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Effects of contractual flexibility on conflict and project success in megaprojects

Effects of contractual flexibility

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Abstract

Purpose – This study aims to investigate the influence of contractual flexibility on different types of conflict, determine if contractual flexibility is significantly correlated with project success between contracting parties, verify the mediating effect of project conflicts on the relationship between contractual flexibility and project success and examine the relationship between different types of conflicts and project success in megaprojects.

Design/methodology/approach – A theoretical model was developed and a structured questionnaire survey was conducted with 468 professionals. The structural equation modeling technique was used to analyze the data.

Findings – The results showed that both types of contractual flexibility – term and process flexibility – were correlated with and significantly positively affected project success, and term flexibility was found to have a greater influence. The introduction of project conflicts significantly weakened the relationship between contractual flexibility and project success, verifying the partial mediating effect of conflicts. All types of project conflicts play a destructive role in achieving project success; relationship conflict had the largest negative effect. Contractual flexibility affects two paths with respect to project success: the direct path (contractual flexibility → project success) and the indirect path (contractual flexibility → conflict → project success). The direct effect of contractual flexibility on project success is positive; the corresponding indirect effect is negative. The direct effect is greater than the corresponding indirect effect.

Research limitations/implications – Different types of conflicts may mutually transform to extent certain degree. However, this study did not address the potential influence of conflict transformation on project success. The results implied that more emphasis should be placed on contractual terms, particularly on developing flexible terms in the contractual document, when implementing megaprojects. Meanwhile, this study reveals the effects of conflicts on project success in megaprojects, which provides a useful reference for project stakeholders to avoid the negative effect of conflicts.

Practical implications – This study provides a better understanding of the relationship between contractual flexibility, types of conflicts in megaprojects and a reliable reference for the project manager to effectively deal with these related issues. This implies the contracting parties strengthen communication and cooperation to establish a trust mechanism, while reducing the negative influence of project conflicts and enhancing the positive effect of contractual flexibility.



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Originality/value – Few studies have investigated the effects of contractual flexibility on conflict and project success in megaprojects; this study contributes significant theoretical and practical insights to contract management and conflict management and provides a reliable reference to achieve project success.

Keywords Structural equation modelling, Conflict, Project success, Megaproject, Contractual flexibility

Paper type Research paper

1. Introduction

With rapid socioeconomic development, an increasing number of megaprojects are being undertaken or have been implemented in China since 1998 (Tai *et al.*, 2009). The “megaproject” plays a growing important role in the national economy and social development (Kardes *et al.*, 2013). Megaprojects usually cost over US\$1bn and attract significant public and political attention because of their significant impact on the environment, society and economy (Hu *et al.*, 2016). Considerable challenges exist for the management of megaprojects. Due to the high complexity with fragmental and diversified traits, the practices in megaprojects significantly differ from those in conventional projects (Biesenthal *et al.*, 2017; Flyvbjerg, 2014; Li *et al.*, 2017). Diverse stakeholders are involved in megaprojects (Hu *et al.*, 2013; Oraee *et al.*, 2017), which presented significant demands on coordination (Hu *et al.*, 2016). It is important to coordinate heterogeneous stakeholders through a contracting process to resolve potential conflicts, such as unfair competition and inefficient resource allocation (Brookes *et al.*, 2017; Ma *et al.*, 2016). Indeed, megaprojects can be seen as sites of conflicting institutional logics brought to bear on their processes (Biesenthal *et al.*, 2017; Fahri *et al.*, 2015).

Managing megaprojects inevitably involves designing contracts between the project owner and one or more specialized contractors. Under such context, contract plays a crucial role to manage megaprojects. These contracts have significant impacts on the economic success of contracting parties (von Branconi and Loch, 2004). Due to the inherent nature, contracts of megaprojects are featured as long term, incomplete and complex. The contractually limited lifespan and temporary characteristic of megaprojects may lead to disputes or conflicts between contracting parties (Zaghloul and Hartman, 2003; Zeng *et al.*, 2015). Similarly, contracts can lead to time and cost overruns if a mechanism is not in place to resolve emerging conflicts on projects (Luo *et al.*, 2017a, 2017b; Olaniran, 2015; Olaniran *et al.*, 2016). It is not unusual that megaprojects experience 50 per cent, or even nearly 100 per cent, of cost overruns (Brady and Davies, 2014).

In addition, high levels of project complexity are positively associated with contract incompleteness and thus with an increased number of unexpected project changes (Tadelis, 2002). The changing and complex environmental conditions associated with megaprojects require flexible contractual terms to address predictable uncertainties (Meyer *et al.*, 2002; Pich *et al.*, 2002). Contractual flexibility helps to achieve greater efficiency, lower costs and minimize project risk (Wang *et al.*, 2017; White *et al.*, 2007). Flexibility in contractual terms tends to provide a framework for cooperation, rather than a hard framework based on risk and allocation. Flexibility in contracting process enables an effective response to the ever-changing circumstances by implementing flexible terms. It is a paradox that flexibility is frequently needed in megaprojects, but flexibility is rarely anticipated (Olsson, 2006).

Due to the high probability of failure in megaprojects (Jia *et al.*, 2011; Wei *et al.*, 2016), it is imperative to investigate the effects of contractual characteristics on conflicts and project success. Few studies have attempted to investigate whether contractual flexibility may affect conflicts and project success in megaprojects. Therefore, a conflict-based model was

developed, including different types of conflicts as the mediating variables to bridge this gap. This study investigated the relationship between contractual flexibility, types of conflicts and project success of megaprojects in China. The specific research objectives are as follows:

- to investigate the influence of contractual flexibility on different types of conflicts;
- determine whether contractual flexibility is significantly correlated with project success between contracting parties;
- verify the mediating effect of project conflicts on the relationship between contractual flexibility and project success; and
- examine the relationship between different types of conflicts and project success.

Very few existing studies have explored the effects of contractual flexibility on conflicts and project success in megaprojects. Therefore, this study can significantly contribute to theoretical and practical insights into contract management and conflict management and, thus, provide a useful reference on achieving project success in megaprojects.

2. Literature review

2.1 Contractual flexibility

Contracts for megaprojects are inevitably incomplete; arrangements are complex within dynamic project environments and high uncertainty (Meyer *et al.*, 2002; Pich *et al.*, 2002; Demirel *et al.*, 2017). Contracts aim at clarifying contracting parties' role and responsibilities, developing trust and encouraging commitments (Lui and Ngo, 2004; Luo, 2002a, 2002b). Current contractual relationships are mainly based on the assumption of confrontational situations, and the level of trust is reflected in the contract documents (Zaghloul and Hartman, 2003). Contract designs should incorporate flexibility to allow the parties to modify goals and measurement procedures over time (Rose and Manley, 2010). Traditionally, megaproject deals have been structured through long-term contracts, which promise to foster incentive alignment and promote durable investments (Schepker *et al.*, 2014). Contracts with flexible and incentivizing terms can motivate contracting parties to achieve project performance (Back *et al.*, 2013). However, the inflexibility and rigidity of contract terms can lead to contract cancellations midway (Susarla, 2012). Therefore, flexibility is often introduced into megaprojects contracts with relational methods. This prepares for future renegotiations and shapes the awareness for the need to accommodate problems that have not yet arisen (Badenfelt, 2011; Tirole, 2009; Nystén-Haarala *et al.*, 2010).

When considering megaprojects, contractual flexibility may relate to the quality of cost estimates, payment terms, schedule, performance guarantees, warranties and securities (von Branconi and Loch, 2004). A contract of high quality should contain term specificity and contingency adaptability (White *et al.*, 2007). Contracts in term specificity include detailed and specific terms, so that parties clearly understand their task, rights and obligations. Contingency adaptability describes how the contracting parties will respond to potential problems and conflicts, and provides guidelines (such as principles, procedures and solutions) on how to handle certain contingencies. According to Olsson (2006) and Nystén-Haarala *et al.* (2010), contract documents must contain flexible terms to address unanticipated contingencies, as well as flexibility in contracting process. Incentives, price compensation and risk allocation terms that encourage cooperative behaviors between contracting parties are essential for megaprojects; this is needed to motivate the contracting parties to execute a signed contract (Athias and Saussier, 2007; Dong and Chiara, 2010; Levin and Tadelis, 2010). If the owner ignores the importance of cooperative relationships, flexible terms in contract documents cannot guarantee the achievement of project success (Rose and Manley, 2011).

Consistent with contract theory, Cruz and Marques (2013) proposed a double entry matrix, based on real options theory, as a new model for contractual flexibility. Ghosh *et al.* (2012) considered the main elements of construction project structure as organizational setting, communication, relationship governance, leadership and contractual interactions. Contracts are more rigid and detailed if parties do not have previous cooperative experiences with another party (Girmscheid and Brockmann, 2010). Proper contractual flexibility can provide a sound atmosphere and incentive mechanism for megaprojects. Avoiding project conflicts and disputes require an understanding of the terms of contractual documents and early communication (Semple *et al.*, 1994). By analyzing flexible contract terms, Weber *et al.* (2011a, 2011b) revealed that contract design could affect the behavior of contracting parties when executing the contract. Yi-Renko *et al.* (2001) proposed that flexibility in contracting process occurs when contracting parties are willing to substitute the contract for relationship quality that adopts the changing and complex environment, and can be measured by the number of informal contracts. Relationship quality depends on a dynamic change in commitment, trust, collaboration and communication between contracting parties during the contract cycle (Chan *et al.*, 2004; Hu *et al.*, 2013).

Therefore, contractual flexibility is the ability of the contracting parties to make adjustments that achieve expected outcomes when faced with project uncertainties. It can be observed as flexibility in contractual terms (term flexibility) and flexibility in contracting process (process flexibility) (Nystén-Haarala *et al.*, 2010; White *et al.*, 2007). Term flexibility refers to the quality of cost estimates, payments terms, schedule and incentive mechanisms as flexible elements in contractual documents that are negotiated between contracting parties (Nystén-Haarala *et al.*, 2010). Process flexibility refers to the favorable relationship, mutual trust and effective communication between the contracting parties as flexible elements (Nystén-Haarala *et al.*, 2010). Contractual flexibility allows the participants to flexibly address the unforeseeable contingencies when executing the signed contract.

2.2 Project conflict

Conflict is a complicated social and psychological phenomenon, and scholars have developed diverse definitions based on different perspectives. Thomas (1974) defined conflict as a process that begins when one party perceives that the other has frustrated, or is about to frustrate, some concern or benefit. Wall and Callister (1995) defined conflict as a process during which one party perceives his concerns are opposed or frustrated by the other. Wang *et al.* (2012) proposed that conflict is a state, such as inharmonious phenomena of hostile action, or a state of confrontation in cognition or emotion. The traditional view of conflict emphasizes objective opposition in competitive situations, and assumes that conflict is generated because there are opposite benefits (Jehn, 1995). In cooperative groups with common goals, however, conflict may still arise even though there are no actual contradictions in objectives (De Dreu, 2007). Conflict can be classified into two groups: collaborative conflict with common goals and competitive conflict where there is a contradiction in objectives (Hemple *et al.*, 2009; Wong *et al.*, 1999). In megaprojects, conflict is more likely to be collaborative conflicts, similar to substantive conflict. The internal conflict is usually related to contracting parties' behaviors and is closely associated with project success (Wu *et al.*, 2017b).

Common types of conflicts in construction projects include task-oriented conflict, disputes related to material benefits, relationship-oriented conflict and underlining interpersonal relationship (Pinkley and Northcraft, 1994). Amason *et al.* (1995) and Amason (1996) further defined these types of conflicts as cognitive conflict and emotional/affective conflict. Cognitive conflict, related to tasks, is a kind of disagreement or expression of

different views. In a project context, cognitive differences are inevitable. Emotional conflict is interpersonal conflict due to personalities (Kunaviktikul *et al.*, 2000), interpersonal relationships (Sommerville and Langford, 1994) and misunderstandings (Boardman and Horowitz, 1994). Task conflict is rational behavior toward objects, while the interpersonal conflict is emotional behavior toward subjects (Jehn, 1995).

Jehn further classified conflicts into three types: task conflict, relationship conflict and process conflict (Jehn and Mannix, 2001; Jehn and Bendersky, 2003). While both task conflict and process conflict are task-oriented, task conflict focuses on different views on project content and goals, whereas process conflict highlights process differences throughout task fulfillment. Lee *et al.* (2015) suggested that task-related conflict serves as a catalyst for collaboration, while process- and relationship-related conflicts impede collaboration. Hjerto and Kuvaas (2017) further divided task conflict into cognitive task conflict and emotional task conflict.

Conflicts inevitably occur in megaprojects, due to opposite or divergent project interests and objectives (e.g. quality, schedule, cost and safety) among the owner, the contractor and other project participants throughout project implementation (Yiu and Cheung, 2007; Hartwick *et al.*, 2004; Wei *et al.*, 2016). Different levels and types of conflicts involve both interactional and intertwined relationships, and can carry out the conversion under certain conditions. Huang (2010) surveyed 529 staff members from 120 research and development (R&D) teams and concluded that approaching conflict management with a goal orientation moderated the relationship between task conflict and relationship conflict. Mele (2011) proposed that different types of conflicts can be transformed, and affect project network value differently. Chen *et al.* (2014) found that relationship conflict, process conflict and task conflict are all positively correlated. Hu *et al.* (2017) found that relationship conflict has a negative relationship with team creativity, whereas task conflict has an inverted U-shaped relationship with team creativity. Therefore, this study specified project conflict in the construction setting as task conflict, relationship conflict and process conflict.

2.3 Project success

Project success has been an important topic in construction management area for many years, and recent developments have combined multiple social and psychosocial factors to supplement definitions of project success (Fahri *et al.*, 2015; Williams, 2016). One key topic focuses on defining project success criteria and contributing factors. Ika (2009) argued that project success includes owner satisfaction, the realization of the owner's strategic objectives, end-user satisfaction and the satisfaction of other stakeholders. Osei-Kyei *et al.* (2017) proposed that the following factors help achieve project success: effective risk management, meeting output specifications, reliable and quality service operations, adherence to schedule, satisfying the need for a public facility/service, long-term relationship and partnership and profitability. Other scholars have suggested that project success must include benefits to the stakeholder group, client/customer specific issues and the "iron triangle", which includes cost, time and quality (Davis, 2017; Nguyen and Hadikusumo, 2017; Niekerk and Steyn, 2011). Carvalho and Rabechini (2017) proposed that there are various aspects of project success such as project efficiency, impact on the clients, impact on the staff, direct business and success, environment damages reduction and preparation for the future. Project success is a broad concept for a megaproject as it includes not only the project implementation process but also the project's influence after completion.

Megaprojects are large-scale, complex investment structures, take many years to complete, involve multiple stakeholders and impact millions of people (Molenaar, 2005; Flyvbjerg, 2014). Megaprojects face several challenges to be a successful completion, including difficulties with financial and contractual arrangements, which are usually

difficult to implement and develop (Mboumoua, 2017; Olaniran *et al.*, 2015). Megaproject success is typically assessed when the construction project has reached its objective, and it is usually evaluated in terms of the traditional iron triangle. The targets for these measures are defined during the scoping phase of the project (Fahri *et al.*, 2015; Luo *et al.*, 2017b). Toor and Ogunlana (2009, 2010) proposed that the traditional criteria of the iron triangle are no longer appropriate for measuring megaproject success. Instead, other indicators are becoming more critical: safety, efficient use of resources, effectiveness, the satisfaction of stakeholders and reduced conflicts and disputes.

Mazur *et al.* (2014) defined project success holistically as a project's ability to meet its operational and stakeholder objectives. This definition emphasizes the people side of project success, rather than the iron triangle alone. del Puerto and Shane (2014) proposed that contracts, commitment, project environment, public outreach and recognition of circumstances, all contribute to project success. Sato and Chagas (2014) proposed five criteria for project success: efficiency, impact on the customer, impact on team, business and direct success and preparation for the future. Other researchers have suggested that factors such as customer satisfaction and culture (Williams, 2016), workforce renewal and training (Fayek *et al.*, 2006), adequate communication and mutual understanding of stakeholders (Toor and Ogunlana, 2009), stakeholder satisfaction and future potential (Joslin and Müller, 2016) are perceived as critical for megaproject success.

Megaprojects are often categorized as large investments, with complex construction and timeframes, as well as involvement of various types of stakeholders (He *et al.*, 2015; Jia *et al.*, 2011; Kardes *et al.*, 2013); they tend to experience time and cost overruns and may fail to meet their stated objectives (Flyvbjerg, 2014). Therefore, facilitating success requires considering critical success factors, such as specific conditions, trust, conflict, culture and circumstances (Jiang *et al.*, 2016; van Marrewijk, 2007; Wu, 2013).

2.4 Knowledge gap

The extensive literature review suggests that very few existing studies focused on the interactions between contractual flexibility, conflicts and projects success in the context of megaprojects. This presents a gap in the knowledge relating to contract and conflict managements. To fill the knowledge gap, this study attempts to develop a theoretical model and validate it through the empirical data collected from a questionnaire survey.

3. Hypothesis development and theoretical model

3.1 Hypotheses development

3.1.1 Term flexibility and project conflict. Relevant studies have addressed the tasks of defining project scope, breaking down the megaproject into several manageable packages and outsourcing these work packages to contractors (Hu *et al.*, 2013; Toor and Ogunlana, 2010). Introducing flexible terms in contractual documents could decrease risk and uncertainty, and lead to a better cooperative relationship (Demirel *et al.*, 2017). Given these conditions, contractual flexibility is critical for managing conflict in megaprojects. When confronted with a foreseeable contingency, the contracting parties can cope with it based on flexible terms in the documents without the owner's permission. Under this circumstance, if the flexibility is appropriate, the contingency may obtain good results. Megaprojects are always affected by changing circumstances due to high levels of dynamic complexity (Hwang and Low, 2012). The flexibility causes disruption in the construction process; however, negotiation between the contracting parties may be needed. Flexible terms in contractual documents may still cause misunderstandings between the contracting parties, leading to adversarial relationships and contractual disputes (Chapman, 2016).

When rigid and flexible terms are balanced in the contractual document, and the contract is signed by equals, appropriately flexible terms may motivate the contracting parties to adopt collaborative behaviors, influencing task conflict (Ng *et al.*, 2007). However, too many task-related disputes may lead to delays due to a compressed schedule. Programmatic elements of megaprojects are complicated, and an explicit method is needed to break down the structure and allocate tasks. Flexible terms may result in misunderstandings about rights and assignments between contracting parties. Furthermore, megaprojects involve numerous stakeholders, many of whom may be collaborating for the first time. The owner tends to design a more complete and rigid contract with the other party (Hart and Moore, 2004). Establishing a trust mechanism between contracting parties is difficult, which may lead to disputes and tensions, and even relationship conflict. Therefore, the study proposed the following hypotheses:

H1a. Flexibility in contractual terms positively affects relationship conflict.

H1b. Flexibility in contractual terms positively affects task conflict.

H1c. Flexibility in contractual terms positively affects process conflict.

3.1.2 Process flexibility and project conflict. Contractual arrangements that bond contracting parties revitalize a shared understanding of contractual terms (Chang *et al.*, 2013). Contracts for megaproject are highly complex; this complexity extends to project conflicts (Kardes *et al.*, 2013; Zhang *et al.*, 2016). Contracts of megaprojects are typically used in contexts of great uncertainty and changing circumstances. Flexibility in contracting process is, therefore, dependent on the mutual trust mechanism, the ability to address possible contingencies and their solutions. When confronted with an unexpected change in the megaproject's external environment, the contracting parties can respond based on predetermined rules. The availability of flexibility in contracting process provides contracting parties with a better understanding of the challenges. If there are mutual trust and effective communication between contracting parties, process flexibility can introduce agile implementation into the contracting process. Megaprojects always have complex contracting processes involving numerous stakeholders (Gkeredakis, 2014). Many stakeholders may be collaborating for the first time, which may undermine the "trust-based" process flexibility. Flexibility in contracting process also initiates discussions about process and task arrangements in megaprojects, stimulating process and task conflicts. The complexity of project task prompts the contracting parties introducing new knowledge and solutions; thus, task conflicts may occur. Due to the opposite or divergent interests and objectives of the various stakeholders, process conflicts are likely to occur when implementing contracts with flexibility. As there is a lack of mutual trust mechanism between contracting parties, flexibility in contracting process may create moral hazards, generating relationship conflict. These points led to the following hypotheses:

H2a. Flexibility in contracting process positively affects relationship conflict.

H2b. Flexibility in contracting process positively affects task conflict.

H2c. Flexibility in contracting process positively affects process conflict.

3.1.3 Contractual flexibility and project success. An appropriate contract structure, with clear and equitable contractual terms, does not ensure project success because the attitudes of the contracting parties and the relationships among the project participants are also equally important (Chapman, 2016; Ke *et al.*, 2015; Rahman and Kumaraswamy, 2002). When studying the contract issues on achieving project success, Suprpto *et al.* (2016) found that projects with incentive contracts achieved better performance than those without flexible terms. Chen *et al.* (2016) proposed that different project characteristics have an interacting

influence on contract types, impacting project success. Project contracts can enable and facilitate stakeholder communication and action, and affect negotiations (Alderman *et al.*, 2005; Koskinen and Mäkinen, 2009). Contract governance is a critical element of project governance, accounting for 22 per cent of project success (Joslin and Müller, 2016; Müller *et al.*, 2017; Zhang *et al.*, 2016). Wang and Chen (2006) showed how the contractual flexibility mediates relationship-based project hazards and project success. Domingues *et al.* (2014) found that contractual flexibility is more likely to contribute to the project's success when implemented in the contract design. Cai *et al.* (2015) proposed flexibility in contractual terms can maximize the expected profits of stakeholders from a supply chain point of view. Contractual flexibility can reduce opportunistic behavior and establish trust mechanisms between contracting parties, providing necessary resources and authority for project success (Brockmann *et al.*, 2016; Liu *et al.*, 2016b). Furthermore, the changing and complex environment of megaprojects requires contractual flexibility to address foreseeable uncertainty. Contractual flexibility provides a framework for cooperation, rather than hard and precise risk and reward allocation. Therefore, the following hypotheses were developed:

H3a. Flexibility in contractual terms positively affects project success.

H3b. Flexibility in contracting process positively affects project success.

3.1.4 Project conflict and project success. Megaprojects are generally characterized by huge investments, unique and complicated designs, high risk, multiple project interfaces with complex contractual arrangements and significant economic and social impacts (Chung *et al.*, 2009). These characteristics require a higher level of stakeholder engagement and collaboration, generating more intensive conflict compared to ordinary projects. Relationship conflicts arising from interpersonal problems, friction and personality clashes cause contracting parties to work less effectively and may negatively influence project success (Wu, 2013; Wu *et al.*, 2017a). For long-term cooperation, coordinating processes are more important. As such, megaprojects may require systematic and continuous process documentation, as too many task conflicts may result in inefficiencies (Nystén-Haarala *et al.*, 2010). Different types of conflicts have different impacts on project success (Puck and Pregel, 2014). Senaratne and Udawatta (2013) concluded that both process and relationship conflict have disruptive effects on construction projects. Brockman (2014) found that relationship conflict weakened project success; this finding was also supported by Zhang and Huo (2015). Chen *et al.* (2014) found that relationship conflict negatively impacted project success, and task conflict influenced project success in an inverse-U-shaped manner. Wu *et al.* (2017a, 2017b) proposed that relationship conflict and process conflict were negative effects on construction projects. Project conflicts are usually perceived as destructive to megaprojects. Therefore, the following hypotheses were proposed:

H4a. Relationship conflict negatively affects project success.

H4b. Task conflict negatively affects project success.

H4c. Process conflict negatively affects project success.

3.2 Model framework

Megaprojects involve diverse stakeholders with different objectives. Many soft factors, such as commitment, trust and communication, are investigated and analyzed for their effects on project success. The role of contractual flexibility in influencing project success remains equivocal. Contractual flexibility leads to potential disagreements and conflicts with respect to contractual terms and contracting processes, and affects project success in megaprojects.

Hence, there appears a close relationship between contractual flexibility, conflicts and project success. In light of this, this study has set project conflict as an intermediate variable, proposing that contractual flexibility could directly and indirectly influence project success. On the basis of the systematic review and hypotheses, a theoretical model was constructed to describe the relationship between contractual flexibility, conflicts and project success in megaprojects (Figure 1).

4. Method and data presentation

4.1 Questionnaire design

To achieve the research objective, a questionnaire was designed to assess four categories:

- (1) contractual flexibility;
- (2) project conflict;
- (3) project success; and
- (4) basic information on survey respondents, including their designations, work experience, project information and enterprise background.

The contractual flexibility scale was designed in accordance with previous studies (Athias and Saussier, 2007; Cruz and Marques, 2013; Demirel *et al.*, 2017; Nystén-Haarala *et al.*, 2010; Susarla, 2012). The project conflict scale was designed using relevant literature (Chen *et al.*, 2014; Ng *et al.*, 2007; Wu, 2013; Wu *et al.*, 2017b; Zhang and Huo, 2015), as was the project success scale (Jiang *et al.*, 2016; Luo *et al.*, 2017b; del Puerto and Shane, 2014; Sato and Chagas, 2014). Variable measures were developed based on a systematic literature review and on-site interviews with experts. To verify the factors derived from the literature review, and to ensure their applicability within the context of Chinese megaprojects, face-to-face interviews with experts were conducted. Experts participating in megaprojects were interviewed to provide information to support the indicators of contractual flexibility, types of conflicts and project success. A total of 11 experts were selected from different departments; all interviewees had participated in megaprojects. Two rounds of face-to-face discussions were conducted to obtain consolidated views. Table I summarizes the experts' backgrounds. The items in the research scales were modified to reflect megaproject characteristics and interview

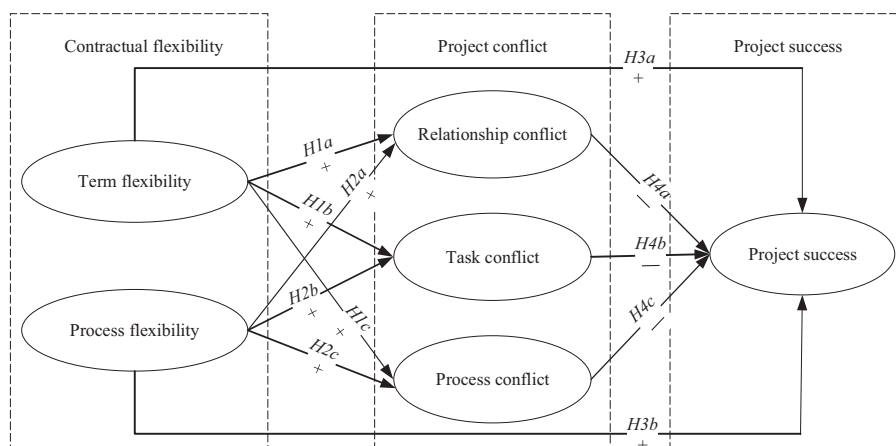


Figure 1.
Theoretical model underlying empirical research

Interviewee no.	Employer	Position	Year of experience
1	Contractor	Chief engineer	5
2	Contractor	Project manager	12
3	Contractor	Process manager	8
4	Contractor	Project management	15
5	Owner	Contract manager	10
6	Owner	Civil budgeting engineer	6
7	Owner	Civil engineer	5
8	Consultant	Civil engineer	20
9	Consultant	Deputy general manager	26
10	Supervision company	Supervision engineer	18
11	Designing institute	Design director	31

Table I.
Background of
experts

insights. All variable measurements in the resulting questionnaire were measured using a five-point Likert scale (i.e. 1 = strongly agree; 5 = strongly disagree).

4.2 Pilot test

The aim of the pilot test was to verify and revise the draft questionnaire. The pilot test was implemented in Zhejiang, Jiangsu and Shanghai in China. Potential survey respondents included people with work experience on megaprojects. A total of 200 questionnaires were sent through email and express delivery, and 135 were returned. After checking the validity of all returned questionnaires, 98 questionnaires were selected, yielding a selection rate of 49 per cent (98/200). The pilot test included three steps. First, the corrected-item total correlation and Cronbach's α were used to clear all variable-measuring items. Second, the Kaiser–Meyer–Olykin (KMO) and Bartlett tests were adopted to assess whether factor analysis could be used. The third step was to perform the exploratory factor analysis. The three steps of the pilot test identified both valid and invalid measures. The analysis results are shown in [Table II](#). After rectifying all measures, the questionnaire was prepared for large-scale sampling ([Table III](#)).

As there was no sampling frame in this survey, a non-probability sampling plan was used. The use of a non-probabilistic sample is due to the need for ease of access to project data and respondents. The use of such a sample was considered to be appropriate because the respondents were chosen not randomly from the population but based on their willingness to participate in the study ([Carvalho and Rabechini, 2017](#); [Wilkins, 2011](#); [Zhao et al., 2013](#)). The sample mainly consists of owner teams, contractor teams, consultant teams and designer teams from different megaprojects. Questionnaires were sent to 200 identified project managers, all of whom agreed to participate in this survey. Each project manager was asked to distribute questionnaires to four members of his/her team. To ensure the availability of the results, no more than five respondents were from the same team. This method was applied in the studies of a similar nature ([Liang et al., 2010](#); [Stewart, 2006](#)). Finally, a total of 1,000 questionnaires were distributed. A total of 512 responses were received. Of these, 468 were usable and were prepared for reliability and validity analysis and structure equation modeling (SEM) analysis. The data were also tested for normality using skewness and kurtosis analyses. The results showed that absolute values of skewness and kurtosis satisfied the normal distribution, and were suitable for further analysis. After these validation tests, a brief statistical analysis was conducted, with a summary of categories and levels shown in [Table IV](#).

Variables	Measurements	Factor loading	Cronbach's α	KMO	Variance explained (%)	Effects of contractual flexibility
Term flexibility	TF-1	0.68	0.80	0.83	66.0	
	TF-2	0.55				
	TF-3	0.54				
	TF-4	0.50				
	TF-5	0.67				
	TF-6	0.61				
	TF-7	0.51				
	TF-8	0.56				
Process flexibility	PF-1	0.55	0.75	0.75	65.1	
	PF-2	0.51				
	PF-3	0.50				
	PF-4	0.52				
	PF-5	0.71				
	PF-6	0.57				
Relationship conflict	RC-1	0.60	0.69	0.62	65.9	
	RC-2	0.58				
	RC-3	0.59				
	RC-4	0.59				
	RC-5	0.62				
Task conflict	TC-1	0.62	0.80	0.76	67.8	
	TC-2	0.53				
	TC-3	0.60				
	TC-4	0.56				
	TC-5	0.58				
	TC-6	0.61				
Process conflict	PC-1	0.61	0.85	0.86	68.0	
	PC-2	0.67				
	PC-3	0.56				
	PC-4	0.65				
	PC-5	0.56				
	PC-6	0.59				
Project success	PS-1	0.70	0.90	0.91	72.0	
	PS-2	0.73				
	PS-3	0.72				
	PS-4	0.73				
	PS-5	0.71				
	PS-6	0.77				
	PS-7	0.71				
	PS-8	0.81				
	PS-9	0.75				
	PS-10	0.70				
	PS-11	0.73				

Table II.
Results of the pilot test

5. Results

5.1 Validity and reliability test

The measurement models provide the relationships between contractual flexibility, conflict and project success (the observable variables) and their respective groupings (the latent variables) (Coltman *et al.*, 2008). This study is aligned with the reflective model because an observed variable on measurements reflects the latent variables and a plus error (MacCallum and Browne, 1993), and the direction of relationships goes from the latent variables to the observable variables (Peterson *et al.*, 2017). SEM was applied to investigate

Variables	Measured items
Term flexibility	TF-1: The contract contains engineering change and project termination terms TF-2: The contract contains price adjustment and compensation terms TF-3: The benefits of contractual parties are directly related to project performance TF-4: The contract contains soft terms for dealing with contingencies TF-5: The contract contains incentive terms to motivate the contractual parties TF-6: The contract contains renegotiation terms to modify the unadaptable terms TF-7: The contract includes terms about preventing and dealing with disputes TF-8: The contract contains flexible cost and schedule terms
Process flexibility	PF-1: We can execute the flexible terms without other parties' permission PF-2: We can adopt a quick response with a foreseeable contingency using a predetermined rule PF-3: We do not transfer the risk to the other party when faced with uncertainty PF-4: We are conscripted to execute contractual terms, even though the project environment changed PF-5: We can effectively deal with unforeseeable contingency with other parties PF-6: There is a concession between contractual parties when faced with a project damage
Relationship conflict	RC-1: There are many personality clashes between your party and the other party RC-2: There are many disputes between your party and the other party RC-3: The other party often withholds information necessary to attain your party's tasks RC-4: There is a significant personal friction between your party and the other party RC-5: There is much emotional conflict between your party and the other party
Task conflict	TC-1: There is much conflict about ideas for the project design and construction TC-2: There are always significant conflicts about ideas for the project goal setting TC-3: There are significant conflicts about the task between your party and the other party TC-4: The other party often disagrees with opinions regarding the work being undertaken TC-5: The other party often has disagreements about the task of the project you are working on TC-6: The other party often has conflicting opinions about the task of the project you are working on
Process conflict	PC-1: The other party always assists your party to accomplish your tasks PC-2: We often assist the other party to accomplish their tasks PC-3: There is much cooperation between your party and the other party PC-4: There are many disagreements about who should do what during the execution of the project PC-5: There is much conflict between your party and the other party about task responsibilities PC-6: Your party often disagrees on resource allocation during the project execution
Project success	PS-1: This project progress follows schedule PS-2: This project is within budget PS-3: The project deliverable meets the client's objectives PS-4: This project has qualified acceptance and successful delivery PS-5: The project can solve most problems encountered during the project execution PS-6: The project process is satisfactory PS-7: This project creates positive impacts for end users PS-8: This project creates positive impacts on ecological environment PS-9: We are optimistic about the success of this project PS-10: We are likely to cooperate with the other party again in the future PS-11: The project satisfied the client's special requirements

Table III.
 Measurements for contractual flexibility, conflict and project success

Characteristic	Category	Frequency	(%)	Effects of contractual flexibility
Work experience	<5 years	98	20.9	
	5-10 years	124	26.5	
	10-20 years	173	37.0	
	>20 years	73	15.6	
Designation	Project manager	111	23.7	
	Department manager	92	19.7	
	Project engineer	126	26.9	
	Professional manager	97	20.7	
	Others	42	9.0	
Project type	Hydroelectric project	147	31.4	
	Road and bridge project	155	33.1	
	Residential project	88	18.8	
	Others	78	16.7	
Project size	<10bn CNY	91	19.4	
	10-50bn CNY	178	38.0	
	50-100bn CNY	102	21.8	
	100-200bn CNY	75	16.0	
	>200bn CNY	22	4.7	
Project duration	<5 years	134	28.6	
	5-10 years	269	57.5	
	>10 years	165	35.3	

the relationship between contractual flexibility, conflict and project success. The SEM has been demonstrated to be an appropriate tool to tackle relationships among variables (Jiang *et al.*, 2016; Zhao *et al.*, 2015), and is widely used in construction management research (Liu *et al.*, 2016a; Luo *et al.*, 2017b; Zhao and Singhaputtangkul, 2016). AMOS 21.0 was used to conduct a certainty factor analysis of the contractual flexibility dimension, conflict dimension and project success. This generated item reliability metrics and the factor construct reliability (CR). Variable measurement items with standardized coefficients below 0.5 were removed. CR was used to reflect the consistency among measurement items. A CR greater than 0.6 indicated good construct reliability. Average variance extracted (AVE) was used to examine convergence validity; an AVE greater than 0.5 indicated good convergence validity of the variable measurement items. Indicators such as chi-square static $\chi^2/\text{degrees of freedom}$ (χ^2/DOF), root mean square error of approximation (RMSEA), goodness-of-fit index (GFI), comparative fit index (CFI), adjusted goodness-of-fit index (AGFI), incremental fit index (IFI) and the normed fit index (NFI), were used to assess goodness-of-fit.

All indicators in each category of variables met the requirements. The standardized coefficients of all the questions were above 0.7. The CR of each potential variable exceeded 0.8, suggesting a high overall reliability of measurement items and high internal consistency. Furthermore, the AVE of each potential variable was above the threshold of 0.6, indicating good convergence validity. The results of the certainty factor analysis are shown in Table V. On the basis of the analysis, the reliability of each variable and the factor construct reliability met the requirements, and SEM could be used to test the constructed theoretical model. In addition, the chi-square method was used to check non-response biases, and the Harman one-factor test was applied to check the common method bias. The results showed a significant heterogeneity between variables, and the data could be seen as low common bias.

Variables	Measurements	Standardized coefficient	CR	AVE	Fitness indicators
Term flexibility	TF-1	0.79	0.92	0.62	$\chi^2/\text{DOF} = 3.58$ RMSEA = 0.074 GFI = 0.92 AGFI = 0.89 NFI = 0.97 IFI = 0.98
	TF-2	0.80			
	TF-3	0.73			
	TF-4	0.76			
	TF-5	0.89			
	TF-6	0.76			
	TF-7	0.79			
	TF-8	0.76			
Process flexibility	PF-1	0.93	0.87	0.63	
	PF-2	0.78			
	PF-3	0.78			
	PF-4	0.75			
	PF-5	0.79			
	PF-6	0.77			
Relationship conflict	RC-1	0.91	0.93	0.76	$\chi^2/\text{DOF} = 3.12$ RMSEA = 0.082 GFI = 0.89 AGFI = 0.86 NFI = 0.96 IFI = 0.97
	RC-2	0.87			
	RC-3	0.83			
	RC-4	0.87			
	RC-5	0.85			
Task conflict	TC-1	0.83	0.90	0.74	
	TC-2	0.74			
	TC-3	0.81			
	TC-4	0.77			
	TC-5	0.81			
	TC-6	0.86			
Process conflict	PC-1	0.80	0.93	0.64	
	PC-2	0.82			
	PC-3	0.77			
	PC-4	0.85			
	PC-5	0.83			
	PC-6	0.75			
Project success	PS-1	0.79	0.92	0.62	$\chi^2/\text{DOF} = 3.06$ RMSEA = 0.081 GFI = 0.98 AGFI = 0.91 NFI = 0.98 IFI = 0.98
	PS-2	0.76			
	PS-3	0.76			
	PS-4	0.78			
	PS-5	0.76			
	PS-6	0.78			
	PS-7	0.76			
	PS-8	0.73			
	PS-9	0.72			
	PS-10	0.79			
	PS-11	0.77			

Table V.
Results of certainty
factor analysis

5.2 Structural model test

Table VI and Figure 2 show the results of the SEM model test. Most fit indices fulfill the requirements. Specifically, χ^2/DOF was 1.77, less than the target of 3. RMSEA was 0.041, less than the target of 0.05. NFI, IFI, AGFI and CFI were 0.96, 0.98, 0.91 and 0.98, respectively. All these values were greater than 0.9.

5.3 Mediating effect of project conflict

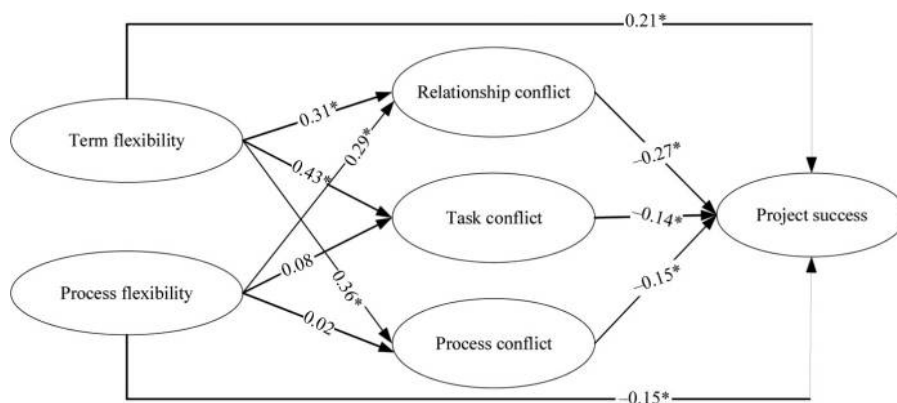
The next step of this study was to verify the mediating effect of project conflict on the relationship between independent variables (term and process flexibilities) and project

Effects of contractual flexibility

Influence category	Relationship between variables	Standardized coefficient		Hypotheses supported
		Model 1	Theoretical model	
Independents on the dependent variables	Terms flexibility → Project success	0.30*	0.21*	<i>H3a</i> : supported
	Process flexibility → Project success	0.26*	0.15*	<i>H3b</i> : supported
Independents on the intermediate variables	Terms flexibility → Relationship conflict	–	0.31*	<i>H1a</i> : supported
	Terms flexibility → Task conflict	–	0.43*	<i>H1b</i> : supported
	Terms flexibility → Process conflict	–	0.36*	<i>H1c</i> : supported
	Process flexibility → Relationship conflict	–	0.29*	<i>H2a</i> : supported
	Process flexibility → Task conflict	–	0.08	<i>H2b</i> : not supported
	Process flexibility → Process conflict	–	0.02	<i>H2c</i> : not supported
Intermediate variables on the dependent variables	Relationship conflict → Project success	–	–0.27*	<i>H4a</i> : supported
	Task conflict → Project success	–	–0.14*	<i>H4b</i> : supported
	Process conflict → Project success	–	–0.15*	<i>H4c</i> : supported

Note: * $p < 0.05$

Table VI.
Verification of the mediation effect of contractual flexibility on project success



Note: *Indicates $p < 0.05$

Figure 2.
SEM test results of the theoretical model

success. Therefore, we verified the model where the independent variables directly influence project success (Model 1), and the model with intermediate variables (Theoretical Model). Table VI compares the standardized path coefficients of these two models. Model 1 demonstrated that variables related to contractual flexibility were significantly related to project success. The results of the theoretical model showed that:

- the variable of term flexibility was significantly related to each dimension of project conflict;
- each dimension of project conflict was significantly related to project success; and

- the introduction of conflict considerably weakened the relationship between the independent and dependent variables.

Hence, this study verified the mediating effect of conflict, as described by [Baron and Kenny \(1986\)](#).

6. Discussion

6.1 *Effects of contractual flexibility on conflicts*

On the basis of standardized path coefficients and variable significances, all hypotheses except for *H2b* and *H2c* were supported. This study found that contractual flexibility positively affected project conflict, while previous studies ([Ng et al., 2007](#); [Toor and Ogunlana, 2010](#)) proposed that contractual flexibility may weaken the conflict. This result may be attributed to the incomplete nature of contracts and the attitudes of the contracting parties in megaprojects ([Chapman, 2016](#)). Due to the complexity of internal and external project environments, many unforeseeable contingencies may emerge, which must be addressed properly and effectively. When a predetermined rule is not contained in the contractual terms, the contracting parties may be unwilling to cope with the contingency. As per Chinese routines, if process rules are not contained in the contractual terms, the contracting parties may not confront the contingency. Even terms that are not suitable and may damage the megaproject may still be executed by contracting parties because the contracting parties are not responsible for the loss. In addition, even if contracting parties believe an activity is beneficial for the megaproject, they may not execute that activity if the contract does not include it. Therefore, the contracting parties do not pay much attention to the process and task because it may cause tension between them. Therefore, flexibility in contracting process does not significantly influence task conflict and process conflict.

Megaprojects are usually very complicated in nature and include complicated relationships between the contracting parties. Furthermore, the large investments and changing environment compel contracting parties to clear their own authorities, obligations and responsibilities. Contractual arrangements coupled with clear and equitable terms are most appropriate to address project conflicts in megaprojects. China is a relationship-based society, with a lack of effective supervisory mechanisms. As such, contracting parties are more likely to cope with project conflicts when they are based on favourable relationships. Contractual flexibility represents an agile implementation of the contracting process and may obscure the contracting parties' authority, obligation and responsibility. This can intensify project conflict in megaprojects.

6.2 *Effects of contractual flexibility on project success*

The main function of contractual flexibility is to motivate cooperation and collaborative behavior between contracting parties. [Herold \(2010\)](#) argued that complete contracts can indicate low mutual trust and usually lead to conflicts. This study does not support that viewpoint. Constructing megaprojects is a complex and unique task, and project conflict is inevitable. This research found that contractual flexibility was positively related to the project success, while the introduction of project conflict considerably weakened the relationship between contractual flexibility and project success. In the theoretical model, contractual flexibility could affect the project success via two paths. The influence coefficient of the direct path (contractual flexibility \rightarrow project success) was 0.36; the influence coefficient of the indirect path (contractual flexibility \rightarrow conflict \rightarrow project success) was -0.28 . The direct effect of contractual flexibility on project success was greater than the corresponding indirect effect. This study also found that the direct effect of

contractual flexibility on project success was positive, while the corresponding indirect effect was negative. Previous studies (Chapman, 2016; Ke *et al.*, 2015) proposed that contractual flexibility had both constructive and destructive effects on project success. This study confirmed their findings in the context of megaprojects.

6.3 Effects of conflicts on project success

In megaprojects, as indicated in the SEM results, the three types of conflicts were destructive to project success. The effect of relationship conflict was the most powerful and was negatively related to project success. Higher levels of relationship conflict would shift the focus of the megaproject to the interpersonal relationships between contracting parties, and this would, in turn, restrict their cognitive functions and provoke opponent behaviors. This can additionally negatively affect the successful delivery of the project. In conventional construction projects, it is easier to form a collaborative atmosphere because there are fewer stakeholders. Thus, the project conflicts may be constructive or functional to project success (Wu, 2013; Wu *et al.*, 2017a, 2017b). However, the constructive effect of conflict on project success was not verified in this study. The significant investments and compressed schedule tend to aggravate the potential risks associated with process assignments and task arrangements. Rational contracting parties tend to transfer risk to other parties, which may cause project conflicts. Furthermore, the inherent nature of megaprojects requires a higher level of stakeholder engagement, which is more likely to generate project conflicts due to their intensive interactions. In complicated circumstances, contracting parties only consider their own maximum interests, neglecting the overarching project's interests if there are disagreements or disputes on task arrangements. In this case, the conflict may be aggravated and escalated, leading to project conflicts that are detrimental to project success.

6.4 Mediating effects of types of conflicts

This study found that contractual flexibility was positively associated with project success. However, the introduction of conflicts considerably weakened the relationship between contractual flexibility and project success. This suggested that conflicts played a partial mediating role between contractual flexibility and project success, which was consistent with a previous study by Wang and Chen (2006). This study provided empirical evidence to support the viewpoint that conflict can be regarded as a mediating variable (Jehn *et al.*, 1999; Pelled *et al.*, 1999). In megaprojects, conflicts continue to magnify the difficulties associated with interactions between contracting parties. When the level of conflicts is too high, difficulties related to contractual issues will escalate to a certain extent. This negatively impacts the trust between contracting parties, thus leading to underdeveloped performance. Therefore, when implementing megaprojects, project managers should emphasize the need for a harmonious atmosphere, thus helping in alleviating the negative effects of conflicts. The underlying explanation is that only when different voices and opinions were effectively expressed and combined into the decision-making process can the benefits of contractual flexibility be adequately developed.

7. Conclusions and future work

7.1 Conclusions and practical implications

Megaprojects in China have long been criticized for confrontational relationships among stakeholders, time and cost overruns and poor project performance. It is of theoretical and practical importance to investigate the effects of contractual flexibility on conflicts and project success. This study focused on the psychological and behavioral conflicts between contracting parties under a formal contract system in megaprojects, and analyzed the

relationship between the contractual flexibility, conflicts and project success. In particular, the mediating effect of conflicts between contractual flexibility and project success was studied. Using a questionnaire completed by 468 practitioners in the Chinese construction industry, a theoretical model was constructed and tested with empirical data. The conclusions and practical implications are as follows.

Contractual flexibility in Chinese megaprojects directly or indirectly affects project success. For both direct and indirect effects, flexibility in contractual terms had a greater influence than flexibility in contracting process. This may be because the contracting parties are more focused on the process of signing a contract, while possibly partially neglecting the importance of fulfilling that contract. This study validated both the constructive and destructive sides of contractual flexibility. It also proved that the contractual governance mechanism between contracting parties is a soft factor that promotes the realization of project success. Therefore, the project owner should pay significant attention to the bidder prequalification. A qualified and competent contractual party can reduce project conflict when implementing megaprojects, enhancing the constructive effect of contractual flexibility on project success in megaprojects.

Project conflict is another soft factor affecting project success in megaprojects. SEM results indicated that project conflict plays a destructive role in achieving project success. Relationship conflict is the factor with the most influence. In practice, the three types of conflicts are not independent in megaprojects. When creating task schemes, the contracting parties may consider their own knowledge and interests, resulting in task conflict. With respect to process schemes, the contracting parties' disagreement on how to carry out specific task may cause process conflict. If task conflict or process conflict is not properly addressed, relationships may deteriorate and relationship conflict may emerge. Relationship conflict can cause intense interpersonal relationship between the contracting parties, provoking task and process conflicts. When implementing megaprojects, different types of conflicts may be closely intertwined, collectively impacting project success. Therefore, contracting parties need to deal with conflicts during the implementation of a megaproject. In addition, contracting parties must enhance communication and foster mutual trust. When contracting parties build a trust-based relationship, the interpersonal relationships are likely to improve. Meanwhile, contracting parties should make greater efforts to deal with task conflict and process conflict to prevent these conflicts from transforming into relationship conflict.

Contractual flexibility and conflict are soft factors that can affect the project success. As one of the soft elements, contractual flexibility helps in coordinating contracting parties' behaviors and fostering trust, thus contributing to project success. Thus, the owner should balance rigid and flexible terms in contractual document in megaprojects. Rigid terms in contractual documents specify the authorities, obligations and responsibilities of contracting parties, which limit behaviors in contracting process. Flexible terms in contractual documents allow a faster response to foreseeable contingencies using predetermined rules. This creates a harmonious atmosphere between contracting parties. Therefore, rigid and flexible terms should coexist in the contract document; the project owner should have a balanced emphasis on these two types of terms. In the early stage of megaprojects, rigid contractual terms may help restrict conflict behaviors. As trust is established, more flexible contractual terms help improve operational efficiencies. Project conflicts are negatively associated with project success and are detrimental to the relationship between contractual flexibility and project success. They may also lead to negative behaviors between contracting parties, which is not conducive to the success of the project. Thus, attention should be paid to the destructive effects of project conflicts. During the implementation of megaprojects, contracting parties should actively coordinate with

other parties, take the correct measures to deal with potential problems, resolve emerging conflicts and prevent the occurrence of underlying conflicts. Furthermore, contracting parties should establish a conflict resolution mechanism on the basis of the equality of cooperation.

From the perspective of contractual governance, handling project conflicts in megaprojects requires finding a qualified and competent bidder and signing a clear and equitable contract. The project owner should acquire detailed information about the capability, property, reputation and past project experiences of the potential bidder. This can help forecast the bidder behaviors when implementing the megaproject. In this case, the owner can add some flexible terms, in line with project practices in the contractual document. This avoids a contract structure that is too rigid or too flexible, either of which may negatively impact project success. In addition, contracting parties should strengthen cooperation and communication to establish a trust mechanism during the contracting process. This can reduce the negative influences of project conflicts and weaken the negative effects of contractual flexibility on project success.

7.2 Limitations and future work

This research successfully achieved its objectives; however, there remain limitations with respect to its conclusions. First, as this study holds a contractual perspective; other factors influencing conflicts and project success, such as trust, communication and commitment, are not considered in the theoretical model. Second, the study did not address the potential influence of conflict transformation on project success. Nonetheless, this study still contributes to the existing knowledge by proposing and validating a theoretical model that describes the relationships between contractual flexibility, types of conflicts and project success in the context of megaprojects. Practical implications drawn from this study provide an in-depth understanding of the effects of contractual flexibility on conflict and project success in megaprojects.

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Further reading

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