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1 **How to Govern Behavioral Relationship in Megaprojects? Examining the Effect**  
2 **of Three Governance Mechanisms under Project Uncertainties**

3 **Xian Zheng<sup>1</sup>, Yujie Lu<sup>2\*</sup>, Ruidong Chang<sup>3</sup>**

4 **Abstract:** The relational behavior of project participants is crucial to the success of a  
5 megaproject. Although project governance has been widely studied with the aim of improving  
6 participants' relational behavior, limited research examines the distinct effectiveness of various  
7 governance mechanisms on influencing relational behavior, especially in megaprojects.  
8 Through examining three varieties of governance mechanisms, including contract, trust and  
9 institutional support, a hierarchical moderated regression analysis has been used to explore the  
10 impact of each of the governance mechanisms in facilitating the relational behavior of  
11 megaproject participants and further team performance. The analysis is based on data collected  
12 from 202 contractors and consultants working at megaprojects in China. Results unveiled that  
13 both contractual term specificity and its interaction with trust can facilitate relational behavior.  
14 Project uncertainty moderates the relationship between governance mechanisms and relational  
15 behavior in affecting project team performance. The findings offer both theoretical and  
16 managerial implications for megaproject participants to cultivate beneficial relational behavior  
17 so as to improve team performance in megaprojects.

18 **Keywords:** Contractual governance, Governance mechanisms, Institutional support,

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19 Megaprojects, Relational behavior, Trust

20 **INTRODUCTION**

21 Relational behavior has been receiving considerable attentions as one of the approaches to  
22 realize high-quality inter-organizational relationships in construction projects (Ning and Ling  
23 2014). Relational behavior refers to the desired actions involved in the exchange that promote  
24 the development of a collaborative relationship. Three most commonly observed relational  
25 behaviors are those pertaining to flexibility, information exchange and solidarity (Heide and  
26 John 1992; Hewett and Bearden 2001; Lusch and Brown 1996). Specifically, *flexibility* refers  
27 to the shared expectations between the partners regarding the way they will behave when  
28 unanticipated changes in the contractual environment occur; *information exchange* is the shared  
29 expectation that information will be continually and freely exchanged; and *solidarity* is defined  
30 as the shared expectation that each partner will behave in a manner that benefits the  
31 collaboration as a whole rather than simply protecting their own interests (Heide and John 1992).  
32 Such behaviors have been proved to be critical to foster and maintain a value-enhancing  
33 relationship among organizations and to enhance their performance (Griffith et al. 2006). This  
34 is especially true for successful megaprojects, such as the Thames Barrier and the Heysham 2  
35 Nuclear Power Station, in which project organizations tend to involve active relational behavior  
36 and high relationship quality between one another (Morris and Hough 1987). The reason is that  
37 megaprojects are expected to accomplish a challenging goal that cannot be completed by  
38 individual party alone, thereby calling for multiple stakeholders to conduct intensive relational  
39 behavior so as to achieve the success of projects (Zheng et al. 2017).

40 Dyer and Singh (1998) pointed out that governance “plays a key role” in the creation of

41 inter-organizational relationship because it influences transaction costs and the willingness of  
42 partners to engage in value-creation initiatives. In the construction field, a project created by  
43 contracts could be regarded as a temporary coalition of firms working collectively with clients  
44 (Winch 1989). A project's temporary, uniqueness, heterogeneous, short-term orientation and  
45 lack of organizational routines pose special challenges to stakeholders' relationship  
46 management (Hanisch and Wald 2011). For instance, the collaboration in the coalition could be  
47 difficult (Phelps and Reddy 2009) and opportunism often occurs (Lau and Rowlinson 2009; Lu  
48 et al. 2016). Thus, effective governance that is able to develop a trustworthy relationship and  
49 implement relational behaviors among project participants is pivotal to the success of  
50 construction projects.

51 The literature has suggested that two main types of governance are at play in an inter-  
52 organizational relationship, namely contractual governance and relational governance (Heide  
53 1994; Jap and Anderson 2003; Poppo and Zenger 2002). Contractual governance refers to  
54 mechanisms that to govern interparty exchanges and to avoid uncertainties through  
55 emphasizing the importance of the contracts between transaction partners (Lumineau et al.  
56 2011). The role of contractual governance has been greatly emphasized by transaction cost  
57 economics in explicit terms and conditions (Cannon et al. 2000). Relational governance  
58 emphasizes inherent and moral control mechanisms, which are used to govern exchanges  
59 through consistent goals and a cooperative atmosphere (Lu et al. 2015). Relational governance  
60 such as trust is based on the relational exchange theory, which offers a less explicit set of terms  
61 to maintain a value-enhancing relationship (Macneil 1980).

62 The effectiveness of contracts and trust in governing inter-organizational behavior and their

63 effects on cooperation performances have been widely studied (Luo 2002; Yang et al. 2011). In  
64 megaprojects, there are many endogenous factors driving relation conflicts such as ambiguous  
65 contracts, opportunistic behaviors, differences in goals and operational routines, and  
66 unexpected market changes (Jap and Ganesan 2000). Most importantly, megaprojects are large-  
67 scale sociotechnical undertakings that cost over 1 Billion RMB (Chinese Currency) and that  
68 are complex and embedded in institutional frames (He et al. 2015). These project incorporated  
69 both traditional infrastructure such as transportation megaprojects but also large-scale public  
70 projects such as National Stadium for the 2008 Olympics and 2010 Shanghai World Expo  
71 projects, providing fundamental public services for economic development, social production,  
72 and people's life (Flyvbjerg 2011). Thus, Flyvbjerg (2014) argued that megaprojects are a  
73 completely different breed of projects and have to be managed differently from conventional  
74 projects. Prominent project management scholars have advocated that high attention needs to  
75 be paid to the institutional environment in which megaprojects are situated, especially in  
76 transition economies such as China (Chi et al. 2011), where the centralized political structure  
77 is implemented and dominated by the government both financially and administratively. The  
78 government who initiates a megaproject usually acts as both a regulator and a client. For  
79 instance, the government in China, as a regulator, often relied on administrative powers and  
80 means to govern megaprojects (Li et al. 2018). This is attributed to China's institutional systems  
81 which are characterized by centralization governance and elitist governance. In addition, the  
82 client's role of government is operationalized through the central role of the *Construction*  
83 *Headquarters*—a project-specific organization set up by the government for managing the  
84 megaproject (Zhai et al. 2017). Thus, in this study, the institutional support is regarded as a

85 governance mechanism to influence relational behavior in megaprojects.

86       Given limited studies on the governance of relational behavior in megaprojects, three  
87 research gaps can be identified as follows. First, extant research regards the contract mechanism  
88 as an individual construct, but ignores different functions of the contract, e.g. specificity and  
89 adaptability, that might have a distinct effect on relational behaviors. Second, previous research  
90 primarily focuses on contractual governance and relationship governance, but seldom  
91 highlights the government's institutional support to influence relational behavior in  
92 megaprojects. Third, limited research has focused on the megaproject's uncertainties that  
93 influence the effect of governance mechanisms on relational behavior. To fill these gaps, this  
94 study empirically examines the effectiveness of various governance mechanisms on relational  
95 behavior among participating organizations under different levels of megaproject uncertainties  
96 in transition economies.

97       Specifically, the three objectives of this study are: (1) to examine two different roles of  
98 contractual governance mechanisms (i.e. contractual term specificity and contractual  
99 contingency adaptability) on relational behavior in megaprojects; (2) to investigate the effect  
100 of trust and institutional support on relational behavior; and (3) to investigate the moderating  
101 effect of project uncertainty in influencing distinct governance mechanisms. These issues were  
102 examined using survey data from 202 contractors and consultants of megaprojects in China.  
103 The results could be helpful to strategize the relationship management and to further improve  
104 team performance.

105       The remainder of this paper is organized as follows. In the following section, we proposed  
106 the research hypotheses, followed by the next section where the research method for data

107 collection and analysis is provided. We then discussed the findings and their managerial  
108 implications, and concluded the study with limitations and suggestions for future research.

## 109 **LITERATURE REVIEW**

### 110 **Relational Behavior**

111 The concept of relational behavior is drawn from the relational exchange norms  
112 framework proposed by Macneil (1980) that identified 28 overlapping relational exchange  
113 norms, each of which refers to a set of shared expectations regarding a particular type of  
114 exchange behavior that reflects the parties' mutuality of interests and a common long-term  
115 orientation (Sezen and Yilmaz 2007). This concept was developed further by Heide and John  
116 (1992), who proposed that the three most commonly observed relational behaviors are those  
117 pertaining to the norms of flexibility, information exchange, and solidarity. This conjecture has  
118 now been supported by a variety of reports in the literature (Hoppner and Griffith 2011; Ni et  
119 al. 2017) and was thus selected as the component of relational behavior for this study.

120 The extant literature on relational behavior in the construction industry has, for the most  
121 part, concentrated on its drivers, hindrances, measure, and consequences (Memon 2014; Che et  
122 al. 2015). Regarding its drivers, the effectiveness of contracts and trust in governing inter-  
123 organizational relationship and their effects on relational behavior have been studied  
124 respectively. For example, Ning et al. (2013) suggested that trust is among one of the most  
125 significant promoters of relational behavior, while Ke et al. (2013) examined the effects of  
126 various relational behaviors on relationship quality and project outcomes under different  
127 contract strategies. However, systematic analysis on the effect of governance mechanisms to  
128 relational behavior is scarce in the field of construction, especially in the context of the

129 megaproject.

130       Compared with ordinary projects, both the frequency of interactions and the level of  
131 uncertainty are high in megaprojects from the perspective of transaction costs economics.  
132 Besides, the outcome of megaprojects is unpredictable, which indicate it is difficult to specify  
133 the contractual terms and clauses in advance (Park et al. 2017). These facts may mean that trust  
134 and the role of government are more important than contracts to facilitate relational behavior  
135 in megaprojects, especially in China — a country rich with *guanxi*. Li et al. (2018) highlighted  
136 that megaproject governance includes mandatory approaches such as formal policies,  
137 regulations, and programs, as well as informal project culture and relationship governance.  
138 Take World Explo 2010 in China as an example, the government support, such as the  
139 appointment of top management teams, the establishment of “project-oriented state-owned  
140 enterprises,” and the relations between government and private entities have great effect on the  
141 project performance. Therefore, it is essential to test the effect of various governance  
142 mechanisms on relational behavior in the context of megaproject settings.

#### 143 **Governance Mechanisms in Megaprojects**

144       Governance mechanisms are safeguards that firms put in place to regulate inter-firm  
145 exchange, minimize exposure to opportunism, protect transaction cost investment, and promote  
146 the continuance of relationships (Jap and Ganesan 2000). It incorporates the formal and  
147 informal rules of exchange between partners, such as incentive structures, monitoring  
148 mechanisms, contractual provisions, reputations, norms, and trust (Jap and Anderson 2003).  
149 The literature has suggested that two main types of governance for inter-organizational  
150 relationships, namely the formal governance mechanism and informal governance mechanism



151 (Cao and Lumineau 2015). The theoretical category used in the main studies to summarize the  
152 interplay of formal and informal governance is demonstrated in Table 1.

153 *(Insert Table 1 here)*

154 As shown in Table 1, contractual governance and trust are two main types suggested by  
155 the previous literature. Contractual governance refers to the extent to which an inter-  
156 organizational relationship is governed by a formal and written contract that explicitly stipulates  
157 the responsibilities and obligations of each party (Williamson 1985). By specifying each party's  
158 rights and duties, contractual governance may reduce opportunism and safeguard an inter-  
159 organizational relationship (Williamson 1985). Contractual governance plays an important role  
160 in reducing risks and facilitating coordination when megaproject participants conduct relational  
161 behavior (Malhotra and Lumineau 2011; Schepker et al. 2014). However, the majority of  
162 previous studies viewed contractual governance as an uni-dimensional construct (i.e., clause  
163 specificity), and caused a debate upon whether contracts should be more specific. Extended  
164 from this, contractual governance has been further defined as a two-dimensional construct that  
165 includes both the extent to which contractual terms are clearly specified (i.e., contractual term  
166 specificity), and the possible contingencies that a contract accounts for (i.e., contractual  
167 contingency adaptability) (Luo 2002). These two dimensions capture different aspects of  
168 contract completeness in which a transaction necessitates high contractual term specificity to  
169 restrain opportunism and also requires descriptions of contingencies that foster adaptation when  
170 unexpected events occur. Drawing on the multidimensional aspect of contracts, this study  
171 intended to investigate the effect of these two contract dimensions on relational behavior in  
172 megaprojects.

173           In addition to formal contracts, Trust is one of the most significant relational governance  
174 mechanisms which is proposed based on the relational exchange theory to maintain value-  
175 enhancing relationship. A higher level of relational governance mechanism application in  
176 megaprojects indicates more informal interaction among stakeholders and less focus on formal  
177 contracts, thus contributing to organizational mutual adaptability and self-enforcing safeguard  
178 against conflicts and commitment-level relationship (Xue et al. 2016). Seen from Table 1,  
179 institutional support from the government has also been regarded as a significant relational  
180 mechanism in emerging economies like China (Chi et al. 2011). Institutional support is  
181 determined by the institutional environment of a country or a state. Emerging economies are  
182 commonly characterized by extensive government involvement and intervention in economic  
183 exchanges and market transactions (Davies and Walters 2004; Hellman and Schankerman 2000).  
184 Researchers have suggested the importance of aligning project governance with projects’  
185 surrounding institutions to facilitate project success (Ahola et al. 2014). Institutional support  
186 from the central or local governments can support relational behavior among parties. Moreover,  
187 a bonding and commitment rested on a relationship can help overcome turbulences in the course  
188 of projects (Henisz et al. 2012). In a real-world situation, several safeguarding measures will  
189 be employed in combination.

190           In addition to a contract as a frequently employed formal mechanism and trust being a  
191 typical informal mechanism, several other mechanisms, such as institutional support from the  
192 government are the third category. Those mechanisms can be categorized to either the formal  
193 or informal influence since in a megaproject, the government could act as both a regulator and  
194 a client to reflect both its administrative powers and informal actions. In this study, those

195 mechanisms are referred as institutional support (by the government) and it highlights the  
196 significant role of government in megaprojects. Thus, three main types of governance  
197 mechanisms for inter-organizational relationships, namely the contract, trust and institutional  
198 support, were identified to examine their effects on relational behavior in megaprojects.

199       Although an increasing number of studies evaluated the effect of several safeguards to  
200 enhance relationship performance (Osipova 2015), few studies examined the dependent nature  
201 of contracts, trust, and institutional support on influencing relational behavior in the context of  
202 a megaproject which is situated in a wide socio-political environment and is subject to a high  
203 level of uncertainty. relationship performance (Osipova 2015), few studies examined the  
204 dependent nature of contracts, trust, and institutional support on relational behavior in the  
205 context of a megaproject which is often subject to the impacts of a wider socio-political  
206 environment and is subject to a high level of uncertainty. For collaboration among multiple  
207 megaproject participants, project uncertainty cannot be ignored as the effect of governance  
208 mechanisms on participants' relational behavior may vary under various levels of project  
209 uncertainty. Consequently, there is a need for empirical research to determine the effect of the  
210 simultaneous use of multiple governance mechanisms on relational behavior under different  
211 megaproject context.

## 212 **HYPOTHESIS DEVELOPMENT**

### 213 **Governance Mechanisms and Relational Behavior**

214       As one of the main component of contractual governance mechanism, contractual term  
215 specificity refers to the extent to which contractual terms are clearly specified. It may reinforce  
216 the relational behavior of megaproject participants through three mechanisms. First, Myers

217 (2007) suggested that contractual term specificity protects a partner's strategic resources and  
218 reduces operational and financial uncertainties by controlling opportunism and spurring  
219 information flow. Using appropriate contractual safeguards to reduce opportunism and preserve  
220 relationships is of paramount importance in megaprojects that typically involve long duration  
221 and the commitment of idiosyncratic assets (Ke et al. 2013). Thus, both decreased opportunism  
222 and increased relationship are beneficial for cultivating the relational behavior of megaproject  
223 participants. Second, contractual specificity can help project participants to exchange their  
224 understanding, expectations, and respective roles in the transaction (Beatty and Samuelson  
225 1990) and to mitigate the risk of misunderstandings that will disrupt collaboration among  
226 (presumably) well-intentioned parties (Malhotra and Lumineau 2011). Thus, specific contracts  
227 could facilitate the formation of relational behavior among participants with reduced risks,  
228 potential conflicts and disputes (Zhang et al. 2016). Third, when clients explicitly specify the  
229 performance outcome, they expect the service supplier to deliver (Das and Teng 2001;  
230 Eisenhardt 1985). It aligns with the preferences and goals of all contracting parties. With a  
231 substantial reduction in incongruent self-interests, contractual term specificity may further  
232 enhance participants' relational behavior.

233 Contractual contingency adaptability is the extent to which unanticipated contingencies  
234 are accounted for and relevant guidelines that are delineated in a contract for handling these  
235 contingencies (Luo 2002). It stipulates principles, guidelines, and possible solutions for dealing  
236 with conflicts and contingencies, outlining a mutually agreed tolerance zone or excuse doctrine  
237 for dealing with unexpected events. In practice, these guidelines or possible solutions are  
238 incorporated in a contract as independent terms (e.g., procedures for handling important

239 contingencies, guidelines in case of doubt or hazards, approaches for overcoming conflict and  
240 handling *force majeure*) or as a part of relevant clauses in specific cases (e.g., how to handle  
241 unanticipated changes in the market or governmental policies). With contractual contingency  
242 adaptability, a contract is expected to foster flexibility by furnishing customized approaches  
243 and contingency procedures for dealing with future contingencies, especially in megaprojects  
244 with great uncertainties, as contracting parties know that the contract is not perfectly rigid and  
245 will evolve as needs change, calling for the processes that can accommodate such changes. For  
246 instance, a demand forecast plan or business continuity plan may contain provisions that entail  
247 contingency plans for the relationship. These provisions reflect the joint expectation that  
248 megaproject participants are willing to make necessary adaptations to the contract as business  
249 and environmental circumstances change (Dwyer et al. 1987). Contractual contingency  
250 adaptability is important and especially conducive to promote inter-organizational relational  
251 behavior (Doz 1996) when a conflict arises. Otherwise, disputing participants are unlikely to  
252 further engage in effective communication (Hinds and Mortensen 2005). Therefore, this study  
253 proposes the following two hypotheses firstly:

254 Hypothesis 1a (H1a): Contractual term specificity in a contract has a positive effect on the  
255 relational behavior of megaproject participants.

256 Hypothesis 1b (H1b): Contractual contingency adaptability in a contract has a positive  
257 effect on the relational behavior of megaproject participants.

258 Rather than contractual governance that relies on formal agreements with third-party  
259 enforcement, relational governance relies on informal structure and self-enforcement by each  
260 party (Dyer and Singh 1998; Malhotra and Murnighan 2002). In the existing literature, trust is

261 one of the most frequently discussed forms of relational governance (Griffith and Myers 2005).  
262 In relational exchange theory, trust relates positively to relational behavior because confidence  
263 in and reliance on the other partners promote their mutual flexibility, solidarity, and information  
264 exchange (Lui et al. 2009). Poppo and Zenger (2002) proposed that trust not only enhances  
265 mutual adaptability and facilitates joint planning (Claro et al. 2003) but also contributes to a  
266 commitment-level relationship that operates as a self-enforcing safeguard against conflicts  
267 (Malhotra and Lumineau 2011).

268 In megaprojects where many conflicts, differences, disputes, and other undesirable  
269 behaviors exist with a high level of trust, participants reduce the cost of monitoring, controlling,  
270 and enforcing (Goo et al. 2009) and increase the possibility to attain mutually beneficial  
271 agreements (Khalfan et al. 2007), eventually improving project performance (Jiang et al. 2016;  
272 Meng 2012). Pinto et al. (2009) found that trust helps to strengthen cooperation, which, in turn,  
273 benefits the project as a whole.

274 In China, the role of trust may be even more salient (Möller and Svahn 2004). The lack of  
275 a robust regulatory institution compels firms to rely more on social connections and trust to  
276 obtain needed resources and protection (Jiang and Lu 2017; Memon et al. 2014). Business  
277 conducted in China also has the tradition of heavily relying on informal ties with trustworthy  
278 partners. As Xin and Pearce (1996) pointed out, trust and credibility are more instrumental than  
279 a legal framework in guiding business cooperation in China. Chinese project managers prefer  
280 to develop and maintain a good, even personal, relationship with their clients (Chen and  
281 Partington 2004), which is an essential attribute of good project management. As a result, good  
282 relationships with all involved parties are vital for resolving conflicts, facilitating

283 communication, and sharing knowledge (Rahman and Alhassan 2012). Thus, the following  
284 hypothesis was proposed:

285 Hypothesis 2 (H2): Trust has a positive effect on the relational behavior of megaproject  
286 participants.

287 Institutional support from the central or local government is another governance  
288 mechanism that incorporates the availability of valuable industry information, subsidies, tax  
289 reductions, and regulatory favors (Pistor et al. 2000). Due to these potential benefits,  
290 megaproject participants would seek increased political networking with the government to  
291 build a close relationship in the expectation of higher chances to win future contracts. Chi and  
292 Javernick - Will (2011) proposed that political networking generates greater value when  
293 located in certain strategic or hierarchical positions where useful information about  
294 opportunities is available, with power derived from decision-making authority or access to  
295 valued resources. In megaprojects, the government can also be understood as an intermediary  
296 that combines its own legal stake and society's moral stake (Sallinen et al. 2013). The  
297 government was actively promoting a shared view of the societal importance of the megaproject  
298 to affirm the commitment of megaproject participants, thus facilitating their relational behavior.  
299 In China, the use of this governance approach has earlier been demonstrated with linkage to  
300 relational norms of national glory and individual values (Chi et al. 2011), and with the potential  
301 to promote relational behavior among megaproject participants. The following hypothesis was  
302 proposed:

303 Hypothesis 3 (H3): Institutional support has a positive effect on the relational behavior of  
304 megaproject participants.

305 **Interaction of Governance Mechanisms**

306 As to the relationship between contractual and relational governance, two viewpoints arise  
307 in the existing literature. Some scholars suggested that these two governance mechanisms can  
308 complement each other's inadequacies and limitations in achieving higher exchange  
309 performance and in constraining opportunism (Lui et al. 2009; Poppo and Zenger 2002).  
310 However, others have viewed the relational mechanism as a substitute for a complex and  
311 explicit contract (Cao and Lumineau 2015). Recent studies have provided more nuanced  
312 explanations of the mutual relationship between contractual and relational governance. They  
313 argued that both complementary and substitute propositions are possible, depending on the  
314 contents and functions of contracts as well as contextual factors (Hinds and Mortensen 2005).  
315 In particular, recent works indicate that multiple dimensions of contractual governance may  
316 have different impacts on relational governance (Malhotra and Lumineau 2011; Schepker et al.  
317 2014).

318 In terms of contractual term specificity, regardless of how explicit a contract is, the  
319 interpretation and application of contracts may be different between cooperative parties. Some  
320 firms use contractual terms rigidly while other firms use the terms in a more flexible way.  
321 Different applications may generate conflicts and degrade cooperation. As such, project  
322 participants may turn to a relational mechanism such as trust (Williamson 1985) because the  
323 continuity and cooperation encouraged by relational mechanisms may generate contractual  
324 refinements and further support greater collaboration (Poppo and Zenger 2002). Trust is broadly  
325 considered as being flexible and adaptable, so it can overcome the adaptive limits of contractual  
326 term specificity and complement it by fostering continuance and bilateralism when change and



327 conflict arise. From another perspective, trust is difficult to be formally codified as ambiguous  
328 expectations and misunderstandings will arise, which undermines coordination and even results  
329 in opportunism (Weitz and Jap 1995). Overcoming the informal limitations of trust, contractual  
330 term specificity can complement it through formal clauses that help establish a solid basis for  
331 the development of trust. Therefore, term specificity can provide a formal framework for a  
332 megaproject and trust can eliminate contract limitations; that is, they function as mutual  
333 complements instead of substitutes. Jointly using these two mechanisms can potentially  
334 improve relational behavior more than using them separately (Liu et al. 2009).

335       Regarding contractual contingency adaptability, due to humans' natural bounded  
336 rationality, it is impossible to write a complete contract that anticipates all possible  
337 contingencies and clarifies the appropriate actions of each party (Wuyts and Geyskens 2005).  
338 Project managers cannot predict and contractually resolve every future contingency and,  
339 therefore, request an "incomplete" contract that is less legally binding as it contains fewer  
340 clauses and/or the clauses are neither observable nor verifiable (Dooley and Ven 1999).  
341 However, a lack of specific clauses may also introduce ambiguity and leave space for  
342 opportunistic behavior (Luo 2002). Furthermore, a higher level of contractual contingency  
343 adaptability may signal a lack of trust, which may be detrimental for the cooperative inter-  
344 organizational relationship (Poppo and Zenger 2002). The following hypotheses were therefore  
345 proposed:

346       Hypothesis 4a (H4a). Contractual term specificity and trust are complementary in  
347 promoting the relational behavior of megaproject participants.

348       Hypothesis 4b (H4b). Contractual contingency adaptability and trust are substitutes in

349 promoting the relational behavior of megaproject participants.

### 350 **Moderating Effect of Project Uncertainty**

351 Project uncertainty refers to the frequency of changes and the degree of instability during  
352 the project lifecycle (Wang et al. 2011). Pertinent studies suggest three main sources of project  
353 uncertainty in a megaproject: task uncertainty, technological novelty, and environmental  
354 uncertainty (Yan and Dooley 2013). Task uncertainty arises from a large number of components  
355 and/or a high level of differentiation and interdependencies between them (Dooley and Ven  
356 1999). High task uncertainty causes equivocality and multiple or conflicting interpretations of  
357 task situations (Koufteros et al. 2002). High uncertainty also requires highly differentiated  
358 expertise, making the integration of knowledge and skills very difficult. During the  
359 development of a megaproject, the complex interdependences among components make it  
360 challenging to predict and understand the impacts of distributed decisions on the overall task  
361 performance. As a result, megaprojects often take a longer time to complete. In addition,  
362 technological novelty is another source of megaproject uncertainty, and it varies at different  
363 levels (Tatikonda and Montoya-Weiss 2001). Novel technologies refer to those that are new to  
364 be used by the participating organizations. At the beginning of a megaproject, when novel  
365 technologies are initially adopted, project members may not fully understand the technology  
366 well neither knowing the appropriate means nor even the consequences of using such  
367 technology. Such unfamiliarity leads to high degree of uncertainty about accomplishing project  
368 development tasks. Empirical studies have found that megaprojects using novel technology are  
369 often less likely to succeed due to their higher level of uncertainty (Tatikonda and Rosenthal  
370 2000). The last source of uncertainty originates from the project's environmental and contextual

371 factors, and that may preclude the effective use of mechanisms to safeguard and enforce a  
372 business relationship (Anderson and Weitz 1989). Environmental uncertainty refers to the rate  
373 of change and the degree of unpredictability in the environment and generated by resource  
374 scarcity and by a lack of perfect knowledge about environmental fluctuations (Dess and Beard  
375 1984). Such environmental uncertainty may lead to information asymmetry among parties and  
376 enable participating organizations to behave opportunistically.

377       The optimal response to uncertainty, based on neoclassical contract theory, is to rely on  
378 the safeguard of a contract (Carson et al. 2006). Megaproject participants may seek to tie down  
379 terms and definitions as a way to remove uncertainties, particularly ambiguity, from a contract.  
380 A specified contract along these lines is one approach to remedy the problems of volatility and  
381 ambiguity. In megaprojects, firms often enter into exceptionally complex contracts to deal with  
382 uncertain contracting situations. The more complex and complete a contract the less flexible  
383 and adaptable it is. Such inflexible contracts create challenges to contractual governance. Ex  
384 post adjustments in megaprojects become problematic when all parties need to renegotiate to  
385 accommodate changes, substantially weakening or eliminating the contract safeguard  
386 capabilities for megaproject participants in conducting relational behavior. Therefore, this study  
387 proposes:

388       Hypothesis 5a (H5a): The higher the project uncertainty, the weaker the positive  
389 relationship between contractual term specificity and megaproject participants' relational  
390 behavior.

391       Another main challenge of project uncertainty is the difficulty in obtaining useful  
392 information (Molm et al. 2009) as information asymmetries place a premium on opportunism

393 (Williamson 1985). From a review of opportunism in exchange relationships, Crosno and  
394 Dahlstrom (2008) found that external uncertainty would increase opportunism by increasing  
395 the likelihood that participants would shirk responsibilities and break the agreements to seek  
396 their own interests (Katsikeas et al. 2009). Under such circumstance, the increased opportunism  
397 dampens inter-organizational commitment, resulting in less relational behavior. Clauses for  
398 contractual contingency adaptability are devised to address different environmental scenarios,  
399 especially unpredicted environmental changes. With adaptable approaches and contingency  
400 procedures for dealing with such inevitable changes, megaproject participants could deal with  
401 uncertainties in a flexible way to decrease conflicts, contributing to the more relational behavior.  
402 Therefore, this study proposes:

403 Hypothesis 5b (H5b): The higher the project uncertainty, the stronger the positive  
404 relationship between contractual contingency adaptability and megaproject participants'  
405 relational behavior.

406 In contrast, trust may overcome the inflexibility disadvantages of contractually-based  
407 governance in a turbulent environment. Trust provides the flexibility to cope with inevitable  
408 uncertainties that arise in a long-term exchange. Such flexibility helps mitigate exchange  
409 hazards under uncertainties and strengthens bilateral commitment to exchange-specific  
410 investments (Luo 2002). Thus, flexibility enables firms to adapt to unforeseeable technological  
411 and market changes. High uncertainty, especially in transition economies like China (Zhou et  
412 al. 2003), is likely to reinforce the cultivation of trust between contracting partners. From  
413 another perspective, trust is supposed to absorb the environmental uncertainty through joint  
414 planning and problem solving (Nyaga et al. 2010). Megaproject participants may employ trust

415 to manage an environment that is more turbulent than each can cope with alone (Morgan and  
416 Hunt 1994). The following hypotheses were therefore proposed:

417 Hypothesis 6 (H6): The higher the project uncertainty, the stronger the positive  
418 relationship between trust and megaproject participants' relational behavior.

#### 419 **Relational Behavior and Team Performance**

420 Pertinent studies have proposed a positive relationship between inter-firm relational  
421 behavior and performance in a supply chain. For example, particularly cooperative behavior,  
422 such as flexibility, shared problem-solving, voluntary information exchange, and restraint in  
423 the use of power, can improve the performance of a supply chain (Singh and Teng 2016;  
424 Koolwijk et al. 2018). Johnston et al. (2004) found that increased cooperative behavior  
425 contributes to higher perceived performance and satisfaction among the buyer firms. Research  
426 also shows that partners who share critical, accurate, and sensitive information in a timely  
427 manner are more successful than those do not exhibit relational behaviors (Chen et al. 2004).

428 Although relational behavior may increase the integrated value of megaprojects, the  
429 sustainability of such behavior depends on how much of the value is captured by each  
430 participating organization (Bowman and Ambrosini 2000). Paulraj et al. (2008) pointed out that  
431 through effective and efficient information sharing between participating organizations,  
432 performance-related errors can be reduced and, task efficiency and stakeholder satisfaction of  
433 individual team can be improved. Especially, when sharing important information regarding  
434 megaproject design issues and materials procurement, participating organizations are more  
435 likely (1) to improve the quality of the megaproject (Carr and Kaynak 2007), (2) to reduce  
436 response time, (3) to reduce the costs of protecting against opportunistic behavior, and (4) to

437 increase cost savings through operational efficiencies (Carr and Pearson 1999). Moreover,  
438 relational behavior also enables participating organizations to make dependable delivery, hence  
439 leading to a high level of project integration and positively contributing to obtaining the loyalty  
440 of project participants.

441 A high degree of solidarity of participants' relational behavior, such as joint planning and  
442 joint problem solving, is expected to contribute to a high level of perceived satisfaction and  
443 team performance. For instance, joint planning could facilitate the efficiency of business  
444 transactions between megaproject participants and improve a team's time performance by  
445 reducing the risk of unexpected problems and a sophisticated negotiation process. As for joint  
446 problem solving, it allows for creative forms of dealing with disagreements and other  
447 contingencies of business relationships, contributing to the reduction of transaction costs and  
448 improving the cost performance of individual teams. Besides, joint problem solving could  
449 promote knowledge transfer between contracting parties by allowing parties to learn from each  
450 other through experience, observation, and/or demonstration (Cai et al. 2009), resulting in the  
451 higher task efficiency of an individual team. Finally, megaproject participating organizations  
452 closely engaging in the current project could build strong social relations for future business  
453 collaboration (Lu and Yan 2007). Thus, it is hypothesized that:

454 Hypothesis 7 (H7). The relational behavior of megaproject participants has a positive  
455 effect on their team performance.

456 After consolidating all hypotheses into a framework, the conceptual model can be  
457 established and shown in Fig. 1.

458 *(Insert Figure 1 here)*

459 **RESEARCH METHOD**

460 To test the research model and hypotheses, a questionnaire survey was developed based  
461 on literature review, refined through a pilot study, and subsequently used for the data collection  
462 and analysis.

463 **Measurements**

464 The development of measurement began with an investigation of the theoretical and  
465 empirical literature on inter-organizational relationship governance. Then the identified  
466 measurement items used for the constructs were modified based on the context of megaprojects.  
467 Specifically, the measures of contractual governance mechanisms concentrated on the  
468 contractual term specificity and contractual contingency adaptability in megaprojects, which  
469 were reflective constructs composed of three items and two items, respectively, based on the  
470 measures reported in the studies of Jap and Ganesan (2000), Goo et al. (2009) and, Luo (2002).  
471 Trust that reflects the confidence of participating organizations in others' reliability and  
472 integrity was also a reflective construct measured by five items referring to the study of Lu et  
473 al. (2015). To measure institutional support, two reflective items were used to assess the  
474 government's support for and protection of megaprojects (Li and Atuahene-Gima 2001).  
475 Consistent with the literature of Hoppner and Griffith (2011), relational behavior was  
476 operationalized as a second-order reflective construct composed of three sub-constructs:  
477 solidarity, flexibility, and information sharing. Project uncertainty was captured by three items  
478 describing change and instability of the external environment, technology, and task during a  
479 megaproject's lifecycle (Yan and Dooley 2013). Based on the work of Lu et al. (2015) and  
480 interviews with field practitioners, team performance was operationalized as a reflective construct

481 of five items, tapping the dimensions of (a) time performance, (b) quality performance, (c) cost  
482 performance, (d) building long-term partnerships, and (e) collaborating joint projects in the  
483 future. Table 2 presents all constructs, along with their measurement items.

484 *(Insert Table 2 here)*

485 The model also incorporates three control variables that have been suggested by previous  
486 studies to have a potential influence on relational behavior, namely prior collaborative  
487 experience with other participating organizations (“prior collaborative experience”), project  
488 duration, and project delivery method. Relational behavior may be influenced by the historical  
489 interactions among participating organizations as prior experience determines their familiarity  
490 and trust development (Buvik and Rolfsen 2015; Zhang et al. 2009). In terms of project duration,  
491 a longer duration is generally expected to cultivate the development of a high-quality  
492 relationship (Levinthal and Fichman 1988), thus, in turn, facilitating relational behavior.  
493 Previous research also suggested that project performance varies under different project  
494 delivery methods (Ling et al. 2004), such as design–bid–build (DBB), design-build (DB), and  
495 EPC, as each delivery method indicates distinct organizational behaviors and team  
496 collaboration. Regarding measurement, megaproject duration was scaled with a dummy  
497 variable: duration less than 3 years (= 1) and above 3 years (= 2). Project delivery method was  
498 treated as a categorical variable, including DBB, EPC, DB, and other methods. The prior  
499 collaborative experience was measured by asking respondents whether they had historical  
500 cooperative experience with contracting partners based on a dichotomy variable (0 = without  
501 prior collaborative experience, 1 = with prior collaborative experience).



502 **Sampling and Data Collection**

503       Based on a comprehensive literature review, we developed a pilot survey questionnaire  
504 that was evaluated by 26 experienced practitioners: 6 clients, 9 contractors and 11 consultants.  
505 By considering the feedback and comments provided, we evaluated the content validity of the  
506 items and tested measurement purification prior to the finalization of the questionnaire and the  
507 execution of the survey. After removing one inappropriate item, splitting one item into two,  
508 and rephrasing items that were not explicitly described, we present the final version of the  
509 measurement items in Appendix S1 in the Supplemental Data.

510       The governance mechanisms are primarily designed and reinforced by megaproject clients  
511 (including governmental officials involved as clients) to manage inter-organizational  
512 relationships effectively, especially between them and service providers (refer to as  
513 “consultants” and “contractors”). Thus, we selected the consultants and contractors as “key  
514 informants” for data collection to investigate the effectiveness of various governance  
515 mechanisms on their relational behavior. The use of key informants of one contracting party as  
516 data sources to understand the inter-organizational relationship has been widely adopted in past  
517 studies (Goo et al. 2009; Paulraj et al. 2008; Shiu et al. 2014). Ning and Ling (2013) emphasized  
518 that the consultants’ and contractors’ behavior is of great importance to high-quality inter-  
519 organizational relationships though they are reluctant to conduct relational behavior. In the  
520 survey, key informants are primarily referred to as project managers who were intimately  
521 involved with megaproject governance and have abundant knowledge about inter-  
522 organizational relationships.

523       Large companies that often participate in megaprojects were approached to complete the

524 questionnaire, including China Railway Group, China State Construction Company, Shanghai  
525 Construction Group Company, Tongji Architectural Design Group, CCDI Group, and Shanghai  
526 Hua Dong Engineering Corporation. These companies are all listed among the Top 20 in the  
527 2015 ENR Top Chinese Contractors and 2015 ENR Top Chinese Design Firms. Two criteria  
528 were adopted to identify qualified participants in the above companies, namely, those who have  
529 worked or are working on projects costing over 1 Billion RMB (Chinese Currency) (He et al.  
530 2015) and those holding senior-level positions in their firm such as directors or managers. To  
531 maximize the number of qualified respondents, a snowball sampling technique was used; that  
532 is, all respondents to the survey were asked to refer other eligible individuals who might be  
533 interested in participating.

534 The survey was completed between January and July 2016. A total of 238 responses were  
535 collected from the 737 questionnaires distributed among potential project consultants and  
536 contractors (32.3% response rate). We then cleaned the raw data by deleting incomplete  
537 questionnaires. The final sample consists of 202 responses, in which 42.6%, 37.1%, and 20.3%  
538 were collected on the spot, via an online survey, and by email, respectively. The answers from  
539 the three types of collection were compared through one-way analysis of variance (ANOVA),  
540 revealing no significant differences at the significance level of 0.05 among them. Hence, the  
541 data from all three sources were used for the analysis without distinction.

542 Among all megaprojects indicated by respondents, 84.2% cost 1–5 billion RMB and 15.8%  
543 cost over 5 billion RMB. Regarding project duration, 46.5% were completed in 2–3 years and  
544 53.5% were completed longer than three years. Furthermore, 71.8% of the projects were public  
545 and 28.2% were private projects. A majority of the megaprojects (86.1%) adopted design–bid–

546 build (DBB) as the delivery method while the remaining 13.9% employed other methods, such  
547 as engineering, procurement, and construction (EPC), and design-build (DB). The rest of the  
548 characteristics for these megaprojects and the survey respondents are shown in Table 3.

549 *(Insert Table 3 here)*

550 To further validate the data quality and address two common issues concerning survey  
551 methodology, i.e., non-response bias and common method variance (Podsakoff et al. 2003), a  
552 series of additional tests have been performed. Non-response bias was evaluated by testing  
553 significant differences between the responses of the first 30 received surveys and that of the  
554 last 30 received surveys (Armstrong and Overton 1977). In this survey, both T-test and ANOVA  
555 results revealed that no significant differences existed. The possibility of common method  
556 variance for all variables was then examined via Harman's one-factor test because respondents  
557 were requested to answer questions on both the dependent and independent variables  
558 (Podsakoff et al. 2003). The result satisfied the required threshold ( $26.53\% < 50\%$ ) regarding  
559 the ratio of the first factor accounting for the overall variance.

## 560 **ANALYSIS AND RESULTS**

561 To validate the proposed hypotheses, two steps were conducted. First, we estimated the  
562 model's reliability and validity by using partial least square structural equation modeling (PLS-  
563 SEM) and confirmatory factor analysis. Second, we tested the theoretical model with  
564 hierarchical moderated regression analyses.

565 In the first step, the validity of all constructs, including their internal consistency, indicator  
566 reliability, convergent validity, and discriminant validity, were assessed (Hair et al. 2011; Le et  
567 al. 2014), with the results presented in Tables 4 and 5. Table 4 displays the descriptive statistics

568 and correlations for each construct and Table 5 shows that the composite reliability (CR) of  
569 each construct was validated ( $CR > 0.70$ ) and the results satisfied the requirement of internal  
570 consistency (Hair et al. 2014). The indicator reliability was also assessed by examining the  
571 loadings of the multiple items on their corresponding constructs, showing that all factor  
572 loadings were statistically significant ( $p < 0.001$ ). The result that average variance extracted  
573 (AVE) of all constructs were greater than 0.50 showed that each item is strongly related to its  
574 latent construct, in support of convergent validity. The discriminant validity used to reflect the  
575 difference between two latent constructs is confirmed in both Table S1 of Appendix S2 and  
576 Table S2 in the Supplemental Data.

577       Regarding the second-order construct — relational behavior, we evaluated the reliability  
578 and validity as well. Firstly, all the outer loadings of eight measurements are well above the  
579 critical value of 0.70. Specifically, the relational behavior's composite reliability (0.84) is  
580 greater than the critical value of 0.70, thus supporting internal consistency reliability. The AVE  
581 of relational behavior has a value of 0.51, also providing evidence of convergent validity.  
582 Furthermore, based on the result of correlations of variables in Table 4, the square root of the  
583 AVE for relational behavior in the diagonal was greater than its highest off-diagonal value (Hair  
584 et al. 2014), providing evidence of discriminant validity among the theoretical constructs.  
585 Finally, it is verified that the relational behavior has strong relationships with its first-order  
586 constructs — solidarity (0.73), flexibility (0.66) and information sharing (0.82). Hence, all first-  
587 order constructs are sufficiently highly correlated for their second-order construct (i.e.,  
588 relational behavior) with high level of explanation for more than 50% of each first-order  
589 construct's variance.

590 *(Insert Table 4 here)*

591 *(Insert Table 5 here)*

592 In the second step, because the proposed model contains interaction terms between  
593 governance mechanisms and project uncertainty, hierarchical moderated regression analysis  
594 was used for validation (Liu et al. 2009) and the results are presented in Table 6. The baseline  
595 model (Model 1 in Table 6) contains control variables as the only inputs. The results revealed  
596 that control variables were not significantly related to relational behavior, as they accounted for  
597 only 1% of the variance in relational behavior. Model 2 adds three kinds of governance  
598 mechanisms — contractual term specificity (X1), contractual contingency adaptability (X2),  
599 trust (X3), institutional support (X4) and the moderator — project uncertainty (X5), resulting  
600 in increasing the predictive power ( $\Delta R^2 = 0.32$ ,  $F = 11.95$ ,  $p < 0.001$ ) in explaining the variance  
601 of relational behavior. Model 3 features all the interactive effects between governance  
602 mechanisms and project uncertainty on relational behavior. Prior to the creation of the  
603 interaction terms in Model 3, the independent variables were centered to reduce  
604 multicollinearity (Aiken and West, 1991) and the variance inflation factors (VIF) was calculated  
605 for every regression equation. The result indicates that the maximum VIF of the model (3.50)  
606 meets the requirement of  $VIF < 10$  (Nachtsheim and Chris 2004). The addition of the interaction  
607 terms in Model 3 further increased the R-square value than Model 2 ( $\Delta R^2 = 0.05$ ,  $F = 8.99$ ,  $p$   
608  $< 0.01$ ), in support of the significant moderating effects of project uncertainty. Finally, we  
609 assessed the effect of relational behavior on team performance in Model 4, in which the  
610 explained variance was significant ( $R^2 = 0.32$ ,  $F = 93.54$ ,  $p < 0.001$ ).

611 **Main Effect**

612       The results in Model 3, demonstrate that term specificity had a significant, positive effect  
613 on relational behavior ( $\beta = 0.23, p < 0.01$ ), providing support for H1a, whereas contractual  
614 contingency adaptability was found to have no significant effect on influencing relational  
615 behavior ( $\beta = -0.01, n.s.$ ), not in support of H1b. These results corroborate previous  
616 recommendations to distinguish contractual term specificity and contingency adaptability and  
617 to examine their differential impacts (Luo 2002). The results also suggest that trust ( $\beta = 0.29,$   
618  $p < 0.001$ ) was positively related to relational behavior, in support of H2, and institutional  
619 support significantly increased relational behavior in megaprojects ( $\beta = 0.19, p < 0.001$ ), in  
620 support of H3, revealing the necessity to take institutional support into account. H7, which  
621 predicted that relational behavior was positively related to team performance of participating  
622 organizations, was also supported ( $\beta = 0.57, p < 0.001$ ). However, the main effect of project  
623 uncertainty slightly facilitates relational behavior of megaproject participants, though not  
624 significantly ( $\beta = 0.04, n.s.$ ).

625 **Moderating Effect**

626       By examining the path coefficients of the interaction variable on relational behavior, we  
627 suggest that contractual term specificity and trust increase relational behavior complementarily  
628 in megaprojects ( $\beta = 0.57, p < 0.001$ ), supporting H4a. In contrast, contractual contingency  
629 adaptability and trust are neither pure substitutes nor complements (Model 3:  $\beta = -0.09, n.s.$ ).  
630 Thus, our results do not support H4b.

631       H5a and H5b predicted the moderating influence of project uncertainty on the relationship  
632 between contractual governance and relational behavior. Seen from Model 3, the coefficient of

633 contractual governance multiplied by project uncertainty is negative and significant ( $\beta = -0.35$ ,  
634  $p < 0.001$ ). Thus, project uncertainty negatively moderates the relationship, and H5a is  
635 supported. Meanwhile, the coefficient of contractual contingency adaptability is positive and  
636 significant in Model 3 ( $\beta = 0.18$ ,  $p < 0.1$ ), thus H5b is also supported. Regarding the interplay  
637 of trust and project uncertainty, in line with our prediction, the results indicate that project  
638 uncertainty positively moderates the relationship between trust and relational behavior ( $\beta =$   
639  $0.13$ ,  $p < 0.1$ ), in support of H6.

640 To further interpret these moderating effects, the respective effects of contract and trust on  
641 relational behavior for low and high levels of project uncertainty are plotted in Fig. 2. The  
642 calculation of the simple slopes and their significance levels was based on Aiken et al. (1991)  
643 approach. Fig. 2(a) reveals that the sloped regression line for the relationship between  
644 contractual term specificity and participating organizations' relational behavior was negative  
645 and not significant for high project uncertainty ( $\beta = -0.08$ , *n.s.*), but was positive and significant  
646 for low project uncertainty ( $\beta = 0.54$ ,  $p < 0.001$ ), in support of H5a of the negative moderating  
647 effect. In contrast, the positive moderating effect of project uncertainty was confirmed in both  
648 Figs. 2(b) and 2(c). In Fig. 2(b), project uncertainty strengthened the effect of contractual  
649 contingency adaptability on participating organizations' relational behavior, though the  
650 relationships between them were both nonsignificant ( $\beta = -0.16$ ) for low project uncertainty  
651 and  $\beta = 0.14$  for high project uncertainty. Similarly, in Fig. 2 (c), trust had a minor positive  
652 effect on participating organizations' relational behavior when comparing high project  
653 uncertainty ( $\beta = 0.42$ ,  $p < 0.001$ ) to low uncertainty ( $\beta = 0.16$ , *n.s.*), in line with H6.

654 ***(Insert Table 6 here)***

655 *(Insert Figure 2 here)*

656 **DISCUSSION AND VALIDATION**

657 By examining the impact of three distinctive governance mechanisms that link  
658 participating organizations' relational behavior to their performance outcomes, this study  
659 provides significant evidences to support the hypotheses H1a, H2 and H3 by confirming the  
660 determinants of contractual term specificity, trust and institutional support in promoting  
661 relational behavior, which in turn facilitates team performance of megaproject participants (H7).  
662 In addition, it is worth noting that the findings of this study favored a differentiated result for  
663 contractual term specificity (H5a) and contractual contingency adaptability (H5b) when the  
664 respective effects on participants' relational behavior are moderated by different levels of  
665 project uncertainty, supporting H5a but not supporting H5b.

666 **The Effect of Governance Mechanisms on Relational Behavior**

667 Among various forms of governance mechanisms, including contractual term specificity,  
668 trust, and institutional support, trust acts as the most effective driver to positively impact project  
669 participants' relational behavior, particularly the contract mechanism. This result is similar to  
670 pertinent studies in other fields. For example, Wu et al. (2017b) demonstrated that trust is more  
671 important than contracts for the performance of cooperative innovation projects in high-tech  
672 enterprises. Trust grants information sharing to access the valuable knowledge of project  
673 participants, and facilitates the acquisition of novel ideas and insights that lay the groundwork  
674 for problem-solving. This is true for both innovation-driven enterprises and megaprojects that  
675 demand massive, accurate, and quickly-responding information from various suppliers, and in  
676 which the cooperation process among participants is complex. Therefore, as a self-enforcing



677 safeguard, the presence of trust is based on mutual commitment and shared values among  
678 contracting partners and it is a more effective and less costly alternative to creating a contract  
679 (Dyer and Singh 1998).

680 Another plausible explanation for the greater role of trust is that many studies endorse the  
681 importance of *guanxi* (literally, interpersonal relationships or connections) in the context of  
682 China. Interpersonal *guanxi* helps determine whether firms gain influence in exchanging  
683 relationships (Zhuang et al. 2008). In Chinese culture, trust is based on a high level of *guanxi*,  
684 which is the lifeblood of business-making. *Guanxi* is utilitarian in developing a friendship that  
685 consists of personal ties or social bonds to share resources in business communities and is  
686 described as the informal connection essential to gain approval for or access to key resources  
687 in China (Wu et al. 2017a). Therefore, we argue that the nature of megaprojects and Chinese  
688 culture make trust more important than contracts to build relational behavior.

689 In addition, the results indicate that institutional support can predict relational behavior  
690 (H4). This, in part, supports the work of Zhai (2017) in which institutional support could  
691 significantly influence the coordination in megaprojects. Megaprojects need specific  
692 governance regimes that can adapt to their societal contexts for efficient supervision and  
693 coordination. The administration not only imposes influences through legislation, but also  
694 proactively exercises its power on various organizations through its regulatory or administrative  
695 control so as to support the smooth implementation of megaprojects. Thus, megaproject  
696 participants are more willing to conduct information sharing, behavioral flexibility and  
697 solidarity with the intention to develop a political network with the government. A supportive  
698 political network might bring participating organizations favorable policy and scarce resources,

699 such as subsidies and tax breaks, and win future business opportunities in tendering other  
700 governmental-invested projects.

701 **The Effect of Contractual Term Specificity and Contingency Adaptability on Relational**  
702 **Behavior**

703 The role of the contract is divided into two aspects in megaprojects. In one way, the result  
704 shows that more specific contractual terms promote better relational behavior of megaproject  
705 participants. This finding is consistent with Goo et al. (2009) who provided evidence in favor  
706 of using a well-structured agreement in an IT outsourcing engagement. Due to the self-  
707 enforcing nature of relational behavior, participating organizations have to rely much more on  
708 contractual term specificity to constrain their partners because they are not familiar with each  
709 other in the early stage (Luo 2002). A well-structured agreement would supply megaproject  
710 engagements with a “safety net” in lieu of exclusive reliance on trust. Thus, specified contracts  
711 are regarded as the basis to initiate megaprojects.

712 From another respective, however, our result did not support the significant effect of  
713 contractual contingency adaptability on relational behavior. This seems to contradict to the  
714 finding of Lui (2009) where the relationship between contingency adaptability and relational  
715 performance is significant. One plausible explanation is that unlike normal-sized projects that  
716 can be easily planned, it is hard to predict all the contingencies in a megaproject due to highly  
717 interdependent works and lack of experience on similar megaprojects (Tanriverdi et al. 2007).  
718 In addition, when contingencies occur and lead to changes in the formal contract, it is preferred  
719 to be negotiated in a continuously interactive environment, whereas mutual adjustment and  
720 reciprocal on contract changes can be more effective, rather than in an environment where

721 contract changes settled by a standardized approach or by any specified plans, procedures, and  
722 schedules prescribed in a megaproject contract.

723 In addition, the findings provide an in-depth understanding about the relationship between  
724 the two types of contractual mechanisms and trust by showing that contractual term  
725 specification has a significant complementary relationship with trust to enhance the relational  
726 behavior of megaproject participants. This is because explicit clauses that help develop social  
727 elements in relational exchanges include a higher level of trust that is usually associated with  
728 hierarchies (Stinchcombe and Heimer 1985). Yang et al. (2011) also emphasized that a  
729 specified contract combined with trust significantly reinforces the long-term orientation. Thus,  
730 this research provides strong evidence that specified formal contracts can be utilized to develop  
731 both trust and relational behavior. However, contractual contingency adaptability was found to  
732 be neither substitutes nor complements with trust.

733 Another difference between these two roles of the contract is that the effect of contractual  
734 term specificity on relational behavior is weakened by uncertainty. This is consistent with  
735 previous studies that argued that formal controls may not be suitable in high uncertainty and  
736 equivocality projects because they impose constraints on the professionals involved and limit  
737 their freedom and innovation capacity (Hope and Fraser 2003). Moreover, a high level of  
738 technology and environmental uncertainty makes it difficult to pin down the terms and clauses,  
739 thus weakening the safeguard effect of contractual term specificity.

#### 740 **MANAGERIAL IMPLICATIONS**

741 The findings of the current study clarify the research and offer three effective implications  
742 for both project participants and policy makers seeking to promote the adoption of relational

743 behavior in megaprojects through appropriate governance mechanisms.

744 First, participating organizations need to develop a well-structured contract between  
745 contracting parties at the outset with a high proportion of clauses representing contractual term  
746 specificity and with a medium proportion reflecting contractual contingency adaptability. A  
747 lack of term specificity leads to erroneous conclusions pertaining to the contract's value in  
748 interacting with trust and promoting relational behavior. Therefore, each party's rights and  
749 obligations should be detailed in writing and unambiguously specified to safeguard exchange  
750 hazards with the intention to promote relational behavior. In terms of contractual contingency  
751 adaptability, the parties concerned should not have excessive processes and methods for various  
752 contingencies and contract changes prescribed in the megaproject contract. Such complex  
753 clauses highlighting contingency adaptability will increase transaction cost but add no  
754 significant value to relationship management. When confronting different scales of  
755 megaprojects, project managers should adjust both contractual term specificity and contractual  
756 contingency adaptability according to the level of project uncertainty. For a high degree of  
757 megaproject uncertainty, managers can relatively increase the degree of contingency  
758 adaptability, such as to set an emergency response clause for quick and efficient onsite decision,  
759 as well as decrease the focus on term specificity for promoting the implementation of relational  
760 behavior. Comparatively, more term specificity and less contingency adaptability should be set  
761 for a megaproject with certain scope and standard, so parties can exhibit their behavior in a  
762 more regulated manner.

763 Second, megaproject participants must attach both the importance of trust and contractual  
764 term specificity because they are mutually complementary to enhance relational behavior.

765 Cultivating mutual trust of megaproject participants cannot be ignored while spending efforts  
766 in drafting contracts with their business partners. Trust-building tools, such as relationship  
767 workshops, are encouraged to be used in megaprojects so as to facilitate open communication,  
768 build relationships, achieve mutual understanding, and to generate innovative programs that  
769 promote coordination (Chen and Manley 2014). For instance, a trust-bond activity can be  
770 arranged to precede or accompany the contract negotiation process so as to obtain the mutual  
771 trust. Then both parties are more engaged and efficient to straightforwardly focus on reviewing  
772 contractual terms rather than wasting time on suspicious doubts, so negotiation time and efforts  
773 can be saved. Through the reciprocal process of fulfilling one contractual term and entering  
774 another, the mutual trust is further enhanced to cultivate the friendly environment not only  
775 benefiting the contract negotiation but also creating the harmonized relationship between both  
776 parties.

777 Third, government officials should endeavor to support the implementation of  
778 megaprojects in transition economies like China, where successful megaproject management  
779 often leverages the government's power to exert its influence on coordination and control. For  
780 example, megaprojects adopt a special leadership committee to integrate all project participants  
781 to provide vision, governance, and leadership (Chen and Manley 2014), and the officials of  
782 Chinese central and local governments are typically delegated as major leaders in providing  
783 strong support for the megaprojects, and, thereby, promote project participants' solidarity,  
784 flexibility, and information sharing. Further, enhancing relational behavior within a  
785 megaproject, project participants are expected to build social capital with the government to  
786 win benefits in the long-run.

787 **CONCLUSIONS**

788 High levels of relational behavior between project participating organizations are vital for  
789 the success of relationship management in megaprojects. Focusing on the governance  
790 perspective, this study developed a theoretical model showing the relationships between  
791 contract, trust, and institutional support, and the association between relational behavior and  
792 team performance. Then, a sample of 202 managers of consultants and contractors in Chinese  
793 megaprojects were collected and analyzed by hierarchical moderated regression analyses.

794 Three main findings were discussed. First, three subcategories of governance  
795 mechanisms—contractual term specificity, trust, and institutional support—are all significant  
796 in improving relational behavior and among them, trust is most effective, indicating that  
797 informal mechanisms like trust are relatively better facilitators of relational behavior than  
798 formal mechanisms, such as contract. Second, regarding the interaction of contract and trust on  
799 relational behavior, it is confirmed that contractual term specificity and trust are complements  
800 rather than substitutes, while contractual term specificity and trust are neither pure  
801 complements nor substitutes. Third, the moderating effect of project uncertainty was  
802 particularly important, exhibiting mixed effects—positively moderating both the relationships  
803 between trust and relational behavior, and between contractual contingency adaptability and  
804 relational behavior—yet negatively moderating the relationship between contractual term  
805 specificity and relational behavior. The findings of the present study offer three key insights for  
806 stakeholders seeking to use appropriate governance mechanisms to promote the adoption of  
807 relational behavior in megaprojects, namely developing a well-structured contract for  
808 megaproject implementation, attaching importance of both trust and contractual term

809 specificity, and calling for more institutional support for megaproject relationship management.

810       This paper contributes to the theory of megaprojects inter-organizational relationship in  
811 three aspects. First, the study contextualizes multiple theories in megaprojects to examine the  
812 characterization of relational behavior and identifies three key paths influencing relational  
813 behavior via reinforcing contractual governance, increasing mutual trust, and offering  
814 institutional support. These paths switch on or off depending on the megaproject uncertainty.  
815 As the three paths reveal different aspects of project governance, understanding their roles is  
816 significant to improve relationship management in megaprojects.

817       Second, the current study provides new insights into contractual governance theory by  
818 expanding the boundary of studying contractual governance as a unidimensional construct. This  
819 study examines two differential roles—both term specificity and contingency adaptability, in  
820 facilitating relational behavior among megaproject participants. The results imply that  
821 contractual term specificity intensifies inter-organizational relational behavior, whereas the  
822 effect of contractual contingency adaptability is not significant. Besides, it is also confirmed  
823 that term specificity and trust are mutually complemented in megaprojects, contributing to the  
824 long-standing debate on the topic of “substitutes versus complements” for the relationship  
825 between contractual governance and relational governance.

826       Last, this study demonstrates the facilitating role of the government through its  
827 institutional support for relational behavior in megaprojects. Previous studies normally assume  
828 full enforcement of contractual mechanism and relational mechanisms on inter-organizational  
829 relationships but ignore the role of the government under different institutional environments,  
830 especially in transition economies. Researchers have called for more assessments of the

831 institutional support provided to megaproject development (Grewal and Dharwadkar 2002),  
832 though empirical evidence is still scarce. This study presents an initial attempt to assess and  
833 confirm that the institutional support has profound effects on strengthening the inter-  
834 organizational relationship among megaproject participants.

835         Despite these theoretical contributions mentioned above, the interpretation of the  
836 findings should be made carefully due to three limitations that must be addressed in future  
837 endeavors. The first limitation is the use of a one-time survey of megaproject participants while  
838 ignoring the dynamic process of relational behavior that changes over time, during which  
839 participating organizations may adjust their governance strategies and collaborative decisions.  
840 Besides, a self-reporting survey was employed to collect behavior information from one  
841 contracting party, which is inevitably subject to the bias perceived by one side. Future research  
842 could take a longitudinal perspective to examine how governance mechanisms and relational  
843 behavior evolve and change over time, and consider to gather matched-dyad data from paired  
844 informants, such as collecting information from both clients and contractors in the same  
845 megaproject.

846         The second limitation is that the study mainly considers the interaction between  
847 contractual mechanisms and trust, without considering other moderating effects (i.e., project  
848 uncertainty and institutional support). Further studies are recommended to extend the  
849 inclusiveness of the governance model that incorporate more interaction effects and potential  
850 moderators in megaprojects. The third limitation is that the empirical data in this study were all  
851 collected from megaprojects in China, so the application of the findings to other countries  
852 should be performed with caution and appropriate adjustments. For instance, China's culture of



853 *guanxi* fosters the popularization of network-centered rather than market-centered strategies in  
854 business operations (Peng 2003). In contrast, in most developed countries, the contract is a  
855 more effective governance mechanism for promoting inter-organizational exchange. A wider  
856 scope of data collection across different countries and regions could provide valuable  
857 information that would expand the generalization of the research results.

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## 863 **SUPPLEMENTAL DATA**

864 Appendixes S1 and S2, and Tables S1 and S2, are available online in the ASCE  
865 Library ([www.ascelibrary.org](http://www.ascelibrary.org)).

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**TABLE 1. Illustrations of main dimensions of key literature on governance mechanisms**

Type of formal governance mechanism	Type of informal governance mechanism	Key literature
<ul style="list-style-type: none"> <li>• Ex ante contracts</li> <li>• Ex post control</li> </ul>	<ul style="list-style-type: none"> <li>• Trust</li> </ul>	Zhang and Zhou (2013)
<ul style="list-style-type: none"> <li>• Formal contract</li> </ul>	<ul style="list-style-type: none"> <li>• Relational norms,</li> <li>• Trust</li> </ul>	Arranz and Arroyabe (2012)
<ul style="list-style-type: none"> <li>• Explicit contracts</li> <li>• Relationship-specific investments</li> </ul>	<ul style="list-style-type: none"> <li>• Social norms</li> <li>• Trust</li> </ul>	Burkert et al. (2012)
<ul style="list-style-type: none"> <li>• Contracts</li> <li>• Structural mechanisms (contracts)</li> <li>• Administrative mechanism (effective allocation and demarcation of responsibilities)</li> </ul>	<ul style="list-style-type: none"> <li>• Trust</li> <li>• Relational mechanism (collaboration and information sharing)</li> </ul>	Chen et al. (2013) Jayaraman et al. (2013)
<ul style="list-style-type: none"> <li>• Contract</li> </ul>	<ul style="list-style-type: none"> <li>• Trust</li> </ul>	Malhotra and Lumineau (2011)
<ul style="list-style-type: none"> <li>• Contractual safeguards</li> </ul>	<ul style="list-style-type: none"> <li>• Trustworthiness</li> </ul>	Schilke and Cook (2015)
<ul style="list-style-type: none"> <li>• Contract</li> <li>• Formal control</li> <li>• Administrative control, through explicit contractual agreements; a dominant power position</li> </ul>	<ul style="list-style-type: none"> <li>• Trust</li> <li>• Social control</li> <li>• A dominant power position</li> <li>• Social/relational control</li> </ul>	Jiang et al. (2013) Jin et al. (2014) Caniëls and Gelderman (2010)
<ul style="list-style-type: none"> <li>• Incentives,</li> <li>• Authority</li> </ul>	<ul style="list-style-type: none"> <li>• Trust</li> </ul>	Olsen et al. (2005)
<ul style="list-style-type: none"> <li>• Contract</li> <li>• Power</li> </ul>	<ul style="list-style-type: none"> <li>• Trust</li> </ul>	Wang et al. (2008)
<ul style="list-style-type: none"> <li>• Formal contracts</li> </ul>	<ul style="list-style-type: none"> <li>• Brokered access,</li> <li>• Shared goals,</li> <li>• Trust</li> </ul>	Li et al. (2010)
None	<ul style="list-style-type: none"> <li>• Relational governance (institutional support from the government)</li> </ul>	Chi and Javernick - Will (2011)
None	<ul style="list-style-type: none"> <li>• Governmental governance (institutional support from the government)</li> </ul>	Zhai (2017)

**TABLE 2.** Measurements of constructs

Constructs	Description of measurement items	Key sources
Contractual term specificity (TS)	TS1 — Governed by written contracts primarily; TS2 — Detailed obligations and rights; TS3 — Detailed rewards and punishments.	Fryxell et al. (2002); Jap and Ganesan (2000)
Contractual contingency adaptability (CA)	CA1 — Detailed approaches for unexpected situations; CA2 — Detailed approaches for conflicts.	Goo et al. (2009); Luo (2002)
Trust (TR)	TR1 — Trustworthy of other participants; TR2 — Ability of other participants to perform tasks; TR3 — Keeping promises; TR4 — Good reputation of other participants; TR5 — Believing provided information of other participants.	Lu et al. (2015)
Institutional support (IS)	IS1 — Building harmonious relationship among multiple stakeholders by the government; IS2 — Implementing policies and programs by the government.	Li and Atuahene-Gima (2001)
Relational behavior (RB)	1) Solidarity (RBS) RBS1 — Addressing problems jointly; RBS2 — Helping others; RBS3 — Committing to improving project relationship. 2) Flexibility (RBF) RBF1 — Flexible to changes; RBF2 — Flexible to conflicts. 3) Information sharing (RBI) RBI1 — Providing proprietary information; RBI2 — Updating information to other participants; RBI3 — Providing information frequently.	Hoppner and Griffith (2011)
Team performance (TP)	TP1 — Satisfied with the time performance; TP2 — Satisfied with the quality performance; TP3 — Satisfied with the cost performance; TP4 — Building long-term partnership; TP5 — Collaborating joint projects in the future.	Lu et al. (2015)
Project uncertainty (PU)	PU1 — Environmental uncertainty; PU2 — Task uncertainty; PU3 — Technological innovation.	Yan and Dooley (2013)

**TABLE 3.** Demographics of surveyed projects and respondents

Variable	Category	Number	Percentage
Types of respondent firms	Designer	106	52.48%
	Contractor	96	47.52%
Positions of respondents	Project directors	36	17.82%
	Project/team managers	77	38.12%
	Department/operation managers	89	44.06%
Project type	Transportation hub	99	49.01%
	Road	12	5.94%
	Bridge	10	4.95%
	Tunnel	9	4.46%
	Railway	6	2.97%
	Highway	2	0.99%
	Airport	13	6.44%
	Skyscraper	11	5.45%
	Dam	32	15.84%
	Public building (such as event facilities)	8	3.96%
Project location	North China	11	5.45%
	Northeast China	1	0.50%
	East China	98	48.51%
	South Central China	72	35.64%
	Southwest China	17	8.42%
	Northwest China	3	1.49%

**TABLE 4.** Descriptive statistics and correlations

Variables	1	2	3	4	5	6	7	8	9	10
1. Contractual term specificity	1									
2. Contractual contingency adaptability	0.70**	1								
3. Trust	0.49**	0.48**	1							
4. Institutional support	0.30**	0.17*	0.23**	1						
5. Relational behavior	0.45**	0.35**	0.48**	0.35**	1					
6. Project uncertainty	0.15*	0.10	0.31**	0.14	0.16*	1				
7. Team performance	0.27**	0.22**	0.35**	0.27**	0.57**	-0.06	1			
8. Project duration	0.01	-0.00	0.21**	-0.08	0.06	-0.01	0.11	1		
9. Project delivery method	0.14*	0.06	0.00	0.01	-0.05	-0.02	-0.15*	-0.05	1	
10. Prior collaborative experience	0.11	0.06	0.03	0.17*	0.06	0.03	0.15*	0.18*	0.10	1
Mean	4.04	3.78	3.91	4.16	3.83	3.55	3.87	1.53	1.29	0.71
Standard Deviation(S.D.)	0.53	0.68	0.52	0.57	0.36	0.64	0.42	0.50	0.79	0.45

Note: Sample size =202.

\*Significance at  $p < 0.05$  level.

\*\*Significance at  $p < 0.01$  level.

**TABLE 5.** Factor loading of each items, AVE and CR of each construct

Construct/item	Loading	<i>t</i> -value	AVE	CR
Contractual term specificity (TS)			0.66	0.85
TS1	0.84	27.71		
TS2	0.84	27.70		
TS3	0.74	14.87		
Contractual contingency adaptability (CA)			0.84	0.91
CA1	0.94	63.46		
CA2	0.89	30.62		
Trust (TR)			0.53	0.85
TR1	0.69	13.34		
TR2	0.71	16.17		
TR3	0.76	20.84		
TR4	0.66	12.19		
TR5	0.82	32.46		
Institutional support (IS)			0.71	0.83
IS1	0.88	20.11		
IS2	0.80	12.31		
Solidarity (RBS)			0.65	0.85
RBS1	0.85	35.60		
RBS2	0.71	15.05		
RBS3	0.85	42.29		
Flexibility (RBF)			0.86	0.92
RBF1	0.92	67.04		
RBF2	0.93	96.60		
Information exchange (RBI)			0.66	0.85
RBI1	0.76	19.87		
RBI2	0.87	43.34		
RBI3	0.81	23.68		
Team performance (TP)			0.61	0.88
TP1	0.84	35.07		
TP2	0.78	25.40		
TP3	0.73	21.78		
TP4	0.79	24.93		
TP5	0.75	20.48		

Construct/item	Loading	<i>t</i> -value	AVE	CR
Project Uncertainty (PU)			0.60	0.82
PU1	0.68	3.10		
PU2	0.85	4.58		
PU3	0.78	4.12		

Note: CR = composite reliability; AVE = average variance extracted.



**TABLE 6.** Standardized regression results <sup>a</sup>

	Model 1 <sup>b</sup>	Model 2	Model 3	Model 4
	$\beta$	$\beta$	$\beta$	$\beta$
Control variables				
<i>Project duration</i>	0.05	0.00	0.01	
<i>Project delivery method</i>	-0.05	-0.09	-0.09	
<i>Prior collaborative experience</i>	0.06	-0.01	-0.01	
Independent variables				
<i>Contractual term specificity (X1)</i>		0.25**	0.23**	
<i>Contractual contingency adaptability (X2)</i>		-0.01	-0.01	
<i>Trust (X3)</i>		0.31***	0.29***	
<i>Institutional support (X4)</i>		0.20***	0.19***	
<i>Relational behavior</i>				0.57***
Moderating variable				
<i>Project uncertainty (X5)</i>		-0.01	0.04	
Interaction terms				
<i>X1*X3</i>			0.19*	
<i>X2*X3</i>			-0.09	
<i>X1*X5</i>			-0.35***	
<i>X2*X5</i>			0.18 <sup>+</sup>	
<i>X3*X5</i>			0.13 <sup>+</sup>	
<i>R<sup>2</sup></i>	0.01	0.33	0.38	0.32
<i>F-value</i>	0.57	11.95***	8.99***	93.54***
<i><math>\Delta R^2</math></i>		0.32***	0.05**	

Note: N = 202

\*\*\* $p < 0.001$ ;

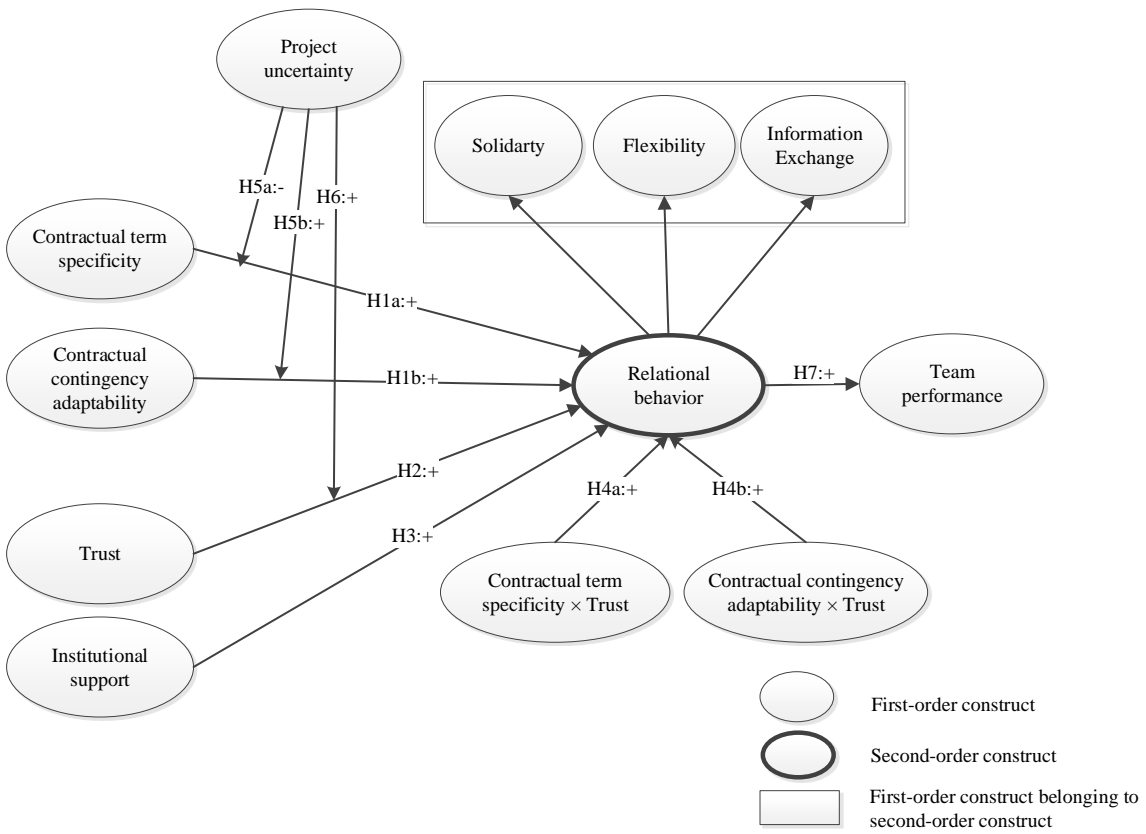
\*\* $p < 0.01$ ;

\* $p < 0.05$ ;

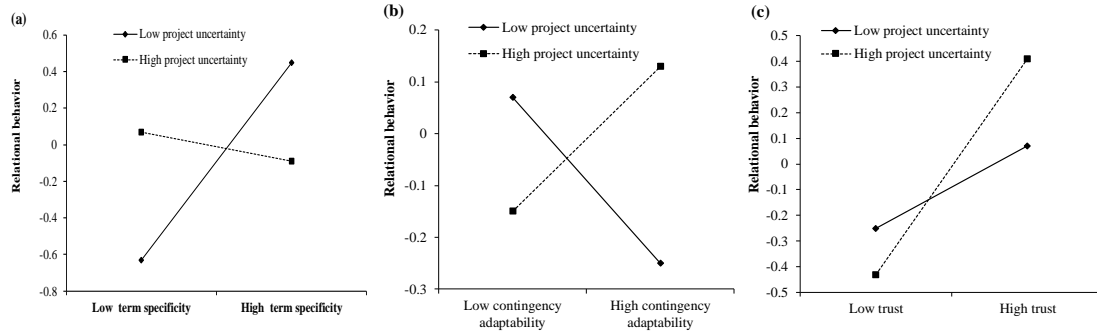
<sup>+</sup> $p < 0.1$  (two-tailed).

<sup>a</sup> The entries in the Table are standardized path coefficients.

<sup>b</sup> The dependent variable of Model 1 to Model 3 is relational behavior while the dependent variable of Model 4 is team performance.



**Fig.1.** Concept model of the effect of governance mechanisms on relational behavior.



**Fig.2.** Moderating effects of project uncertainty on the relationship (a) between contractual term specificity and relational behavior; (b) between contractual contingency adaptability and relational behavior; (c) between trust and relational behavior.

Notes: Low and high project uncertainty are equivalent to one standard deviation below and above the means of project uncertainty.