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ORIGINAL PAPER

Investigating the Effectiveness of Response Strategies for Vulnerabilities to Corruption in the Chinese Public Construction Sector

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Abstract Response strategy is a key for preventing widespread corruption vulnerabilities in the public construction sector. Although several studies have been devoted to this area, the effectiveness of response strategies has seldom been evaluated in China. This study aims to fill this gap by investigating the effectiveness of response strategies for corruption vulnerabilities through a survey in the Chinese public construction sector. Survey data obtained from selected experts involved in the Chinese public construction sector were analyzed by factor analysis and partial least squares-structural equation modeling. Analysis results showed that four response strategies of leadership, rules and regulations, training, and sanctions, only achieved an acceptable level in preventing corruption vulnerabilities in the Chinese public construction sector. This study contributes to knowledge by improving the understanding of the effectiveness of response strategies for corruption vulnerabilities in the public construction sector of developing countries.

Keywords Corruption vulnerabilities · Response strategies · Public construction sector · China

Introduction

Corruption vulnerabilities in the public construction sector have been raised in various countries around the world, particularly in those developing ones, which are

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caused by continual economic growth and rapid urbanization worldwide (Transparency International 2002, 2006, 2008, 2011). Corruption vulnerabilities can ruin the public construction sector at multiple levels and lead to underperformance of public projects, such as quality defects, cost overruns and delivery delays (Kenny 2009). It is estimated that corruption vulnerabilities may result in a loss ratio of project cost ranging from 10 to 50 % (Jain 2001). Therefore, a growing number of research efforts have been devoted to related issues in recent years (Alutu 2007; Sohail and Cavill 2008; de Jong et al. 2009; Bowen et al. 2012; Tabish and Jha 2011, 2012; Gunduz and Önder 2013; Le et al. 2014a, b).

Corruption vulnerabilities commonly exist in both developed and developing countries with various political and economic systems (Ehrlich and Francis 1999; Cendrowski et al. 2007; Melgar et al. 2009). As a result of the lack of mature legislative and institutional systems, developing countries face a greater challenge in preventing corruption than developed countries do (Ofori 2000). China is one example. For instance, the National Bureau of Corruption Prevention reported 15,010 cases of corruption recorded in the public construction sector between 2009 and 2011, which caused an estimated loss of CNY 3 billion (approximately USD 490 million) (Xinhua Net 2011). The serious corruption situation has forced the government to pay more attention to anti-corruption issues and improve relevant supervision in the Chinese public construction sector (Xinhua Net 2009).

Various response strategies, such as economic (e.g., raising wage level, tax reform), administrative (e.g., public procurement reform, decentralization of decision-making), political (e.g., political competition, transparency in party financing), legislative (e.g., anti-corruption legislation, respect for the rule of law), and auditing strategies (e.g., independent judiciary, independent/free media), have been proposed in previous studies to mitigate corruption vulnerabilities (Riley 1998; Chandler 2002; Desta 2006; Peisakhin and Pinto 2010; Karhunen and Ledyaeva 2012; Klinkhammer 2013). However, few studies have evaluated the effectiveness of these response strategies. Therefore, this study focuses on the Chinese public construction sector, and aims to evaluate the effectiveness of existing response strategies by examining its relationships with corruption vulnerabilities.

Conceptual Framework and Hypothesis Development

The conceptual framework of this study was developed based on Tabish and Jha (2011, 2012), which investigated corruption vulnerabilities and response strategies in the Indian public project procurement. Their frameworks were adopted as the theoretical foundation of this study for the following reasons. First, few researchers, apart from Tabish and Jha (2011, 2012), have examined the vulnerabilities to corruption and response strategies in the public construction sector of developing countries. Second, China and India have many similar aspects, such as close locations, economy, population and industrial structures (Cheng et al. 2007). Most importantly, both China and India are undergoing rapid urbanization and face a similar challenge of preventing corruption in the public construction sector (Le et al.

2014b). Furthermore, in order to make the framework of Tabish and Jha (2011, 2012) to fit with the Chinese context, a series of interviews were conducted by interviewing with experienced experts in China.

Corruption Vulnerabilities

Corruption vulnerabilities play a critical role in corruption research, particularly in developing countries which lack a sound legislative and administrative system (Doig 1997; Lee et al. 2010). Sohail and Cavill (2008) outlined various corruption vulnerabilities and related stakeholders in the project execution and delivery process. Tabish and Jha (2011) further conceived key corruption vulnerabilities in public procurement in terms of irregularities. In their study, Tabish and Jha (2011) identified 61 irregularities in the Indian public procurement projects, and categorized these irregularities into five groups, namely transparency, professional standards, fairness, contract monitoring and regulation, and procedural accountability irregularities. Based on the aforementioned consideration, these five groups and their affiliated irregularities were used in this study as the initial measurement framework of corruption vulnerabilities in the Chinese public construction sector.

Response Strategies

According to Tabish and Jha (2012), the response strategies for corruption vulnerabilities in the public construction sector consist of four constructs, namely, leadership, rules and regulations, training, and sanctions.

Leadership can develop and facilitate values of integrity in an organization which are manifested by appropriate actions (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 way (Sööt 2012). Meanwhile, the 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 good leaders is vital for an organization to fight against potential corruption vulnerabilities (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 the 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 and 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 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 (Boehm and Nell 2007; Schwartz 2004, 2009). Many international associations, such as the International Federation of Consulting Engineers, the American Society of Civil Engineers, the UK Institution of Civil Engineers, the UK Chartered Institute of Building, and the UK Royal Institution of Chartered Surveyors, have incorporated training as an important component into their anti-corruption guidelines (Boyd and Padilla 2009; Crist 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 response 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).

Hypothesis Development

A hypothesis model (Fig. 1) based on the aforementioned conceptual framework was proposed to investigate the relationships between corruption vulnerabilities and response strategies in the Chinese public construction sector. As shown in Fig. 1, response strategies in the hypothesis model are considered as four-dimensional and second-order construct composed of leadership, rules and regulations, training, and sanctions. Corruption vulnerabilities are deemed as a five-dimensional and second-order construct composed of transparency, professional standards, fairness, contract monitoring and regulation, and procedural accountability irregularities. The development of the model adopted the second-order construct approach recommended by Wetzels et al. (2009), because it maximizes the interpretability of both measurement and hierarchical models. In the proposed model, the hypothesis that response strategies are negatively correlated with corruption vulnerabilities in the public construction sector, is to be tested.

Research Methodology

The whole research process consists of four steps. First, a hypothesis model for defining the relationships between corruption vulnerabilities and response strategies was formulated based on Tabish and Jha (2011, 2012). Second, the model was refined by interviewing selected experts to fit in the Chinese context. Third, a questionnaire instrument was developed based on the refined framework, and was used in the survey to collect opinion-based data from target respondents. Lastly, both factor analysis (FA) and partial least squares structural equation modeling (PLS-SEM) were conducted to analyze the data collected and to validate the hypothesis model. Qualitative and quantitative methods were sequentially adopted

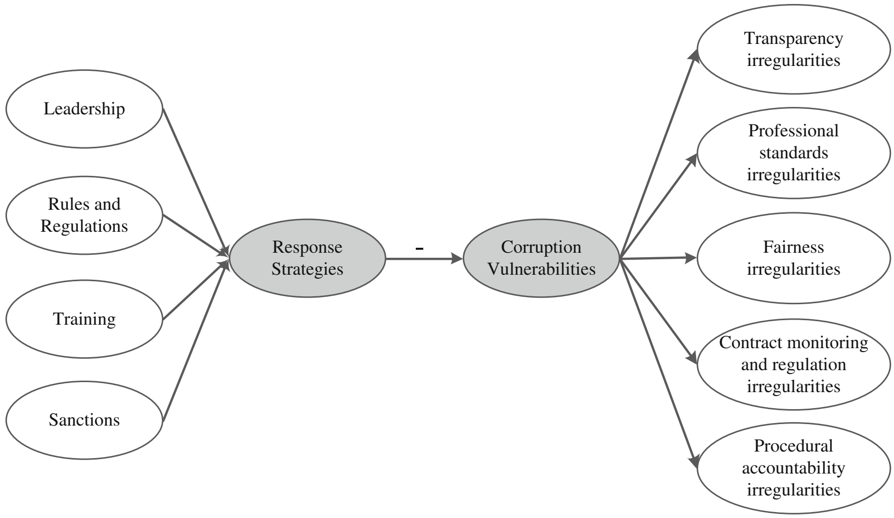

Fig. 1 Hypothesis model of corruption vulnerabilities and response strategies

in this study. Results obtained from diverse methods can triangulate and complement each other, thus yielding stronger and more reliable findings (Xia et al. 2009; Zhao et al. 2014).

Interviews

To verify the hypothesis model derived from Tabish and Jha (2011, 2012) and make it fit in with the Chinese context, a series of face-to-face interviews were conducted between July and August 2013. Each interview contained two sections. In Section A, the interviewee was asked to provide his/her opinion on the measurement items of the response strategies of Tabish and Jha (2012), in terms of their involvement in the Chinese public construction sector. In Section B, the interviewee was asked to provide his/her opinions on the measurement items of corruption vulnerabilities derived from Tabish and Jha (2011) in terms of a five-point Likert scale: "1-strongly disagree," "2-disagree," "3-neutral," "4-agree," and "5-strongly agree." Each interviewee was also encouraged to supplement the measurement items of corruption vulnerabilities that were not recorded in the interview.

A total of 14 experienced industrial and academic experts were invited to participate in the interviews. To ensure the reliability and quality of the interviews, a purposive approach was adopted to select the interviewees. All the interviewees had at least 10-year experience in the public construction sector and senior positions within their organizations. The selection of interviewees also considered the diversity of professional expertise of experts, which helped increase the heterogeneity of the interview panel and thus improve the validity of interviews. Table 1 shows the backgrounds of interviewees.

Table 1 Backgrounds of interviewees

No.	Employer	Position	Years of experience	Largest project ever managed/consulted
A	Government	Director	20	USD 363 million
B	Government	Deputy director	16	USD 308 million
C	Client	Project manager	19	USD 363 million
D	Client	Project manager	17	USD 308 million
E	Client	Director	13	USD 167 million
F	Contractor	General manager	25	USD 363 million
G	Contractor	Project manager	20	USD 122 million
H	Contractor	Director	15	USD 85 million
I	Consultant	General manager	20	USD 363 million
J	Consultant	Project manager	16	USD 122 million
K	Consultant	Project manager	15	USD 85 million
L	Academic	Professor	22	USD 197 million
M	Academic	Professor	17	USD 73 million
N	Academic	Associate professor	13	USD 363 million

All interviewees agreed with the applicability of Tabish and Jha's (2012) categorization of response strategies for corruption vulnerabilities in the Chinese context. Only a few statements of measurement items were adjusted as suggested by interviewees. According to Interviewees A, C, and L, the items of 'fear of suspension', 'fear of disciplinary action', and 'fear of caution/warning letter' proposed by Tabish and Jha (2012) were revised to 'fear of economic sanction', 'fear of penal sanction', and 'fear of administrative sanction', respectively.

According to the interview feedback, the mean score of each measurement item of Tabish and Jha (2011) was calculated. Only those achieving a value of 2.5 or above were used in the final questionnaire for the survey. This method was suggested by Hsueh et al. (2009). Finally, 19 measurement items regarding corruption vulnerabilities were extracted and used in the questionnaire survey (Table 2). In addition, five new measurement items (i.e., contractors provide false certificates in bidding, substitution of unqualified materials in construction, site supervisor neglects his duties by taking a bribe from a contractor, confidential information of bidding is disclosed to a specific bidder, and a large project should have called for bids is split into several small projects and contracted without bidding) regarding corruption vulnerabilities advocated by most experts were added to elaborate the hypothesis model and make a tailor fit with the Chinese context (Table 3). Correspondingly, five categories of corruption vulnerabilities were renamed as opacity (formerly transparency), immorality (formerly professional standards), unfairness (formerly fairness), contractual violation (formerly contract monitoring and regulation), and procedural violation (formerly procedural accountability). Figure 2 shows the revised hypothesis model.

Table 2 Measurement items of corruption vulnerabilities

Construct	Code	Measurement item	Evaluation	Factor loading	Variance explained (%)
Immorality	IMM1	The work is not executed as per original design accorded	3.93	0.727	33.679
	IMM2	Work is executed without the availability of funds for the said purpose	3.93	0.474[b]	
	IMM3	The changes, especially in abnormally high rated and high value items are not properly monitored and verified	3.29	0.696	
	IMM4[a]	Contractors provide false certificates in bidding	3.96	0.673	
	IMM5[a]	Substitution of unqualified materials in construction	3.54	0.735	
	IMM6[a]	Site supervisor neglects his duties for taking bribe from contractor	3.91	0.750	
Unfairness	UNF1	The consultant is not appointed after proper publicity and open competition	3.64	0.797	9.718
	UNF2	The criteria adopted in prequalification of consultant are restrictive and benefit only few consultants	3.43	0.849	
	UNF3	The selection of consultant not done by appropriate authority	3.57	0.451[b]	
	UNF4	The criteria for selection of contractor are restrictive and benefit only few contractors	3.00	0.708	
	UNF5	The conditions/specifications are relaxed in favor of contractor to whom the work is being awarded	3.50	0.636	
	UNF6[a]	Confidential information of bidding is disclosed to a specific bidder	3.76	0.654	
Opacity	OPA1	Adequate and wide publicity is not given to tender	2.71	0.720	6.644
	OPA2	Adequate time for submission of tender/ offer not given	2.64	0.482[b]	
	OPA3	The evaluation of tenders is not done exactly as per the notified Criteria	2.57	0.752	
	OPA4	The negotiation on tender not done as per laid down guidelines	3.00	0.759	
	OPA5[a]	A large project should have called for bids is split into several small projects and contracted without bidding	3.40	0.616	
Procedural violation	PRV1	Administrative approval and financial sanction not taken to execute the work	2.79	0.742	6.300
	PRV2	Lack of the sanctioned financial provisions from the government	3.86	0.707	
	PRV3	Work is not executed for the same purpose for which the sanction was accorded	2.93	0.640	

Table 2 continued

Construct	Code	Measurement item	Evaluation	Factor loading	Variance explained (%)
	PRV4	The proper record of hindrances is not being maintained from the beginning	2.93	0.440[b]	
Contractual violation	COV1	Escalation clause is not applied correctly for admissible payment	3.57	0.746	5.281
	COV2	Compliance with conditions regarding deployment of technical staff not being followed by contractor	3.71	0.573	
	COV3	The work order/supply order is not placed within justified rates	2.71	0.443[b]	

[a] IMM4, IMM5, IMM6, UNF6, and OPA5 were added by the interviewees

[b] IMM2, UNF3, OPA2, PRV4, and COV3 were excluded with factor loadings lower than 0.5

Questionnaire Survey

A questionnaire survey was administered based on the measurement items consolidated in the interviews. The target respondents included clients, contractors, designers, consultants, governmental officials, and academics involved in public construction projects in China. To maximize the number of potential respondents, a number of government agencies, research institutions, and companies within the construction industry were contacted. In the end, eight institutions, namely, (1) Research Institute of Complex Engineering and 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 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 dispatched between September and October 2013 via three channels. First, an online version of the questionnaire was developed and disseminated to the staff of the aforementioned supporting institutions. Second, hard copies of the questionnaire were also distributed in an industrial forum held in Shanghai. Some qualified attendants of this meeting were invited to participate in this survey. Third, field surveys were performed on sites in Shanghai (in the eastern China), Jinan city (in the eastern China), and Zhengzhou city (in the central China), respectively. The three survey channels in this study enhanced the maximized number of survey respondents. Lastly, 188 valid replies were recorded: 87 were from the online survey, 20 from the forum, and 81 from the field survey. Table 4 shows the backgrounds of respondents.

Table 3 Sources and evaluations of added measurement items

Code	Measurement item	Interviewee														Evaluation
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	
LPIC6	Interpersonal connections				√	√	√		√		√	√	√		√	3.96
IMM4	Contractors provide false certificates in bidding	√	√	√				√	√		√		√	√		3.96
IMM5	Substitution of unqualified materials in construction	√	√		√	√				√	√	√	√	√	√	3.54
IMM6	Site supervisor neglects his duties by taking a bribe from a contractor		√	√	√	√				√	√		√	√	√	3.91
UNF6	Confidential information of bidding is disclosed to a specific bidder	√			√			√		√		√	√		√	3.76
OPA5	A large project should have called for bids is split into several small projects and contracted without bidding				√	√	√		√		√	√	√		√	3.40

Tools for Data Analysis

Factor Analysis

Factor analysis (FA) is a statistical technique commonly adopted to identify a small number of individual factors beneath a set of interrelated variables (Choi et al. 2011). FA was conducted using a Statistical Package for the Social Sciences 17.0 to condense and summarize measurement items of corruption vulnerabilities and response strategies in this study. Principal Component Analysis was conducted to identify the underlying principal factors for its simplicity and distinctive capacity of data-reduction (Chan et al. 2010). To obtain principal factors for a clearer image, factor extraction with Promax Rotation and Kaiser Normalization suggested by Conway and Huffcutt (2003) was conducted. Before FA, both Kaiser–Meyer–Olkin (KMO) and Bartlett's Test of Sphericity analyses were conducted to examine the

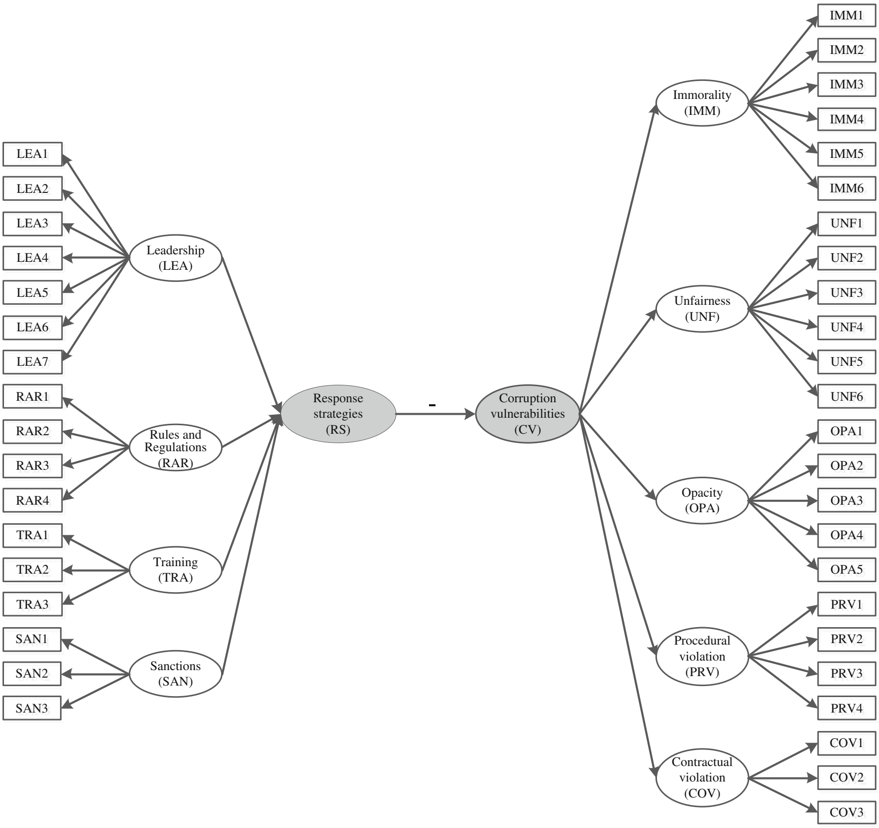

Fig. 2 Refined hypothesis model

appropriateness of employing FA technique in this study. According to Norusis (2008) and Choi et al. (2011), a 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).

PLS-SEM

PLS-SEM was adopted to test the hypothesis in the refined hypothesis model. PLS-SEM is a combined technique consisting of principal components analysis, path analysis, and regression to simultaneously evaluate theory and data (Aibinu and Al-Lawati 2010). PLS-SEM can estimate latent constructs as linear combinations of observable variables, and further estimate parameters for links among different constructs (Mohamed 2002). Additionally, PLS-SEM has a minimum requirement of sample size, but it can handle nonnormal data sets (Reinartz et al. 2009; Ringle et al. 2012). Therefore, PLS-SEM was adopted in this study.

Table 4 Backgrounds of respondents

Personal attributes	Categories	Number of respondents	Percentage
Organization	Government	20	10.6
	Client	43	22.9
	Contractor	43	22.9
	Consultant	46	24.5
	Designer	26	13.8
	Academic	10	5.3
Position	Top managerial level (e.g., director, general manager, professor)	49	26.1
	Middle managerial level (e.g., project manager)	88	46.8
	Professional (e.g., engineer, quantity surveyor)	51	27.1
Years of experience	>20	24	12.8
	11–20	40	21.3
	6–10	76	40.4
	<5	48	25.5
Working place[a]	Eastern China	63	33.5
	Central China	55	29.2
	Western China	37	19.7
	Northeastern China	33	17.6

[a] 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)

Results of PLS-SEM include a set of measurement models and a structural model. In this study, four kinds of validity of the measurement models, namely, (1) internal consistency reliability; (2) indicator reliability; (3) convergent validity; and (4) discriminating validity, were assessed by three indicators, namely, Composite Reliability, Loadings of measurement items on the corresponding construct, and average variance extracted (AVE) (Hair et al. 2011; Ning and Ling 2013; Zhao et al. 2013). Composite Reliability is used to assess the internal consistency reliability, whose value should be larger than 0.7 (Hair et al. 2011). Loadings of measurement items on the corresponding construct are used to assess the indicator reliability, whose value should be at least larger than 0.4 (Hair et al. 2011; Ning and Ling 2013). The AVE is used to evaluate the convergent validity, whose value should be larger than 0.5 (Hair et al. 2011). Loadings of measurement items on the corresponding construct and the AVE are also used to evaluate the discriminating validity: the square root of the AVE of each construct should exceed the inter-construct correlation; a measurement item's loading should be larger than all of its cross loadings (Cenfetelli and Bassellier 2009; Hair et al. 2011; Zhao et al. 2013). Regarding the evaluation of the structural model, the significance of path coefficients was adopted with the aid of Bootstrapping (Hair et al. 2011; Ning and Ling 2013; Zhao et al. 2013).

Analysis Results

Factor Analysis

Table 2 shows the FA results of measurement items of corruption vulnerabilities. Five constructs encapsulating 24 measurement items were generated. The KMO value is 0.863. The total variance explained is 61.623 %. The Bartlett's Test of Sphericity produced $\chi^2 = 1{,}308.051$ ($df = 276$, $p = 0.000$). Thus, all the statistical indicators were acceptable to conduct FA (Dziuban and Shirkey 1974; Norusis 2008). Hair et al. (2010) stated that the factor loading of each measurement item on its corresponding construct should be higher than 0.5. Therefore, IMM2, UNF3, OPA2, PRV4, and COV3 were deleted from the list of measurement items.

Table 5 shows the FA results of the measurement items of response strategies. Four constructs encapsulating 17 measurement items were generated, which is in line with the findings of Tabish and Jha (2012). The KMO value is 0.821. The total variance explained is 68.391 %. The Bartlett's Test of Sphericity produced $\chi^2 = 1{,}787.405$ ($df = 136$, $p = 0.000$). All the statistical indicators were also acceptable to conduct FA (Dziuban and Shirkey 1974; Norusis 2008).

Evaluation of Measurement Models

Tables 6, 7, 8 show the evaluation results of measurement models. Table 6 shows that (1) all loadings are larger than 0.4 with t values larger than 2.58, indicating the acceptable indicator reliability (Hair et al. 2011; Ning and Ling 2013); (2) the values of Composite Reliability are over 0.7, suggesting a satisfactory level of reliability of internal indicators with each construct (Hair et al. 2011); (3) the AVE value of each construct is higher than 0.5, showing a satisfactory level of convergent validity of the constructs (Hair et al. 2011).

Table 7 shows that the square root of the AVE value of each construct is higher than its squared correlation with any other construct. Table 8 indicates that each measurement item has the highest loading on the corresponding construct and the bold values are significant at the 0.01 level. These results indicate the high discriminate validity of the constructs (Cenfetelli and Bassellier 2009; Hair et al. 2011; Zhao et al. 2013).

Evaluation of Hierarchical Models

Table 9 shows that all path coefficients for hierarchical models are significant (t value >2.58). The values of Composite Reliability are also over 0.7, which indicates a satisfactory level of reliability of first-order constructs with the corresponding second-order construct (Bagozzi and Yi 1988; Ling et al. 2013).

Table 5 Factor analysis results of measurement items of response strategies

Construct	Code	Measurement items	Factor loading	Variance explained (%)
Leadership	LEA1	Anti-corruption issues are important	0.732	36.578
	LEA2	Act positively and cooperate	0.793	
	LEA3	Act decisively when anti-corruption issues are important	0.806	
	LEA4	Praise for working honestly	0.823	
	LEA5	Remind each other to work fairly and honestly	0.739	
	LEA6	Provide help to work honestly	0.750	
	LEA7	Corruption free environment is provided	0.772	
Rules and regulations	RAR1	Adequate source of information	0.836	11.360
	RAR2	Rules protect us from vigilance cases	0.820	
	RAR3	Rules should be consulted by all	0.765	
	RAR4	Rules do not impose restrictions	0.641	
Training	TRA1	Training is necessary	0.850	10.547
	TRA2	Training helps me	0.902	
	TRA3	Training helps in prevention of corrupt practices	0.670	
Sanction	SAN1	Fear of administrative sanction	0.843	9.906
	SAN2	Fear of economic sanction	0.951	
	SAN3	Fear of penal sanction	0.891	

Evaluation of Structural Models

The path coefficient between response strategies and corruption vulnerabilities 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 response strategies are negatively correlated with corruption vulnerabilities is supported in the hypothesized sign. Figure 3 shows the testing results of the hypothesis model.

Discussion

Based on the PLS-SEM results, all the statistical indicators were found to be acceptable, which loosely supported the hypothesis in the study. Analysis results also revealed that four response strategies grouped under various constructs did not play an effective role in preventing corruption vulnerabilities as predicted in prior studies received. The most effective response strategy, Leadership (LEA), only received a path coefficient of 0.636; the path coefficients of other three strategies were about 0.200, which were relatively low.

Table 6 Evaluation of measurement models

Construct	Code	Loading	*T* value	AVE	CR
LEA	LEA1	0.7747	18.4748	0.6189	0.9189
	LEA2	0.8291	31.4307		
	LEA3	0.8332	31.9189		
	LEA4	0.7800	22.5243		
	LEA5	0.6849	14.8957		
	LEA6	0.8010	24.0851		
	LEA7	0.7947	27.7269		
RAR	RAR1	0.8553	38.5360	0.6061	0.8569
	RAR2	0.8602	35.8571		
	RAR3	0.8070	26.0362		
	RAR4	0.5491	7.3855		
TRA	TRA1	0.6805	6.1983	0.6564	0.8499
	TRA2	0.8733	16.3155		
	TRA3	0.8621	22.6795		
SAN	SAN1	0.8871	55.4446	0.8147	0.9294
	SAN2	0.9444	82.7454		
	SAN3	0.8747	32.1513		
PRV	PRV1	0.7948	20.7161	0.5462	0.7821
	PRV2	0.6581	11.3510		
	PRV3	0.7574	15.2654		
UNF	UNF1	0.7676	22.1089	0.5601	0.8639
	UNF2	0.8017	22.1503		
	UNF4	0.7669	19.0669		
	UNF5	0.6890	12.6701		
	UNF6	0.7110	17.3696		
OPA	OPA1	0.6162	8.2653	0.5524	0.8302
	OPA3	0.8011	23.7254		
	OPA4	0.7895	25.4593		
	OPA5	0.7515	17.7858		
IMM	IMM1	0.7199	19.9375	0.5485	0.8584
	IMM3	0.6867	13.6543		
	IMM4	0.7316	13.5434		
	IMM5	0.7716	22.4705		
	IMM6	0.7887	23.9111		
COV	COV1	0.8356	19.5299	0.6686	0.8013
	COV2	0.7994	15.1437		

Leadership

Leadership (LEA) was regarded as the most useful response strategy in the survey, which has reinforced the findings of earlier studies (Sims 2000; Ashforth and Anand

Table 7 Correlation matrix and square root of average variance extracted of constructs

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

[a] The square root of the AVE value of each construct

Table 8 Cross loadings for individual measurement items

	COV	IMM	LEA	OPA	PRV	SAN	RAR	TRA	UNF
COV1	**0.8356**	0.5163	−0.1244	0.1700	0.2863	−0.1166	−0.1651	−0.0234	0.4122
COV2	**0.7994**	0.3943	−0.0506	0.2111	0.3705	−0.1132	−0.1473	−0.1290	0.3394
IMM1	0.3434	**0.7199**	−0.0374	0.4022	0.2998	−0.0488	−0.1926	0.0369	0.5499
IMM3	0.4502	**0.6867**	−0.0160	0.3282	0.2988	0.0411	−0.0428	−0.0706	0.2962
IMM4	0.4895	**0.7316**	−0.1122	0.2740	0.2382	−0.1154	−0.1153	−0.1653	0.3224
IMM5	0.3763	**0.7716**	−0.1206	0.3458	0.3249	−0.0188	−0.1833	−0.1083	0.3896
IMM6	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
OPA3	0.2881	0.3402	−0.1177	**0.8011**	0.3040	−0.0219	−0.1176	0.0794	0.5065
OPA4	0.1791	0.3517	0.0711	**0.7895**	0.3891	0.0590	−0.0284	0.1818	0.4163
OPA5	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

Table 8 continued

	COV	IMM	LEA	OPA	PRV	SAN	RAR	TRA	UNF
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
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**
UNF4	0.3383	0.3893	−0.0761	0.5198	0.4685	0.0072	−0.1378	−0.0212	**0.7669**
UNF5	0.2793	0.4125	−0.0740	0.4828	0.1846	−0.1495	−0.0408	−0.0599	**0.6890**
UNF6	0.4876	0.5630	−0.2010	0.4559	0.4172	−0.0634	−0.3069	−0.0118	**0.7110**

Table 9 Evaluation results of hierarchical models

Paths	Path coefficient	*T* value	CR
LEA → RS	0.6359	17.8615	0.9008
RAR → RS	0.2830	10.2842	
TRA → RS	0.1428	5.2634	
SAN → RS	0.2356	8.1213	
CV → PRV	0.6857	17.1155	0.9045
CV → UNF	0.8629	51.1495	
CV → OPA	0.7402	17.7132	
CV → COV	0.6377	11.7899	
CV → IMM	0.8157	21.6029	

RS represents for response strategies

CV represents for corruption vulnerabilities

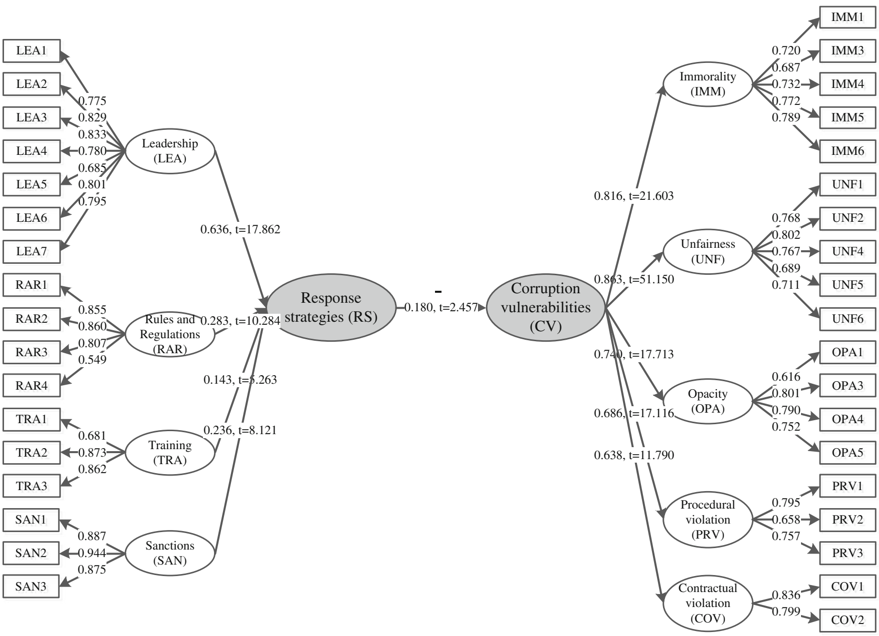

Fig. 3 Testing results of the hypothesis model

2003; Tabish and Jha 2012). Compared with western countries, leadership plays a more critical role in China. This 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 but it still has a long road to incorporate it into the existing institutions. Consequently, accountability for integrity of leadership needs to be improved in future public construction (People's Liberation Army Daily

2013). By establishing this mechanism, leaders have duty to secure the integrity of the projects with the exercise of his/her leadership, which can also produce a positive impact on his/her subordinates' corrupt practices.

Rules and Regulations

This response strategies received a low path coefficient of 0.283 (*t* value 10.28), which indicated that the effectiveness of rules and regulations (RAR) is loosely supported by the respondents. This may be due to the fact that the existing response rules and regulations at the macro level are reactive, which seldom address the need of proactively preventing corrupt practices at the micro level (He 2000). Although the Chinese government has already recognized this fact and begun promulgating a series of more detailed and workable rules and regulations focusing on the micro level (Legal Weekly 2014), such as *the interpretation of issues that are 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 *Implementing regulations of the Law of Bidding of People's Republic of China* (People Net 2010; The State Council of P.R. China 2011), which have been evidenced by a growing number of corruption cases revealed in recent years, it still has a long way to go to see the effectiveness of these new rules and regulations.

Sanctions

This strategy received 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 is merely regarded as acceptable by the respondents, which has echoed the belief of the Chinese public that only a few suspects have received 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 paying a bribe to the judicial department (Xinhua Net 2014). This fact has explained why the respondents are reluctant to provide a high evaluation on the effectiveness of sanctions (SAN). In order to change this situation, a series of reforms have been made by the Chinese Government. According to the China Ministry of Supervision, 11,273 people received an administrative sanction, and 5,698 people received a penal sanction for their corrupt crimes in the public construction sector between September 2009 and March 2011 (Xinhua Net 2011), which indicated that the execution of sanctions for corruption crimes seems to be gradually strengthening.

Training

Training (TRA) received the lowest path coefficient of 0.143 (*t* value 5.26) among the four response strategies, which indicated that most survey respondents held a belief that existing training methods seeking to prevent corruption remain in abeyance. Undoubtedly, training is regarded as an indispensable response strategy for corruption prevention for its proactive role of forestalling corruption (Heineman

Jr and Heimann 2006). Thus, related training needs to be implemented in all Chinese public construction projects. Zou (2006) stated that existing training seldom addresses doubts on emergent ethical dilemmas, such as conflicts of interest, and gift giving/receiving. Similar problems are common to industry practitioners as a result the inappropriate response to ethical dilemmas (Luo 2002). Therefore, future professional training should incorporate corruption issues and help industrial professionals maintain the highest integrity standards.

Conclusions

A questionnaire survey was conducted in this study to evaluate the effectiveness of response strategies for vulnerabilities to corruption in the Chinese public construction sector. The survey results showed that the effectiveness of four response strategies, namely, leadership (LEA), rules and regulations (RAR), training (TRA), and sanctions (SAN), only leadership achieved an acceptable level in corruption prevention. Although leadership (LEA) is found to be the most effective construct of response strategies and plays a decisive role in preventing corruption vulnerabilities, the effectiveness of this strategy remained limited and needs to be improved in future. Conversely, the effectiveness of rules and regulations (RAR), sanctions (SAN), and training (TRA) are found to be loosely supported by the respondents, implicating more efforts should be directed to these aspects. The major findings of this study are beneficial to researchers and practitioners to get more knowledge of anti-corruption issues in developing countries, particularly in China.

The main limitation of this study lies in the sample size of the questionnaire survey. Although this study has made great efforts in disseminating questionnaires and collecting feedback from various regions of China, this study still has room for collecting more empirical data and providing stronger evidence for model validation.

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