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Understanding Collusive Practices in Chinese Construction Projects

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Abstract

Collusion is of critical concern to the construction sector as it undermines free competition in the construction market. Given that previous research on collusive practices concentrates mainly on bidding phase, this study extended the research focus to the entire construction period and aimed to investigate specific collusive practices in Chinese construction projects. A total of 22 specific collusive practices in Chinese construction projects were first identified based on a comprehensive literature review and a Delphi survey with 15 industry experts. Then a questionnaire survey was conducted to prioritize the identified collusive practices in terms of their probability and severity. The survey results indicate that the primary collusive practices in Chinese construction projects are *misrepresentation of qualification certificates, loose site supervision, misusing prequalification requirements, fake tendering, approval of the unnecessary change orders, collective collusive tendering by helping one another, the nomination of a particular supplier, issuing certified works falsely, and inflating tender price*. The findings of the study not only provide a clearer picture of collusive practices in construction projects in China but also provide better understandings of collusive practices in

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18 other emerging economies.

19 **Keywords**

20 Collusive practice; Construction projects; China

21 **Introduction**

22 Collusion is a set of behaviors where competitors coordinate their market behavior
23 surreptitiously, which is contrary to the principles of free competition (Chotibhongs and Ardit
24 2012a; b; Zarkada-Fraser 2000). Collusion is also insidious and harmful to the management of
25 construction projects because it may decrease the number of bidders and increase contract
26 prices, thus resulting in a poor project outcome (Oladinrin and Ho 2014; Zarkada-Fraser and
27 Skitmore 2000). Moreover, collusion has brought a ‘dirty’ image to the construction sector and
28 degraded public trust on the sector (Zarkada-Fraser 2000).

29 Identifying collusive practices is critical because it is an initial but fundamental step of
30 collusion research, which would benefit the establishment of anti-collusion measures. Several
31 researchers have scrutinized collusive practices in the construction sectors of diverse countries,
32 such as Australia (Ray et al. 1999; Vee and Skitmore 2003; Zarkada-Fraser and Skitmore 2000),
33 India (Tabish and Jha 2011), The Netherlands (Dorée 2004; Priemus 2004), Nigeria (Alutu
34 2007; Alutu and Udhawuve 2009), South Africa (Bowen et al. 2012; 2007a; b), and Zambia
35 (Sichombo et al. 2009). However, little research input in the construction sector of China,
36 which contributes significantly to the global construction market.

37 Since the establishment of the socialist market economy in 1992, China has been

38 continuously uplifting its construction sector by reforming administrative systems,
39 reorganizing industry structure, and promoting free competition (Mayo and Liu 1995).
40 However, collusion is a stubborn problem concerning the Chinese construction sector (Le and
41 Shan 2013; Zou 2006). According to the National Bureau of Corruption Prevention of China
42 (2011), the number of commercial bribery cases in the construction sector between 2007 and
43 2009 was 13,006, accounting for nearly 44% of all business bribery cases (29,600) occurred in
44 that period. It has been widely accepted that a collusive agreement is a fundamental element in
45 any commercial bribery case in China (Le et al. 2014). This could be attributed to the following
46 facts. First, the key players of the Chinese construction market are the major state-owned
47 construction companies (National Bureau of Statistics 2014), which are more likely to involve
48 collusion practices due to the principal-agent problem (Le and Shan 2013). Second, current
49 Chinese construction laws merely target collusive practices in the bidding stage, ignoring those
50 prevail in other construction stages (Lam and Chen 2004). Given these unique features, there
51 is an urgent need to investigate collusive practices in the Chinese construction projects.

52 Furthermore, the current literature investigating collusive practices have mainly
53 concentrated on project bidding phase (Ballesteros-Pérez et al. 2013; Lo et al. 1999; Ray et al.
54 1999; Sohail and Cavill 2008; Vee and Skitmore 2003; Zarkada-Fraser and Skitmore 2000).
55 However, collusive practices can also occur in other project phases, such as conception phase
56 and implementation phase (Bowen et al. 2007a; b). Therefore, this study attempts to broaden
57 the research boundary by identifying and evaluating specific collusive practices in the entire
58 construction period.

59 **Literature Review**

60 To identify collusive practices in construction projects, a systematic literature search was
61 conducted to spot the collusion-related papers published in peer-reviewed construction
62 engineering and management (CEM) journals in the past two decades (1995-2014). It followed
63 the structured search method, advocated by Hu et al. (2015) and Yi and Chan (2014), which
64 consists of the following two steps.

65 Step 1, ten peer-reviewed CEM journals, comprising *Journal of Construction Engineering*
66 *and Management*, *Construction Management and Economics*, *Journal of Management in*
67 *Engineering*, *International Journal of Project Management*, *Project Management Journal*,
68 *Building and Environment*, *Automation in Construction*, *Building Research and Information*,
69 *Engineering, Construction and Architectural Management*, and *Journal of Professional Issues*
70 *in Engineering Education and Practice*, were first selected as target journals. Considering that
71 collusive practice is a type of unethical corrupt behavior (Le et al. 2014), a combined code of
72 “Collusion OR Collusive OR Ethics OR Ethical OR Corruption” was searched in the
73 Title/Abstract/Keyword field in the database of these ten target journals between 1995 and
74 2014.

75 Step 2, in order to gather more collusion-related papers, a new search was carried out
76 using two popular search engines, namely the Web of Science and Scopus. The combined code
77 of “Collusion OR Collusive OR Ethics OR Ethical OR Corruption AND Construction” was
78 searched in the Title/Abstract/Keyword field of Scopus, and in the Topic field of Web of
79 Science respectively, within the period from 1995 to 2014.

80 Subsequently, a visual examination was further conducted on the initial papers to verify
 81 its relevance to the topic of this study. Only those examine the collusive practices were retained.
 82 Finally, a total of 20 papers were retained via this systematic search process. Table 1 lists the
 83 20 identified papers, as well as their original countries.

84 Table 1 Collusive practice papers identified from literature review

No.	Reference	Construction period involved	Country/Region
1.	Lo et al. (1999)	Bidding & tendering	Taiwan
2.	Ray et al. (1999)	Bidding & tendering	Australia
3.	Zarkada-Fraser and Skitmore (2000)	Bidding & tendering	Australia
4.	Vee and Skitmore (2003)	Bidding & tendering	Australia
5.	Dorée (2004)	Bidding & tendering	The Netherlands
6.	Priemus (2004)	Bidding & tendering	The Netherlands
7.	Zou (2006)	Bidding & tendering, construction	China
8.	Alutu (2007)	Bidding & tendering	Nigeria
9.	Bowen et al. (2007a)	Design, bidding & tendering, construction	South Africa
10.	Bowen et al. (2007b)	Design, bidding & tendering, construction	South Africa
11.	Sohail and Cavill (2008)	Planning, design, bidding & tendering, construction	Not indicated
12.	Alutu and Udhawuve (2009)	Bidding & tendering	Nigeria
13.	Hartley (2009)	Bidding & tendering	Australia
14.	de Jong et al. (2009)	Bidding & tendering	Not indicated
15.	Sichombo (2009)	Bidding & tendering	Zambia
16.	Wang et al. (2009)	Construction	China
17.	Ameh and Odusami (2010)	Bidding & tendering	Nigeria
18.	Tabish and Jha (2011)	Conception, bidding & tendering, construction	India
19.	Bowen et al.(2012)	Bidding & tendering	South Africa
20.	Ballesteros-Pérez et al (2013)	Bidding & tendering	Spain

85 The existing literature reveals that particular efforts have been made to investigate
 86 collusive practices in construction projects. For instance, Ray et al. (1999), Priemus (2004),
 87 and Ballesteros-Pérez (2013) regarded collusion as one of the major ethical issues in tendering
 88 because it enables unethical tenderers to reap an illicit profit. Zarkada-Fraser and Skitmore
 89 (2000) conducted a survey in the Australian construction industry and identified three collusive

90 practices committed by tenderers, i.e. submission of cover prices, withdrawal from the bidding
91 process, and inflation of tenders by a pre-arranged amount. Vee and Skitmore (2003)
92 investigated the collusive practices between clients and their preferred tenderers, including
93 clients divulging more tender information to preferred tenderers and withholding vital
94 information from the other tenderers, bias in tendering evaluations to favor major contractors,
95 and clients pre-selecting consultant then calling tenders to fulfill organizational or statutory
96 requirements.

97 Bowen et al.(2007a) conducted a survey in the South African construction industry and
98 found various forms of collusive tendering, including leaking of tender price in return for
99 payment, cover pricing, bid cutting, hidden fees and commissions, compensation of tendering
100 costs to unsuccessful tenderers. Sohail and Cavill (2008) revealed a typical collusive practice
101 where project requirements may be overstated or tailored to fit the preferred tenderer. Tabish
102 and Jha (2011) investigated collusive practices involved in the Indian public procurement, such
103 as adequate and full publicity not given to tender, pre-qualification not done as per notified
104 criteria, and evaluation of tenders not done correctly as per announced rules. Alutu (2007)
105 and Alutu and Udhawuve (2009) scrutinized the collusive practices in the Nigerian construction
106 industry and found that the chief executive may award a contract to his/her preferred company
107 illegally without a necessary procedure of tendering, that the use of incomplete and/or low-
108 quality materials by contractor are ignored by the supervising team due to the collusive
109 agreement between the two parties, and that completion certificates are sometimes issued
110 illegally to the contractor to enable collection of payments, even when jobs are incomplete or
111 sometimes abandoned. Sichombo et al. (2009) also obtained similar findings in their research

112 on collusive practices in the Zambian construction industry.

113 Collusive practices have also been dispersedly investigated in the contexts of Taiwan and
114 mainland China. For instance, Lo et al.(1999) found that, in Taipei mass rapid transit projects,
115 clients might set high prequalification requirements to restrain competition, and certain
116 contractors may use the name of qualified contractors to bid and operate projects. Zou (2006)
117 mentioned some collusive practices of contractors in his study of anti-corruption strategies in
118 the Chinese construction sector. Wang et al. (2009) stated that, in Chinese construction projects,
119 supervising engineers might collude with contractors or clients by concealing their illegal
120 activities to government authorities.

121 This brief review indicates that, although efforts have been made to investigate collusive
122 practices in construction projects, research of this topic in the Chinese context remains limited.
123 Meanwhile, studies of collusive practices are mainly focused on project bidding phase,
124 ignoring project conception and implementation phases. Thus, this study attempted to fill this
125 knowledge gap by conducting a systematic investigation of collusive practices in the Chinese
126 construction projects.

127 **Research Methods**

128 A combination of qualitative and quantitative research methods was employed to address the
129 research question in this study. First, an initial list of collusive practices in construction projects
130 was identified from a comprehensive literature review. Second, the initial collusive practices
131 were refined by a two-round Delphi panel. Third, based on the consolidated framework, an
132 empirical questionnaire survey was administered to gauge these refined collusive practices in

133 terms of probability and severity. The sequential use of qualitative and quantitative research
134 method is expected to yield stronger and more reliable findings (Hon et al. 2013).

135 ***Delphi Survey***

136 Based on a comprehensive literature review, an initial list of 22 collusive practices was
137 established (see Table 2). To refine this initial list under the context of China, a two-round
138 Delphi survey was conducted.

Table 2 Collusive practices identified from literature review

No.	Collusive practice	Definition
CP1	Misusing prequalification requirements	A client misuses prequalification requirements by setting up the tailored prequalification requirements to fit its preferred tenderer.
CP2	Leaking vital information by the client	A client leaks vital information (e.g. pricing by other tenderers) to its preferred tenderer.
CP3	Inflating tender price	A client hints tenderers to inflate tender price in return for kickbacks.
CP4	Fake tendering	A client pre-selects a contractor/consultant/supplier, and then calls tenderers to fulfill organizational or statutory requirements.
CP5	Intervening in tender evaluation	The chief executive in a client organization intervenes in tender evaluation and helps his/her preferred tenderer win the contract.
CP6	Splitting a large project illegally	To evade the due tender procedure, a client splits a large project which should be awarded by tendering into several small projects and awards them directly to his/her preferred tenderer.
CP7	The lack of publicity	A client gives insufficient or inadequate advertising of tender.
CP8	Insufficient tender time	A client sets an excessively short tender time for the potential tenderers.
CP9	The absence of tender	The chief executive in a client organization approves and awards a contract to his/her preferred tenderer directly but illegally without a necessary tender procedure.
CP10	Bias in tender evaluation	A tenderer bribes the member(s) of tender evaluation panel to seek for the illegal competitive advantages in tender evaluation.
CP11	Misrepresentation of qualification certificates	A qualified contractor facilitates an unqualified contractor to participate in tendering by providing its qualification certificate illegally.
CP12	Collective collusive tendering by helping one another	Collusive tenderers assist one of them in winning the contract according to an agreement that they help each other win the contract in turns.
CP13	Helping the pre-established tenderer by giving up the contract	A collusive agreement is reached that the tenderer providing the most competitive price helps the pre-established tenderer win the contract by giving up the contract.
CP14	Leaking vital information by the bidding consultant	A bidding consultant leaks vital tendering information to the particular tenderer who has paid bribery.
CP15	Loose site supervision	The irregularities conducted by a contractor in project construction are ignored by the site supervising team because of the collusive pact between the two parties.

No.	Collusive practice	Definition
CP16	Issuing the certified works falsely	A quantity surveyor falsely issues the certified works in order to obtain extra money from the contractor.
CP17	Seeking for unnecessary change orders	To get extra profits from construction changes, a contractor bribes the designer and asks for the unnecessary design change orders.
CP18	Approval of the unnecessary change orders	A contractor bribes the client staff for his/her active approval of the unnecessary change orders.
CP19	The nomination of a particular supplier	A supplier bribes the client staff to get it nominated as a supplier of the project and recommended to the contractor.
CP20	The manipulated design for a particular supplier	Based on a collusive pact between the designer and the supplier, project design is manipulated to benefit the latter.
CP21	The usage of unqualified materials	The unqualified construction materials are provided and used favorably according to the collusive agreement between the supplier and the contractor.
CP22	Inflating material price	The prices of the materials supplied are inflated due to the collusive agreement between the supplier and the client.

141 The Delphi method is a structured communication and consensus building approach
142 amongst a group of experts on a complex problem, which has been widely adopted in CEM
143 research (e.g. Ameyaw et al. 2016; Hallowell and Gambatese 2009; Xia and Chan 2012a, b).
144 The success of a Delphi survey depends primarily on the careful selection of panel members
145 (Chan et al. 2001; Xia et al. 2009). Therefore, the following criteria were employed to identify
146 eligible participants for this Delphi survey: (1) at least ten years of experience in the Chinese
147 construction sector and (2) possessing management experience related to bidding and tendering
148 ever before. In particular, the latter criterion was highlighted, considering that the majority of
149 identified collusive practices are related to bidding and tendering affairs in construction
150 projects.

151 A total of 15 experts (as shown in Table 3) meeting the selection criteria were identified
152 and invited to participate in this Delphi survey. The target experts were from one research
153 institution at Tongji University (i.e., Research Institute of Complex Engineering and
154 Management, Tongji University), and five industry institutions (i.e., Jinan Hi-Tech Holding
155 Group, China Construction Eighth Engineering Division Company, Shanghai Construction
156 Consultants Association, Shanghai Xian Dai Architectural Design (Group) Co., Ltd., and
157 Baosteel Group Corporation), which have close collaboration relationships with Tongji
158 University. All the experts hold senior positions in their organizations and have sufficient work
159 experience, especially a sound knowledge of collusive practices in Chinese construction
160 projects. Additionally, their diversified employer backgrounds (i.e., clients, contractors,
161 consultants, designers, suppliers, and academics) help increase the heterogeneity of the Delphi
162 panel and thus improve the survey validity.

163 Table 3 Profile of the Delphi panel

Expert	Employer	Position	Years of experience	Largest project ever managed/consulted
A	Client	Project Manager	19	US\$ 167 million
B	Client	Deputy Manager	16	US\$ 308 million
C	Client	Director	15	US\$ 231 million
D	Contractor	Deputy Manager	17	US\$ 363 million
E	Contractor	Project Manager	25	US\$ 122 million
F	Contractor	Project Manager	20	US\$ 85 million
G	Consultant	Deputy Manager	16	US\$ 35 million
H	Consultant	Deputy Manager	18	US\$ 20 million
I	Consultant	General Manager	16	US\$ 55 million
J	Designer	Director	25	US\$ 197 million
K	Designer	Project Manager	20	US\$ 73 million
L	Supplier	General Manager	15	US\$ 122 million
M	Supplier	General Manager	17	US\$ 167 million
N	Academia	Professor	20	US\$ 363 million
O	Academia	Professor	17	US\$ 231 million

164 In the first-round Delphi survey, experts were requested to assess the occurrence
 165 probability of each initial collusive practice, using a five-point rating scale (i.e. 1 = very few,
 166 2 = few, 3 = medium, 4 = common, and 5 = very common). Additionally, based on their
 167 experience, experts were encouraged to list any new collusive practices that were not included
 168 in the Delphi survey. The mean score of each collusive practice was calculated and then fed
 169 back to the Delphi panel. In the second-round survey, experts were asked to re-assess their
 170 evaluations in the light of the findings obtained in the previous round. A threshold of 3.0 points
 171 was established as a cut-off criterion, as recommended by Jamieson (2004). To verify if
 172 significant difference exists in experts of different backgrounds, Kruskal-Wallis test was
 173 conducted as recommended by Hon et al. (2012) and Ameyaw et al.(2016).

174 According to the feedbacks from the first-round survey, no additional collusive practices

175 were supplemented by the Delphi panel. Table 4 shows the results of the two-round Delphi
 176 survey. The Kruskal-Wallis test result shows that the asymptotic significance value of each
 177 collusive practice is greater than 0.05, indicating no significant difference among the experts
 178 of different employer backgrounds (Ameyaw et al. 2016; Hon et al. 2012). The mean scores of
 179 lack of publicity (CP7) and insufficient tender time (CP8) were below the threshold of 3.0
 180 points and thus were deleted from the list of collusive practices, revealing that the Delphi panel
 181 believes the current publicity and tender time of most tenders in the Chinese context are
 182 adequate. This may be due to the fact that the authority in the Chinese construction sector has
 183 issued mandatory regulations on the level of publicity and tender time for tendering (The
 184 National People's Congress of People's Republic of China 1999) and the majority of industry
 185 practitioners are following these regulations. Figure 1 depicts the network the 20 identified
 186 collusive practices, in which each link represents one specific collusive practice occurring
 187 between the two relevant project stakeholders. The figure reveals that ten collusive practices
 188 occur between the client and other contracting parties and other nine collusive practices occur
 189 between the contractor and other contracting parties. Thus, 19 out of 20 collusive practices
 190 refer to the client and contractor. All these indicate that the client and contractor are the two
 191 primary contracting parties responsible for the collusion in construction projects.

192 Table 4 Results of the two-round Delphi survey

Code	First Round		Second Round	
	Mean	Asymp. Sig. of KWT	Mean	Asymp. Sig. of KWT
CP1	3.94	0.435	3.96	0.467
CP2	3.73	0.546	3.70	0.613
CP3	3.44	0.428	3.38	0.586
CP4	3.33	0.740	3.28	0.703
CP5	3.28	0.671	3.21	0.609
CP6	3.15	0.273	3.11	0.348
CP7 *	2.78	0.543	2.76	0.505

Code	First Round		Second Round	
	Mean	Asymp. Sig. of KWT	Mean	Asymp. Sig. of KWT
CP8 *	2.25	0.431	2.20	0.487
CP9	3.54	0.434	3.51	0.429
CP10	3.18	0.435	3.14	0.438
CP11	3.89	0.578	3.90	0.613
CP12	3.68	0.286	3.64	0.292
CP13	3.16	0.532	3.11	0.574
CP14	3.80	0.531	3.82	0.589
CP15	3.92	0.336	3.93	0.388
CP16	3.63	0.333	3.56	0.443
CP17	3.50	0.581	3.44	0.550
CP18	3.69	0.504	3.62	0.539
CP19	3.32	0.356	3.29	0.345
CP20	3.43	0.443	3.41	0.450
CP21	3.57	0.436	3.60	0.467
CP22	3.74	0.517	3.75	0.523

Note: KWT represents for Kruskal-Wallis test

* The collusive practice is deleted due to an evaluation below 3.0 points.

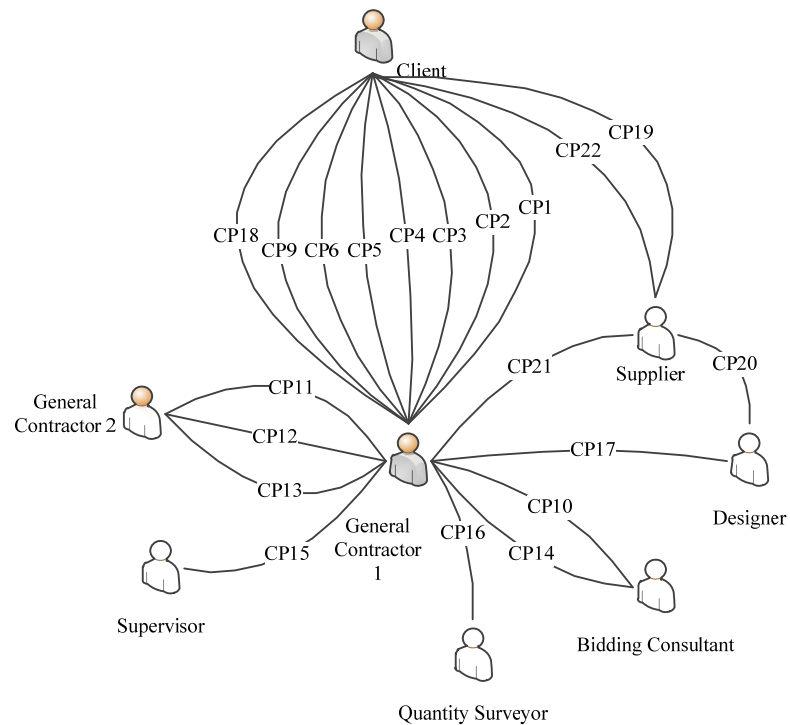


Figure 1 Collusion network in construction projects

193 *Questionnaire Survey*

194 Research of collusive practice was carried out predominantly with the help of a questionnaire
195 survey (Bowen et al. 2007a; b; Le and Shan 2012; Vee and Skitmore 2003), because a
196 questionnaire is an effective and widely used instrument to gauge people's perceptions on
197 collusion, a topic that is sensitive and difficult to get objective data (Kenny 2009; Shan et al.
198 2015). Hence, based on the framework consolidated from the two-round Delphi survey, a
199 questionnaire survey was administered to evaluate the refined collusive practice in Chinese
200 construction projects, in terms of probability and severity.

201 Given that the Chinese construction sector is a large and complex sector with about
202 29,212,000 employees across the country (National Bureau of Statistics of China 2015), it is
203 extremely difficult to conduct probability sampling in the questionnaire survey. Therefore, this
204 study employed purposive sampling, a typical type of nonprobability sampling approach that
205 can also help obtain a representative sample (Liu et al. 2016; Trochim 2006; Zhao et al. 2015).
206 To maximize the number of potential survey respondents, some government agencies, research
207 institutions, and enterprises were contacted. In the end, a total of 12 institutions agreed to
208 facilitate the questionnaire survey. These institutions are: (1) China State Construction
209 International Holdings Ltd., (2) China Construction Eighth Engineering Division Company, (3)
210 Shanghai Construction Consultants Association, (4) Shanghai Xian Dai Architectural Design
211 (Group) Co., Ltd., (5) China Construction Design International, (6) Research Institute of
212 Complex Engineering & Management, Tongji University, (7) Zhengzhou Municipal
213 Construction Commission, (8) Shanghai Pudong New Area Highway Administration, (9)
214 Shanghai Lujiazui Finance & Trade Zone Development Company Ltd., (10) Zhengzhou Metro

215 Group Co., Ltd., (11) Jinan Hi-Tech Holding Group, and (12) Baosteel Group Corporation.
216 These institutions cover diverse stakeholders of Chinese construction sector, including client,
217 contractor, consultant, designer, supplier, and academia. Apart from that, all these institutions
218 are active players in their fields, suggesting that they could represent the Chinese construction
219 sector to a certain extent. In addition, the employees of these support institutions are believed
220 to possess real and profound understandings of Chinese construction sector and thus are
221 qualified respondents for the questionnaire survey.

222 A web-based anonymous questionnaire was developed and distributed to the potential
223 respondents from the 12 support institutions. Respondents were requested to evaluate the
224 probability and severity of each collusive practice using a five-point rating scale (i.e., “1”
225 represents the least probability and severity, “5” represents the highest likelihood and severity).
226 Such measuring approach is recommended by Shen et al.(2001), Molenaar (2005), Zou and
227 Zhang (2009), and Ke et al. (2011) in their risk evaluation studies which are similar to the
228 assessment of collusive practices in this study.

229 **Results**

230 A total of 108 responses were collected from the questionnaire survey. After a careful visual
231 examination, 11 were found to be inappropriately filled out and thus excluded. Therefore, a
232 total of 97 valid responses were used for the further data analysis. Table 5 shows the profile of
233 the respondents. The respondents were from diversified employers (i.e., government, client,
234 contractor, consultant, designer, and academia). More than 70% of them had at least six years
235 of practical experience in this sector. More than 80% of them were holding middle or senior

236 managerial positions in their organizations. Such a panel of respondents is believed to be able
 237 to provide reliable evaluations on the collusive practices.

238 Table 5 Profile of respondents

Personal attribute	Category	Number of respondents	Percentage	Cumulative percentage
Employer	Client	19	20	29
	Contractor	25	26	55
	Consultant	18	19	74
	Designer	15	15	89
	Supplier	11	11	100
	Academia	9	9	9
Position	Top managerial level (e.g., president, general manager, chief director, professor)	22	23	23
	Middle managerial level (e.g., project manager, department director, associate professor)	48	49	72
	Professional (e.g., engineer, technician, quantity surveyor)	27	28	100
Years of experience	>20	19	20	20
	11-20	28	29	49
	6-10	37	38	87
	<5	13	13	100

239 As the probability and severity of each collusive practice were evaluated simultaneously,
 240 the following Formula 1 was developed as suggested by Ke et al. (2011) and Hwang et al.
 241 (2015a), to calculate the significance index of each collusive practice provided by each
 242 respondent. Table 6 shows evaluation results of the refined framework of collusive practices.

$$243 \quad CP_{ni} = \sqrt{CP_{npi} \times CP_{nsi}} \quad (\text{Formula 1})$$

244 Where CP_{ni} = the significance index of the i th collusive practice provided by the n th
 245 respondent

246 CP_{npi} = the probability assessment of the i th collusive practice by the n th respondent

247 CP_{nsi} = the severity assessment of the i th collusive practice by the n th respondent

248 Table 6 Rankings of collusive practices

Code	Significance index			Respondents of different stakeholder											
				Client (CL)		Contractor (CT)		Designer (DE)		Consultant (CS)		Supplier (SU)		Academia (AC)	
	Score	Rank	Normalization [#]	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
CP11	4.03	1	1	4.25	2	3.86	4	3.87	6	4.06	1	3.96	1	4.19	1
CP15	3.97	2	0.89	4.23	3	3.82	5	3.94	4	3.83	9	3.93	2	4.08	4
CP1	3.94	3	0.83	3.45	12	4.25	1	4.11	1	3.92	4	3.94	3	3.96	10
CP4	3.93	4	0.81	3.32	18	4.13	2	4.03	2	4.01	2	3.95	2	4.15	2
CP18	3.91	5	0.78	3.95	6	3.72	11	3.94	4	3.87	7	3.89	5	4.09	3
CP12	3.90	6	0.76	4.35	1	3.54	15	3.98	3	3.78	13	3.67	12	4.08	4
CP19	3.88	7	0.72	3.74	9	4.08	3	3.85	8	3.96	3	3.65	13	3.98	9
CP16	3.84	8	0.65	4.08	4	3.61	14	3.86	7	3.65	17	3.85	6	3.99	8
CP3	3.77	9	0.52	3.34	17	3.73	10	3.85	8	3.83	9	3.85	6	4.03	7
CP20	3.75	10	0.48	3.82	8	3.75	9	3.54	17	3.92	4	3.52	18	3.93	14
CP17	3.74	11	0.46	3.87	7	3.43	20	3.51	18	3.82	11	3.85	6	3.96	10
CP21	3.74	12	0.46	4.06	5	3.52	17	3.82	10	3.85	8	3.23	20	3.95	13
CP22	3.72	13	0.43	3.43	14	3.79	6	3.79	11	3.91	6	3.37	19	4.05	6
CP5	3.71	14	0.41	3.45	12	3.78	7	3.69	13	3.73	14	3.78	9	3.85	15
CP6	3.71	15	0.41	3.24	19	3.77	5	3.71	12	3.82	11	3.78	9	3.96	10
CP10	3.67	16	0.33	3.70	10	3.47	18	3.66	14	3.69	15	3.72	11	3.79	18
CP9	3.63	17	0.26	3.37	15	3.69	12	3.64	15	3.67	16	3.61	14	3.82	17
CP2	3.59	18	0.19	3.23	20	3.66	13	3.63	16	3.61	19	3.58	15	3.84	16
CP13	3.54	19	0.09	3.36	16	3.45	19	3.50	19	3.65	17	3.54	16	3.72	19
CP14	3.49	20	0	3.65	11	3.53	16	3.32	20	3.27	20	3.53	17	3.66	20

249 Note: [#] normalized value = (average actual value – average minimum value) / (average maximum value – average minimum value)

250 After the significance indices of all collusive practices were calculated, statistical tests
251 were conducted with the aid of Statistical Package for the Social Sciences (SPSS) 17.0. To test
252 its reliability, the common tool Cronbach's alpha was adopted (Deng et al. 2014). In this study,
253 the Cronbach's alpha was 0.935, higher than the threshold of 0.7. Therefore, the evaluations
254 provided by the respondents can be considered as reliable.

255 To test whether each collusive practice has significant impact on Chinese construction
256 project, the one-sample *t*-test was conducted as suggested by Hwang et al. (2015b) and Zhao
257 et al. (2013a, 2013b). The hypothesized value of 3.00 and the significance level of 0.05 were
258 adopted. As shown in Table 7, the *p*-values of all the collusive practices were less than 0.05,
259 suggesting that all the collusive practices have significant impacts on Chinese construction
260 projects.

Table 7 Statistical test results of collected data

Code	CL- CT	CL- DE	CL- CS	CL- SU	CL- AC	CT- DE	CT- CS	CT- SU	CT- AC	DE- CS	DE- SU	DE- AC	CS- SU	CS-AC	SU- AC	<i>p</i> - Value
	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
CP1	0.539	0.499	0.896	0.660	0.899	0.875	0.101	0.348	0.162	0.060	0.284	0.108	0.666	0.595	0.525	0.000 [#]
CP2	0.583	0.355	0.589	0.647	0.771	0.363	0.671	0.692	0.129	0.138	0.255	0.119	0.910	0.121	0.228	0.000 [#]
CP3	0.148	0.060	0.078	0.098	0.196	0.122	0.780	0.316	0.573	0.344	0.904	0.081	0.122	0.602	0.179	0.000 [#]
CP4	0.299	0.285	0.567	0.385	0.598	0.702	0.064	0.303	0.082	0.072	0.367	0.085	0.632	0.659	0.354	0.000 [#]
CP5	0.359	0.272	0.218	0.290	0.192	0.768	0.555	0.439	0.986	0.680	0.215	0.809	0.144	0.536	0.449	0.000 [#]
CP6	0.121	0.074	0.103	0.091	0.100	0.724	0.405	0.408	0.572	0.156	0.192	0.690	0.808	0.179	0.208	0.000 [#]
CP9	0.109	0.145	0.101	0.136	0.060	0.654	0.377	0.874	0.224	0.639	0.847	0.385	0.522	0.532	0.186	0.000 [#]
CP10	0.059	0.064	0.061	0.079	0.143	0.192	0.644	0.341	0.773	0.464	0.986	0.223	0.623	0.563	0.349	0.000 [#]
CP11	0.665	0.165	0.267	0.060	0.383	0.202	0.056	0.126	0.175	0.124	0.474	0.214	0.141	0.884	0.085	0.000 [#]
CP12	0.623	0.467	0.521	0.482	0.672	0.357	0.642	0.507	0.749	0.647	0.965	0.323	0.769	0.489	0.389	0.000 [#]
CP13	0.502	0.408	0.720	0.561	0.640	0.645	0.378	0.892	0.499	0.153	0.628	0.292	0.574	0.953	0.636	0.000 [#]
CP14	0.080	0.262	0.092	0.231	0.244	0.859	0.873	0.674	0.852	0.754	0.638	0.779	0.760	0.942	0.871	0.000 [#]
CP15	0.080	0.055	0.244	0.061	0.131	0.140	0.233	0.269	0.372	0.373	0.621	0.406	0.877	0.880	0.782	0.000 [#]
CP16	0.968	0.933	0.771	0.743	0.713	0.898	0.441	0.422	0.556	0.351	0.365	0.639	0.789	0.223	0.275	0.000 [#]
CP17	0.100	0.055	0.144	0.089	0.156	0.498	0.213	0.780	0.363	0.129	0.845	0.111	0.178	0.945	0.284	0.000 [#]
CP18	0.178	0.213	0.297	0.346	0.254	0.748	0.785	0.872	0.507	0.555	0.707	0.400	0.962	0.716	0.724	0.000 [#]
CP19	0.704	0.473	0.773	0.465	0.845	0.294	0.833	0.573	0.282	0.201	0.797	0.071	0.463	0.361	0.149	0.000 [#]
CP20	0.754	0.699	0.804	0.718	0.703	0.904	0.736	0.716	0.799	0.604	0.729	0.839	0.515	0.569	0.915	0.000 [#]
CP21	0.570	0.390	0.565	0.516	0.654	0.414	0.551	0.585	0.832	0.125	0.986	0.393	0.263	0.803	0.546	0.000 [#]
CP22	0.548	0.320	0.229	0.323	0.089	0.108	0.245	0.129	0.139	0.483	0.780	0.643	0.377	0.181	0.902	0.000 [#]

Note: [#]The collusive practice exists in significantly and has significant impact on Chinese construction projects at the significance level of 0.05.

263 To test if significant difference exists among respondents of different employer
264 backgrounds, the independent samples t-test was conducted, as suggested by Zhao et al.
265 (2013c), Ning and Ling (2013), and Hwang et al. (2014a). A confidence level of 95% was
266 adopted in this study. The test results in Table 7 show that significance values of all collusive
267 practices are greater than 0.05, indicating no significant differences among the respondents of
268 different employer backgrounds.

269 **Discussions of the Primary Collusive Practices**

270 To identify the primary collusive practices in construction projects, normalization was engaged
271 to the questionnaire survey results, as instructed by Xu et al. (2010). Table 6 shows the
272 normalization results. A cut-off threshold of 0.5 was adopted according to Xu et al. (2010).
273 Correspondingly, the top nine collusive practices were selected as the primary collusive
274 practices and discussed in details.

275 Misrepresentation of qualification certificates was ranked first with an evaluation of 4.03
276 points by the respondents. This collusive practice refers to the misuse of technical qualification
277 certificates by the tenderers. In the Chinese construction sector, a corresponding qualification
278 certificate is a mandatory precondition for a tenderer to participate in tendering. Nevertheless,
279 in some cases, companies having qualified certificates may reach collusive pacts with
280 unqualified companies and let its certificates out to the latter (Tai and Qiu 2011). Hence, by
281 using the rented certificates, the unqualified companies can participate in tendering and are
282 given the opportunity to win projects that they are incapable of implementing, which would

283 bring numerous risks to the projects.

284 Loose site supervision ranked second among all collusive practices. In the Chinese
285 construction sector, a site supervisor supervises the execution of a construction project on
286 behalf of the client (Rojas 2013). Thus, many contractors would bribe site supervisors in order
287 to reap a higher profit. Meanwhile, the income of site supervisors in the Chinese construction
288 sector is low compared with other project professionals such as contractors, consultants,
289 designers, and suppliers (Lin and Chen 2004). Therefore, unsurprisingly some site supervisors
290 may fail in maintaining their integrity standard and collude with contractors.

291 Misusing prequalification requirements ranked third with an evaluation of 3.94 points. As
292 an important and necessary tool for contractor selection, prequalification has been widely
293 adopted in Chinese construction projects (Russell and Skibniewski 1988; Xia and Ye 2005).
294 But it can also be utilized illegally by the conspirators. For instance, current Chinese tendering
295 regulations allow a client to shortlist potential tenderers via prequalification if there are
296 numerous potential tenderers. Whereas some clients misuse this privilege by setting specific
297 requirements to exclude qualified tenderers and only allow its favored tenderers to participate
298 in tendering (Xia and Ye 2005), which runs counter to the rule of free competition. Table 5
299 shows that respondents from the contractor and designer subgroups both gave a top ranking to
300 this collusive practice.

301 Fake tendering received the fourth ranking with an evaluation of 3.93 points. This is a
302 typical collusive practice in the Chinese construction sector, committed by the client and its
303 preferred tenderers (Le et al. 2012a; Wang and Qin 2011). In conducting this collusive practice,

304 a client usually pre-selects a contractor/consultant/supplier in advance based on its preference
305 and then calls other tenderers to undertake the organizational or statutory tendering procedures.
306 Obviously, such collusive practice is difficult to be detected because all the tendering
307 procedures have been followed rigorously based on the protocols.

308 Approval of the unnecessary change orders was ranked fifth in this survey with an
309 evaluation of 3.91 points. Changes in construction projects arise due to the active or passive
310 modification of the original scope, execution time, or project design, and its occurrence is
311 inevitable due to the complexity, uncertainty, and uniqueness of each project (Hanna et al. 2002;
312 Hwang et al. 2014b). Meanwhile, the change of orders is also a major source of cost overruns
313 (Jiang et al. 2001). Therefore, to maximize their profit, though illegally, many contractors are
314 inclined to propose as many unnecessary change orders as they can, and try to get these change
315 orders approved even by bribing the client staffs. Undoubtedly, this typical collusive practice,
316 which exists widely in the Chinese construction sector, leads the project to be over-budgeted
317 (Le et al. 2012b; Zhou et al. 2007).

318 The collusive practice of collective collusive tendering by helping one another severely
319 damages the competitive nature of tendering, and was ranked sixth in this survey with an
320 evaluation of 3.90 points. Under the excessive competition pressure in the Chinese construction
321 market, some contractors may enter into a collusive agreement where a “designed winner” is
322 designated in turns and others should help the “designed winner” win the project (Wu et al.
323 2009). More specifically, the “designed winner” submits an artificially high tender price,
324 whereas others submit even higher ones to help the “designed winner” win the project.
325 Additionally, after the “designed winner” signs the contract, it may provide some compensation

326 to the “unsuccessful” tenderers or employ the “unsuccessful” tenderers as subcontractors
327 (Zhang and Zhao 2008; Zou 2007). The similar collusive practice has also been identified and
328 discussed in the Australian and South African construction sectors (Bowen et al. 2007a; b; Vee
329 and Skitmore 2003).

330 The nomination of a particular supplier was ranked seventh with an evaluation of 3.88
331 points. In the Chinese construction sector, the client usually has the privilege to nominate one
332 supplier for material or equipment supply and recommends it to the general contractor. Hence,
333 a supplier may bribe the client staff for such a collusive nomination. However, to compensate
334 the cost for the bribery, the supplier may provide cheap and unqualified materials & equipment,
335 which inevitably lead to the potential quality hazard (He et al. 2009).

336 Issuing the certified works falsely was ranked eighth with an evaluation of 3.84 points.
337 Considered as most susceptible to bribery (Ameh and Odusami 2010), quantity surveyors play
338 a vital role in this collusive practice together with contractors. After reaching a collusive
339 agreement, the quantity surveyor would issue completion certificates to the contractor even
340 when jobs are incomplete or sometimes abandoned. Other specific cases of this collusive
341 practice include over-measurement of quantities of various items of works, covering
342 unexecuted items of work in the periodic evaluation, over-blowing cost of design variation,
343 and inflation in prices of the works (Zou 2006).

344 Inflating tender price received ninth ranking with an assessment of 3.77 points. In doing
345 this collusive practice, some staffs of the client usually imply its preferred tenderer to inflate
346 the tender price first and then seek kickback in return after the contract is awarded. This

347 collusive practice is more common in Chinese public projects (Le et al. 2012a). This can be
348 explained by the principal-agent theory that the agent (i.e. the collusive staff of the client) has
349 different idea and purpose from the principal (i.e. the client) inevitably, which may finally lead
350 to a moral hazard that the agent reaps his/her private benefits in cost of the principal's (Turner
351 and Müller 2003).

352 **Conclusions**

353 Through a systematic literature review, a two-round Delphi survey, and an empirical
354 questionnaire survey, this study identified and ranked the collusive practices in Chinese
355 construction projects. The survey results indicated that the primary collusive practices in
356 current Chinese construction projects are, misrepresentation of qualification certificates, loose
357 site supervision, misusing prequalification requirements, fake tendering, approval of the
358 unnecessary change orders, collective collusive tendering by helping one another, the
359 nomination of a particular supplier, and issuing certified works falsely.

360 Although the identification and prioritization of the collusive practices in the Chinese
361 construction projects have been provided, this study suffered several limitations. First, the
362 prioritization of the collusive practices is subjective as it was obtained from the opinion-based
363 data, and thus influenced by the individual experience of those surveyed. Second, this study
364 employed a nonprobability sampling approach that is less accurate and rigorous than
365 probability sampling (Trochim 2006). Moreover, due to the sensitive nature of the topic, this
366 study only received a small number of feedbacks in its questionnaire survey. Therefore,
367 cautions should be warranted when the results are interpreted and generalized. Lastly, the

368 findings from this study were interpreted in the context of China, which may vary in the context
369 of other countries.

370 In spite of these limitations, implications of this study is still useful, especially for those
371 international contractors that are being or going to be involved in the Chinese construction
372 sector. This study provides helpful insight about collusive practices in the country. Further
373 research actions could be directed to the following two directions. First, underlying factors
374 contributing to the collusive practices should be investigated, which may reveal the rationality
375 of collusion in construction. Second, corresponding anti-collusion strategies, as well as its
376 effectiveness, should be examined, which may provide the industry with a full-scale
377 understanding of collusion and thus facilitate in curbing it more efficiently.

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