society of Civil Engineers, the U.K. Institution of Civil Engineers, the U.K. Chartered Institute of Building, and the U.K. Royal Institution of Chartered Surveyors, have incorporated training as an important component into their anti-corruption guidelines (Boyd and Padilla 2009; Crist Jr 2009; Le et al. 2014a).

Sanctions should be imposed for corrupt practices that have been detected (Tabish and Jha 2012). Imposed sanctions is an indispensable anti-corruption strategy that is affected by four factors, namely, probability of being caught, enforcement, independence of the judiciary from politicians, and equal access to the law for every one (Arvey and Ivancevich 1980; Jain 2001; Mulder et al. 2009). An adequate sanction can curb corruption, because the harsh punishment will undoubtedly change the cost-benefit calculation of potential corruptors, particularly in cases when the risk of being caught is sufficiently high (Johannsen and Pedersen 2012).

Based on the findings of Section 4.3.3, a structural equation model was hypothesized (as shown in Figure 7.2) to investigate the effectiveness of prevailing anti-corruption strategies in the Chinese public construction sector. Similar to the hypothesized model proposed in Chapter 6, the hypothesized model of the prevailing anti-corruption strategies and corruption indicators also comprises several measurement models, two second-order hierarchical models, and one structural model. To be specific, the hypothesized model contains nine measurement models, including four measurement models measuring the four constructs of anti-corruption strategies, namely, leadership, rules and regulations, training, and sanctions, and five measurement models measuring the five constructs of corruption indicators, namely, immorality, unfairness, opacity, procedural violation, and contractual violation. Meanwhile, the hypothesized model contains two second-order hierarchical models which measure the anti-corruption strategies and corruption indicators, respectively. With respect to these hierarchical models, anti-corruption strategies were considered as a four-dimensional and second-order construct, and corruption indicators were considered as a five dimensional and second-order construct. Additionally, the hypothesized model contains one structural model which measures the interrelationships between anti-corruption strategies and corruption indicators, which is exactly the effectiveness of the prevailing anti-corruption strategies. The hypothesis that the prevailing anti-corruption strategies are negatively correlated with corruption indicators is to be tested within this hypothesized structural equation model.

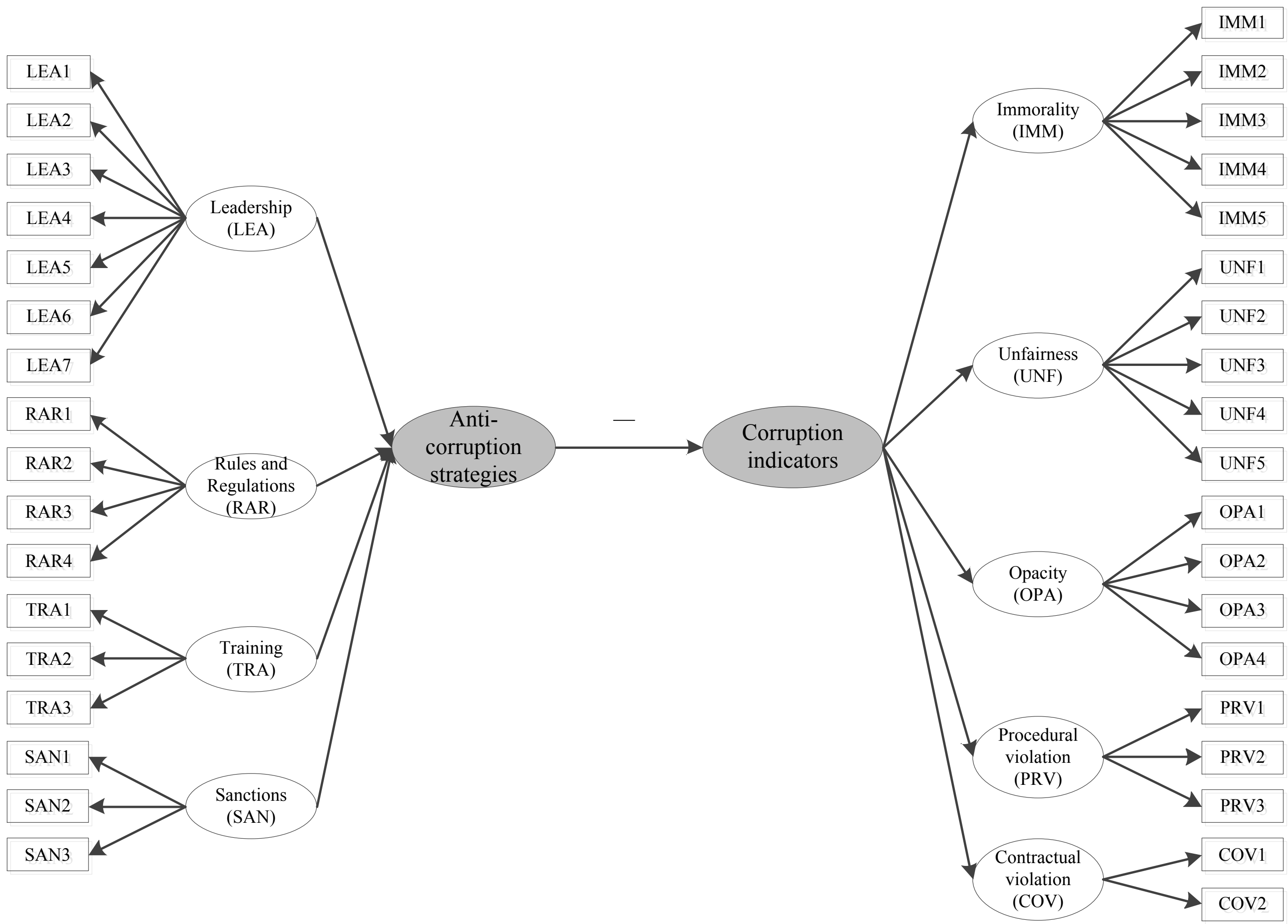



Figure 7.2 A hypothesis structural equation model of prevailing anti-corruption strategies and corruption indicators

## 7.3 MODEL EVALUATION

Data of the prevailing anti-corruption strategies and corruption indicators were collected from the questionnaire survey and then input the software Smart PLS 2.0M3 to test the hypothesized structural equation model. Considering that the structure of the hypothesized model in this Chapter is highly similar to the one proposed in Chapter 6, and that its evaluation process is also the same as that has been previously introduced in Section 6.3, the evaluation details of model would not be fully discussed in this Chapter. By reviewing the results of Tables 7.1 to 7.4 obtained from the evaluation process, it could be found that all the statistical indicators related to the evaluation of measurement models and hierarchical models are acceptable. Moreover, as the testing results shown in Figure 7.3, the path coefficient between the prevailing anti-corruption strategies and corruption indicators has a t-value that is higher than 1.96, suggesting its statistical significance at the 0.05 level (Henseler et al. 2009). The hypothesis that anti-corruption strategies are negatively correlated with corruption indicators is supported in the hypothesized sign.

Table 7.1 Evaluation results of measurement models

| Direction | Loading | Weight | T-value | AVE | CR |
|---|---|---|---|---|---|
| LEA1←LEA | 0.7747 | 0.1850 | 18.4748 | 0.6189 | 0.9189 |
| LEA2←LEA | 0.8291 | 0.1946 | 31.4307 | | |

| Direction | Loading | Weight | T-value | AVE | CR |
|---|---|---|---|---|---|
| LEA3←LEA | 0.8332 | 0.1906 | 31.9189 | | |
| LEA4←LEA | 0.7800 | 0.1685 | 22.5243 | | |
| LEA5←LEA | 0.6849 | 0.1478 | 14.8957 | | |
| LEA6←LEA | 0.8010 | 0.1894 | 24.0851 | | |
| LEA7←LEA | 0.7947 | 0.1915 | 27.7269 | | |
| RAR1←RAR | 0.8553 | 0.3554 | 38.5360 | 0.6061 | 0.8569 |
| RAR2←RAR | 0.8602 | 0.3881 | 35.8571 | | |
| RAR3←RAR | 0.8070 | 0.3363 | 26.0362 | | |
| RAR4←RAR | 0.5491 | 0.1652 | 7.3855 | | |
| TRA1←TRA | 0.6805 | 0.2194 | 6.1983 | 0.6564 | 0.8499 |
| TRA2←TRA | 0.8733 | 0.4206 | 16.3155 | | |
| TRA3←TRA | 0.8621 | 0.5607 | 22.6795 | | |
| SAN1←SAN | 0.8871 | 0.4166 | 55.4446 | 0.8147 | 0.9294 |
| SAN2←SAN | 0.9444 | 0.3603 | 82.7454 | | |
| SAN3←SAN | 0.8747 | 0.3317 | 32.1513 | | |
| PRV1←PRV | 0.7948 | 0.4683 | 20.7161 | 0.5462 | 0.7821 |
| PRV2←PRV | 0.6581 | 0.3847 | 11.3510 | | |
| PRV3←PRV | 0.7574 | 0.4945 | 15.2654 | | |
| UNF1←UNF | 0.7676 | 0.2562 | 22.1089 | 0.5601 | 0.8639 |
| UNF2←UNF | 0.8017 | 0.2537 | 22.1503 | | |
| UNF3←UNF | 0.7669 | 0.2842 | 19.0669 | | |
| UNF4←UNF | 0.6890 | 0.3847 | 12.6701 | | |
| UNF5←UNF | 0.7110 | 0.2993 | 17.3696 | | |
| OPA1←OPA | 0.6162 | 0.2382 | 8.2653 | 0.5524 | 0.8302 |
| OPA2←OPA | 0.8011 | 0.3700 | 23.7254 | | |
| OPA3←OPA | 0.7895 | 0.3496 | 25.4593 | | |
| OPA4←OPA | 0.7515 | 0.3736 | 17.7858 | | |

| Direction | Loading | Weight | T-value | AVE | CR |
|---|---|---|---|---|---|
| IMM1←IMM | 0.6867 | 0.2451 | 13.6543 | 0.5485 | 0.8584 |
| IMM2←IMM | 0.7316 | 0.2481 | 13.5434 | | |
| IMM3←IMM | 0.7199 | 0.2930 | 19.9375 | | |
| IMM4←IMM | 0.7716 | 0.2730 | 22.4705 | | |
| IMM5←IMM | 0.7887 | 0.2898 | 23.9111 | | |
| COV1←COV | 0.7994 | 0.5836 | 15.1437 | 0.6686 | 0.8013 |
| COV2←COV | 0.8356 | 0.6384 | 19.5299 | | |

Table 7.2 Correlation matrix and square root of AVE values of the underlying factors

| | COV | IMM | LEA | OPA | PRV | SAN | RAR | TRA | UNF |
|---|---|---|---|---|---|---|---|---|---|
| **COV** | **0.8177*** | | | | | | | | |
| **IMM** | 0.5597 | **0.7406*** | | | | | | | |
| **LEA** | -0.1090 | -0.1301 | **0.7867*** | | | | | | |
| **OPA** | 0.2317 | 0.4490 | -0.0337 | **0.7432*** | | | | | |
| **PRV** | 0.3990 | 0.4209 | -0.0405 | 0.4601 | **0.7391*** | | | | |
| **SAN** | -0.1405 | -0.0694 | 0.4103 | 0.0271 | 0.0557 | **0.9026*** | | | |
| **RAR** | -0.1913 | -0.2228 | 0.4972 | -0.0754 | -0.140 | 0.2835 | **0.7785*** | | |
| **TRA** | -0.0902 | -0.1074 | 0.3079 | 0.1422 | 0.0137 | 0.2747 | 0.3141 | **0.8102*** | |
| **UNF** | 0.4612 | 0.5507 | -0.1947 | 0.5938 | 0.5011 | -0.072 | -0.2408 | -0.0698 | **0.7484*** |

**Note: *Square root of each underlying factor's AVE**

Table 7.3 Cross loadings for the prevailing anti-corruption strategies and the specific corruption indicators

| | COV | IMM | LEA | OPA | PRV | SAN | RAR | TRA | UNF |
|---|---|---|---|---|---|---|---|---|---|
| **COV1** | **0.7994** | 0.3943 | -0.0506 | 0.2111 | 0.3705 | -0.1132 | -0.1473 | -0.1290 | 0.3394 |
| **COV2** | **0.8356** | 0.5163 | -0.1244 | 0.1700 | 0.2863 | -0.1166 | -0.1651 | -0.0234 | 0.4122 |
| **IMM1** | 0.4502 | **0.6867** | -0.0160 | 0.3282 | 0.2988 | 0.0411 | -0.0428 | -0.0706 | 0.2962 |

| | COV | IMM | LEA | OPA | PRV | SAN | RAR | TRA | UNF |
|---|---|---|---|---|---|---|---|---|---|
| **IMM2** | 0.4895 | **0.7316** | -0.1122 | 0.2740 | 0.2382 | -0.1154 | -0.1153 | -0.1653 | 0.3224 |
| **IMM3** | 0.3434 | **0.7199** | -0.0374 | 0.4022 | 0.2998 | -0.0488 | -0.1926 | 0.0369 | 0.5499 |
| **IMM4** | 0.3763 | **0.7716** | -0.1206 | 0.3458 | 0.3249 | -0.0188 | -0.1833 | -0.1083 | 0.3896 |
| **IMM5** | 0.4300 | **0.7887** | -0.1880 | 0.3049 | 0.3865 | -0.1083 | -0.2663 | -0.1047 | 0.4506 |
| **LEA1** | -0.0222 | -0.0470 | **0.7747** | -0.0032 | -0.0953 | 0.3719 | 0.4002 | 0.2850 | -0.1607 |
| **LEA2** | -0.0600 | -0.1520 | **0.8291** | -0.0189 | -0.0304 | 0.3658 | 0.4320 | 0.2581 | -0.1592 |
| **LEA3** | -0.0746 | -0.0820 | **0.8332** | 0.0497 | 0.0465 | 0.3403 | 0.4119 | 0.2079 | -0.1680 |
| **LEA4** | -0.0788 | -0.0601 | **0.7800** | -0.0440 | -0.0040 | 0.2317 | 0.2766 | 0.2790 | -0.1090 |
| **LEA5** | -0.0837 | -0.0529 | **0.6849** | -0.0865 | 0.0256 | 0.1937 | 0.2578 | 0.2240 | -0.1516 |
| **LEA6** | -0.1854 | -0.1632 | **0.8010** | -0.0821 | -0.1172 | 0.3443 | 0.4287 | 0.2713 | -0.1389 |
| **LEA7** | -0.0951 | -0.1426 | **0.7947** | -0.0166 | -0.0352 | 0.3790 | 0.4947 | 0.1767 | -0.1821 |
| **OPA1** | 0.1268 | 0.1417 | 0.0249 | **0.6162** | 0.2725 | 0.0007 | 0.0507 | 0.1446 | 0.3146 |
| **OPA2** | 0.2881 | 0.3402 | -0.1177 | **0.8011** | 0.3040 | -0.0219 | -0.1176 | 0.0794 | 0.5065 |
| **OPA3** | 0.1791 | 0.3517 | 0.0711 | **0.7895** | 0.3891 | 0.0590 | -0.0284 | 0.1818 | 0.4163 |
| **OPA4** | 0.0864 | 0.4454 | -0.0561 | **0.7515** | 0.3925 | 0.0387 | -0.0912 | 0.0396 | 0.4976 |
| **PRV1** | 0.3165 | 0.2806 | 0.0018 | 0.3927 | **0.7948** | 0.0492 | -0.1313 | -0.0166 | 0.3743 |
| **PRV2** | 0.2344 | 0.2000 | 0.0079 | 0.3021 | **0.6581** | 0.1141 | -0.0721 | -0.0907 | 0.3585 |
| **PRV3** | 0.3247 | 0.4297 | -0.0897 | 0.3235 | **0.7574** | -0.0227 | -0.1028 | 0.1140 | 0.3800 |
| **SAN1** | -0.2080 | -0.1782 | 0.4279 | 0.0024 | -0.0404 | **0.8871** | 0.3227 | 0.3316 | -0.1097 |
| **SAN2** | -0.1115 | -0.0466 | 0.3445 | 0.0728 | 0.1093 | **0.9444** | 0.2357 | 0.2025 | -0.0422 |
| **SAN3** | -0.0412 | 0.0653 | 0.3252 | -0.0004 | 0.1000 | **0.8747** | 0.1935 | 0.1918 | -0.0334 |
| **RAR1** | -0.1899 | -0.2058 | 0.4353 | -0.0646 | -0.1311 | 0.2254 | **0.8553** | 0.2322 | -0.1889 |
| **RAR2** | -0.1398 | -0.1842 | 0.4905 | -0.0552 | -0.0878 | 0.2650 | **0.8602** | 0.3035 | -0.2144 |
| **RAR3** | -0.1410 | -0.1494 | 0.4007 | -0.0932 | -0.0971 | 0.2227 | **0.8070** | 0.2641 | -0.1889 |
| **RAR4** | -0.1342 | -0.1687 | 0.1052 | 0.0016 | -0.1616 | 0.1554 | **0.5491** | 0.1508 | -0.1631 |
| **TRA1** | 0.0594 | 0.1218 | 0.1021 | 0.0915 | 0.0041 | 0.0929 | 0.0636 | **0.6805** | 0.0479 |
| **TRA2** | -0.0138 | -0.0370 | 0.2304 | 0.1273 | 0.0643 | 0.2215 | 0.2166 | **0.8733** | -0.0035 |

| | COV | IMM | LEA | OPA | PRV | SAN | RAR | TRA | UNF |
|---|---|---|---|---|---|---|---|---|---|
| **TRA3** | -0.1737 | -0.2115 | 0.3364 | 0.1223 | -0.0253 | 0.2874 | 0.3727 | **0.8621** | -0.1407 |
| **UNF1** | 0.2632 | 0.3447 | -0.2572 | 0.4044 | 0.4006 | -0.0637 | -0.2490 | -0.1231 | **0.7676** |
| **UNF2** | 0.3276 | 0.3228 | -0.1138 | 0.3447 | 0.3751 | -0.0078 | -0.1421 | -0.0553 | **0.8017** |
| **UNF3** | 0.3383 | 0.3893 | -0.0761 | 0.5198 | 0.4685 | 0.0072 | -0.1378 | -0.0212 | **0.7669** |
| **UNF4** | 0.2793 | 0.4125 | -0.0740 | 0.4828 | 0.1846 | -0.1495 | -0.0408 | -0.0599 | **0.6890** |
| **UNF5** | 0.4876 | 0.5630 | -0.2010 | 0.4559 | 0.4172 | -0.0634 | -0.3069 | -0.0118 | **0.7110** |

Table 7.4 Evaluation results of hierarchical models

| Paths | Path coefficient | T-value | CR |
|---|---|---|---|
| LEA→Anti-corruption strategies | 0.6359 | 17.8615 | 0.9008 |
| RAR→Anti-corruption strategies | 0.2830 | 10.2842 | |
| TRA→Anti-corruption strategies | 0.1428 | 5.2634 | |
| SAN→Anti-corruption strategies | 0.2356 | 8.1213 | |
| Corruption indicators→PRV | 0.6857 | 17.1155 | 0.9045 |
| Corruption indicators→UNF | 0.8629 | 51.1495 | |
| Corruption indicators→OPA | 0.7402 | 17.7132 | |
| Corruption indicators→COV | 0.6377 | 11.7899 | |
| Corruption indicators→IMM | 0.8157 | 21.6029 | |

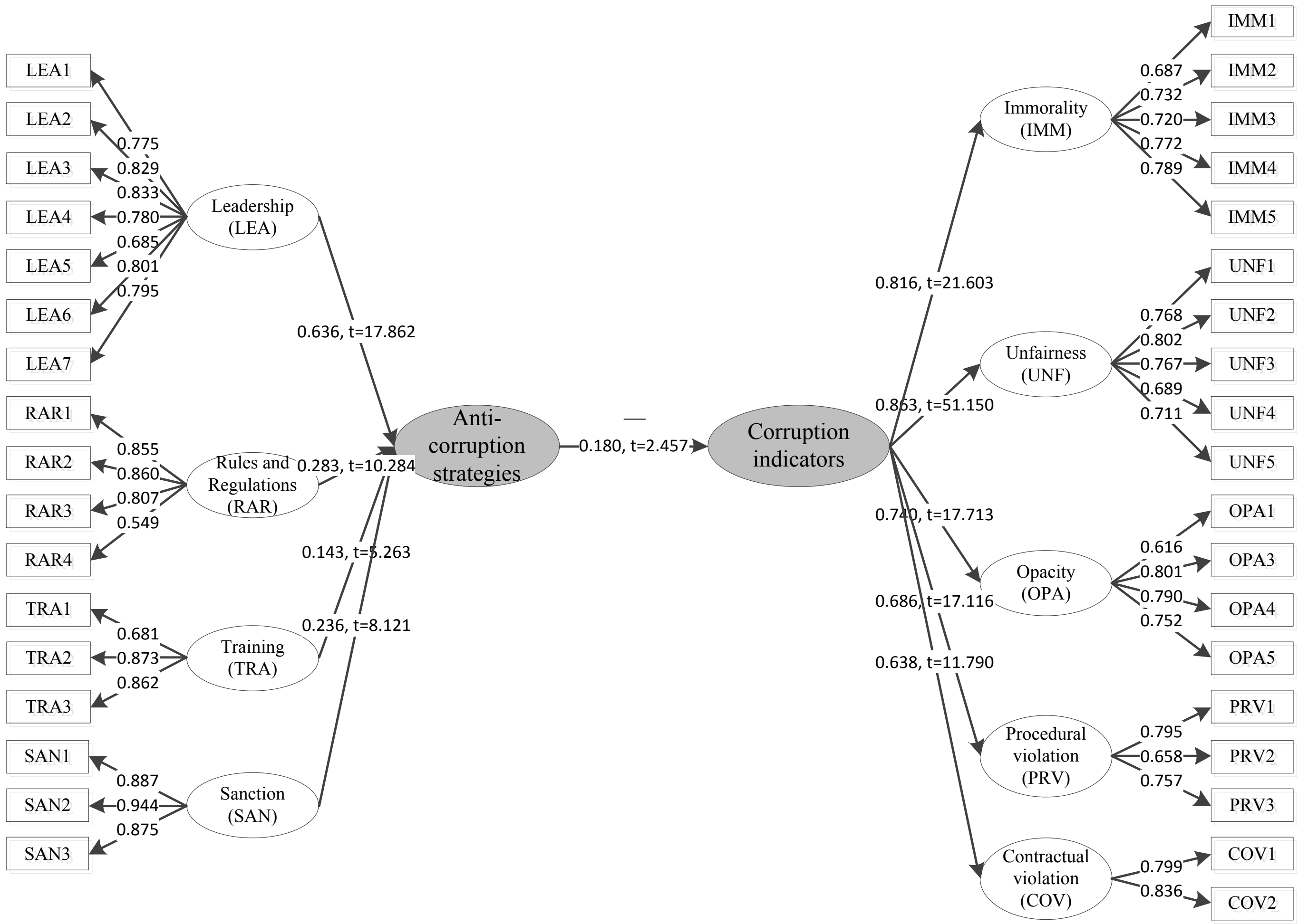



Figure 7.3 Testing result of the hypothesized structural equation model of anti-corruption strategies and corruption indicators

## 7.4 DISCUSSIONS OF EFFECTIVENESS OF THE PREVAILING ANTI-CORRUPTION STRATEGIES

Based on the PLS-SEM results, although all the statistical indicators were found to be acceptable, the low path coefficient of -0.18 between the prevailing anti-corruption strategies and the corruption indicators show that the hypothesis is only loosely supported. Generally, the path coefficients of the four prevailing anti-corruption strategies reveal that the four anti-corruption strategies do not play an effective role in preventing corruption in the Chinese public construction sector. The most effective anti-corruption strategy, leadership, only has a marginal path coefficient of 0.636. The path coefficients of the other three strategies are about 0.200, which is relatively low.

### 7.4.1 Leadership

Leadership is regarded as the most effective anti-corruption strategy in the survey, reinforcing the findings of earlier studies (Sims 2000; Ashforth and Anand 2003; Tabish and Jha 2012). Unlike in Western countries, leadership plays a more critical role in China. This finding can be due to the tradition of rule by man. Although rule by law has been gradually accepted and practiced to improve the legislative and administrative systems in the country, it still has a long way to go in being incorporated with the existing institutions.

Consequently, accountability for integrity of leadership should be improved in future public construction (People's Liberation Army Daily 2013). By establishing this mechanism, leaders have the duty to secure the integrity of the projects by exercising their leadership, which can also produce a positive impact on their subordinates‟ corrupt practices.

### 7.4.2 Rules and Regulations

This anti-corruption strategy has a low path coefficient of 0.283 (t-value = 10.28), which indicates that the effectiveness of rules and regulations is loosely supported by the respondents. This finding may be due to the fact that the existing response rules and regulations at the macro level are reactive, and they seldom address the need for proactively preventing corrupt practices at the micro level (He 2000). The Chinese government already recognizes this fact and has begun to promulgate a series of more detailed and workable rules and regulations focusing on the micro level (Legal Weekly 2014), such as the interpretation of issues applicable to the Disciplinary Regulations of the Chinese Communist Party because of illegal interference on construction projects by the leader members of the Party, and the implementation of the regulations of the Law of Bidding of People‟s Republic of China (People Net 2010; The State Council of P. R. China 2011), as evidenced by the growing number of corruption cases revealed in recent years. However, the government still has a long way to go in realizing the effectiveness of these new rules and regulations.

### 7.4.3 Sanctions

This strategy has a low path coefficient of 0.236 (t-value = 8.12). Although imposing serious sanctions on corrupt crimes is regarded the most useful strategy for preventing corruption (Tanzi 1998), the effectiveness of this strategy does not receive a high evaluation from the respondents, consistent with the belief of the Chinese public that only a few suspects receive sanctions for their corrupt crimes (He 2000). In extreme cases, some suspects may be sentenced to jail for their corrupt crimes, but their terms of imprisonment may be commuted by bribing the judicial department (Xinhua Net 2014b). This fact explains why the respondents were reluctant to provide a high evaluation of the effectiveness of sanctions. To change this situation, a series of reforms was made by the Chinese government. According to the China Ministry of Supervision, 11,273 people received administrative sanctions, and 5,698 received penal sanctions for their corrupt crimes in the public construction sector between September 2009 and March 2011 (Xinhua Net 2011b). This fact indicates that the execution of sanctions for corruption crimes seems to be gradually strengthening.

### 7.4.4 Training

Training has the lowest path coefficient of 0.143 (t-value = 5.26) among the four anti-corruption strategies. This finding indicates that most survey respondents held the belief that existing training on corruption remains lacking. Undoubtedly, training is considered an indispensable anti-corruption strategy for corruption prevention because of its proactive role in forestalling corruption (Heineman Jr. and Heimann 2006). Therefore, related training should be implemented in all Chinese public construction projects. According to Zou (2006), existing training seldom addresses the doubts on emergent ethical dilemmas, such as conflicts of interest, and gift giving/receiving. Similar problems are common to industry practitioners as a result of the inappropriate response to ethical dilemmas (Luo 2002). Therefore, future professional training should incorporate corruption issues and help industry professionals maintain the highest integrity standards.

## 7.5 RECOMMENDATIONS

According to Zhou (1998), anti-corruption strategies should be comprehensive and consist of precaution, relief, and warning as well as combine sanctions and education with a constant reminder to public servants of their duties and reputations and the penalties for breaches of the laws and regulations. The findings obtained in this chapter reveal that the prevailing anti-corruption strategies in the Chinese public construction sector still need to be reinforced. Therefore, this study proposed four specific anti-corruption measures with the expectation that these measures could effectively restrain corruption in the public construction sector. The four anti-corruption measures are introduced in detail in the following sections.

### 7.5.1 Limiting the Power of Chief Government Leaders

Chief government leaders were found to be closely related to corruption in Chinese public construction projects (Li et al. 2013). For their private benefits, these leaders may propose to construct an unnecessary project, intervene in project awarding through their administrative influence, or even embezzle project funds. Therefore, restraining the behaviors of chief government leaders is extremely important in the prevention of corruption in the public construction sector. Numerous studies have stated that controlling their power is paramount to dealing with corruption issues of chief government leaders. However, the reality in China is that a chief government leader always has arbitrary power, causing the supervision mechanism to be implemented ineffectively in most circumstances. Thus, this study proposed that limiting their power is important. Three specific strategies are proposed as follows.

First, reduce the requirement for multifarious administrative licenses and permits. Requiring various multifarious administrative licenses and permits provide fertile grounds for the occurrence of corruption because many companies choose to pay bribes to staff of governmental departments, particularly chief government leaders, to accelerate the issuance of administrative licenses and permits. Hence, reducing the quantities of administrative licenses and permits will shrink the corruption space of chief government leaders.

Second, reduce the discretion of chief government leaders. Excessive discretion is also a significant cause of corruption because it provides opportunities and incentives for corruption through exploitation of regulations on access to goods and services by chief government leaders to extract rents from groups vying for access to such goods and services (Quah 1999). In reducing the discretion of chief leaders, top management officials with professional backgrounds and rights to vote should participate in the decision making for the project. This step could be beneficial for the occurrence of a scientific and reasonable decision making.

Third, strengthen the supervision function of congressional departments at all levels. The Chinese constitution has authorized veto power of congressional departments if they recognize that the decision made by the government of the same level is unreasonable. However, in reality, such veto power has been seldom exercised because of the arbitrary power given to the government. In some places, the chief leaders in both governmental and congressional departments are the same people, thereby weakening the supervision function of congressional departments. Therefore, congressional institutions in China must be reformed to ensure that the congress can function independently.

### 7.5.2 Development of Honest and Ethical Construction Culture

Developing an honest and ethical culture in the construction sector is essential because it will create an honest and ethical atmosphere in the sector, which in turn will have a positive effect on the acts of industrial practitioners. When taking actions to promote a healthy and ethical construction culture, several issues should be considered, including: (1) recur to political leadership and top management; (2) identify risk factors to corruption and improve staff awareness on these factors; (3) educate the staff on the corresponding actions in the face of moral dilemmas; (4) fostering a trustworthy atmosphere to enable staff members to feel safe in reporting corruption; and (5) linking contract award to integrate practices of potential contractors.

### 7.5.3 Use of Transparency Mechanism

A significant concern in Chinese public construction projects is that project information is opaque to the public in most cases, providing a good cover for the occurrence of corruption. Therefore, transparency should be employed because it could tear up this cover. The mechanism of transparency is helpful in corruption prevention because by using it, the processes of project, including decision making, project approval, project bidding, and project implementation, could be brought to the thorough supervision of the public. Two specific measures are suggested as follows.

First, an open hearing should be conducted before the start of a public project. The hearing must involve government officials, residents around the project, and experts with diverse professional backgrounds, such as urban planning, archeology, environmental protection, civil engineering, and construction. The hearing can ensure that the decision making process is transparent and fair.

Second, information, including project properties, bidding, plans, and implementation, should be publicly announced. Specifically, a website should be established to ensure that project information could be tracked by the public, enabling the public to monitor the project.

### 7.5.4 Supervision Scheme on Corruption for Project Life Cycle

Identifying areas where and stages when corruption has the potential to occur is crucial to the effective prevention of corruption in construction. However, current literature reveals that little effort has been made to address this problem, except for Zou (2006). Zou (2006) developed a comprehensive list of areas of corruption risks in a Chinese construction project from its conception to its post-construction stage, and correspondingly proposed a series of anti-corruption strategies against these risks. Considering that Zou"s (2006) efforts focus mainly on corruption risks in general construction projects, a modification was made to the list to summarize the areas of corruption risks involved in a Chinese public construction project at diverse project stages, as well as the anti-corruption strategies. The modified list is shown in Table 7.5.

Table 7.5 Areas of corruption risks and corresponding anti-corruption strategies

| **Project stage** | **Area of corruption risk** | **Corresponding anti-corruption strategy** |
|---|---|---|
| Project conception stage | Project approved autocratically by the chief leader of the government | Check the project has a convincing buildability report. Additionally, before the project is approved, an open hearing should be conducted to collect citizens" opinions on the project. |
| | Failure to obtain necessary approvals | Examine all relevant approvals to ensure they were properly obtained before the project started. |

| Project stage | Area of corruption risk | Corresponding anti-corruption strategy |
|---|---|---|
| | Cheating on compensations to land occupants | Check if appropriate fees have been paid to land occupants with the pre-agreed amount of money or in-kind. Checking with both parties, i.e., the client and the land occupants, on their agreement and the actual fees in reality is necessary. |
| | Unauthorized changes to the scope of the project | Review project design documents and drawings to ensure that the project under review strictly complies with its original sanctioned design. |
| | Evasion of tender scrutiny by splitting project into a number of small projects | Review project design documents and drawings to ensure that the project is not part of a larger project. Specifically, other projects associated with the same land by the same client should be checked. |
| Tendering stage | Appropriateness of tender prequalification criteria | Check if the tender prequalification criteria were prepared strictly in relation to the nature and scope of the project. Ensure that prequalification criteria were not set for a certain tenderer. |
| | Invitation of unqualified tenderers | Ensure that original tendered qualification conditions are attached to the invitation letters to potential tenderers. Check qualification of tenderers and current project commitment of proposed project managers. |
| | Tenderer offering bribes to client staffs | Review contract to ensure its conformity with design documentation and consistency with tender documentation. |
| | Integrity of members of | Check and audit the work done by committee |

| Project stage | Area of corruption risk | Corresponding anti-corruption strategy |
|---|---|---|
| | tender evaluation committees | members to determine if any preference has been given to a particular tenderer. Review evaluation report provided by tender evaluation committee to ensure scoring is consistent with pre-determined criteria and scale; review scoring scale for suitability to project and impartiality. |
| Construction stage | Technical competence of contractor staffs | Check conformity of deployment of contractor technical staff with tender documentation or contract. |
| | Appropriate checks and monitoring of supervision undertaken by the on-site supervision company | Examine supervision company diaries for details and conformity with project progress, including construction progress, day-to-day supervision activities, quality testing, and safety checks. |
| | Collusion between on-site supervision company and contractor | Examine previous projects to identify unusual or suspicious relationships between on-site supervision company and contractor. |
| | Excessive construction changes | Independently check the necessity of all construction changes proposed by the contractor. |
| | Substitution of substandard and unauthorized materials | Randomly examine materials utilized during construction to check if there was use of unauthorized materials. |
| | Project delay | Review approvals for extension of time to ensure appropriateness in terms of liability and extent in terms of the contract |

| Project stage | Area of corruption risk | Corresponding anti-corruption strategy |
|---|---|---|
| | Illegal subcontracting | Check to ensure the absence of illegal subcontracting or improper transfer of contract to another contractor. |
| Post-construction stage | Whether the contract price is the same as the one determined during tendering and the final cost aligns with the contract price | Compare the tender price, contract amount, and final cost. Review the sources and causes of design variations (for example, documentation errors or client requests). Review variation authorizations to ensure that variations were necessary and unavoidable; cost estimations were detailed and independently verified; clear instructions were provided to contractor as to extent of variation; and financial approval was provided prior to commencement of variation work. |
| | Improper commission of electrical and hydraulic equipment or plants | Check if all electrical and hydraulic equipment or plants have been properly tested, signed off by licensed engineers, and of adequate quality. |
| | Process for approving progress payments and final cost evaluations | Review documentation to ensure the absence of undue delay or impropriety in final cost evaluation and approval. Examine contract price and final price to ensure that any variation between the two prices has been properly authorized and is reasonable under all circumstances. |

## 7.6 CHAPTER SUMMARY

This chapter investigated the effectiveness of prevailing anti-corruption strategies those are being implemented in the Chinese public construction sector. The analysis results revealed that although the anti-corruption strategies were found to be negatively correlated with corruption indicators, their effectiveness was poorly acknowledged by the respondents. The results also showed that, among the four anti-corruption strategies, only leadership received a marginal acceptable evaluation on its effectiveness, and the other three anti-corruption strategies received no high evaluations. These results implied that the anti-corruption strategies in the Chinese public construction sector needed to be strengthened urgently. Four specific anti-corruption measures, namely limiting the power of chief government leaders, development of honest and ethical construction culture, use of transparency mechanism, and supervision scheme on corruption for project life cycle, were further proposed to curb corruption in the Chinese public construction sector.

# CHAPTER 8 MEASURING VULNERABILITY TO CORRUPTION IN THE CHINESE PUBLIC CONSTRUCTION PROJECTS

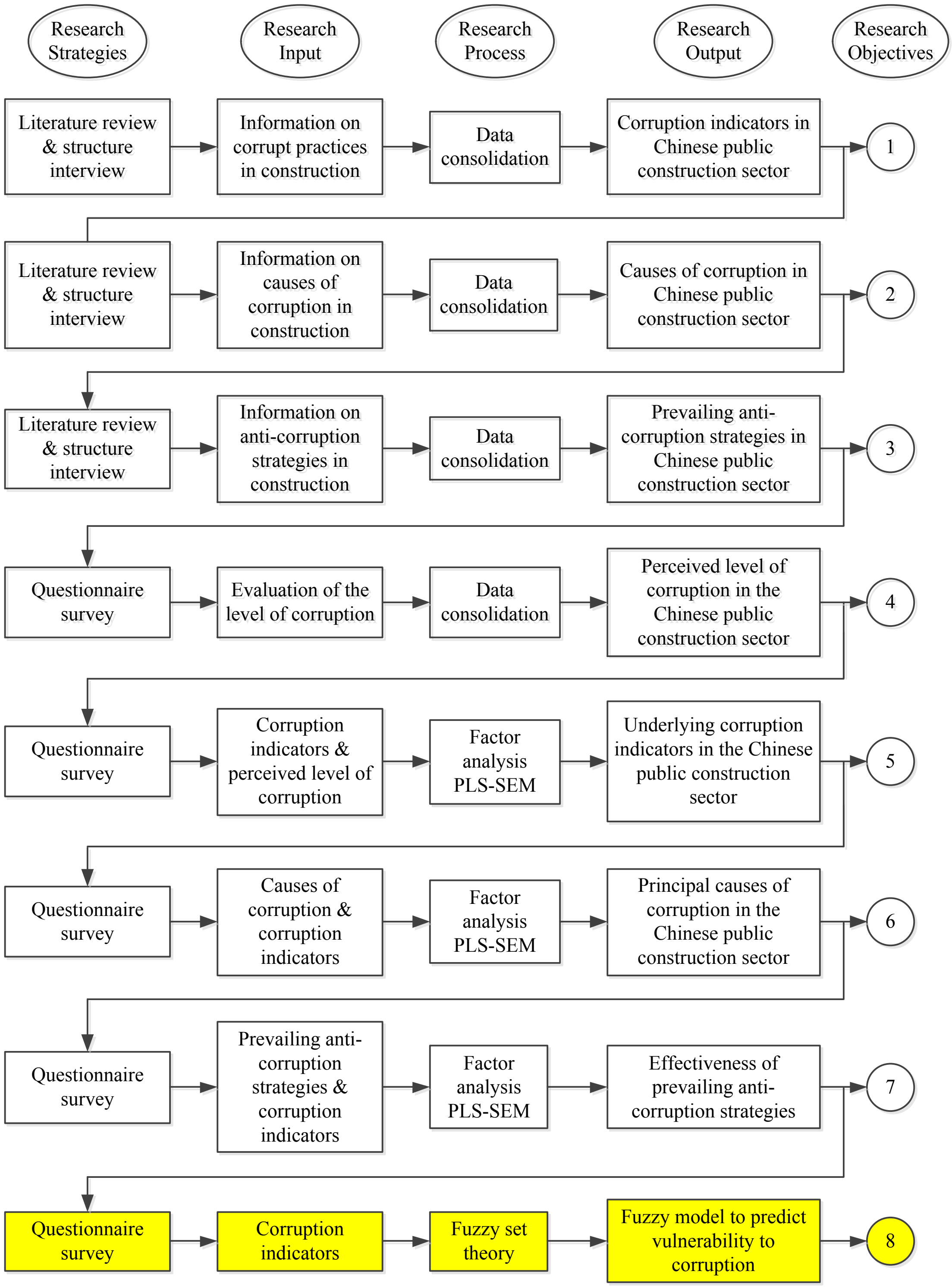



Figure 8.1 Overall flow of research

# CHAPTER 8 MEASURING VULNERABILITY TO CORRUPTION IN CHINESE PUBLIC CONSTRUCTION PROJECTS[5]

## 8.1 INTRODUCTION

Based on the data of corruption indicators that were collected from the questionnaire survey, and using the fuzzy set theory approach, this chapter develops a fuzzy model to assess the vulnerability to corruption in Chinese public construction projects. The developed model has also been further applied in two selected public projects.

## 8.2 MEASURING VULNERABILITY TO CORRUPTION

Measuring vulnerability to corruption is necessary to achieve progress towards greater integrity, transparency, and accountability in corruption-free performance (Andersson and Heywood 2009; Goel and Nelson 2011; Foster et al. 2012; León et al. 2013). Only by understanding how much corruption and in what areas, can effective response strategies be formulated and then implemented (Sampford et al. 2006). Researchers have applied diverse

[5] Major part of this chapter has been published in the following paper:
Shan, M., Chan, A.P.C., Le, Y.*, Xia, B., & Hu, Y. (2015). Measuring corruption in public construction projects in China. *ASCE Journal of Professional Issues in Engineering Education and Practice,* doi: 10.1061/(ASCE)EI.1943-5541.0000241, 05015001.

approaches to measure vulnerability to corruption. Kaufmann et al. (1999) created an aggregate measure of vulnerability to corruption by combining three elements of governance, namely, probity, bureaucratic quality, and rule of law. Hall and Yago (2000) developed an index of opacity, which is the opposite of transparency. Extensive efforts have also been devoted to measuring vulnerability to corruption at the country level by many international organizations, such as the Business International Corporation, the Political Risk Services Group, the World Economic Forum, the Political and Economic Risk Consultancy Ltd., Transparency International, and the World Bank (Mauro 1995; Lancaster and Montinola 1997; Lambsdorff 1998; Tanzi and Davoodi 1998; Jain 2001; Svensson 2005). However, few efforts have been made to measure vulnerability to corruption in the construction sector. The present study aims to bridge this knowledge gap.

## 8.3 DATA COLLECTION METHOD

Data source is critical for measuring vulnerability to corruption, and it includes perception indicators, judicial system reports, and indirect and outcome indicators (e.g., objective indicators covering financial flows and sector outcomes) (Kenny 2009b). Data from judicial system reports can improve the precision of measurement and disclose more significant details of corruption (Della Porta 2001), but these judicial reports are rarely available to the public

(Han 2011). Although indirect and outcome indicators can be widely available, the reliability of the results derived from these data may be compromised because factors other than corruption may contribute to the final evaluation result (Ko and Samajdar 2010). In this study, perception indicators were used to solicit perception-based data to measure vulnerability to corruption in public construction projects. This data collection method has also been widely used for the measurement of vulnerability to corruption at the country level (Mauro 1995; Lancaster and Montinola 1997; Lambsdorff 1998; Andersson and Heywood 2009; Goel and Nelson 2011; Foster et al. 2012). However, subjective data collected by this approach can only reflect vague and generic perceptions of corruption rather than specific objective realities and are thus sometimes unreliable (Golden and Picci 2005; Duncan 2006; Seligson 2006). Nevertheless, perceptions of corruption based on respondents" actual experiences are, in most cases, the best and the only information researchers can obtain, as corruption is usually conducted clandestinely and leaves no paper trail (Jain 2001).

## 8.4 DEVELOPMENT OF A FUZZY MODEL TO EVALUATE VULNERABILITY TO CORRUPTION IN CONSTRUCTION PROJECTS

### 8.4.1 Weighting Calculation

This study adopted the framework consolidated in Section 4.3.3.1 to measure vulnerability to corruption in Chinese public construction projects. The weightings of various specific corruption indicators and underlying corruption indicators involved in the framework should be calculated before the development of the evaluation model. The data collected from the questionnaire survey were adopted to calculate the weightings because these data are composed of perceptions of numerous industry practitioners to corruption indicators in the Chinese public construction sector.

The weighting of probability for the $m$th corruption indicator within the underlying factor $i$ ($W_{pim}$) can be computed by the following formula:

$$W_{pim} = MS_{pim} \Big/ \sum_{m=1}^{n} MS_{pim} \quad \text{(Formula 8.1)},$$

where $MS_{pim}$ represents the mean value of the corruption indicator $m$; and $n$ = the number of corruption indicators involved in the underlying factor $i$.

The probability weighting of the underlying factor $i$ ($W_{pi}$) can be computed by the following formula:

$$W_{pi} = TMS_{pi} \Big/ \sum_{i=1}^{5} TMS_{pi} \quad \text{(Formula 8.2)},$$

where $TMS_{pi}$ represents the total mean values of corruption indicators within the underlying factor $i$.

Similarly, the weighting of severity for $m$th corruption indicator within the underlying factor $i$ ($W_{sim}$), and the weighting of the underlying factor $i$ ($W_{si}$), can be computed by the same approach. Table 8.1 shows the weightings of all the corruption indicators and its related underlying factors.

Table 8.1 Weightings of each corruption indicator and its related underlying factor

| **Underlying factor** | **Previous code** | **New code** | **Probability** | | **Severity** | |
|---|---|---|---|---|---|---|
| | | | **Mean** | **Weighting** | **Mean** | **Weighting** |
| Immorality | | | | 0.28 | | 0.33 |
| | CI15 | CI1.1 | 3.45 | 0.22 | 3.69 | 0.20 |
| | CI18 | CI1.2 | 3.06 | 0.19 | 3.60 | 0.19 |
| | CI21 | CI1.3 | 3.04 | 0.19 | 3.70 | 0.19 |
| | CI23 | CI1.4 | 3.01 | 0.19 | 4.06 | 0.21 |
| | CI24 | CI1.5 | 3.23 | 0.21 | 4.00 | 0.21 |
| Unfairness | | | | 0.29 | | 0.24 |
| | CI4 | CI2.1 | 3.43 | 0.21 | 3.26 | 0.20 |
| | CI5 | CI2.2 | 3.14 | 0.19 | 3.14 | 0.19 |
| | CI9 | CI2.3 | 3.21 | 0.20 | 3.34 | 0.20 |
| | CI12 | CI2.4 | 3.54 | 0.22 | 2.92 | 0.18 |
| | CI22 | CI2.5 | 3.05 | 0.18 | 3.73 | 0.23 |
| Opacity | | | | 0.18 | | 0.19 |

| Underlying factor | Previous code | New code | Probability | | Severity | |
|---|---|---|---|---|---|---|
| | | | Mean | Weighting | Mean | Weighting |
| | CI7 | CI3.1 | 2.74 | 0.26 | 3.05 | 0.23 |
| | CI10 | CI3.2 | 2.62 | 0.25 | 3.37 | 0.25 |
| | CI11 | CI3.3 | 2.28 | 0.22 | 3.50 | 0.26 |
| | CI20 | CI3.4 | 2.79 | 0.27 | 3.51 | 0.26 |
| Procedural | | | | 0.14 | | 0.14 |
| Violation | CI1 | CI4.1 | 2.63 | 0.32 | 3.30 | 0.33 |
| | CI2 | CI4.2 | 3.20 | 0.38 | 3.50 | 0.34 |
| | CI3 | CI4.3 | 2.47 | 0.30 | 3.31 | 0.33 |
| Contractual | | | | 0.11 | | 0.10 |
| Violation | CI16 | CI5.1 | 3.52 | 0.53 | 3.61 | 0.52 |
| | CI19 | CI5.2 | 3.08 | 0.47 | 3.28 | 0.48 |

### 8.4.2 Model Development – Fuzzy Measurement

The perceptions of probability and severity of corruption indicators by the respondents are typically characterized by subjectivity and uncertainty and are fuzzy by nature. Thus, the fuzzy set theory was used to develop the evaluation model in this study. Fuzzy set theory is a branch of modern mathematics formulated by Zadeh (1965) to model vagueness intrinsic in the human cognitive process. Based on linguistic variables and membership functions with varying grades, fuzzy set theory enables the development of strong and significant instruments for the measurement of ambiguities and provides the opportunity to represent meaningfully ambiguous concepts expressed in the natural language (Zadeh 1978; Hong and Choi 2000; Zimmermann 2001). This approach is appropriate to deal with complex problems due to imprecise, uncertain, or unreliable information that characterizes real-world systems (Baloi and Price 2003; Chan et al. 2009).

Fuzzy set theory deals with a set of objects characterized by a membership function that assigns to each object a membership grade ranging from 0 (no membership) to 1 (full membership) (Shaheen et al. 2007). Theoretically, membership functions can take various forms (Lorterapong and Moselhi 1996). However, in modeling real-life problems, linear approximation such as triangular fuzzy number (TFN) is commonly used (Chen and Hwang 1992; Zhao et al. 2013b). Additionally, precision in the shape of the membership functions is unimportant because of the quantitative nature of the problems with vague predicates, and the fuzzy numbers with simpler membership function shapes tend to have a more intuitive and more natural interpretation (Nieto-Morote and Ruz-Vila 2011; Zhao et al. 2013b). Therefore, this study uses TFN to quantify the qualitative data collected through the questionnaire survey.

The input data of the proposed model are the values of linguistic variables. Although linguistic variables have lower quality of exactness than numerical variables, the values of which are numbers, they are more meaningful

(Hadipriono 1988). This study defined two linguistic variables for each corruption indicator, namely, probability and severity, respectively. A five-point Likert scale (i.e. very low, low, medium, high, and very high) was used to assign the linguistic variables as recommended by Zhao et al. (2013b). This rating system is easy for users to understand these linguistic terms and evaluate the corruption indicators.

The values of linguistic variables were then transformed into triangular fuzzy numbers. Each fuzzy set should overlap with its neighboring sets to a certain extent. Although no precise algorithm exists for determining the minimum or maximum degree of overlap, in most cases, the overlap for triangle-to-triangle fuzzy regions averages between 25% and 50% of the fuzzy set base (Gottwald 1993; Li et al. 2006). According to Gottwald (1993), a high degree of overlap ensures that any small changes in the rating system can be detected and handled immediately. Therefore, this study adopts 50% as the degree to which each triangular fuzzy region overlaps with its neighboring region. Figure 8.2 shows the membership functions of various linguistic values.

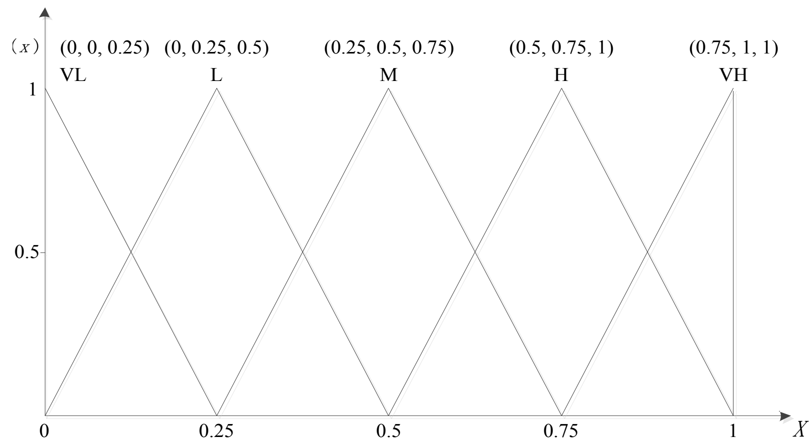



Figure 8.2 Membership functions of linguistic values

The TFN of $m$th corruption indicator within the underlying factor $i$ in the assessment of probability, that is $\tilde{C}_{pim}$, can be computed using the following formula:

$$\tilde{C}_{pim} = 1/k \times \sum_{j=1}^{k} \tilde{C}_{pimj} = 1/k \times \left( \sum_{j=1}^{k} l_{pimj1}, \sum_{j=1}^{k} l_{pimj2}, \sum_{j=1}^{k} l_{pimj3} \right)$$ (Formula 8.3),

where $k$ = number of respondents who assess the corruption indicators; and $l_{pimj1}$, $l_{pimj2}$, and $l_{pimj3}$ are lower bound, strongest membership degree, and upper bound of $\tilde{C}_{pimj}$, respectively.

Then the TFN of the underlying factor $i$ in the assessment of probability, that is $\tilde{C}_{pi}$, can be computed using following formula:

$$\tilde{C}_{pi} = \sum_{m=1}^{n} \tilde{C}_{pim} \times W_{pim}$$ (Formula 8.4),

where $n$ = number of corruption indicators within the underlying factor $i$; and $W_{pim}$ = weighting of $m$th corruption indicator within the underlying factor $i$ in the assessment of probability, and is available in Table 8.1.

The TFN of corruption in the assessment of probability, namely, $\tilde{C}_p$, can be computed using the formula below.

$$\tilde{C}_p = (p_1, p_2, p_3) = \sum_{i=1}^{5} \tilde{C}_{pi} \times W_{pi} \quad \text{(Formula 8.5)},$$

where $W_{pi}$ = weighting of the underlying factor $i$ in the assessment of probability and is available in Table 8.1; and $p_1$, $p_2$, and $p_3$ are lower bound, strongest membership degree, and upper bound of $\tilde{C}_p$, respectively.

Similarly, the TFN of corruption in the assessment of severity, namely, $\tilde{C}_s = (s_1, s_2, s_3)$ can be calculated using the same approach. $s_1$, $s_2$, and $s_3$ are lower bound, strongest membership degree, and upper bound of $\tilde{C}_s$, respectively.

Defuzzification is the process of determining a crisp value that adequately represents the fuzzy number (Georgy et al. 2005). There are several defuzzification methods such as center of gravity (COG) (calculation of geometric center of the fuzzy outputs), mean of maxima (MOM) (mean of the highest membership values of the fuzzy outputs), and bisection (crisp value that divides the area of the membership function of the fuzzy output into two equally sized sections), with each one having its strengths and weakness (Filev and Yager 1994; Lam et al. 2010; Kishore et al. 2011). As this study uses the TFN, the COG is easy to compute, and the defuzzified value tends to move smoothly around the output fuzzy region. Thus, the assessment of corruption in terms of probability ($C_p$) and severity ($C_s$) can be calculated using the following formulas:

$$C_p = 1/3 \times \sum_{t=1}^{3} p_t \quad \text{(Formula 8.6)}$$

$$C_s = 1/3 \times \sum_{t=1}^{3} s_t \quad \text{(Formula 8.7)}$$

Finally, the potential corruption in a public construction project can be calculated using the following formula as recommended by Xu et al. (2010):

$$C = \sqrt{C_p \times C_s} \quad \text{(Formula 8.8)}$$

The potential corruption in a public construction project, namely, $C$, is a crisp value in the interval [0, 1] that falls into the regions of two adjacent linguistic terms. The corruption can be interpreted by the linguistic term that has a higher membership value, as suggested by Zhao et al. (2013b).

## 8.5 ILLUSTRATIVE APPLICATIONS OF THE EVALUATION MODEL

The developed evaluation model was applied in two Chinese public construction projects to measure its potential corruption. To facilitate the model application, a questionnaire was developed on the basis of the consolidated framework of corruption indicators, as shown in Appendix H. As the major potential respondents of the questionnaire are Chinese, a Chinese version of the questionnaire was also prepared, as shown in Appendix I. The applications of the evaluation model are illustrated as follows.

### 8.5.1 Model Application in Case One

A public construction project in Jinan (the capital city of Shandong Province, Eastern China) was contacted to assess its vulnerability to corruption using the proposed model. The project was selected for two reasons. First, the project was a typical public project with a high estimated cost (CNY 23 billion or approximately USD 3.74 billion) that caught the attention of the local society. Second, the author used to provide consultancy service for this project and could thus obtain highly reliable data considering the sensitive topic of the study. The input data for the model were collected from five professionals of a consultancy company employed to provide the auditing service for this project.

The backgrounds of the five researchers are presented in Table 8.2. The calculation of vulnerability to corruption in this project is illustrated as follows.

Table 8.2 Backgrounds of the professionals

| **Professional** | **Employer** | **Position** |
|---|---|---|
| A | Consultant | Project Manager |
| B | Consultant | Deputy Project Manager |
| C | Consultant | Quantity Surveyor Staff |
| D | Consultant | Quantity Surveyor Staff |
| E | Consultant | Quantity Surveyor Staff |

The TFN of each corruption indicator in the assessment of probability was calculated using Formula 8.3. For instance, CI1.3, *Contractors provide false certificates in bidding*, obtained the linguistic values of high, very high, high, high, and very high from the five professionals. Figure 8.2 suggests that the TFNs of high and very high are (0.50, 0.75, 1.00) and (0.75, 1.00, 1.00), respectively. Therefore, $\tilde{C}_{p13}$ was calculated as follows:

$$\tilde{C}_{p13} = 1/5\times [(0.50, 0.75, 1.00)+ (0.75, 1.00, 1.00)+ (0.50, 0.75, 1.00)+ (0.50, 0.75, 1.00)+ (0.75, 1.00, 1.00)]$$

$$= (0.60, 0.85, 1.00)$$

Then using the TFNs of corruption indicators as input in Formula 8.4 and the TFNs of various underlying factors of corruption indicators were obtained. Finally, the TFNs of various underlying factors of corruption indicators were inputted in Formula 8.5, and the TFN of corruption in terms of probability of this project was obtained. By using the same approach, the TFNs of each corruption indicator, each underlying factor of corruption indicators, as well as corruption in terms of severity were calculated. Table 8.3 shows all the values of $\tilde{C}_{pim}$, $\tilde{C}_{pi}$, $\tilde{C}_{p}$, $\tilde{C}_{sim}$, $\tilde{C}_{si}$, and $\tilde{C}_{s}$.

Then, $C_p$ and $C_s$ were computed using Formula 8.6 and Formula 8.7 as follows:

$$C_p = 1/3 \times (0.423 + 0.663 + 0.861) = 0.649$$

$$C_s = 1/3 \times (0.402 + 0.651 + 0.891) = 0.648$$

Lastly, corruption of this project was computed upon Formula 8.8:

$$C = \sqrt{0.649 \times 0.648} = 0.648$$

According to Figure 8.3, the value of $C$ (0.648) falls into the two adjacent regions of medium and high. The linguistic value of high has a higher membership value than that of medium when the $X$ value is 0.648. Therefore, the vulnerability to corruption of this project is high. Moreover, the values of various underlying factors of corruption indicators, such as immorality, unfairness, opacity, procedural violation, and contractual violation, were calculated using the same approach using Formulas 8.6, 8.7, and 8.8. Figure 8.4 shows the calculation results. The results suggest that this project has high corruption potential in terms of immorality and contractual violation.

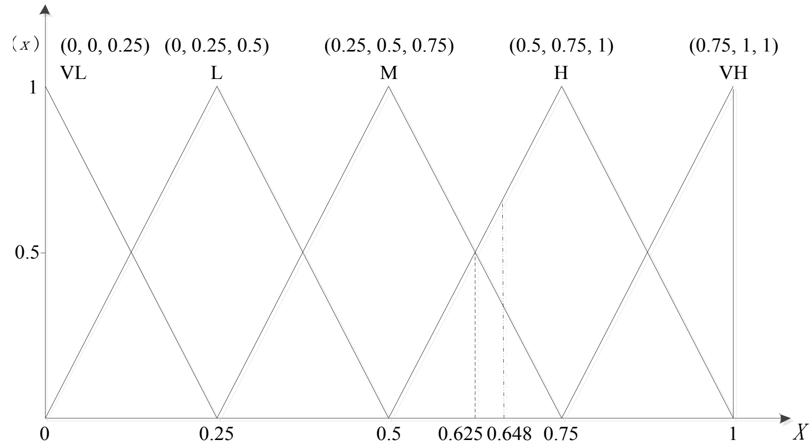



Figure 8.3 Distribution of linguistic values in Case One

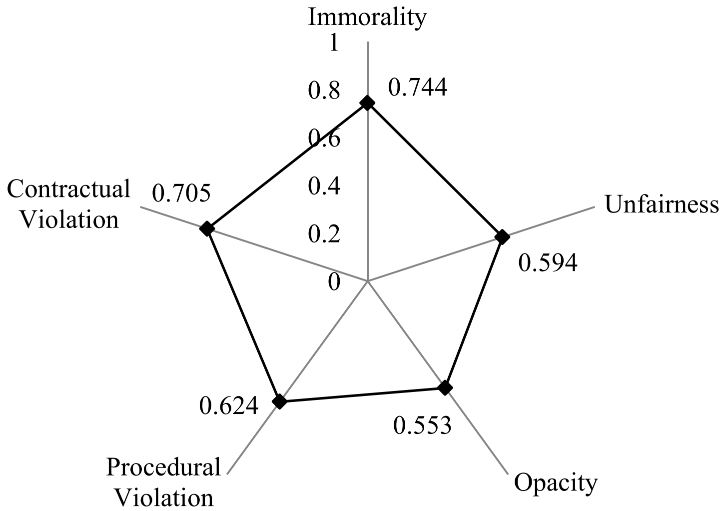



Figure 8.4 Values of various underlying factors of corruption indicators in Case One

Unexpectedly, the author was informed two months later after the model application that corruption was indeed found in this project. The author was informed that one client staff and one site supervisor staff had been detained due to their corrupt practices. The professional also mentioned the following corrupt practices verified by the prosecutor: (1) fake bidding was conducted by the client and its designated contractor; (2) some front-line workers hired by the contractor had no practicing certifications, thus resulting in low construction quality; and (3) site supervision engineers took bribes from the contractor and loosened their supervision. These corrupt acts are exactly reflected in the corruption indicators (e.g. CI16, CI21, and CI24) under the construct of immorality and contractual violation in the proposed model. Therefore, the results obtained from the proposed model could be regarded as reliable.

Table 8.3 Illustrative example of the model application in Case One

| Measurement item | Probability | | | | | Severity | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $\tilde{C}_{pim}$ | $W_{pim}$ | $\tilde{C}_{pi}$ | $W_{pi}$ | $\tilde{C}_{p}$ | $\tilde{C}_{sim}$ | $W_{sim}$ | $\tilde{C}_{si}$ | $W_{si}$ | $\tilde{C}_{s}$ |
| Immorality | | | (0.57, 0.80, 0.96) | 0.28 | (0.160, 0.224, 0.269) | | | (0.46, 0.71, 0.95) | 0.33 | (0.152, 0.234, 0.314) |
| MI1.1 | (0.65, 0.90, 1.00) | 0.22 | | | | (0.55, 0.80, 1.00) | 0.20 | | | |
| MI1.2 | (0.50, 0.75, 0.95) | 0.19 | | | | (0.45, 0.70, 0.95) | 0.19 | | | |
| MI1.3 | (0.60, 0.85, 1.00) | 0.19 | | | | (0.40, 0.65, 0.90) | 0.19 | | | |
| MI1.4 | (0.55, 0.80, 0.95) | 0.19 | | | | (0.45, 0.70, 0.95) | 0.21 | | | |
| MI1.5 | (0.55, 0.70, 0.90) | 0.21 | | | | (0.45, 0.70, 0.95) | 0.21 | | | |
| Unfairness | | | (0.39, 0.64, 0.86) | 0.29 | (0.113, 0.186, 0.249) | | | (0.31, 0.56, 0.81) | 0.24 | (0.074, 0.134, 0.194) |
| MI2.1 | (0.40, 0.65, 0.85) | 0.21 | | | | (0.25, 0.50, 0.75) | 0.20 | | | |
| MI2.2 | (0.40, 0.65, 0.85) | 0.19 | | | | (0.20, 0.45, 0.70) | 0.19 | | | |
| MI2.3 | (0.45, 0.70, 0.95) | 0.20 | | | | (0.40, 0.65, 0.90) | 0.20 | | | |
| MI2.4 | (0.45, 0.70, 0.90) | 0.22 | | | | (0.20, 0.45, 0.70) | 0.18 | | | |
| MI2.5 | (0.25, 0.50, 0.75) | 0.18 | | | | (0.45, 0.70, 0.95) | 0.23 | | | |
| Opacity | | | (0.23, 0.47, 0.71) | 0.18 | (0.041, 0.085, 0.128) | | | (0.41, 0.66, 0.87) | 0.19 | (0.077, 0.124, 0.164) |
| MI3.1 | (0.20, 0.45, 0.70) | 0.26 | | | | (0.25, 0.50, 0.75) | 0.23 | | | |
| MI3.2 | (0.25, 0.50, 0.75) | 0.25 | | | | (0.40, 0.65, 0.90) | 0.25 | | | |
| MI3.3 | (0.10, 0.30, 0.55) | 0.22 | | | | (0.45, 0.70, 0.90) | 0.26 | | | |
| MI3.4 | (0.35, 0.60, 0.80) | 0.27 | | | | (0.50, 0.75, 0.90) | 0.26 | | | |
| Procedural Violation | | | (0.38, 0.60, 0.81) | 0.14 | (0.053, 0.084, 0.113) | | | (0.40, 0.65, 0.90) | 0.14 | (0.056, 0.091, 0.126) |
| MI4.1 | (0.35, 0.55, 0.75) | 0.32 | | | | (0.45, 0.70, 0.95) | 0.33 | | | |
| MI4.2 | (0.40, 0.60, 0.80) | 0.38 | | | | (0.50, 0.75, 1.00) | 0.34 | | | |
| MI4.3 | (0.40, 0.65, 0.90) | 0.30 | | | | (0.25, 0.50, 0.75) | 0.33 | | | |
| Contractual Violation | | | (0.51, 0.76, 0.93) | 0.11 | (0.056, 0.084, 0.102) | | | (0.43, 0.68, 0.93) | 0.10 | (0.043, 0.068, 0.093) |
| MI5.1 | (0.60, 0.85, 1.00) | 0.53 | | | | (0.50, 0.75, 1.00) | 0.52 | | | |
| MI5.2 | (0.40, 0.65, 0.85) | 0.47 | | | | (0.35, 0.60, 0.85) | 0.48 | | | |
| Total | | | | 1 | (0.423, 0.663, 0.861) | | | | 1 | (0.402, 0.651, 0.891) |

### 8.5.2 Model Application in Case Two

The second case applying the developed evaluation model is the Zhengzhou Metro Project. This project was the largest public project ever conducted in Zhengzhou, the capital city of Henan Province. The investment of this project reached around CNY 100 billion (USD 16 trillion), making it at risk for corruption (Dahe Net 2008). With the approval of Construction Commission of Zhengzhou Municipality, the author visited the Zhengzhou Metro Project and invited five industry experts involved in the project to evaluate the potential corruption using the developed model. The profiles of the five experts are shown in Table 8.4.

Table 8.4 Profile of the five selected experts

| **Expert** | **Employer** | **Position** |
|---|---|---|
| A | Contractor | Project Manager |
| B | Consultant | Chief Supervisor |
| C | Client | Deputy Project Manager |
| D | Designer | Chief Designer |
| E | Government | Quality Supervising Staff |

Data collected from the five experts were entered into the developed model and calculated using Formulas 8.3 to 8.8. Table 8.5 shows the illustrative process of model application in the Zhengzhou Metro Project. The result indicates that the potential corruption of this project is 0.390, which falls into the two adjacent regions of low and medium as shown in Figure 8.5. The linguistic value of medium has a higher membership value than that of low when the X value is 0.390. Therefore, the vulnerability to corruption of this project is medium, which is better than that of Case One. Moreover, the values of various underlying factors of corruption indicators, such as immorality, unfairness, opacity, procedural violation, and contractual violation, were calculated. Their results, which are shown in Figure 8.6, indicate that the evaluation values of all underlying factors range from 0.321 to 0.512. Thus, the corrupt practices from these perspectives were under control. In reality, no corruption cases have been reported since the Zhengzhou Metro Project was constructed in 2009 (Zhengzhou Ditie Net 2012). Therefore, the model application result can be considered valid because it matches what occurs in the real world.

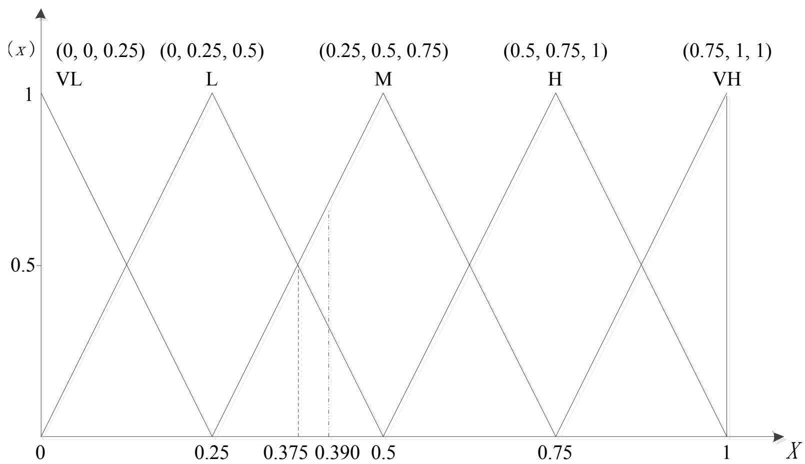



Figure 8.5 Distribution of linguistic values in Case Two

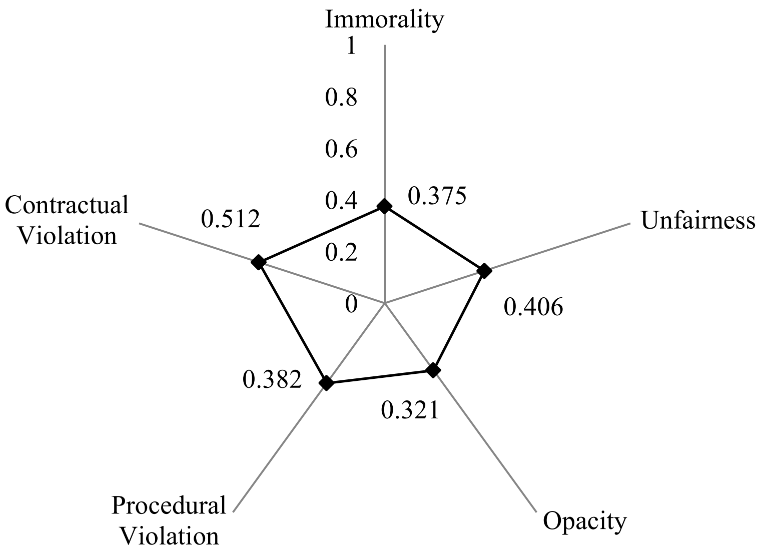



Figure 8.6 Values of various underlying factors of corruption indicators in Case Two

### 8.5.3 Implications of Model Applications

Model applications on the two cases revealed different results. Compared with the project in Case Two, the project in Case One was found to be under higher corruption risk, which could be ascribed to the different authority attitudes on the two projects. The project in Case One is one of several public development projects simultaneously conducted in Jinan City. The project in Case Two, namely Zhengzhou Metro Project, could be regarded as the number one project in Zhengzhou City, and therefore, the authorities focused considerable attention on this project. Thus, practitioners in the project would be quite cautious before deciding to conduct corrupt practices. Such results also echoed the findings obtained in Chapter 7 that leadership is the most effective anti-corruption strategy in the current Chinese public construction sector.

The model is expected to be particularly useful to a third-party unit responsible for the supervision of a public construction project. Under such circumstance, the input data will be more reliable, and thus, a more objective evaluation result can be expected. The model can also be adopted in measuring corruption at different project stages, during which only the related corruption indicators need to be selected from the original measurement framework and then evaluated.

Table 8.5 Illustrative example of the model application in Case Two

| Measurement item | Probability | | | | | Severity | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $\tilde{C}_{pim}$ | $W_{pim}$ | $\tilde{C}_{pi}$ | $W_{pi}$ | $\tilde{C}_{p}$ | $\tilde{C}_{sim}$ | $W_{sim}$ | $\tilde{C}_{si}$ | $W_{si}$ | $\tilde{C}_{s}$ |
| Immorality | | | (0.08, 0.24, 0.49) | 0.28 | (0.022, 0.067, 0.137) | | | (0.33, 0.52, 0.72) | 0.33 | (0.109, 0.172, 0.238) |
| MI1.1 | (0.10, 0.20, 0.45) | 0.22 | | | | (0.45, 0.60, 0.70) | 0.20 | | | |
| MI1.2 | (0.05, 0.20, 0.45) | 0.19 | | | | (0.35, 0.50, 0.70) | 0.19 | | | |
| MI1.3 | (0.10, 0.25, 0.50) | 0.19 | | | | (0.25, 0.50, 0.75) | 0.19 | | | |
| MI1.4 | (0.05, 0.30, 0.55) | 0.19 | | | | (0.30, 0.45, 0.70) | 0.21 | | | |
| MI1.5 | (0.10, 0.25, 0.50) | 0.21 | | | | (0.30, 0.55, 0.75) | 0.21 | | | |
| Unfairness | | | (0.11, 0.31, 0.56) | 0.29 | (0.032, 0.090, 0.162) | | | (0.29, 0.50, 0.71) | 0.24 | (0.070, 0.120, 0.170) |
| MI2.1 | (0.05, 0.25, 0.50) | 0.21 | | | | (0.35, 0.60, 0.80) | 0.20 | | | |
| MI2.2 | (0.25, 0.50, 0.75) | 0.19 | | | | (0.30, 0.55, 0.75) | 0.19 | | | |
| MI2.3 | (0.15, 0.30, 0.55) | 0.20 | | | | (0.15, 0.30, 0.55) | 0.20 | | | |
| MI2.4 | (0.05, 0.30, 0.55) | 0.22 | | | | (0.30, 0.45, 0.65) | 0.18 | | | |
| MI2.5 | (0.05, 0.20, 0.45) | 0.18 | | | | (0.35, 0.60, 0.80) | 0.23 | | | |
| Opacity | | | (0.05, 0.16, 0.41) | 0.18 | (0.009, 0.029, 0.074) | | | (0.31, 0.46, 0.69) | 0.19 | (0.059, 0.087, 0.131) |
| MI3.1 | (0.05, 0.15, 0.40) | 0.26 | | | | (0.30, 0.45, 0.70) | 0.23 | | | |
| MI3.2 | (0.05, 0.15, 0.40) | 0.25 | | | | (0.35, 0.50, 0.70) | 0.25 | | | |
| MI3.3 | (0.05, 0.20, 0.45) | 0.22 | | | | (0.30, 0.45, 0.65) | 0.26 | | | |
| MI3.4 | (0.05, 0.15, 0.40) | 0.27 | | | | (0.30, 0.45, 0.70) | 0.26 | | | |
| Procedural Violation | | | (0.07, 0.23, 0.48) | 0.14 | (0.010, 0.032, 0.067) | | | (0.37, 0.55, 0.77) | 0.14 | (0.052, 0.077, 0.108) |
| MI4.1 | (0.05, 0.30, 0.55) | 0.32 | | | | (0.30, 0.45, 0.70) | 0.33 | | | |
| MI4.2 | (0.10, 0.20, 0.45) | 0.38 | | | | (0.50, 0.75, 0.95) | 0.34 | | | |
| MI4.3 | (0.05, 0.20, 0.45) | 0.30 | | | | (0.30, 0.45, 0.65) | 0.33 | | | |
| Contractual Violation | | | (0.13, 0.38, 0.63) | 0.11 | (0.014, 0.042, 0.069) | | | (0.46, 0.71, 0.90) | 0.10 | (0.046, 0.071, 0.090) |
| MI5.1 | (0.20, 0.45, 0.70) | 0.53 | | | | (0.60, 0.85, 1.00) | 0.52 | | | |
| MI5.2 | (0.05, 0.30, 0.55) | 0.47 | | | | (0.30, 0.55, 0.80) | 0.48 | | | |
| Total | | | | 1 | (0.087, 0.260, 0.510) | | | | 1 | (0.335, 0.527, 0.737) |

## 8.6 CHAPTER SUMMARY

Based on the fuzzy set theory and the data collected from the questionnaire survey, this chapter develops a fuzzy model to assess the vulnerability to corruption in the Chinese public construction projects. The developed model has been applied in two selected Chinese public construction projects and the predicted results match the reality. Therefore, the validity of the model has been verified.

# CHAPTER 9 VALIDATION OF THE STUDY

# CHAPTER 9 VALIDATION OF THE STUDY

## 9.1 INTRODUCTION

This chapter checks the validity of the whole study from five perspectives, namely, content validity, construct validity, internal validity, face validity, and external validity. Ten industry experts are invited to facilitate the assessment. The evaluation results indicate an acceptable validity of this entire study.

## 9.2 VALIDATION STRATEGY OF THIS STUDY

Validation is the final and an indispensable step in each research cycle to ensure that each phase of the chosen research methodology adheres to the highest standards of quality (Lucko and Rojas 2010). Validation can be conducted qualitatively and quantitatively. In qualitative validation, opinion-based data on the effectiveness and performance of the research methodology adopted are collected, whereas in quantitative validation, statistical data are collected to evaluate the appropriateness of the adopted research methodology (O'Keefe et al. 1987; Ayel and Laurent 1991). Ware et al. (2003) suggested that qualitative validation is particularly appropriate for ethnographic research which explores cultural phenomena from the point of view of the subject. Thus, this study conducted a qualitative validation.

## 9.3 VALIDATION FRAMEWORK OF THIS STUDY

In studying research validation in the construction domain, Lucko and Rojas (2010) enumerated seven validity aspects for evaluating construction engineering and management research: (1) internal validity, (2) external validity, (3) face validity, (4) content validity, (5) criterion validity, (6) construct validity, and (7) reliability. Criterion validity is defined as the extent to which the results of an assessment instrument correlate with those of another instrument developed in previous studies (Fowler 2009). Given the fact that no similar model or instrument focusing on the Chinese public construction sector has been developed, the test of criterion validity of this study is omitted. Reliability is related to the concepts of consistency and repeatability in the data collection (Lucko and Rojas 2010), which is verified by diverse statistical analysis techniques in previous sections as mentioned. Therefore, this chapter mainly examines the remaining five kinds of validity aspects, namely, internal validity, external validity, face validity, content validity, and construct validity, respectively.

### 9.3.1 Content Validity

Content validity is a non-statistical approach that focuses on determining if the content of a study fairly represents reality. Its primary concern is “the degree to which a measure covers the range of meanings included within the concept”

(Fowler 2009). Three questions were designed in this study to assess content validity.

Q1. Are the corruption indicators proposed in this study applicable?

Q2. Are the causes of corruption proposed in this study applicable?

Q3. Are the observed variables of the prevailing anti-corruption strategies proposed in this study applicable?

### 9.3.2 Construct Validity

Construct validity refers to whether the operationalization of theoretical constructs are appropriate. In other words, construct validity is concerned with ensuring that a research effort is measuring what it is supposed to measure according to its stated objectives (Leedy and Ormrod 2013). Three questions were designed in this study to assess construct validity.

Q4. Is the framework for identifying corruption indicators reasonable?

Q5. Is the framework for identifying causes of corruption reasonable?

Q6. Is the framework for identifying the prevailing anti-corruption strategies reasonable?

### 9.3.3 Internal Validity

Internal validity is related to the concept of causality and is preoccupied with the derivability of relations within data (Leedy and Ormrod 2013). Internal validity can be threatened by many problems, including ill-defined theoretical models that include spurious relationships or correlated explanatory variables, biases in data collection that render comparisons ineffective, and failure to entertain alternative explanations during data analysis (Lucko and Rojas 2010). Two questions were designed in this study to assess the internal validity.

Q7. Is the causality between the causes of corruption and corruption indicators proposed in this study clear?

Q8. Is the causality between the prevailing anti-corruption strategies and corruption indicators proposed in this study clear?

### 9.3.4 Face Validity

Face validity requires the "approval" of non-researchers regarding the validity of a study (Lucko and Rojas 2010). Three questions were designed in this study to assess face validity.

Q9. Are the underlying corruption indicators obtained in this study reasonable?

Q10. Are the principal causes of corruption obtained in this study reasonable?

Q11. Are the evaluation results of the prevailing anti-corruption strategies obtained in this study reasonable?

### 9.3.5 External Validity

External validity is related to the concept of induction and focuses on the generalizability of results for prediction purposes (Leedy and Ormrod 2013). External validity can be threatened by a variety of issues, including lack of statistical rigor in the selection of sample sizes and in collecting actual data, the presence of any special circumstances during the research efforts, and oversimplification of the phenomenon under study (Lucko and Rojas 2010). One question was designed in this study to assess the external validity:

Q12. Can the evaluation model of vulnerability to corruption developed in this study be generalized?

Structural interviews were conducted on the basis of the 12 validation questions with ten selected interviewees who had been involved in the Chinese public construction sector in late May 2014. All interviewees met the following criteria: (1) non-involvement in the development works of the models in this study, (2) five years‟ industrial experience or above, and (3) sound knowledge and understanding of vulnerabilities to corruption in the Chinese public construction sector. The selection of these interviewees could improve the effectiveness and quality of validation. Table 9.1 presents the profiles of the interviewees. In each interview, an interviewee was asked to comment on each of 12 validation questions based on a five-point rating system (i.e., 1 = very poor, 2 = poor, 3 = medium, 4 = good, and 5 = very good) after the overall research process and the major research findings were explained. The validation questionnaire and its Chinese translated version are attached in Appendix J and K, respectively.

Table 9.1 Profile of the interviewees

| Interviewee | Employer | Position | Years of experience |
|---|---|---|---|
| A | Client | Project Engineer | 13 |
| B | Client | Senior Engineer | 9 |
| C | Contractor | Associate Project Manager | 10 |
| D | Contractor | Engineer | 10 |
| E | Consultant | Chief Supervisor | 32 |
| F | Consultant | Engineer | 8 |
| G | Designer | Project Manager | 15 |
| H | Designer | Senior Engineer | 10 |
| I | Academic | Associate Professor | 6 |
| J | Government | Director | 20 |

## 9.4 VALIDATION RESULTS OF THIS STUDY

Table 9.2 shows the evaluation results of all the 12 proposed questions. The assessment values of 3.8, 3.9, and 3.4 points on Q1, Q2, and Q3 indicate that the proposed corruption indicators, causes of corruption, and observed variables of the prevailing anti-corruption strategies are applicable. The assessment values of 3.8, 3.9, and 3.5 points on Q4, Q5, and Q6 indicate that the frameworks of corruption indicators, causes of corruption, and the prevailing anti-corruption strategies are reasonable. The assessment values of 3.9 and 3.4 points on Q7 and Q8 indicate a clear causal relationship between causes of corruption and corruption indicators, and between prevailing anti-corruption strategies and corruption indicators. The assessment values of 3.6 and 3.9 points on Q9 and Q10 indicate that the underlying corruption indicators and the principal causes of corruption obtained in the study are regarded reasonable by interviewees. The assessment value of 3.8 points on Q11 suggests that the evaluation result of the effectiveness of the prevailing anti-corruption strategies obtained in the study is also considered reasonable. The assessment value of 3.8 points on Q12 indicates the interviewees believe the developed evaluation model of vulnerability to corruption to be reliable. Therefore, to summarize, the results suggest that the five kinds of validities evaluated, namely, content validity, construct validity, internal validity, face validity, and external validity, are verified.

The validation of a study can be conducted from different perspectives, such as macro perspective and micro perspective. The check at the micro perspective has been conducted through a series of statistical test by using some statistical indicators such as composite reliability, average variance extracted value as reported previously in the structural equation modeling analysis. While the validation of this study was conducted at the macro level, to see if the research has been properly designed and performed. Therefore the 12 questions were developed in a general way. However, before each validation interview started, a briefing of the study was provided to the interviewee to inform him/her the research backgrounds, objectives, and design of the study, how the data were collected and analyzed, and what were the main research findings. The feedbacks from the interviewees suggested that they generally considered the research design was proper, and the findings were close to their perceptions to the reality. Therefore, it is believed that the validation results were reliable.

Table 9.2 Validation results of the study

| **Validity** | | **Interviewee** | | | | | | | | | | **Mean** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **A** | **B** | **C** | **D** | **E** | **F** | **G** | **H** | **I** | **J** | |
| Content validity | Q1 | 3 | 4 | 4 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 3.8 |
| | Q2 | 3 | 4 | 3 | 3 | 4 | 5 | 4 | 4 | 5 | 4 | 3.9 |
| | Q3 | 3 | 4 | 2 | 4 | 4 | 3 | 3 | 3 | 4 | 4 | 3.4 |
| Construct validity | Q4 | 3 | 5 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3.8 |
| | Q5 | 3 | 5 | 3 | 4 | 3 | 4 | 4 | 4 | 5 | 4 | 3.9 |

| Validity | | Interviewee | | | | | | | | | | Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **A** | **B** | **C** | **D** | **E** | **F** | **G** | **H** | **I** | **J** | |
| | Q6 | 4 | 4 | 3 | 4 | 3 | 2 | 3 | 4 | 3 | 5 | 3.5 |
| Internal validity | Q7 | 4 | 5 | 3 | 4 | 4 | 4 | 4 | 3 | 3 | 5 | 3.9 |
| | Q8 | 3 | 4 | 3 | 4 | 3 | 3 | 4 | 3 | 3 | 4 | 3.4 |
| Face validity | Q9 | 4 | 3 | 3 | 4 | 3 | 4 | 3 | 4 | 4 | 4 | 3.6 |
| | Q10 | 4 | 4 | 3 | 4 | 4 | 4 | 4 | 4 | 3 | 5 | 3.9 |
| | Q11 | 4 | 5 | 3 | 4 | 4 | 3 | 3 | 4 | 4 | 4 | 3.8 |
| External validity | Q12 | 4 | 5 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 5 | 3.8 |

## 9.5 CHAPTER SUMMARY

This chapter conducted a validation of the entire study. A total of 12 questions were proposed to evaluate the five kinds of validities of the study, namely, content validity, construct validity, internal validity, face validity, and external validity. Ten industry experts were invited to facilitate the evaluation. The evaluation results indicated that all the five kinds of validities are acceptable, which verify the validity of the entire study.

# CHAPTER 10 CONCLUSION AND FUTURE RESEARCH DIRECTIONS

# CHAPTER 10 CONCLUSION AND FUTURE RESEARCH DIRECTIONS

## 10.1 INTRODUCTION

This chapter summarizes the major findings and limitations of the study. Future research directions have also been presented in this chapter.

## 10.2 SUMMARY OF THE MAJOR FINDINGS

This study aims to investigate the corruption issues in the Chinese public construction sector, such as the corruption indicators, the causes of corruption, and the prevailing anti-corruption strategies. This study also develops a fuzzy model to assess the vulnerability to corruption in a public construction project. The major findings are summarized as follows.

### 10.2.1 Underlying Corruption Indicators in the Chinese Public Construction Industry

A framework of corruption indicators which consists of 19 items was consolidated in this study. The 19 specific corruption indicators were categorized into five underlying corruption indicators, namely, immorality, opacity, unfairness, procedural violation, and contractual violation. Based on the data of corruption indicators and the perceived level of corruption collected from the questionnaire survey, and using the approach of structural equation modeling analysis, this study reveals that immorality is the most influential underlying corruption indicator in the Chinese public construction sector, followed by opacity, unfairness, procedural violation, and contractual violation.

### 10.2.2 Principal Causes of Corruption in the Chinese Public Construction Sector

This study identified ten causes of corruption in the Chinese public construction sector and categorized them into two principal set of causes, namely, flawed regulation systems and lack of a positive industrial climate. This study found that, compared with the lack of a positive industrial climate, the flawed regulation systems have a greater influence on corruption indicators. Based on the structural equation modeling analysis and with regard to the flawed regulation systems, the most significant specific cause is negative leader roles, followed by inadequate sanctions, lack of rigorous supervision, and multifarious licenses and permits. With regard to the lack of a positive industrial climate, the most significant specific cause is interpersonal connections, followed by over-close relationships among contracting parties, great project complexity, and poor professional ethical standards.

### 10.2.3 Effectiveness of the Prevailing Anti-Corruption Strategies

This study consolidated a framework of the prevailing anti-corruption strategies composed of four underlying factors: leadership, rules and regulations, sanctions, and training. By investigating the relationships between the prevailing anti-corruption strategies and the corruption indicators using the structural equation modeling analysis, this study found that among four anti-corruption strategies only leadership received a marginal acceptable evaluation on its effectiveness, and that the other three anti-corruption strategies (rules and regulations, sanctions, and training) all received low evaluations. The esults indicate that in a country such as China which has a long tradition of rule by individual decision instead of law, political leadership and top management play a critical role in combating corruption, and that more efforts should be invested to anti-corrupiton strategies related to rules and regulations, sanctions, and training. To reinforce these anti-corruption strategies, this study has proposed four specific measures, including limiting power of chief leaders in government, development of honest and ethical construction culture, use of transparency mechanism, and supervision scheme for project life cycle, expecting that they could restrain corruption in the Chinese public construction sector effectively.

### 10.2.4 An Evaluation Model of Vulnerability to Corruption

Based on fuzzy set theory and the consolidated framework of corruption indicators, an evaluation model of vulnerability to corruption in public construction projects was developed. The evaluation model was sequentially applied to two Chinese public construction projects. The predicted results were in accordance with the actual corruption situation of the two projects. The validity of the evaluation model was verified, and the generalization potential of the model was proved.

## 10.3 LIMITATIONS OF THE STUDY

Although increasing efforts have been made in corruption research in recent years, only a few researchers, except for Tabish and Jha (2011a), systematically investigated the framework of corruption indicators in the construction sector. This reason is why the framework of Tabish and Jha (2011a) was selected as the initial framework of corruption indicators in this study. Expert interviews were also conducted to help refine the framework to the Chinese context.

Another limitation of this study lies in the sample size of the questionnaire survey. Although this study made a great effort to disseminate questionnaires and collect feedback from various regions in China, and the empirical data obtained supported the developed hypothesis, it can still be improved by collecting more empirical data to provide stronger evidence for model validation.

## 10.4 FUTURE RESEARCH DIRECTIONS

This study proved that poor professional ethical standards are a significant cause of corruption and revealed that immorality is the most influential underlying factor of corruption indicators. These results imply that ethics has a significant influence on corruption issues in the construction sector. Therefore, further research actions should be directed to ethical issues in the construction sector. To examine the topic of ethics, the following specific problems should be addressed: (1) the causes of poor professional ethical standards in the construction sector, (2) the barriers to improving professional ethical standards in the construction sector, and (3) the critical paths for improving professional ethical standards in the construction sector.

Another future research direction is conducting a systematic statistical analysis on corruption issues in the construction sector. That is, based on the dashboard data collected from the statistical communique released by the government and the corruption cases disclosed by the media, the interrelationships between corruption and other social and economic constructs can be explored. For example, we can verify whether significant relationships exist among corruption and construction output value, social and economic development levels of different geographic areas, wage levels of different geographic areas, and the rules and regulation systems of different geographic areas.

The study also revealed that the industry is more concerned about the effectiveness of the prevailing anti-corruption strategies. Therefore, subsequent research should also examine anti-corruption strategies. The following specific questions may be answered: what are the root causes of the ineffectiveness of the prevailing anti-corruption strategies? What are the barriers to the implementation of anti-corruption strategies? Are there innovative anti-corruption strategies that can effectively curb corruption?

## 10.5 CHAPTER SUMMARY

To conclude, this chapter summarized the major findings and acknowledged the limitations of this study. Directions for future research have also been proposed. The information shared herein should be able to shed light on how to improve corruption prevention in the Chinese public construction sector, and spark further research interest in the topic.

# APPENDIX A LIST OF CORRUPTION PAPERS IN ENGLISH CONSTRUCTION JOURNALS

| No. | Journal | Year | Vol. (Iss.) | Author(s) |
|---|---|---|---|---|
| 1 | Automation in Construction | 2010 | 19(7) | Xu, Y., Yeung, J.F.Y., Chan, A.P.C., Chan, D.W.M., Wang, S.Q., Ke, Y. |
| 2 | Business Ethics Quarterly | 2004 | 14(4) | Black, W.K. |
| 3 | Building Research Information | 2000 | 28(2) | Bologna, R., Del Nord, R. |
| 4 | Construction Management & Economics | 2012 | 30(12) | Ling, F.Y.Y., Tran, P.Q. |
| 5 | Construction Management & Economics | 2012 | 30(10) | Bowen, P.A., Edwards, P.J., Cattell, K. |
| 6 | Construction Management & Economics | 2012 | 30(10) | Tang, L.C.M., Atkinson, B., Zou, R.R. |
| 7 | Construction Management & Economics | 2012 | 30(1) | Tabish, S.Z.S., Jha, K.N. |
| 8 | Construction Management & Economics | 2011 | 29(8) | Tabish, S.Z.S., Jha, K.N. |
| 9 | Construction Management & Economics | 2011 | 29(3) | Tabish, S.Z.S., Jha, K.N. |
| 10 | Construction Management & Economics | 2007 | 25(6) | Bowen, P.A., Akintoye, A., Pearl, R., Edwards, P.J. |
| 11 | Construction Management | 2004 | 22(1) | Pan, Z. |

| No. | Journal | Year | Vol. (Iss.) | Author(s) |
|---|---|---|---|---|
| | & Economics | | | |
| 12 | Construction Management & Economics | 1998 | 16(4) | Crosthwaite, D. |
| 13 | Crime, Law and Social Change | 2005 | 44(2) | Van den Heuvel, G. |
| 14 | Engineering, Construction and Architectural Management | 2011 | 18(5) | Ke, Y., Wang, S.Q., Chan, A.P.C., Cheung, E. |
| 15 | Industrial & Labor Relations Review | 1992 | 45(3) | Brooks, G.W. |
| 16 | International Journal of Project Management | 2002 | 20(8) | Sonuga, F., Aliboh, O., Oloke, D. |
| 17 | International Public Management Journal | 2012 | 15(1) | Jancsics, D., Javor, I. |
| 18 | Journal of Construction Engineering and Management | 2013 | 139(1) | Meduri, S.S., Annamalai, T.R. |
| 19 | Journal of Construction Engineering and Management | 2009 | 135(10) | Ling, F.Y.Y., Pham, V.M.C., Hoang, T.P. |
| 20 | Journal of Construction Engineering and Management | 2008 | 134(9) | Sohail, M., Cavill, S. |
| 21 | Journal of Construction | 2000 | 126(3) | Wang, S.Q., Tiong, R.L.K., |

| No. | Journal | Year | Vol. (Iss.) | Author(s) |
|---|---|---|---|---|
| | Engineering and Management | | | Ting, S.K., Ashley, D. |
| 22 | Journal of Construction Engineering and Management | 1999 | 125(3) | Wang, S.Q., Tiong, R.L.K., Ting, S.K., Ashley, D. |
| 23 | Journal of Management in Engineering | 2011 | 27(3) | Chan, A.P.C., Yeung, J.F.Y., Yu, C.C.P., Wang, S.Q., Ke, Y. |
| 24 | Journal of Management in Engineering | 2009 | 25(1) | Alutu, O.E., Udhawuve, M.L. |
| 25 | Journal of Professional Issues in Engineering Education and Practice | 2010 | 136(3) | Ling, F.Y.Y., Hoang, V.T.P. |
| 26 | Journal of Professional Issues in Engineering Education and Practice | 2010 | 136(1) | Ameh, O.J., Odusami, K.T. |
| 27 | Journal of Professional Issues in Engineering Education and Practice | 2007 | 133(2) | Teo, E.A.L., Aibinu, A.A. |
| 28 | Leadership and Management in Engineering | 2009 | 9(3) | Tashjian, L. |
| 29 | Leadership and Management in | 2009 | 9(3) | Krishnan, C. |

| No. | Journal | Year | Vol. (Iss.) | Author(s) |
|---|---|---|---|---|
| | Engineering | | | |
| 30 | Leadership and Management in Engineering | 2009 | 9(3) | De Jong, M., Henry, W.P., Stansbury, N. |
| 31 | Leadership and Management in Engineering | 2009 | 9(3) | Stansbury, C. |
| 32 | Leadership and Management in Engineering | 2009 | 9(3) | Crist, R.A. |
| 33 | Leadership and Management in Engineering | 2009 | 9(3) | Stansbury, N. |
| 34 | Leadership and Management in Engineering | 2009 | 9(3) | Dall'Acqua, C. |
| 35 | Leadership and Management in Engineering | 2009 | 9(3) | Smith, J.H. |
| 36 | Leadership and Management in Engineering | 2009 | 9(3) | Henry, W.P. |
| 37 | Leadership and Management in | 2009 | 9(3) | Hartley, R. |

| No. | Journal | Year | Vol. (Iss.) | Author(s) |
|---|---|---|---|---|
| | Engineering | | | |
| 38 | Leadership and Management in Engineering | 2009 | 9(3) | Boeckmann, A. |
| 39 | Leadership and Management in Engineering | 2009 | 9(3) | Boyd, J.M., Padilla, J. D. |
| 40 | Leadership and Management in Engineering | 2009 | 9(2) | Singh, A. |
| 41 | Leadership and Management in Engineering | 2006 | 6(4) | Shiramizu, S., Singh, A. |
| 42 | Proceedings of the Institution of Civil Engineers: Civil Engineering | 2012 | 165(5) | Kenny, C. |
| 43 | Proceedings of the Institution of Civil Engineers: Civil Engineering | 2011 | 164(1) | Mapara, V. |
| 44 | Science and Engineering Ethics | 2013 | 19(2) | Gunduz, M., Onder, O. |
| 45 | Science and Engineering | 2006 | 12(2) | Benzley, S.E. |

| No. | Journal | Year | Vol. (Iss.) | Author(s) |
|---|---|---|---|---|
| | Ethics | | | |
| 46 | Transport Reviews | 2009 | 29(1) | Kenny, C. |
| 47 | Urban History | 2012 | 39 (Part3) | Jone, P. |

## APPENDIX B LIST OF CORRUPTION PAPERS IN TOP CHINESE MANAGEMENT JOURNALS

| 序号 | 期刊 | 年份 | 卷（期） | 作者 |
|---|---|---|---|---|
| 1. | 管理工程学报 | 2013 | 27（2） | 乌云娜，杨益晟，冯天天，黄勇 |
| 2. | 管理工程学报 | 2013 | 27（2） | 冯明，焦静，任华勇 |
| 3. | 管理评论 | 2013 | 25（8） | 李永奎，乐云，张兵，单明 |
| 4. | 公共管理学报 | 2013 | 10（3） | 乐云，张兵，关贤军，李永奎 |
| 5. | 公共管理学报 | 2008 | 5（4） | 龙朝阳，田银华 |
| 6. | 公共管理学报 | 2004 | 1（3） | 何增科 |
| 7. | 公共管理学报 | 2004 | 1（3） | 李秀峰，李俊 |
| 8. | 公共管理学报 | 2004 | 1（2） | 王乐夫，倪星 |
| 9. | 中国软科学 | 2008 | （5） | 吴俊培，姚莲芳 |
| 10. | 中国软科学 | 2008 | （1） | 南旭光，孟卫东 |
| 11. | 中国软科学 | 2005 | （6） | 张跃进 |
| 12. | 中国软科学 | 2002 | （6） | 邓晓梅，田芋 |
| 13. | 中国软科学 | 1999 | （11） | 吕荣杰，刘兵 |
| 14. | 中国软科学 | 1999 | （9） | 张文军，沈建山 |
| 15. | 中国软科学 | 1998 | （3） | 莫克，杨贤，李怀祖 |
| 16. | 管理世界 | 2013 | （12） | 徐细雄，刘星 |
| 17. | 管理世界 | 2011 | （12） | 谭亚莉，廖建桥，李骥 |
| 18. | 管理世界 | 2001 | （6） | 胡鞍钢，过勇 |

| 序号 | 期刊 | 年份 | 卷（期） | 作者 |
|---|---|---|---|---|
| 19. | 管理世界 | 2001 | （1） | 解冰，康均心 |
| 20. | 管理世界 | 1994 | （3） | 葛延风 |
| 21. | 管理世界 | 1989 | （5） | 向以斌 |
| 22. | 系统工程理论与实践 | 2008 | （6） | 吴付科，胡适耕，曾宪初 |
| 23. | 系统工程理论与实践 | 1999 | （9） | 安立仁，赵文华，席酉民 |
| 24. | 数量经济技术经济研究 | 2004 | （12） | 周军，刘民权 |
| 25. | 数量经济技术经济研究 | 2004 | （5） | 周新苗 |
| 26. | 中国工业经济 | 2005 | （8） | 夏光，张胜波 |

# APPENDIX C LIST OF CORRUPTION PAPERS IN TOP CHINESE MANAGEMENT JOURNALS (ENGLISH VERSION)

| No. | Journal | Year | Vol. (Iss.) | Author(s) |
|---|---|---|---|---|
| 1. | Journal of Industrial Engineering and Engineering Management | 2013 | 27（2） | Wu, Y., Yang, Y., Feng T., and Huang, Y. |
| 2. | Journal of Industrial Engineering and Engineering Management | 2013 | 27（2） | Feng, M., Jiao, J., and Ren, H. |
| 3. | Management Review | 2013 | 25（8） | Li, Y., Le, Y., Zhang, B., and Shan, M. |
| 4. | Journal of Public Management | 2013 | 10（3） | Le, Y., Zhang, B., Guan, X., and Li, Y. |
| 5. | Journal of Public Management | 2008 | 5（4） | Long, Z., and Tian, Y. |
| 6. | Journal of Public Management | 2004 | 1（3） | He, Z. |
| 7. | Journal of Public Management | 2004 | 1（3） | Li, X., and Li, J. |
| 8. | Journal of Public Management | 2004 | 1（2） | Wang, L., and Ni, X. |
| 9. | China Soft Science Magazine | 2008 | （5） | Wu, J., and Yao, L. |
| 10. | China Soft Science Magazine | 2008 | （1） | Nan, X., and Meng, W. |
| 11. | China Soft Science Magazine | 2005 | （6） | Zhang, Y. |
| 12. | China Soft Science Magazine | 2002 | （6） | Deng, X., and Tian, Q. |
| 13. | China Soft Science Magazine | 1999 | （11） | Lv, R., and Liu, B. |

| No. | Journal | Year | Vol. (Iss.) | Author(s) |
|---|---|---|---|---|
| 14. | China Soft Science Magazine | 1999 | （9） | Zhang, W., and Shen, J. |
| 15. | China Soft Science Magazine | 1998 | （3） | Mo, K., Yang, X., and Li, H. |
| 16. | Management World | 2013 | （12） | Xu, X., and Liu, X. |
| 17. | Management World | 2011 | （12） | Tan, Y., Liao, J., and Li, J. |
| 18. | Management World | 2001 | （6） | Hu, A., and Guo, Y. |
| 19. | Management World | 2001 | （1） | Xie, B., and Kang, J. |
| 20. | Management World | 1994 | （3） | Ge, Y. |
| 21. | Management World | 1989 | （5） | Xiang, Y. |
| 22. | System Engineering – Theory & Practice | 2008 | （6） | Wu, F., Hu, S., and Zeng, X. |
| 23. | System Engineering – Theory & Practice | 1999 | （9） | An, L., Zhao, W., and Xi, Y. |
| 24. | The Journal of Quantitative & Technical Economics | 2004 | （12） | Zhou, J., and Liu, M. |
| 25. | The Journal of Quantitative & Technical Economics | 2004 | （5） | Zhou, X. |
| 26. | China Industrial Economics | 2005 | （8） | Xia, G., and Zhang, S. |

## APPENDIX D STRUCTURED INTERVIEW DOCUMENT OF THE STUDY (ENGLISH VERSION)

The objective of this interview is to identify corruption indicators, causes of corruption, as well as prevailing anti-corruption strategies in the Chinese public construction sector.

**Part A – Background of Interviewee**

Interviewee: ________________ Position: ________________ Stakeholder: ________________ Years of Experience: __________

Interviewer: ________________ Venue: ________________ Time and Date: ______________ Record taken by: ___________

**Part B – Identification of corruption indicators in the Chinese public construction sector**

Please evaluate the applicability of each item below as the corruption indicator in the Chinese public construction sector.

| No. | Item | Very inapplicable | Inapplicable | Medium | Applicable | Very applicable |
|---|---|---|---|---|---|---|
| **1.** | Administrative approval and financial sanction not taken to execute the work | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **2.** | The provisions are not as per laid down yardstick | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **3.** | Work is not executed for the same purpose for which the sanction was accorded | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **4.** | Realistic technically sound estimates are not prepared | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **5.** | Some components are repeated in more than one item | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **6.** | The consultant is not appointed after proper publicity and open competition | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **7.** | The credentials of all consultants have not been verified | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **8.** | The criteria adopted in prequalification of consultant are restrictive and benefit only few consultants | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **9.** | The offer of lowest consultant is ignored on flimsy grounds | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **10.** | The selection of consultant not done by appropriate authority | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **11.** | The role of consultant is not clearly defined | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **12.** | The provisions are not made for payment to consultant for part performance or repetitive work | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **13.** | The upper ceiling limit for payments to consultant is not fixed | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **14.** | The detailed project report is not prepared as per actual site requirement | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **15.** | Consultant does not submit performance guarantee in time | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **16.** | Performance guarantee submitted by consultant is not renewed from time to time | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **17.** | The reimbursement of service tax, excise duty, etc. is not done after obtaining the actual proof of depositing the same | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **18.** | The updated standard bidding document is not used for tendering process | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **19.** | The tender documents are not approved by competent authority | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **20.** | Stipulated conditions in the contract are not feasible to be operated | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **21.** | The performance guarantee clause is not stipulated | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **22.** | The condition regarding splitting of quantities, if required, is not stipulated in the tender document | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **23.** | The nomenclature of the items, drawings and specifications do not conform to each other | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **24.** | Adequate & wide publicity is not given to tender | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **25.** | Adequate time for submission of tender/offer not given | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **26.** | Complete address of place of tender submission not notified | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **27.** | Documents for sale and opening of tender are not properly maintained in transparent manner | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **28.** | Unduly restrictive criteria stipulated, creating entry barrier for potential bidders | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **29.** | The objective evaluation criteria for contractor not clearly notified in the tender document | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

| No. | Item | Very inapplicable | Inapplicable | Medium | Applicable | Very applicable |
|---|---|---|---|---|---|---|
| **30.** | Stipulated prequalification criteria for selection of contractor are stringent | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **31.** | The prequalification criteria are not kept same during evaluation of potential bidders as notified | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **32.** | The evaluation criteria are not notified to the bidders | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **33.** | The prequalification is not carried out as per notified criteria | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **34.** | The credentials of the bidders are not matched and verified with the notified criteria | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **35.** | The evaluation of tenders is not done exactly as per the notified criteria | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **36.** | The bids/tenders are not opened in presence of bidders | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **37.** | All corrections, omissions, insertions, overwriting are not attested and accounted for | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **38.** | „On the spot summary" is not prepared in tender opening register and signed by the person present | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **39.** | The decision on tender is not given by appropriate authority within validity period | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **40.** | Some items are deleted after opening of tender | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **41.** | The negotiation on tender not done as per laid down guidelines | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **42.** | The conditions/specifications are relaxed in favor of contractor to whom the work is being awarded | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **43.** | The offer of lowest bidder is ignored on flimsy grounds | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **44.** | The work order/supply order is not placed within justified rates | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **45.** | Work is executed without the availability of funds for the said purpose | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **46.** | The work is not executed as per original sanction accorded | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **47.** | The bank guarantees submitted by bidder not verified | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **48.** | Compliance with conditions regarding obtaining licenses, insurance policies and deployment of technical staff not being followed by contractor | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **49.** | The compliance with agreement conditions not fulfilled | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **50.** | All the mandatory tests not being carried out | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **51.** | The proper record of hindrances is not being maintained from the beginning | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **52.** | The technical staff as per tender stipulation is not provided at site | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **53.** | The contractors are paid for that part of the work which was not done by them | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **54.** | The contractors are not paid for that part of the work which was done by them | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **55.** | All the recoveries as per contract are not effected | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **56.** | The deviations, especially in abnormally high rated and high value items are not properly monitored and verified | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **57.** | Duplicate payment for the same activity under two different items is released | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **58.** | Recoveries for the land rent or equipment given to contractor not effected | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **59.** | The recoveries for statutory taxes/duties not made before releasing the payment | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **60.** | Escalation clause is not applied correctly for admissible payment | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **61.** | The required guarantees for water tightness of roof/ basements, etc. and termite proofing are not obtained | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

If you think there is/are corruption indicator(s) missed in this interview, please provide the supplementation and also the evaluation accordingly.

| No. | Item | Very inapplicable | Inapplicable | Medium | Applicable | Very applicable |
|---|---|---|---|---|---|---|
| **1.** | | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **2.** | | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

| No. | Item | Very inapplicable | Inapplicable | Medium | Applicable | Very applicable |
|---|---|---|---|---|---|---|
| 3. | | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 4. | | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

**Part C – Identification of causes of corruption in the Chinese public construction sector**

Please indicate your endorsement on the following causes of corruption.

| No. | Cause of corruption | Definition | Strongly disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|---|---|---|
| 1. | Multifarious licenses or permits | Some construction related companies choose to bribe governmental officials to obtain the multifarious licenses or permits those designated by the government department in a shorter time. | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 2. | Deficiencies in rules and laws | Deficiencies in rules and laws could create a fertile ground for corruption vulnerabilities. | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 3. | Excessive competition in the construction market | Excessive competition in the construction market urges contractors to bribe some client staff members to obtain a competitive advantage in securing contracts. | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 4. | Lack of rigorous supervision | Supervisions on the corrupt practices are not executed rigorously for some private purpose of the supervisors. | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 5. | Low wage level | Wage level in the construction industry is low, making industrial practitioners be inclined to conduct corrupt practices to reap extra money. | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 6. | Inadequate sanctions | Sanctions on corruption crimes are too light, so that corruption players are not afraid of punishment when they are considering doing corruption. | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 7. | Poor professional ethical standards | Poor professional ethical standards make practitioners can't keep integrity in front of economic attraction thereby contributing to the occurrence of corruption. | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 8. | Negative leader roles | Negative leader roles of corruption, especially who is not punished will inspire other people to conduct corrupt practices. | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 9. | Over-close relationships among contracting parties | Over-close relationships among contracting parties bring more convenience for illegal trade thereby contributing to the occurrence of corruption. | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 10. | Great project complexity | A public construction project with a characteristic of high complexity is more inclined to be eroded by corruption, for the numerous practitioners and information asymmetry existing in this kind of project. | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

If you think there is/are cause(s) of corruption missed in this interview, please provide the supplementation and also the evaluation accordingly.

| No. | Cause of corruption | Definition | Strongly disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|---|---|---|
| 1. | | | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 2. | | | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 3. | | | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 4. | | | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

**Part D – Identification of prevailing anti-corruption strategies in the Chinese public construction sector**

Please evaluate the effectiveness of the following anti-corruption strategies.

| No. | Anti-corruption strategy | Definition | Very ineffective | Ineffective | Neutral | Effective | Very effective |
|---|---|---|---|---|---|---|---|
| 1. | Positive Leadership | Leadership of nature in integrity helps prevent corruption in organizations. | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 2. | A completed legal | A thorough legal framework provides much support for the | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

| No. | Anti-corruption strategy | Definition | Very ineffective | Ineffective | Neutral | Effective | Very effective |
|---|---|---|---|---|---|---|---|
| | framework | governance on corruption. | | | | | |
| **3.** | Sound systems | Sound systems could eliminate the leaks those could be taken advantages by the corruption players. | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **4.** | A rigorous execution of laws, rules, and systems | A rigorous execution of laws, rules, and institutions help prevent the occurrence of corruption. | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **5.** | Transparency | Information of the project constructed should be announced to the public thereby a wider public supervision could be obtained. | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **6.** | Raising wage level | An increase in wage level in industrial practitioners is likely to reduce corruption. | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **7.** | Education and training | Education and training on the industrial practitioners could raise their morality levels thereby restraining the corruption in public construction projects. | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **8.** | Administrative sanction | Administrative sanction on corruption players, such as degradation of certificates, and debarment of bidding for new projects help restrain corruption. | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **9.** | Economic sanction | Economic sanction such as fine could help prevent corruption in public construction projects. | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **10.** | Penal sanction | Penal sanction provides much fear for the corruption players so that corruption could be prevented. | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

If you think there is/are anti-corruption strategy/strategies missed in this interview, please provide the supplementation and also the evaluation accordingly.

| No. | Anti-corruption strategy | Definition | Very ineffective | Ineffective | Neutral | Effective | Very effective |
|---|---|---|---|---|---|---|---|
| **1.** | | | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **2.** | | | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **3.** | | | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| **4.** | | | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

## APPENDIX E STRUCTURED INTERVIEW DOCUMENT OF THE STUDY (CHINESE VERSION)

本次访谈的目的是为确定中国政府投资建设项目腐败测量指标、腐败诱因，以及现时实施的反腐败策略。

### A 部： 受访者背景信息

受访人：________ 职位：________ 项目参与方：________ 从业时间：________

访问人：________ 地点：________ 时间与日期：________ 记 录：________

### B 部： 中国政府投资建设项目腐败测量指标界定

以下指标是否适用于测定中国政府投资建设项目腐败现象，请您做出评价。

| 序号 | 腐败测量指标 | 极不适用 | 不适用 | 中立 | 适用 | 极其适用 |
|---|---|---|---|---|---|---|
| 1. | 项目实施前未取得立项审批与财政拨款支持 | □1 | □2 | □3 | □4 | □5 |
| 2. | 项目财政拨款无法正常拨付 | □1 | □2 | □3 | □4 | □5 |
| 3. | 项目实际用途与项目立项批复文件所列用途不一致 | □1 | □2 | □3 | □4 | □5 |
| 4. | 项目实施前未开展切合实际的概算工作 | □1 | □2 | □3 | □4 | □5 |
| 5. | 一项工作在多项分部分项工作中重复计算，导致重复付款现象出现 | □1 | □2 | □3 | □4 | □5 |
| 6. | 咨询方不是通过公开招投标遴选得到 | □1 | □2 | □3 | □4 | □5 |
| 7. | 咨询方的相关资质证书没有经过核实 | □1 | □2 | □3 | □4 | □5 |
| 8. | 针对咨询方的资格预审条件比较严格且具有倾向性 | □1 | □2 | □3 | □4 | □5 |
| 9. | 报价最低的咨询方在没有充分理由的条件下未获得委托 | □1 | □2 | □3 | □4 | □5 |
| 10. | 咨询方的遴选并非由专业机构实施 | □1 | □2 | □3 | □4 | □5 |
| 11. | 咨询方的角色与权责缺乏清晰明确的定义 | □1 | □2 | □3 | □4 | □5 |
| 12. | 咨询方在部分完成工作或重复完成工作情况下的咨询费支付事项没有在委托合同中注明 | □1 | □2 | □3 | □4 | □5 |
| 13. | 针对咨询方的付费未设付款上限 | □1 | □2 | □3 | □4 | □5 |
| 14. | 项目报告书与项目实际情况存在差异 | □1 | □2 | □3 | □4 | □5 |
| 15. | 咨询方没有及时将承包商履约保函转交业主方 | □1 | □2 | □3 | □4 | □5 |
| 16. | 由咨询方转交业主方的承包商履约保函没有实时更新 | □1 | □2 | □3 | □4 | □5 |
| 17. | 服务税等可以退税的税项在收到准确的发票时没有得到及时的退款（报销） | □1 | □2 | □3 | □4 | □5 |
| 18. | 项目招标没有按照最新规范流程操作 | □1 | □2 | □3 | □4 | □5 |
| 19. | 招标文件不是由专业机构认可并发出 | □1 | □2 | □3 | □4 | □5 |
| 20. | 合同文件里面的规定性条款缺乏可执行性 | □1 | □2 | □3 | □4 | □5 |
| 21. | 与承包商合同文件中没有注明履约保函条款 | □1 | □2 | □3 | □4 | □5 |
| 22. | 项目存在若干标段，但招标文件中没有清晰定义各标段之间界限 | □1 | □2 | □3 | □4 | □5 |
| 23. | 分部分项工程的术语、图纸和说明等相互之间不一致 | □1 | □2 | □3 | □4 | □5 |
| 24. | 项目招标公告的公开性对投标单位而言不够充分 | □1 | □2 | □3 | □4 | □5 |
| 25. | 项目招标没有给投标单位留有足够的时间准备投标文件 | □1 | □2 | □3 | □4 | □5 |
| 26. | 项目招标文件中没有详细说明递交投标文件的地址 | □1 | □2 | □3 | □4 | □5 |
| 27. | 招标文件的发售和开标过程没有以透明的方式开展 | □1 | □2 | □3 | □4 | □5 |
| 28. | 设置过多的限制性条件，为潜在投标人投标设置障碍 | □1 | □2 | □3 | □4 | □5 |
| 29. | 招标文件中没有明确说明针对承包商自身的评价准则（即除技术标、商务标等内容外对承包商业绩、资信等的评价准则） | □1 | □2 | □3 | □4 | □5 |
| 30. | 项目资格预审过程中设置极其严格的资格预审条件 | □1 | □2 | □3 | □4 | □5 |
| 31. | 资格预审中实际执行的资格预审条件与事先公布的资格预审条件不同 | □1 | □2 | □3 | □4 | □5 |
| 32. | 评标办法没有告知投标人 | □1 | □2 | □3 | □4 | □5 |
| 33. | 资格预审没有全部按照事先公布的标准执行，仅执行了部分标准 | □1 | □2 | □3 | □4 | □5 |
| 34. | 投标人的资质证书不满足资格预审文件的要求，且未核实，但通过资格预审环节 | □1 | □2 | □3 | □4 | □5 |
| 35. | 针对每一个投标文件的评审没有完全按照事先公布的评标办法实施 | □1 | □2 | □3 | □4 | □5 |
| 36. | 项目开标时投标文件在投标人缺席的情况下被打开 | □1 | □2 | □3 | □4 | □5 |
| 37. | 对招标文件的局部更改没有做到投标人全部知悉 | □1 | □2 | □3 | □4 | □5 |

| 序号 | 腐败测量指标 | 极不适用 | 不适用 | 中立 | 适用 | 极其适用 |
|---|---|---|---|---|---|---|
| 38. | 开标现场没有准备投标人签到程序 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 39. | 中标通知书并非在投标有效期内公布 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 40. | 部分分部分项工程在开标后被删除 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 41. | 项目中标人的选定并非由已公布的评价准则产生 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 42. | 项目评标过程对已承接招标人建设的其他工程的承包商有倾向性 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 43. | 报价最低的投标人在没有充分理由的条件下被否决 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 44. | 施工方或材料供应商无法通过合同的履行而获得正常合理的利润 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 45. | 施工过程中工程款无法正常按期支付 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 46. | 项目没有完全按照设计图纸施工，存在大量施工变更 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 47. | 投标人提交的银行担保没有经过核实 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 48. | 承包商没有遵照相关约定配备足够的施工技术人员、购买保险及取得相关证书 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 49. | 承包商和业主之间的合同条款没有得到彻底、严格地执行 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 50. | 在施工过程中，针对建筑材料的强制性检验没彻底、严格的执行 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 51. | 项目施工阶段没有良好的现场文档记录 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 52. | 承包商没有在现场按照投标文件的允诺配备相关技术人员 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 53. | 部分分布分项工程并非由承包商完成，业主方却支付相应工程款 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 54. | 部分分布分项工程由承包商完成，业主方却拒绝支付相应工程款 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 55. | 合同当中有关工程维修的条款没有被激活 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 56. | 高利润率及高价值的分部分项工程的变更没有得到适当的监管和核实 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 57. | 分部分项工程中的某一项目被重复计算并重复支付工程款 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 58. | 本该返还给承包商的场租费、设备费补贴没有返还 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 59. | 支付的工程款中没有包括法定的应该返还给承包商的退税 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 60. | 合同中的调价条款没有得到正确、合理的运用 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 61. | 承包商施工维修保证金没有留存 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

如您认为本次访谈问卷遗漏了部分腐败测量指标，请您补充并评价。

| 序号 | 腐败测量指标 | 极不适用 | 不适用 | 中立 | 适用 | 极其适用 |
|---|---|---|---|---|---|---|
| 1. | | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 2. | | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 3. | | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 4. | | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

## C 部：中国政府投资建设项目腐败诱因界定

您是否认同以下条目为政府投资建设项目腐败诱因，请您做出评价。

| 序号 | 腐败诱因 | 定义 | 极不同意 | 不同意 | 中立 | 同意 | 极其同意 |
|---|---|---|---|---|---|---|---|
| 1. | 行政审批过多 | 建设行业主管部门设置的种类繁多的行政审批事项 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 2. | 监督法制不健全 | 现有建设监督法制体系不健全，腐败分子有机可乘 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 3. | 建筑业激烈竞争 | 建筑业中存在的激烈竞争迫使项目参与方将腐败作为谋求项目的手段 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 4. | 监管实施不严格 | 针对腐败行为的监管实施不严格，执法不严 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 5. | 薪资水平较低 | 项目从业人员薪资水平较低并诱发腐败行为 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 6. | 处罚力度过轻 | 针对腐败行为的处罚力度过轻，不足以形成对腐败分子的威慑力 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 7. | 职业道德水平较低 | 项目从业人员职业道德水平较低并诱发腐败行为 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 8. | 负面示范影响 | 腐败行为的负面示范作用，例如部分人员实施了腐败行为且未收到惩罚 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 9. | 项目参与方联系 | 项目参与方长久合作后形成的联系有可能会导致工程腐败现象 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 10. | 项目复杂性 | 大型工程项目复杂性带来的管理难度使工程腐败现象有机可乘 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

如您认为本次访谈问卷遗漏了部分腐败诱因，请您补充并评价。

| 序号 | 腐败诱因 | 定义 | 极不同意 | 不同意 | 中立 | 同意 | 极其同意 |
|---|---|---|---|---|---|---|---|
| **1.** | | | □1 | □2 | □3 | □4 | □5 |
| **2.** | | | □1 | □2 | □3 | □4 | □5 |
| **3.** | | | □1 | □2 | □3 | □4 | □5 |
| **4.** | | | □1 | □2 | □3 | □4 | □5 |

**D 部：中国政府投资建设项目反腐败策略界定**

请您评价以下中国政府投资建设项目反腐败策略的有效性。

| 序号 | 反腐败策略 | 定义 | 极其无效 | 无效 | 中立 | 有效 | 极其有效 |
|---|---|---|---|---|---|---|---|
| **1.** | 领导力 | 组织内正直、廉洁的领导力量建设有助于遏制腐败现象 | □1 | □2 | □3 | □4 | □5 |
| **2.** | 完善法制体系 | 完善法制建设，为遏制工程腐败行为提供法律支撑 | □1 | □2 | □3 | □4 | □5 |
| **3.** | 健全制度体系 | 健全项目建设管理各项规章制度，完善权力运行机制和决策运行机制 | □1 | □2 | □3 | □4 | □5 |
| **4.** | 严格实施监管 | 完善监督机制，确保各项建设法规、项目管理规章制度得到严格的执行 | □1 | □2 | □3 | □4 | □5 |
| **5.** | 透明机制 | 及时发布建设项目相关信息，使公众享有知情权、监督权、批评权和建议权，提升公众参与度 | □1 | □2 | □3 | □4 | □5 |
| **6.** | 提升薪资水平 | 提升从业人员的工资待遇水平，遏制其腐败动机 | □1 | □2 | □3 | □4 | □5 |
| **7.** | 培训及教育 | 对从业人员进行系统的职业道德培训及反腐败教育 | □1 | □2 | □3 | □4 | □5 |
| **8.** | 行政处罚 | 对工程腐败行为进行行政处罚，例如对腐败公职人员给予降职或开除处分，对腐败企业给予资质降级处分 | □1 | □2 | □3 | □4 | □5 |
| **9.** | 经济处罚 | 对工程腐败行为进行经济处罚 | □1 | □2 | □3 | □4 | □5 |
| **10.** | 刑事处罚 | 对工程腐败行为进行刑事处罚 | □1 | □2 | □3 | □4 | □5 |

如您认为本次访谈问卷遗漏了部分反腐败策略，请您补充并评价。

| No. | 反腐败策略 | 定义 | 极其无效 | 无效 | 中立 | 有效 | 极其有效 |
|---|---|---|---|---|---|---|---|
| **1.** | | | □1 | □2 | □3 | □4 | □5 |
| **2.** | | | □1 | □2 | □3 | □4 | □5 |
| **3.** | | | □1 | □2 | □3 | □4 | □5 |
| **4.** | | | □1 | □2 | □3 | □4 | □5 |

# APPENDIX F QUESTIONNAIRE DOCUMENT (ENGLISH VERSION)

**Part A – Introduction of Survey**

Dear expert,

You are cordially invited to participate into a questionnaire survey on corruption in public construction projects in China. This survey is part of a research project funded by the National Natural Science Foundation of China (Project No. 71172107), Tongji University, and The Hong Kong Polytechnic University.

This questionnaire survey contains five sections. Section A introduces the background of this questionnaire survey. Section B is related to the particulars of each informant. In Section C, you are invited to evaluate the corruption indicators in the Chinese public construction sector. In Section D, you are invited to assess the causes of corruption in the Chinese public construction sector. In Section E, you are invited to evaluate the effectiveness of prevailing anti-corruption strategies. In Section F, please provide your perception of corruption situation in the Chinese public construction sector.

Please email this questionnaire back to ming.shan@ before October 31. You are assured that this survey is completely anonymous and responses will be treated with the strictest confidentiality.

Thank you very much for your participation.

Best regards,

SHAN Ming
PhD Student jointly supervised by Tongji University and The Hong Kong Polytechnic University

LE Yun
Professor, Department of Construction Management and Real Estate, Tongji University

CHAN Ping Chuen
Professor, Department of Building and Real Estate, The Hong Kong Polytechnic University

**Part B – Respondent Background**

1. Your current professional affiliation:

   ☐ Government ☐ Client ☐ Contractor ☐ Designer Consultant ☐ Others (Please specify__________)

2. Your previous professional affiliation (if any):

   ☐ Government ☐ Client ☐ Contractor ☐ Designer ☐ Consultant ☐ Others (Please specify__________)

3. Current position in your organization:____________________

4. Your working experience in public construction projects:

   ☐ 0-5 years ☐ 6-10 years ☐ 11-20 years ☐ Above 20 years

5. Your working place(s) in latest 3 years:___________________

**Part C – Evaluation of corruption indicators in the Chinese public construction sector**

Please provide your perception of probability and severity of each risk factor to corruption listed below.

| No. | Corruption Indicator | Probability | | | | | Severity | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Very Low | Low | Neutral | High | Very High | Very Low | Low | Neutral | High | Very High |
| 1 | Administrative & financial approvals not taken to execute the work | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 2 | The provisions are not as per laid down yardstick | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 3 | Work is not executed for the same purpose for which the sanction was accorded | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 4 | The consultant is not appointed after proper publicity and open competition | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 5 | The criteria adopted in prequalification of consultant are restrictive and benefit only few consultants | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 6 | The selection of consultant not done by appropriate authority | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 7 | Adequate & wide publicity is not given to tender | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 8 | Adequate time for submission of tender/offer not given | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 9 | Prequalification criteria for selection of contractor are stringent | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 10 | The evaluation of tenders is not done exactly as per the notified criteria | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 11 | The negotiation on tender not done as per laid down guidelines | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 12 | The conditions/specifications are relaxed in favor of contractor to whom the work is being awarded | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 13 | The work order/supply order is not placed within justified rates | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 14 | A large project should have called for bids is split into several small projects and contracted without bidding | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 15 | Bidding documents submitted do not match the real condition of the contractor | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 16 | Confidential information of bidding is disclosed to a specific bidder | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 17 | Work is executed without the availability of funds for the said purpose | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 18 | The work is not executed as per original sanction accorded | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 19 | Compliance with conditions regarding obtaining licenses, insurance policies and deployment of technical staff not being followed by contractor | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 20 | The proper record of hindrances is not being maintained from the beginning | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 21 | The deviations, especially in abnormally high rated and high value | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

| No. | Corruption Indicator | Probability | | | | | Severity | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Very Low | Low | Neutral | High | Very High | Very Low | Low | Neutral | High | Very High |
| | items are not properly monitored and verified | | | | | | | | | | |
| 22 | Escalation clause is not applied correctly for admissible payment | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 23 | Substitution of unqualified materials in construction | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 24 | Supervision on the project construction is not adequate | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

**Section D – Evaluation of causes of corruption in the Chinese public construction sector**

Please indicate your endorsement on the causality between the following causes of and risk factors to corruption in the Chinese public construction sector

| No. | Cause of corruption | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| 1 | Multifarious licenses or permits | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 2 | Deficiencies in rules and laws | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 3 | Excessive competition in the construction market | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 4 | Lack of rigorous supervision | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 5 | Inadequate sanctions | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 6 | Poor professional ethical standards | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 7 | Negative leader roles | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 8 | Over-close relationships among contracting parties | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 9 | Great project complexity | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 10 | Interpersonal connections | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

**Section E – Evaluation of anti-corruption strategies in the Chinese public construction sector**

Please indicate your endorsement on the following statements based on your experience in the Chinese public construction sector

| No. | Statement | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|---|
| 1 | I clearly consider anticorruption measures to be equally as important as construction | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 2 | I act positively and cooperate with anticorruption agencies | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 3 | I act decisively when an anticorruption issue is raised | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 4 | I praise staff members for working honestly | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 5 | We often remind each other on how to work fairly and honestly | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 6 | As a group we maintain good working relationship and offer help when needed to perform job honestly | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 7 | As a group we maintain corruption free workplace environment | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 8 | I believe that anticorruption rules and regulations are adequate source of information on anticorruption | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 9 | I believe that anticorruption rules and regulations are there to protect me from vigilance cases/ disciplinary action | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 10 | I believe that anticorruption rules and regulation should be consulted by all recruits | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 11 | I believe that anticorruption rules and regulations do not put rigid restriction in the adoption of new products and technological processes | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 12 | I believe adequate training is necessary to perform my job honestly | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 13 | I believe adequate training help me in taking action to prevent corruption | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 14 | I believe adequate training helps me to prevent workplace corrupt practices and help me to follow fair and transparent practices | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 15 | I recognize I have complied with the anticorruption measures like rules and regulations etc of my job for fear of administrative sanction from my boss | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 16 | I recognize I have complied with the anticorruption measures like rules and regulations etc of my job for fear of economic sanction | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |
| 17 | I recognize I have complied with the anticorruption measures like rules and regulations etc of my job for fear of penal sanction | ☐1 | ☐2 | ☐3 | ☐4 | ☐5 |

**Section F – Evaluation of corruption situation in the Chinese public construction sector**

Please provide your perception of corruption situation in the Chinese public construction sector:

| | | | | |
|---|---|---|---|---|
| ☐1 Not serious at all | ☐2 Not Serious | ☐3 Neutral | ☐4 Serious | ☐5 Very serious |

**Reply Slip (Optional)**

Those who wish to receive a summary of the research findings, please enter the details below:

Name: Telephone Number: Email Address:

## APPENDIX G QUESTIONNAIRE DOCUMENT (CHINESE VERSION)

### 政府投资建设项目腐败现象研究调研问卷

尊敬的专家：

您好！

由同济大学建设管理与房地产系联同香港理工大学建筑及房地产学系共同组建的研究团队正在进行一项与我国政府投资建设项目中存在的腐败现象相关的国家自然科学基金课题研究——《政府投资建设项目中"隧道行为"的机理、动态演化及对策研究》（项目编号:71172107）。鉴于您在建筑工程领域的相关成就和经验，我们诚挚地邀请您参与此次问卷调研。

此次问卷调研分为五个部分。其中,第一部分为本研究概要介绍；第二部分为受访者背景资料的收集；第三部分为我国政府投资建设项目腐败测量指标评价；第四部分为工程腐败诱因评价；第五部分为政府投资建设项目反腐败策略评价；第六部分为政府投资建设项目腐败态势总体评价。

我们向您保证有关调查资料只用于学术研究，并且绝对不会透露您的个人信息。请您尽量于2013年10月31日之前将此问卷返回至ming.shan@ ,我们特此向您致谢！

非常感谢您能在百忙中抽出时间完成此问卷。

敬祝您身体健康、工作顺利！

博士生　　单　明

同济大学建设管理与房地产系教授　　乐　云

香港理工大学建筑及房地产学系教授　　陈炳泉

二零一三年九月

**第一部分 受访者背景资料**（请用“√”的形式选择您的回答，或直接填写您的回答）

1. 请问您目前工作单位的性质是：

☐政府 ☐业主方 ☐施工方 ☐设计方 ☐咨询方 ☐其他（请注明______）

2. 请问您曾经工作单位的性质是（可多选）：

☐政府 ☐业主方 ☐施工方 ☐设计方 ☐咨询方 ☐其他（请注明______）

3. 请问您的职称（或职务）是：____________________

4. 请问您在建筑工程领域的从业时间是：_______年

5. 请问您近 3 年的工作地点是：____________________（可填多个地点，例如上海市，或山东省济南市等）

**第二部分 政府投资建设项目腐败测量指标评价**

请您对下列政府投资建设项目中存在的腐败测量指标做出评价，请用“√”的形式选择您的评价。

| 序号 | 腐败测量指标 | 发生概率 | | | | | 危害程度 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.1 | 项目正式实施（即设计工作启动）前未取得立项审批 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.2 | 项目实施所需财政拨款不能按时拨付到位 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.3 | 项目实际用途与项目立项批复文件所列用途不一致 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.4 | 咨询方不是通过公开招投标遴选得到，或业主明招暗定（即业主在招标前已确定意向单位，尔后由意向单位组织若干其他投标人按规定执行招投标程序） | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.5 | 针对咨询方设置具有倾向性的资格预审条件 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.6 | 咨询方的遴选并非由独立的第三方机构实施 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.7 | 项目潜在投标人不能及时接触到招标人发布的招标信息 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.8 | 招标人设定的投标文件准备期无法让投标人完成一份令其自身满意的投标文件 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.9 | 针对施工承包商设置具有倾向性的资格预审条件 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.10 | 评标委员会对每一份投标文件的评审没有完全按照事先制定的评标准则实施 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.11 | 最终确定并公布的项目中标候选单位结果与评标委员会拟定的中标候选单位结果存在明显差异 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.12 | 业主方在某一新建工程的施工承包商遴选过程中，对正在承接该业主方其他建设工程的承包商有倾向性 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.13 | 施工承包商无法通过履行其与业主方签订的施工承包合同获得令其基本满意的利润 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.14 | 项目施工过程中工程款无法正常按期支付 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |

| 序号 | 腐败测量指标 | 发生概率 | | | | | 危害程度 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.15 | 项目没有严格按照设计图纸施工，存在大量施工变更 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.16 | 承包商没有遵照合同的相关约定配备技术力量及现场管理力量 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.17 | 项目施工阶段没有完备的现场施工过程文档记录 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.18 | 高利润率及高价格的分部分项工程的变更没有得到适当的监管和核实 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.19 | 合同中的调价条款没有得到正确、合理的运用 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.20 | 业主方将某项按规定应公开招标的项目肢解后直接委托，规避招投标程序 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.21 | 投标人在投标文件中弄虚作假，提供与其实际不符的资质、资信及人员技术力量证明 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.22 | 投标人通过非正常渠道获得有关招标活动的机密信息，例如标底及其他参与竞标的单位信息等 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.23 | 在项目施工阶段，承包商使用不合格建筑材料代替合格建筑材料，以期降低施工成本从而获得更大收益 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.24 | 在项目施工阶段，承包商串通监理，使其对承包商在施工阶段的违规行为放松监管 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |

## 第三部分 政府投资建设项目腐败诱因评价

以下因素有可能会导致政府投资建设项目出现腐败现象，您是否认同该观点，请您用“√”选择您的评价。

| 序号 | 政府投资建设项目中腐败现象诱因 | 评 价 | | | | |
|---|---|---|---|---|---|---|
| 3.1 | 政府行政主管部门具有过于集中的行政审批权，行政审批科目繁多 | ☐非常不同意 | ☐不同意 | ☐一般 | ☐同意 | ☐非常同意 |
| 3.2 | 建设监督法规不健全 | ☐非常不同意 | ☐不同意 | ☐一般 | ☐同意 | ☐非常同意 |
| 3.3 | 国内建筑业市场存在的激烈竞争 | ☐非常不同意 | ☐不同意 | ☐一般 | ☐同意 | ☐非常同意 |
| 3.4 | 工程腐败行为的监督法规、管理制度实施不严格 | ☐非常不同意 | ☐不同意 | ☐一般 | ☐同意 | ☐非常同意 |
| 3.5 | 工程腐败行为的处罚力度过轻 | ☐非常不同意 | ☐不同意 | ☐一般 | ☐同意 | ☐非常同意 |
| 3.6 | 机构内其他成员实施腐败行为且未受到相应监管及惩罚（即负面示范影响） | ☐非常不同意 | ☐不同意 | ☐一般 | ☐同意 | ☐非常同意 |
| 3.7 | 建筑工程领域中个别从业人员职业道德水平较低 | ☐非常不同意 | ☐不同意 | ☐一般 | ☐同意 | ☐非常同意 |
| 3.8 | 项目参与方之间因长久合作而导致的过于紧密的联系 | ☐非常不同意 | ☐不同意 | ☐一般 | ☐同意 | ☐非常同意 |
| 3.9 | 大型工程项目复杂性，例如项目参与方众多、项目投资额巨大、管理体系复杂等 | ☐非常不同意 | ☐不同意 | ☐一般 | ☐同意 | ☐非常同意 |
| 3.10 | 我国社会特有的人情关系（如上下级、亲属、朋友关系等），该因素有可能会导致被动腐败现象的出现 | ☐非常不同意 | ☐不同意 | ☐一般 | ☐同意 | ☐非常同意 |

第四部分 政府投资建设项目反腐败策略评价

针对以下有关政府投资建设项目反腐败策略的表述，请结合您的工程实践经验做出相应的评价。

| 序号 | 有关政府投资建设项目反腐败策略的表述 | 评 价 | | | | |
|---|---|---|---|---|---|---|
| 4.1 | 我非常重视工程建设过程中的反腐败事宜 | □非常不同意 | □不同意 | □一般 | □同意 | □非常同意 |
| 4.2 | 当收到有关工程腐败现象的报告时，我总能在第一时间做出积极的回应 | □非常不同意 | □不同意 | □一般 | □同意 | □非常同意 |
| 4.3 | 我对工程腐败事宜的处理非常果断 | □非常不同意 | □不同意 | □一般 | □同意 | □非常同意 |
| 4.4 | 我经常赞扬在工作中保持廉洁的同事 | □非常不同意 | □不同意 | □一般 | □同意 | □非常同意 |
| 4.5 | 同事之间经常相互提醒在工程中要保持廉洁 | □非常不同意 | □不同意 | □一般 | □同意 | □非常同意 |
| 4.6 | 我会为促使员工廉洁地工作提供足够的帮助 | □非常不同意 | □不同意 | □一般 | □同意 | □非常同意 |
| 4.7 | 现有机构的整体工作氛围是廉洁的 | □非常不同意 | □不同意 | □一般 | □同意 | □非常同意 |
| 4.8 | 现有监管机制足以应对当前存在的工程腐败现象 | □非常不同意 | □不同意 | □一般 | □同意 | □非常同意 |
| 4.9 | 现有监管机制可以使我免于受到工程腐败现象的威胁 | □非常不同意 | □不同意 | □一般 | □同意 | □非常同意 |
| 4.10 | 现有监管机制能够得到建筑业各参与方的认可 | □非常不同意 | □不同意 | □一般 | □同意 | □非常同意 |
| 4.11 | 现有涉及工程腐败现象的监管机制不会阻碍工程项目的顺利实施，亦不会阻碍新型政府投资建设项目管理模式的出现 | □非常不同意 | □不同意 | □一般 | □同意 | □非常同意 |
| 4.12 | 开展反腐教育培训很有必要 | □非常不同意 | □不同意 | □一般 | □同意 | □非常同意 |
| 4.13 | 开展反腐教育培训对促使从业人员在工作中保持廉洁很有帮助 | □非常不同意 | □不同意 | □一般 | □同意 | □非常同意 |
| 4.14 | 当前实施的反腐教育培训能够遏制工程腐败现象的出现 | □非常不同意 | □不同意 | □一般 | □同意 | □非常同意 |
| 4.15 | 从业人员会因担心受到领导的警告或批评而不敢实施工程腐败行为 | □非常不同意 | □不同意 | □一般 | □同意 | □非常同意 |
| 4.16 | 从业人员会因担心被所属机构除名而不敢实施工程腐败行为 | □非常不同意 | □不同意 | □一般 | □同意 | □非常同意 |
| 4.17 | 从业人员会因担心受到监管体制的制裁（即行政、经济、刑事处罚）而不敢实施工程腐败行为 | □非常不同意 | □不同意 | □一般 | □同意 | □非常同意 |

第五部分 政府投资建设项目腐败态势总体评价

总体而言，您认为当前政府投资建设项目中存在的腐败现象：□非常不严重 □不严重 □一般 □严重 □非常严重

**问卷已结束，谢谢您的帮助与支持！**

**关于本课题，如果您有兴趣获取我们的研究成果，欢迎您留下您的联系方式：**

**姓名：____________ 电话：______________ 电子邮件：______________________**

# APPENDIX H QUESTIONNAIRE FACILITATING MODEL APPLICATION （ENGLISH VERSION）

Dear expert,

You are cordially invited to participate into an interview that aims to validate an evaluation model of corruption which was developed in a study focusing on corruption research in the Chinese public construction sector. The study was conducted between January 2012 and April 2014, by a joint research group teaming by researchers from Department of Building and Real Estate, The Hong Kong Polytechnic University, and Department of Construction Management and Real Estate, Tongji University.

Please evaluate the items of this questionnaire based on the project you are now engaging in. You are assured that this questionnaire is completely anonymous and responses will be treated with the strictest confidentiality.

Thank you very much for your participation and support!

SHAN Ming

PhD Student jointly supervised by Tongji University and The Hong Kong Polytechnic University

LE Yun

Professor, Department of Construction Management and Real Estate, Tongji University

CHAN Ping Chuen

Professor, Department of Building and Real Estate, The Hong Kong Polytechnic University

May, 2014

**Section A Interviewee Background （Please fill the blank or indicate accordingly using √）**

1. Your current professional affiliation:

   ☐ Government ☐ Client ☐ Contractor ☐ Designer

   ☐ Consultant ☐ Others (Please specify__________)

2. Your current position in your organization:____________________

3. Your working experience in public construction projects:__________

**Section B Items Need to be Evaluated (Please indicate accordingly using √)**

| No. | Item | Probability | | | | | Severity | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.1 | Administrative approval and financial sanction not taken to execute the work | □Very Low | □Low | □Neutral | □High | □Very High | □Very Low | □Low | □Neutral | □High | □Very High |
| 2.2 | Lack of the sanctioned financial provisions from the government | □Very Low | □Low | □Neutral | □High | □Very High | □Very Low | □Low | □Neutral | □High | □Very High |
| 2.3 | Work is not executed for the same purpose for which the sanction was accorded | □Very Low | □Low | □Neutral | □High | □Very High | □Very Low | □Low | □Neutral | □High | □Very High |
| 2.4 | The consultant is not appointed after proper publicity and open competition | □Very Low | □Low | □Neutral | □High | □Very High | □Very Low | □Low | □Neutral | □High | □Very High |
| 2.5 | The criteria adopted in prequalification of consultant are restrictive and benefit only few consultants | □Very Low | □Low | □Neutral | □High | □Very High | □Very Low | □Low | □Neutral | □High | □Very High |
| 2.6 | Adequate & wide publicity is not given to tender | □Very Low | □Low | □Neutral | □High | □Very High | □Very Low | □Low | □Neutral | □High | □Very High |
| 2.7 | The criteria for selection of contractor are restrictive and benefit only few contractors | □Very Low | □Low | □Neutral | □High | □Very High | □Very Low | □Low | □Neutral | □High | □Very High |
| 2.8 | The evaluation of tenders is not done exactly as per the notified criteria | □Very Low | □Low | □Neutral | □High | □Very High | □Very Low | □Low | □Neutral | □High | □Very High |
| 2.9 | The negotiation on tender not done as per laid down guidelines | □Very Low | □Low | □Neutral | □High | □Very High | □Very Low | □Low | □Neutral | □High | □Very High |
| 2.10 | The conditions/specifications are relaxed in favor of contractor to whom the work is being awarded | □Very Low | □Low | □Neutral | □High | □Very High | □Very Low | □Low | □Neutral | □High | □Very High |
| 2.11 | The work is not executed as per original design accorded | □Very Low | □Low | □Neutral | □High | □Very High | □Very Low | □Low | □Neutral | □High | □Very High |
| 2.12 | Compliance with conditions regarding deployment of technical staff not being followed by contractor | □Very Low | □Low | □Neutral | □High | □Very High | □Very Low | □Low | □Neutral | □High | □Very High |
| 2.13 | The changes, especially in abnormally high rated and high value items are not properly | □Very Low | □Low | □Neutral | □High | □Very High | □Very Low | □Low | □Neutral | □High | □Very High |

| No. | Item | Probability | | | | | Severity | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | monitored and verified | | | | | | | | | | |
| **2.14** | Escalation clause is not applied correctly for admissible payment | **□Very Low** | **□Low** | **□Neutral** | **□High** | **□Very High** | **□Very Low** | **□Low** | **□Neutral** | **□High** | **□Very High** |
| **2.15** | A large project should have called for bids is split into several small projects and contracted without bidding | **□Very Low** | **□Low** | **□Neutral** | **□High** | **□Very High** | **□Very Low** | **□Low** | **□Neutral** | **□High** | **□Very High** |
| **2.16** | Contractors provide false certificates in bidding | **□Very Low** | **□Low** | **□Neutral** | **□High** | **□Very High** | **□Very Low** | **□Low** | **□Neutral** | **□High** | **□Very High** |
| **2.17** | Confidential information of bidding is disclosed to a specific bidder | **□Very Low** | **□Low** | **□Neutral** | **□High** | **□Very High** | **□Very Low** | **□Low** | **□Neutral** | **□High** | **□Very High** |
| **2.18** | Substitution of unqualified materials in construction | **□Very Low** | **□Low** | **□Neutral** | **□High** | **□Very High** | **□Very Low** | **□Low** | **□Neutral** | **□High** | **□Very High** |
| **2.19** | Site supervisor neglects his duties for taking bribe from contractor | **□Very Low** | **□Low** | **□Neutral** | **□High** | **□Very High** | **□Very Low** | **□Low** | **□Neutral** | **□High** | **□Very High** |

This is the end of the interview. Thank you very much for your support!

# APPENDIX I QUESTIONNAIRE FACILITATING MODEL APPLICATION (CHINESE VERSION)

## 政府投资建设项目腐败测定模型验证调研

尊敬的专家：

您好！

由同济大学建设管理与房地产系联同香港理工大学建筑及房地产学系共同组建的研究团队正在进行一项与我国政府投资建设项目中存在的腐败现象相关的国家自然科学基金课题研究——《政府投资建设项目中"隧道行为"的机理、动态演化及对策研究》(项目编号:71172107)。鉴于您在政府投资建设项目领域丰富的工作经验,我们诚挚地邀请您参与此次问卷调研。

基于模糊集理论，本研究提出一项政府投资建设项目腐败指数预测模型，旨在预测项目潜在的腐败风险水平。为验证该模型的可靠性，请结合您目前正在参与的项目，对本问卷所列各条目的发生概率和危害程度做出评价

我们向您保证有关调查资料只用于学术研究，并绝对不会透露您的个人信息！

非常感谢您能在百忙中抽出时间完成此问卷。

敬祝您身体健康、工作顺利！

博士生　　单　明

同济大学建设管理与房地产系教授　　乐　云

香港理工大学建筑及房地产学系教授　　陈炳泉

二零一四年五月

**第一部分 受访者背景资料**（请用“√”的形式选择您的回答，或直接填写您的回答）

1. 请问您目前工作单位的性质是：

☐政府 ☐业主方 ☐施工方 ☐设计方 ☐咨询方 ☐其他（请注明______）

2. 请问您的职称（或职务）是：____________________

3. 请问您在建筑工程领域的从业时间是：_______年

**第二部分 问卷调研题目**

请用“√”的形式选择您的评价。

| 序号 | 测量指标 | 发生概率 | | | | | 危害程度 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.1 | 项目正式实施（即设计工作启动）前未取得立项审批 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.2 | 项目实施所需财政拨款不能按时拨付到位 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.3 | 项目实际用途与项目立项批复文件所列用途不一致 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.4 | 咨询方不是通过公开招投标遴选得到，或业主明招暗定（即业主在招标前已确定意向单位，尔后由意向单位组织若干其他投标人按规定执行招投标程序） | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.5 | 针对咨询方设置具有倾向性的资格预审条件 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.6 | 项目潜在投标人不能及时接触到招标人发布的招标信息 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.7 | 针对施工承包商设置具有倾向性的资格预审条件 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.8 | 评标委员会对每一份投标文件的评审没有完全按照事先制定的评标准则实施 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.9 | 最终确定并公布的项目中标候选单位结果与评标委员会拟定的中标候选单位结果存在明显差异 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.10 | 业主方在某一新建工程的施工承包商遴选过程中，对正在承接该业主方其他建设工程的承包商有倾向性 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.11 | 项目没有严格按照设计图纸施工，存在大量施工变更 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.12 | 承包商没有遵照合同的相关约定配备技术力量及现场管理力量 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.13 | 高利润率及高价格的分部分项工程的变更没有得到适当的监管和核实 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一般 | ☐较大 | ☐极大 |
| 2.14 | 合同中的调价条款没有得到正确、合 | ☐极少 | ☐较少 | ☐一般 | ☐较多 | ☐极多 | ☐极小 | ☐较小 | ☐一 | ☐较大 | ☐极大 |

| 序号 | 测量指标 | 发生概率 | | | | | 危害程度 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 理的运用 | | | | | | | | 般 | | |
| 2.15 | 业主方将某项按规定应公开招标的项目肢解后直接委托，规避招投标程序 | □极少 | □较少 | □一般 | □较多 | □极多 | □极小 | □较小 | □一般 | □较大 | □极大 |
| 2.16 | 投标人在投标文件中弄虚作假，提供与其实际不符的资质、资信及人员技术力量证明 | □极少 | □较少 | □一般 | □较多 | □极多 | □极小 | □较小 | □一般 | □较大 | □极大 |
| 2.17 | 投标人通过非正常渠道获得有关招标活动的机密信息，例如标底及其他参与竞标的单位信息等 | □极少 | □较少 | □一般 | □较多 | □极多 | □极小 | □较小 | □一般 | □较大 | □极大 |
| 2.18 | 在项目施工阶段，承包商使用不合格建筑材料代替合格建筑材料，以期降低施工成本从而获得更大收益 | □极少 | □较少 | □一般 | □较多 | □极多 | □极小 | □较小 | □一般 | □较大 | □极大 |
| 2.19 | 在项目施工阶段，承包商串通监理，使其对承包商在施工阶段的违规行为放松监管 | □极少 | □较少 | □一般 | □较多 | □极多 | □极小 | □较小 | □一般 | □较大 | □极大 |

若您认为本研究遗漏了一些可以用来量度工程腐败行为的测量指标，请您补充并评价

| 序号 | 政府投资建设项目腐败行为测量指标 | 发生概率 | | | | | 危害程度 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | | □极少 | □较少 | □一般 | □较多 | □极多 | □极小 | □较小 | □一般 | □较大 | □极大 |
| 21 | | □极少 | □较少 | □一般 | □较多 | □极多 | □极小 | □较小 | □一般 | □较大 | □极大 |
| 22 | | □极少 | □较少 | □一般 | □较多 | □极多 | □极小 | □较小 | □一般 | □较大 | □极大 |
| 23 | | □极少 | □较少 | □一般 | □较多 | □极多 | □极小 | □较小 | □一般 | □较大 | □极大 |

本次调研已经结束，非常感谢您的帮助与支持！

# APPENDIX J INTERVIEW DOCUMENT FOR VALIDATING THE STUDY (ENGLISH VERSION)

Dear expert,

You are cordially invited to participate into an interview that aims to validate a study focusing on corruption research in the Chinese public construction sector which was conducted between January 2012 and April 2014 by a joint research group teaming by researchers from Department of Building and Real Estate, The Hong Kong Polytechnic University, and Department of Construction Management and Real Estate, Tongji University.

This interview contains four sections: (1) an introduction to the theoretical framework and research design, (2) an introduction to research findings, (3) solicitation on profile information of interviewees, and (4) items need to be evaluated.

Thank you very much for your participation and support!

SHAN Ming
PhD Student jointly supervised by Tongji University and The Hong Kong Polytechnic University

LE Yun
Professor, Department of Construction Management and Real Estate, Tongji University

CHAN Ping Chuen
Professor, Department of Building and Real Estate, The Hong Kong Polytechnic University

May, 2014

**Section A: An Introduction to Theoretical Framework and Research Design**

## 1.1 Theoretical Framework of Corruption Indicators

Based on a comprehensive literature review and expert interviews, this study identified 24 corruption indicators and categorized them into five underlying factors, namely, immorality, unfairness, opacity, procedural violation, and contractual violation. The theoretical framework of corruption indicators is shown in Table 1.

Table 1 Theoretical framework of corruption indicators

| Underlying factor | Corruption Indicator |
|---|---|
| Immorality | Site supervisor neglects his duties for taking bribe from contractor |
| | Substitution of unqualified materials in construction |
| | Contractors provide false certificates in bidding |
| | The work is not executed as per original design accorded |
| | The changes, especially in abnormally high rated and high value items are not properly monitored and verified |
| | The provisions are not as per laid down yardstick |
| Unfairness | The consultant is not appointed after proper publicity and open competition |
| | The criteria adopted in prequalification of consultant are restrictive and benefit only few consultants |
| | The selection of consultant not done by appropriate authority |
| | The criteria for selection of contractor are restrictive and benefit only few contractors |
| | The conditions/specifications are relaxed in favor of contractor to whom the work is being awarded |
| | Confidential information of bidding is disclosed to a specific bidder |
| Opacity | Adequate & wide publicity is not given to tender |
| | Adequate time for submission of tender/offer not given |
| | The evaluation of tenders is not done exactly as per the notified criteria |
| | The negotiation on tender not done as per laid down guidelines |
| | A large project should have called for bids is split into several small projects and contracted without bidding |
| Procedural Violation | Administrative approval and financial sanction not taken to execute the work |
| | Lack of the sanctioned financial provisions from the government |
| | Work is not executed for the same purpose for which the sanction was accorded |

| Underlying factor | Corruption Indicator |
| --- | --- |
| | The proper record of hindrances is not being maintained from the beginning |
| Contractual Violation | Compliance with conditions regarding deployment of technical staff not being followed by contractor |
| | Escalation clause is not applied correctly for admissible payment |
| | The work order/supply order is not placed within justified rates |

### 1.2 Theoretical Framework of Causes of Corruption

Based on a comprehensive literature review and expert interviews, this study identified ten causes of corruption and categorized them into two underlying factors, namely, flawed regulation systems and the lack of a positive industrial climate. The theoretical framework of causes of corruption is shown in Table 2.

Table 2 Theoretical framework of causes of corruption

| Underlying factor | Causes of Corruption |
| --- | --- |
| Flawed Regulation Systems | Multifarious authorizations |
| | Deficiencies in institutions |
| | Lack of rigorous supervision |
| | Inadequate sanctions |
| | Negative role model of leadership |
| Lack of a Positive Industrial Climate | Poor standards of professional ethics |
| | Fierce competition in the construction market |
| | Close relationships among contract parties |
| | Complexity of public construction projects |
| | Interpersonal connections |

### 1.3 Theoretical Framework of Anti-Corruption Strategies

Based on a comprehensive literature review and expert interviews, this study identified 17 observed variables to measure anti-corruption strategies and categorized them into four underlying factors, namely, leadership, rules and regulations, training, and sanctions. The theoretical framework of anti-corruption strategies is shown in Table 3.

Table 3 Theoretical framework of anti-corruption strategies

| Underlying factor | Observed Variables |
|---|---|
| Leadership | Anti-Corruption issues are important |
| | Act positively and cooperate |
| | Act decisively when anti-corruption issues are important |
| | Praise for working honestly |
| | Remind each other to work fairly and honestly |
| | Provide help to work honestly |
| | Corruption free environment is provided |
| Rules and Regulations | Adequate source of information |
| | Rules protect us from vigilance cases |
| | Rules should be consulted by all |
| | Rules do not impose restrictions |
| Training | Training is necessary |
| | Training helps me |
| | Training helps in prevention of corrupt practices |
| Sanctions | Fear of administrative sanction |
| | Fear of economic sanction |
| | Fear of penal sanction |

### 1.4 Research Hypotheses and Research Design

Based on aforementioned theoretical frameworks, this study proposed three research hypotheses as follows:

H1: Corruption indicators have positive relationships with perceived level of corruption in the Chinese public construction sector;

H2: Causes of corruption have positive relationships with corruption indicators;

H3: Prevailing anti-corruption strategies have negative relationships with corruption indicators.

Based on the three hypotheses, a questionnaire was developed and distributed via three channels, namely, online survey platform, interviews with participants of industrial conferences, and field surveys in three public projects. This study received 216 replies. With a full visual examination, a total of 188 replies were considered valid. After that, the data were analyzed using partial least squares structural equation modeling method.

**Section B: Research Findings**

Data analysis results revealed the following key findings:

1. Corruption indicators are positively correlated with the perceived level of corruption in the Chinese public construction sector. Current study also found immorality the most influential underlying factors of corruption indicators with a path coefficient of 0.342, followed by opacity (0.309), unfairness (0.296), procedural violation (0.191), and contractual violation (0.145). The analysis result is shown in Figure 1.

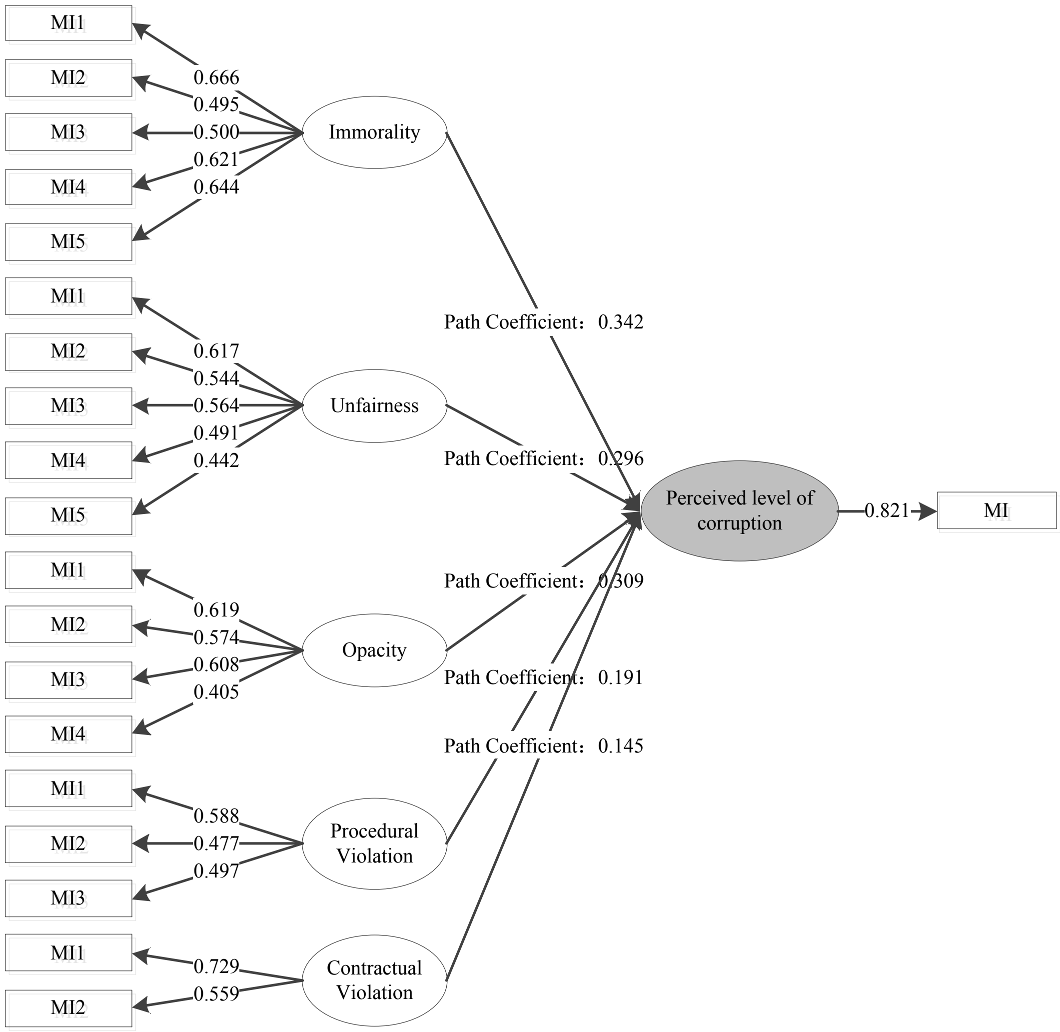



Figure 1 Tested model of corruption indicators and the perceived level of corruption

2. Causes of corruption are positively correlated with corruption indicators. Furthermore, flawed regulation systems were found to contribute more to corruption indicators than the lack of a positive industrial climate. The analysis result is shown in Figure 2.

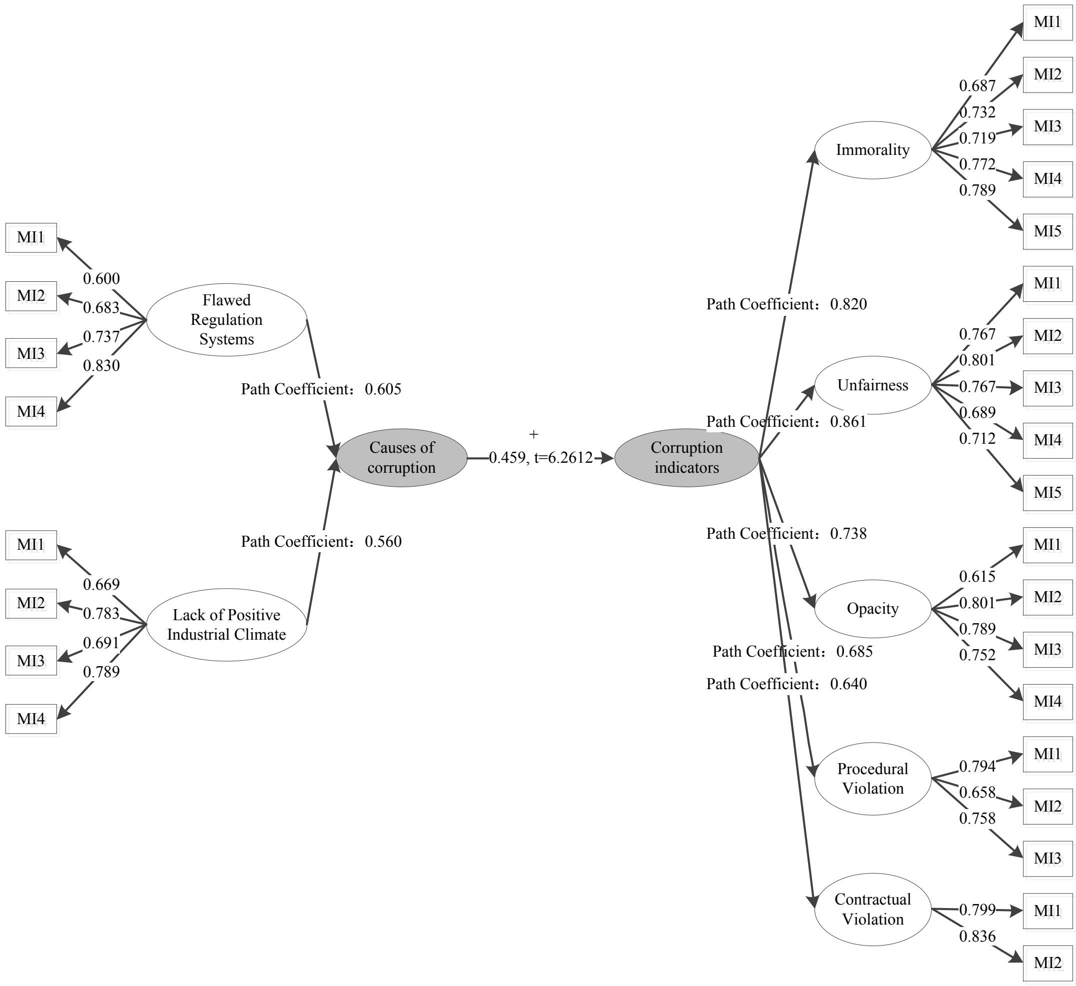



Figure 2 Causal relationships between causes of corruption and corruption indicators

3. Prevailing anti-corruption strategies were proved to be negatively correlated with corruption indicators. Moreover, leadership was found to be the most effective anti-corruption strategy, followed by rules and regulations, sanctions and training. The analysis result is shown in Figure 3 as follows.

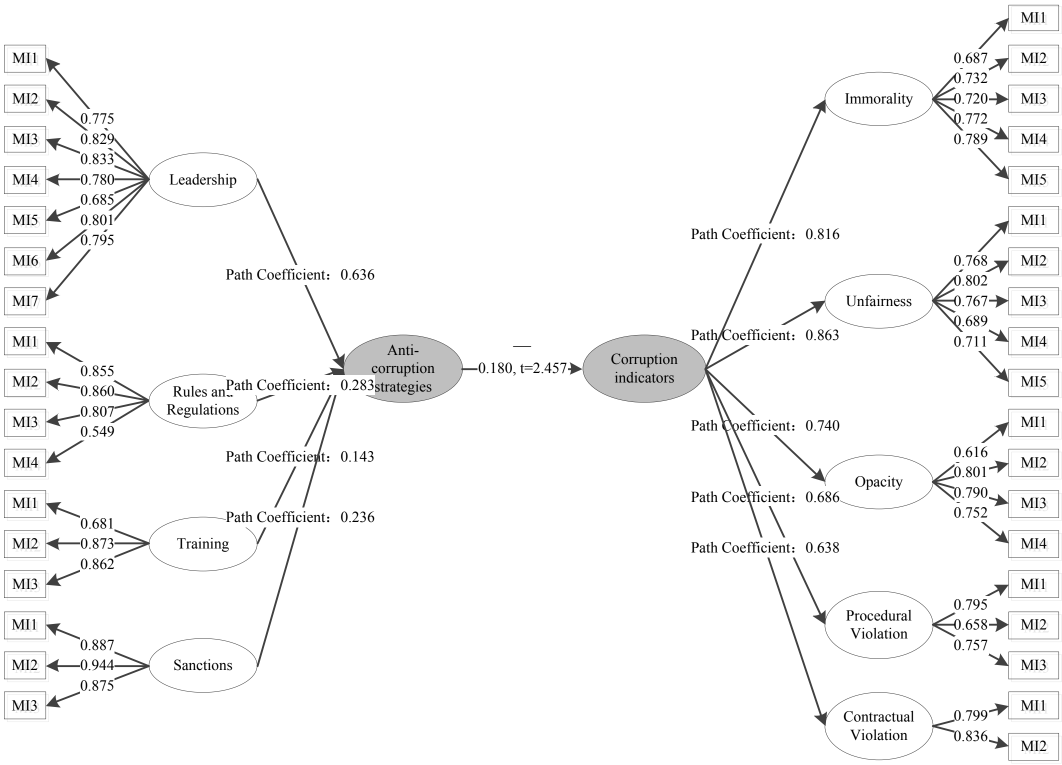



Figure 3 Interrelationships between anti-corruption strategies and corruption indicators

Additionally, based on the data collected from the questionnaire survey and the fuzzy set theory, an evaluation model was developed to assess the potential corruption in public construction projects. The developed model has been consecutively applied in two Chinese public projects. One project is in Jinan, Shandong Province, eastern China; the other project is in Zhengzhou, Henan Province, central China. The predicted results of the model revealed that the former project was under high corruption risk whereas the latter project was under medium corruption risk. These results basically match the real state of the two projects.

**Section C Interviewee Background （Please fill the blank or indicate accordingly using √）**

1. Your current professional affiliation:

   ☐ Government ☐ Client ☐ Contractor ☐ Designer

   ☐ Consultant ☐ Others (Please specify__________)

2. Your current position in your organization:_____________________

3. Your working experience in public construction projects:__________

**Section D Items for Validating the Study**

Please evaluate the items using the following rating scale:

1: Very Poor, 2: Poor, 3: Medium, 4: Good, and 5: Very Good

| No. | Item | Evaluation | | | | |
|---|---|---|---|---|---|---|
| 1 | Are the corruption indicators proposed in this study applicable? | 1 | 2 | 3 | 4 | 5 |
| 2 | Are the causes of corruption proposed in this study applicable? | 1 | 2 | 3 | 4 | 5 |
| 3 | Are the observed variables of prevailing anti-corruption strategies proposed in this study applicable? | 1 | 2 | 3 | 4 | 5 |
| 4 | Is the framework for identifying corruption indicators reasonable? | 1 | 2 | 3 | 4 | 5 |
| 5 | Is the framework for identifying causes of corruption reasonable? | 1 | 2 | 3 | 4 | 5 |
| 6 | Is the framework for identifying the prevailing anti-corruption strategies reasonable? | 1 | 2 | 3 | 4 | 5 |
| 7 | Is the causality between the causes of corruption and corruption indicators proposed in this study clear? | 1 | 2 | 3 | 4 | 5 |
| 8 | Is the causality between the prevailing anti-corruption strategies and corruption indicators proposed in this study clear? | 1 | 2 | 3 | 4 | 5 |
| 9 | Are the underlying corruption indicators obtained in this study reasonable? | 1 | 2 | 3 | 4 | 5 |
| 10 | Are the principal causes of corruption obtained in this study reasonable? | 1 | 2 | 3 | 4 | 5 |
| 11 | Are the evaluation results of the prevailing anti-corruption strategies obtained in this study reasonable? | 1 | 2 | 3 | 4 | 5 |
| 12 | Can the evaluation model of vulnerability to corruption developed in this study be generalized? | 1 | 2 | 3 | 4 | 5 |

This is the end of the interview. Thank you very much for your support!

# APPENDIX K INTERVIEW DOCUMENT FOR VALIDATING THE STUDY （CHINESE VERSION）

## 政府投资建设项目腐败现象研究介绍及验证调研

尊敬的专家：

您好！

由同济大学建设管理与房地产系联同香港理工大学建筑及房地产学系共同组建的研究团队于2012年1月至2014年4月期间进行了一项与我国政府投资建设项目腐败现象相关的国家自然科学基金课题研究，获得了一些研究发现与结论。为确保研究过程的科学严谨与研究结论的客观准确，需对该项研究进行专家验证。鉴于您在政府投资建设项目领域丰富的工作经验，我们邀请您参与此次专家验证调研，并对本项研究的研究设计与研究结论做出评价。

本次调研包含四部分,第一部分为理论框架及研究设计介绍,第二部分为研究发现与结论介绍,第三部分受访专家背景信息调研,第四部分为需评分的调研题目。

非常感谢您的参与及支持！

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二零一四年五月

## 第一部分 理论框架及研究设计介绍

### 1.1 工程腐败行为理论框架

通过文献梳理和专家访谈，本研究识别了 24 项工程腐败测量指标，并将其分为“职业道德缺失”、“公正缺失”、“透明度缺失”、“程序违规”及“合约违规”五个维度。理论框架体系如表 1 所示。

表 1 工程腐败测量指标体系

| 分类 | 腐败测量指标 |
|---|---|
| 1. 职业道德缺失 | 1. 在项目施工阶段，承包商串通监理，使其对承包商在施工阶段的违规行为放松监管 |
| | 2. 在项目施工阶段，承包商使用不合格建筑材料代替合格建筑材料，以期降低施工成本从而获得更大收益 |
| | 3. 投标人在投标文件中弄虚作假，提供与其实际不符的资质、资信及人员技术力量证明 |
| | 4. 项目没有严格按照设计图纸施工，存在大量施工变更 |
| | 5. 高利润率及高价格的分部分项工程的变更没有得到适当的监管和核实 |
| | 6. 项目施工过程中工程款无法正常按期支付 |
| 2. 公正缺失 | 1. 咨询方不是通过公开招投标遴选得到，或业主明招暗定（即业主在招标前已确定意向单位，尔后由意向单位组织若干其他投标人按规定执行招投标程序） |
| | 2. 针对咨询方设置具有倾向性的资格预审条件 |
| | 3. 咨询方的遴选并非由独立的第三方机构实施 |
| | 4. 针对施工承包商设置具有倾向性的资格预审条件 |
| | 5. 业主方在某一新建工程的施工承包商遴选过程中，对正在承接该业主方其他建设工程的承包商有倾向性 |
| | 6. 投标人通过非正常渠道获得有关招标活动的机密信息，例如标底及其他参与竞标的单位信息等 |
| 3. 透明度缺失 | 1. 项目潜在投标人不能及时接触到招标人发布的招标信息 |
| | 2. 招标人设定的投标文件准备期无法让投标人完成一份令其自身满意的投标文件 |
| | 3. 评标委员会对每一份投标文件的评审没有完全按照事先制定的评标准则实施 |
| | 4. 最终确定并公布的项目中标候选单位结果与评标委员会拟定的中标候选单位结果存在明显差异 |
| | 5. 业主方将某项按规定应公开招标的项目肢解后直接委托，规避招投标程序 |
| 4. 程序违规 | 1. 项目正式实施（即设计工作启动）前未取得立项审批 |
| | 2. 项目实施所需财政拨款不能按时拨付到位 |
| | 3. 项目实际用途与项目立项批复文件所列用途不一致 |
| | 4. 项目施工阶段没有完备的现场施工过程文档记录 |

| 分类 | 腐败测量指标 |
| --- | --- |
| 5. 合约违规 | 1. 承包商没有遵照合同的相关约定配备技术力量及现场管理力量 |
| | 2. 合同中的调价条款没有得到正确、合理的运用 |
| | 3. 施工承包商无法通过履行其与业主方签订的施工承包合同获得令其基本满意的利润 |

## 1.2 工程腐败诱因理论框架

通过文献梳理和专家访谈,本研究识别了 10 项用于量度工程腐败诱因的测量指标，并将其分为“监管体系缺陷”和“行业积极氛围缺失”两个维度。理论框架体系如表 2 所示。

表 2 工程腐败诱因测量指标框架体系

| 分类 | 测量指标 |
| --- | --- |
| 1. 监管体系缺陷 | 1. 政府行政主管部门拥有过于集中的行政审批权，行政审批科目繁多 |
| | 2. 建设监督法规不健全 |
| | 3. 工程腐败行为的监督法规、管理制度实施不严格 |
| | 4. 工程腐败行为的处罚力度过轻 |
| | 5. 机构内其他成员实施腐败行为且未受到相应监管及惩罚（即负面示范影响） |
| 2. 行业积极氛围缺失 | 1. 建筑工程领域中个别从业人员职业道德水平较低 |
| | 2. 国内建筑业市场存在的激烈竞争 |
| | 3. 项目参与方之间因长久合作而导致的过于紧密的联系 |
| | 4. 大型工程项目复杂性，例如项目参与方众多、项目投资额巨大、管理体系复杂等 |
| | 5. 我国社会特有的人情关系（如上下级、亲属、朋友关系等），该因素有可能会导致被动腐败现象的出现 |

## 1.3 工程反腐败策略理论框架

通过文献梳理,本研究识别了 17 项用于量度工程反腐败策略的测量指标，并将其分为“领导力”、“监管机制”、“培训”和“惩戒”四个维度。理论框架体系如表 3 所示。

表 3 工程反腐败策略测量指标框架体系

| 分类 | 测量指标 |
| --- | --- |
| 1. 领导力 | 1. 我非常重视工程建设过程中的反腐败事宜 |
| | 2. 当收到有关工程腐败现象的报告时，我总能在第一时间做出积极的回应 |
| | 3. 我对工程腐败事宜的处理非常果断 |
| | 4. 我经常赞扬在工作中保持廉洁的同事 |

| 分类 | 测量指标 |
|---|---|
| | 5. 同事之间经常相互提醒在工程中要保持廉洁 |
| | 6. 我会为促使员工廉洁地工作提供足够的帮助 |
| | 7. 现有机构的整体工作氛围是廉洁的 |
| 2. 监管机制 | 1. 现有监管机制足以应对当前存在的工程腐败现象 |
| | 2. 现有监管机制可以使我免于受到工程腐败现象的威胁 |
| | 3. 现有监管机制能够得到建筑业各参与方的认可 |
| | 4. 现有涉及工程腐败现象的监管机制不会阻碍工程项目的顺利实施,亦不会阻碍新型政府投资建设项目管理模式的出现 |
| 3. 培训 | 1. 开展反腐教育培训很有必要 |
| | 2. 开展反腐教育培训对促使从业人员在工作中保持廉洁很有帮助 |
| | 3. 当前实施的反腐教育培训能够遏制工程腐败现象的出现 |
| 4. 惩戒 | 1. 从业人员会因担心受到领导的警告或批评而不敢实施工程腐败行为 |
| | 2. 从业人员会因担心被所属机构除名而不敢实施工程腐败行为 |
| | 3. 从业人员会因担心受到监管体制的制裁（即行政、经济、刑事处罚）而不敢实施工程腐败行为 |

### 1.4 研究假设及研究设计

基于以上理论框架体系，本研究建立了三项研究假设：

**假设一：**工程腐败测量指标体系与我国政府投资建设项目整体腐败态势之间存在正相关关系；

**假设二：**工程腐败诱因测量指标体系与工程腐败测量指标体系之间存在正相关关系；

**假设三：**工程反腐败策略测量指标体系与工程腐败测量指标体系之间存在负相关关系。

基于以上三项研究假设及相关理论框架形成调研问卷一份，并通过网络调研平台、行业会议与会者调研及项目实地调研三类方式发放问卷。调研共回收问卷 216 份，其中有效问卷 188 份。随后，利用德国洪堡大学科研团队研发的偏最小二乘法结构方程模型（Partial Least Squares Structural Equation Modeling）平台 SmartPLS 2.0M3 对调研数据进行分析从而得出研究结论。

## 第二部分 研究发现与结论介绍

根据偏最小二乘法结构方程模型分析的结果，本研究获得以下发现：

1. 工程腐败测量指标体系与我国政府投资建设项目整体腐败态势之间存在正相关关系的假设成立。同时，依据模型路径系数分析，发现对工程腐败行为影响最大的维度为“职业道德缺失”（路径系数 0.342），其次是“透明度缺失”（路径系数 0.309）、“公正缺失”（路径系数 0.296）、“程序违规”（路径系数 0.191）及“合约违规”（路径系数 0.145）,模型分析结果如图 1 所示：

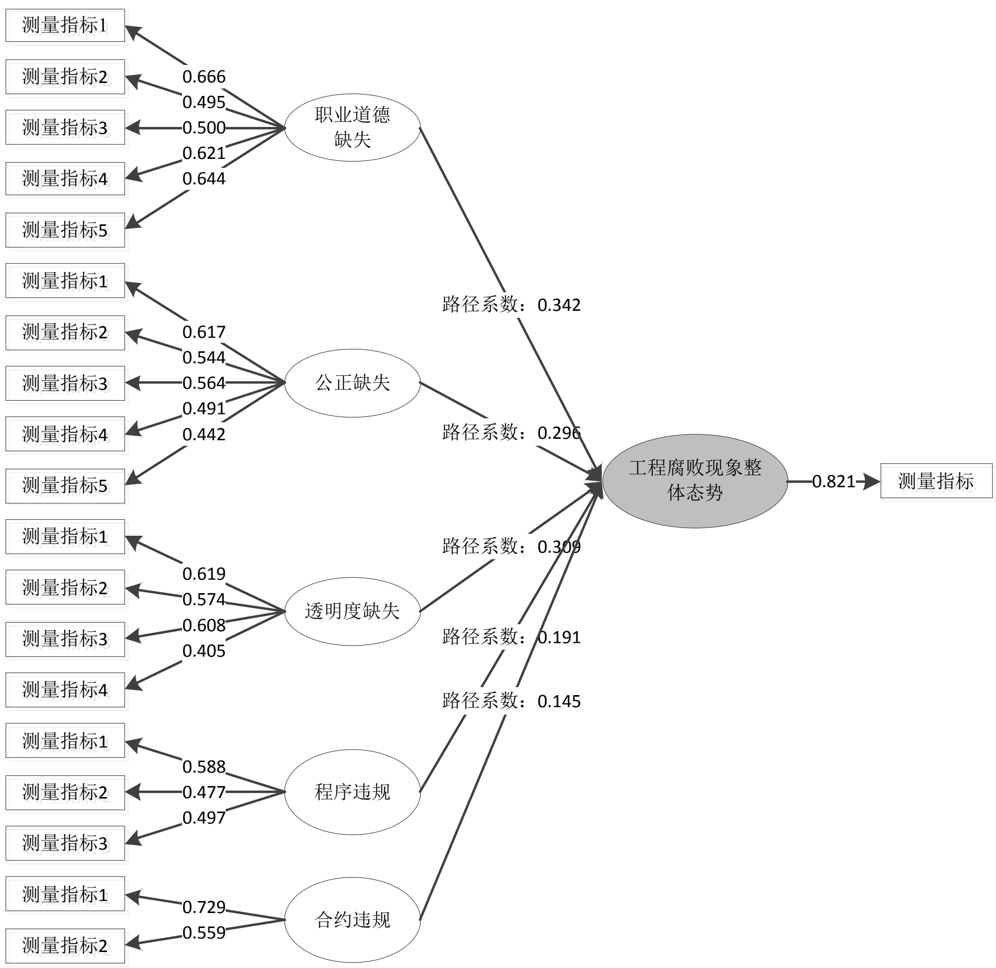


图 1 工程腐败风险因素指标体系结构方程模型分析结果

2. 工程腐败诱因测量指标体系与工程腐败测量指标体系之间存在正相关关系的假设成立。同时，依据模型路径系数分析，发现对工程腐败行为影响最大的腐败诱因维度为“监管体系缺陷”（路径系数

0.605），其次为“行业积极氛围缺失”（路径系数 0.560），模型分析结果如图 2 所示：

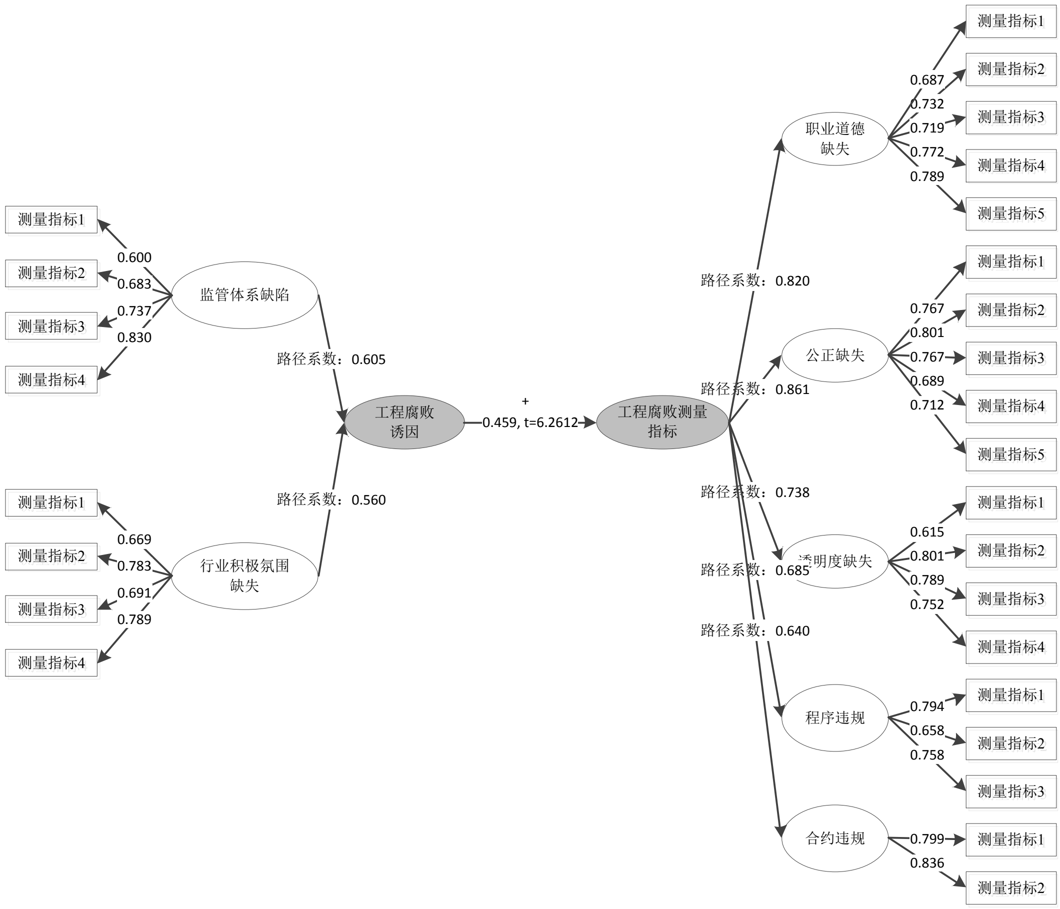

图 2 工程腐败诱因及工程腐败测量指标结构方程模型分析结果

3. 工程反腐败策略测量指标体系与工程腐败测量指标体系之间存在负相关关系的假设成立。同时，依据模型路径系数分析，发现对工程腐败行为遏制最为有效的反腐败策略维度为“领导力”（路径系数 0.636），其次为“监管机制”（路径系数 0.283）、“惩戒”（路径系数 0.236）和“培训”（路径系数 0.143），模型分析结果如图 3 所示：

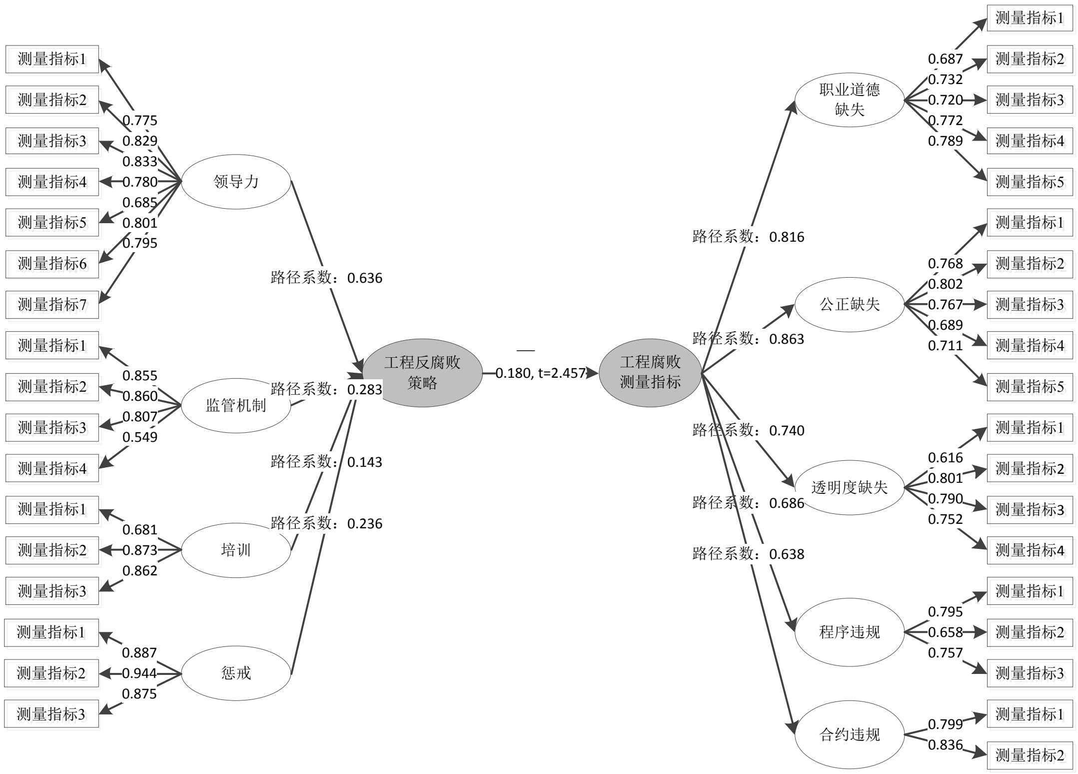


图 3 工程反腐败策略及工程腐败测量指标结构方程模型分析结果

与此同时，基于工程腐败测量指标体系及问卷调研数据，本研究利用模糊集理论构建了政府投资建设项目腐败测定模型。该模型先后在济南和郑州的两个政府投资建设项目进行了应用。模型预测出前者处于高腐败风险水平，后者处于中等腐败风险水平。预测结果与项目实际状况相吻合。

**第三部分 受访者背景资料**（请用“√”的形式选择您的回答，或直接填写您的回答）

1. 请问您目前工作单位的性质是：

☐政府 ☐业主方 ☐施工方 ☐设计方 ☐咨询方 ☐其他（请注明______）

2. 请问您的职称（或职务）是：______________________

3. 请问您在建筑工程领域的从业时间是：_______年

**第四部分 研究验证评价**

请您对本项研究的研究过程和研究结论做出评价，评分标准如下：

1 分：很差，2 分：差，3 分：一般，4 分：好，5 分：很好

| 序号 | 研究验证评价问题 | 评分 | | | | |
|---|---|---|---|---|---|---|
| 1 | 您认为本研究识别的工程腐败测量指标适用性如何？ | 1 | 2 | 3 | 4 | 5 |
| 2 | 您认为本研究识别的用于量度工程腐败诱因的指标适用性如何？ | 1 | 2 | 3 | 4 | 5 |
| 3 | 您认为本研究识别的用于量度工程反腐败策略的指标适用性如何？ | 1 | 2 | 3 | 4 | 5 |
| 4 | 您认为本研究提出的工程腐败测量指标理论框架是否合理？ | 1 | 2 | 3 | 4 | 5 |
| 5 | 您认为本研究提出的工程腐败诱因测量指标理论框架是否合理？ | 1 | 2 | 3 | 4 | 5 |
| 6 | 您认为本研究提出的反腐败策略测量指标理论框架是否合理？ | 1 | 2 | 3 | 4 | 5 |
| 7 | 您认为本研究建立的工程腐败诱因与工程腐败测量指标之间的理论假设是否合理？ | 1 | 2 | 3 | 4 | 5 |
| 8 | 您认为本研究建立的工程反腐败策略与工程腐败测量指标之间的理论假设是否合理？ | 1 | 2 | 3 | 4 | 5 |
| 9 | 您认为本研究得到的工程腐败测量指标潜在理论维度的结果是否合理？ | 1 | 2 | 3 | 4 | 5 |
| 10 | 您认为本研究得到的工程腐败核心诱因的结果是否合理？ | 1 | 2 | 3 | 4 | 5 |
| 11 | 您认为本研究得到的工程反腐败策略有效性评价的结果是否合理？ | 1 | 2 | 3 | 4 | 5 |
| 12 | 请您对本研究提出的腐败测定模型的通用性做出评价。 | 1 | 2 | 3 | 4 | 5 |

本次调研已经结束，非常感谢您的帮助与支持！

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