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UNDERSTANDING THE RELATIONSHIP BETWEEN TASK CONFLICT AND CONSTRUCTION PROJECT PERFORMANCE: UNCERTAINTY MANAGEMENT PERSPECTIVE

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Abstract. Task conflict is prevalent among construction project parties, however, how task conflict affects construction project performance still lacks a comprehensive investigation. Against this background, this study adopts an uncertainty management perspective to conduct an integrative model including both positive and negative mediators as well as one moderator to investigate the link between task conflict and construction project performance. Using 206 samples from the Chinese construction industry, the proposed hypotheses are empirically examined. Results suggest that project commitment (effect size = –0.046) negatively mediates the link between task conflict and project performance, whereas knowledge integration (effect size = 0.053) has a positive mediating effect. What's more, task reflexivity is found to mitigate the negative effects of task conflict on both project commitment (coefficient of interaction item = 0.12) and knowledge integration (coefficient of interaction item = 0.08). It is also found that task reflexivity changes the direction and strength of the link from task conflict to project performance by both project commitment (from –0.155 to 0.069) and knowledge integration (from –0.049 to 0.052). These findings provide a holistic understanding of the relationship between task conflict and construction project performance, thus contributing to construction project management theoretically and practically.

Keywords: task conflict, task reflexivity, project performance, knowledge integration, project commitment.

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1. Introduction

Participants in a construction project commonly comprise multiple parties with diverse expertise from different organizations. Diversity in knowledge domains tends to engender different opinions about what to do and how to accomplish the current tasks (Costa et al., 2019; Ma et al., 2020; Wu et al., 2017a). Consequently, project parties will perceive disagreements in viewpoints and ideas pertaining to the tasks or assignments to be performed, which is formally defined as task conflict (Amason, 1996; Jehn & Mannix, 2001). Examples of task conflict include differences in the priority of the project goals and which methods should be adopted. In practice, many projects suffer from task conflict because participants can't reach a consensus and may indulge in endless arguments, which further induces cost overrun, schedule delays, and even quality defects (Lu & Guo, 2019). Yet, it is also observed that some projects can benefit from task conflict because it sparks new ideas and solutions (Jia et al., 2021; Wu et al., 2018). As a result, the effect of task conflict on project performance seems a myth for practitioners, hindering the formulation of effective management strategies. To solve this issue, the first thing is to figure out why task conflict could both improve and deteriorate project performance simultaneously, which constitutes the central of this study.

Although previous research has endeavored a lot to investigate the effect of task conflict on project performance, until now, they have not reached a consensus. Positive, negative, and inverted-U relationships are all found (Chen et al., 2014; Khosravi et al., 2020; Wu et al., 2017b, 2018; You et al., 2019). Such inconsistencies puzzle managers how to manage task conflict in an appropriate way. In view of this, some scholars attempted to figure out the underlying reasons. Put another way, they further explored the link between task conflict and project performance by considering mediating mechanisms. Several scholars found that the positive link between task conflict

and project performance is attributable to organizational learning induced by task conflict (Jia et al., 2021; Liang et al., 2010; Mu et al., 2021). Some other scholars found that the negative link arises from affect hampering induced by task conflict (Chiocchio et al., 2011; Lu & Guo, 2019). However, why the same task conflict could induce totally different consequences still lacks a deep understanding and investigation.

Specifically, there exist three limitations in the extant literature. First, prior studies investigating the mediating mechanisms mostly paid attention to either positive or negative mechanisms. Few studies incorporated both into an integrative model, thus losing the opportunity to compare different mediating paths and calculate the total mediating effect. From the methodological perspective, adopting a multiple mediation approach also provides a more accurate estimate of parameters (Preacher & Hayes, 2008). Second, the separated investigations of mediating mechanisms only focused on the part of task conflict, a deep understanding of the double sides of task conflict is in lack. Third, although the mediating mechanisms have been specified, little is known about how to leverage the positive effects and mitigate the negative effects. In other words, the boundary conditions of these mediating paths have been largely ignored, which has always been advocated by scholars in the conflict management field (Jehn, 1995).

This study is thus motivated to fill the above-identified literature gaps. During the course of a construction project, while what task conflict will arise is uncertain, the occurrence of task conflict is certain. On the one hand, according to uncertainty management theory, it is a natural tendency for behavior agents to avoid uncertainty, which will first be reflected emotionally or affectively (van den Bos & Lind, 2002; Lind & van den Bos, 2002). Such arguments are also consistent with the fact that conflict is in essence emotional (Jehn, 1995). The inherent emotional characteristic of conflict will inevitably, if not managed or controlled, lead members to make attributions to other parties (Cronin & Bezrukova, 2019). As a consequence, their sense of responsibility for the project work is diminished (Hoegl et al., 2004; Zhu et al., 2021). Briefly, task conflict may hamper project commitment. On the other hand, as management of uncertainty is a basic motive (Lind & van den Bos, 2002), the certain occurrence of task conflict thus tends to compel project parties to make preparations in advance, such as periodic meetings. Task conflict involves arguments and interpretations of task-related ideas, which potentially intensifies knowledge-related activities (Jehn, 1995; Jia et al., 2021; Mu et al., 2021). As a result, knowledge integration that combines different strands of knowledge is likely to be realized (Zahra et al., 2020). In addition, both knowledge integration and project commitment have been confirmed to be positive predictors of project performance (Hoegl et al., 2004; Rauniar et al., 2019; Yang et al., 2020b), the two are thus expected to link task conflict and construction project performance positively and negatively, respectively.

What's more, self-regulation theory suggests that self-regulated teams can evaluate current behavior against set goals, and adapt their cognitions and behaviors to decrease the identified discrepancies and thus increase the likelihood of goal attainment (Bandura, 1991; DeShon et al., 2004). Task conflict indicates disorders and often distracts members' attention to focus on emotions instead of tasks, thus inducing relationship conflict and conflict escalation (van den Berg et al., 2014; Greer et al., 2008; Simons & Peterson, 2000). In this way, self-regulation affords a possible approach to buffering the effects of task conflict and its consequences. As Nonaka (1994) argued, fluctuation tends to produce destructive outcomes with the absence of reflection. Given this, a critical regulatory process, task reflexivity, is considered to be a moderator between task conflict and construction project performance.

Based on the above arguments, the research objectives of this study are as follows:

(1) Examine project commitment and knowledge integration as two mediators simultaneously that, negatively and positively, respectively, link task conflict and construction project performance.

(2) Examine the buffering role of task reflexivity in changing the link between task conflict and construction project performance.

In summary, this study aims to reveal the complex relationship between task conflict and performance in the construction project context. From an uncertain management perspective, this study investigates the mediating mechanism and the moderating mechanism in an integrative model. The present study attempts to make the following several contributions. First, this study adopts an uncertain management perspective to renew our understanding of task conflict, which deepens our cognition of task conflict and affords insights to both scholars and managers. Second, following the logic, this study conducts an integrative model and explores how task conflict can influence project performance positively and negatively as well as corresponding boundary conditions. This approach is significantly different from previous studies focusing on either positive or negative links between task conflict and project performance. In this way, this study contributes to the literature on conflict management in the construction field. Third, this study empirically confirms the effectiveness of self-regulation in construction projects, thus enriching our knowledge of regulation processes within construction projects and contributing to self-regulation theory.

2. Theoretical background

2.1. Task conflict

Task conflict involves disagreements among project parties about the content of the tasks being performed, including differences in viewpoints, ideas, and opinions (Jehn, 1995). In construction projects, members commonly come from different companies with diverse expertise such as archi-

tecture, structure, and mechanical, electrical and plumbing (Ma et al., 2020). As a result, when dealing with project issues, project members not only represent their respective knowledge domains but also argue for their parent companies. Consequently, task conflict is prevalent in construction projects and challenges project outcomes (Mu et al., 2021; Wu et al., 2017a).

Despite relevance and urgency, scholarship has not fully resolved this issue so far in the construction field. Some early studies found inconsistent conclusions on the direct relationship between task conflict and project performance (Chen et al., 2014; Khosravi et al., 2020; Wu et al., 2017b, 2018). This compels scholars to explore the underlying mechanism of the link. Jia et al. (2021) found that task conflict could facilitate organizational learning, which in turn improves project performance. Lu and Guo (2019) revealed that relationship behavior negatively mediates the link between task conflict and relationship quality. What's more, several scholars investigate potential moderating mechanisms. Wu et al. (2017c) suggested that under a collaborating strategy, task conflict would benefit construction project performance. Surprisingly, as the indication of a collaborating strategy, the attenuating effect of trust on the link is not supported in Khosravi's et al. (2020) study. Although the above studies progressively advance our knowledge of the relationship between task conflict and construction project performance, such scattered studies and inconsistent findings seem to further mask this relationship, thus appealing for an integrative model to provide a comprehensive and clear picture of this link. To the best of our knowledge, no study has conducted such a model that incorporates both positive and negative mediators as well as moderators, which is the gap this study attempts to fill.

2.2. Uncertainty management theory

The key element of uncertainty is the salience of either the unpredictability of future events or the inconsistency between important cognitions, experiences, or behaviors (van den Bos & Lind, 2002). It is believed that task conflict satisfies the above two criteria because participants commonly can't fully predict what task conflict will happen and task conflict itself involves inconsistency in cognitions or behaviors.

Uncertainty management theory argues that uncertainty is essentially a detestable state because uncertainty will decrease individual self-awareness, controllable perception, and predictability, which further arouses negative emotions. Commitment is a kind of emotional dependence in nature, which is mainly determined by noneconomic factors such as autonomy and trust (Becker, 1960; Spanuth & Wald, 2017). The development of commitment is a process in which employees gradually develop psychological bonds with their organizations (Kline & Peters, 1991; Zhu et al., 2021). Thus, project commitment can be viewed as an emergent and affective state during the course of projects (Hoegl et al., 2004; Marks et al., 2001). In the current literature, job stress, emotional intelligence, job satisfaction, and conflict have been shown to significantly affect organizational commitment (Reichers, 1985; Simons & Peterson, 2000; Zhu et al., 2021). In consequence, emotions or emotional activities induced by uncertainty (task conflict in this study) are inferred to significantly influence project commitment (Zhu et al., 2021).

Uncertainty management theory predicts that management or avoidance of uncertainty is a rather basic motive. Although what task conflict will arise is uncertain, the occurrence of task conflict is certain. In this way, construction managers will adopt formal and informal mechanisms to manage task conflict in advance. Formal mechanisms involve management interventions, such as management control and project planning (Lin et al., 2019; Yang et al., 2020b). As for informal mechanisms, social mechanisms such as social capital and trust have been widely studied (Huang & Newell, 2003; Rauniar et al., 2019; Di Vincenzo & Mascia, 2012). These mechanisms have been verified to help synthesize different types of knowledge.

2.3. Self-regulation theory

The core opinion of self-regulation theory is that self-regulated teams can evaluate current behavior against set goals, and adapt their cognitions and behaviors to decrease the identified discrepancies and thus increase the likelihood of goal attainment (Bandura, 1991; DeShon et al., 2004). For construction projects, task reflexivity is a typical self-regulation activity, which refers to the process in which project parties collectively reflect on and communicate about the project's objectives, strategies, and processes (Shin, 2014; West, 1996). Task reflexivity in construction projects entails activities such as monitoring the extent of goal achievement, analyzing the causes of goal deviation, and developing strategies to keep the project on track (DeShon et al., 2004). Reflexivity can occur before, during, or after the course of tasks and can vary in duration (West, 2000). As a self-regulatory process, reflexivity entails reflection, planning, and action/adaptation (West, 2000). As such, reflexive construction project teams are able to evaluate the status quo including past actions and performance, craft action intentions for improved future functioning, and make needed adaptations to the desired states or outcomes (Ellis et al., 2014; Schippers et al., 2014). These reflexive processes help control construction processes and outcomes, thus benefiting construction project performance.

Task reflexivity has been verified to be a significant contributor to performance indicators such as team effectiveness, decision-making quality, and team innovation (Lyubovnikova et al., 2017; Schippers et al., 2015; Shin, 2014; Shin et al., 2017; Yang et al., 2020a). Of note, the primary role of reflexivity becomes prominent in teams undertaking non-routine or complex tasks (Gurtner et al., 2007; Hoegl & Parboteeah, 2006). In these situations, de-

spite the cost of time and energy, reflexive teams will actively discuss the nature of their encountered problems, previously adopted procedures and tools, and even the norms and values of the team (Schippers et al., 2007, 2013). In this way, they can better deal with the dynamism originating from both internal and external environmental changes, which forms the foundation for high project performance (Elbanna, 2015).

Besides, task reflexivity has been confirmed to buffer the effects of various team processes and team outcomes. For instance, the effect of diversity on team performance is found to be contingent on the level of task reflexivity (Nederveen Pieterse et al., 2011; Schippers et al., 2003). Briefly, task reflexivity helps make use of the benefits of diversity and regulates the negative facet of team diversity (De Dreu, 2002). Similarly, as a form of diversity, it is expected that task reflexivity potentially buffers the effects of task conflict on project performance, which has been largely ignored in the literature, especially in construction projects (Wu et al., 2017d).

3. Hypothesis development

3.1. Moderation effects

Although task conflict itself concerns different opinions or viewpoints on project tasks, the inherently emotional nature of task conflict easily distracts project parties' attention from tasks to interpersonal disputes (Cronin & Bezrukova, 2019; Van Kleef & Coté, 2018; Xin & Pelled, 2003). Besides, due to interest inconsistency among project parties, they are likely to attribute the occurrence of task conflict to other parties and expect other parties to make adjustments to align with their opinions or goals. Besides, conflict is commonly viewed as bad news and challenges temporarily established relationships (Keil et al., 2007). In this way, the commonly avoidable and reactive responses to task conflict tend to escalate conflicts. The accompanied outcome is that each party prioritizes its own goals and is unwilling to adjust opinions to advance the overall project (Jehn et al., 2008). Simply, they will become committed to their own organizations instead of the ongoing project (Lu & Guo, 2019). Thus, it is expected that task conflict will negatively affect project commitment, which is formally defined as a strong belief in the achievement of project goals and the willingness to engage in the project (Hoegl et al., 2004; Reichers, 1985).

To avoid such negative consequences, self-regulation has always been regarded as an effective means (Curşeu & Schruijer, 2012; Jordan & Troth, 2004). When task conflict occurs, if project parties can spare time to systematically review the previously adopted procedures and methods, they are more likely to have a comprehensive understanding of the sources of task conflict (Suifan et al., 2020). In this way, they will have an objective, even if not collective, knowledge of the current task conflict. As such, they tend to focus on the task conflict itself instead of expressing emotions (van den Berg et al., 2014). The task-oriented discussion during the conflict episode enables project parties to pay attention to the achievement of project goals. Besides, such a reflexive process affords a buffering time window to avoid conflict escalation. At the individual level, emotion regulation has been revealed to attenuate the negative effects of task conflict on relationship conflict (van den Berg et al., 2014). Informed by these arguments, the following hypothesis is proposed:

H1: *Task reflexivity moderates the relationship between task conflict and project commitment, such that the relationship becomes more negative as task reflexivity decreases.*

Task conflict is a social interaction process, in which each party will express their respective ideas upon the execution mode of project tasks, objectives, and results (Jehn & Mannix, 2001). Although passively, project parties have to share their knowledge to argue for their ideas and opinions (Amason, 1996). Otherwise, the project will be progressed without much consideration of their concerns. In reality, if one party wants to persuade other parties to accept its viewpoints or plans, the party has to take other parties' ideas into account. In this way, the iterative discussion of task conflict among project parties means a conscious combination of different strands of knowledge (Jia et al., 2021). Such a process is characterized as a knowledge conversation. As such, knowledge integration, referring to the process of synthesizing different types of knowledge (Okhuysen & Eisenhardt, 2002), is a possible outcome of task conflict. Previous research also affirmed the positive role of task conflict in knowledge activities (Jia et al., 2021; Mu et al., 2021).

To integrate the scattered knowledge among project parties, a deliberate self-regulation process such as task reflexivity is necessary (Shin et al., 2017). Otherwise, project parties may indulge in task conflict and just clarify their respective opinions and interests. On the one hand, task reflexivity provides an opportunity to systematically process divergent information (De Dreu, 2007; Schippers et al., 2014). In consequence, a holistic understanding of the current state of the project such as resource constraints is formulated and engenders system thinking. On the other hand, reflection on objectives, strategies, and processes informs project parties on where they are going, where they are, and how they can attain the desired goal (Otte et al., 2018; Wiedow & Konradt, 2011). With these in mind, project parties could understand the current task conflict from a broader perspective and align the disposition of conflict with project goals. Prior research also found that reflexive teams can benefit from task reflexivity and thus improve teamwork quality (Suifan et al., 2020). Therefore, it is inferred that projects characterized by high reflexivity will be more likely to achieve knowledge integration. As such, the following hypothesis is formulated:

H2: *Task reflexivity moderates the relationship between task conflict and knowledge integration, such that the relationship becomes more positive as task reflexivity increases.*

3.2. Mediation effects

Project commitment involves the acceptance of and strong belief in the goals and values of the project (Hoegl et al., 2004). In this way, high project commitment means strong identification with the project among project parties. Consequently, project parties will feel responsible for the project outcome (Buvik & Tvedt, 2017; McDonough, 2000). Further, such a sense of responsibility enables project parties to be engaged in the project, which is a necessity for project success. By contrast, low project commitment indicates that each party cares less about the overall project. As construction projects should be operated as a whole, if efforts from project parties can't be integrated, project failure will follow. Extant literature has shown that project commitment is a good predictor of project performance in the construction project context (Iyer & Jha, 2006; Zhu et al., 2021). Together, the joint impact of task conflict on project commitment (Hypothesis 1) and the project performance benefits of project commitment (see above) suggest that project commitment mediates the relationship between task conflict and construction project performance. Therefore, the following hypothesis is formulated:

H3: *Project commitment negatively mediates the relationship between task conflict and project performance.*

In construction projects, a primary goal is to integrate diverse knowledge from project parties to apply to the construction system (Ma et al., 2020). Hence, it is expected that knowledge integration is a significant indication of project success. Besides, from the organizational learning perspective, knowledge integration is a learning process in which project parties communicate knowledge (Zahra et al., 2020). As a result, creative ideas and innovation can be induced. The developed common knowledge in the collective learning process will help transcend knowledge differences and foster shared understanding (Majchrzak et al., 2012). In this way, knowledge integration not only ensures the completion of routine tasks but also improves innovative performance (Demirkesen & Ozorhon, 2017; Huang & Newell, 2003). For construction projects, the two both significantly affect the final project outcome. The critical role of knowledge integration in construction projects has also been confirmed (Jia et al., 2021; Yang et al., 2020b). Together, the joint impact of task conflict on knowledge integration (Hypothesis 2) and the project performance benefits of knowledge integration (see above) suggest that knowledge integration mediates the relationship between task conflict and construction project performance. Hence, the following hypothesis is suggested:

H4: *Knowledge integration positively mediates the relationship between task conflict and project performance.*

Knowledge integration is also expected to improve project commitment. When the construction project encounters challenging issues, only when each party pools its expertise, will these project-related problems be solved. In such a process, each party contributes their knowledge and finally helps achieve other parties' or the overall project's goal. In this case, the project party will feel valued by others and be willing to contribute their efforts in the future (Lu & Guo, 2019). Gradually, all parties will bind as a whole and be committed to the common project goals (Buvik & Tvedt, 2017). Besides, knowledge integration is commonly embedded in the process of problem-solving (Ahern et al., 2014). Successful problem-solving with joint efforts strengthens the strong belief in the goals of the project as well as the desire to maintain membership. Razzaq et al. (2019) have verified the positive effect of knowledge activities on organizational commitment in public sectors. Hypothesis 2 indicates the association between task conflict and knowledge integration, and Hypothesis 3 suggests the association between project commitment and project performance. Taken together, knowledge integration and project commitment are expected to serially link task conflict and project performance. Thus, the following hypothesis is proposed:

H5: *Knowledge integration and project commitment have a positive serial mediating effect on the relationship between task conflict and project performance.*

3.3. Moderated mediation effects

The indirect effect of task conflict on project performance mediated by project commitment is expected to be contingent on the degree of task reflexivity. According to Hypothesis 3, project commitment will transform the negative facet of task conflict into low project performance. The theoretical rationale of this logic lies in the propagation of conflict-induced bad emotions (Keil et al., 2007; Van Kleef & Coté, 2018). Actually, emotional states are vulnerable and transitional (Marks et al., 2001). When project parties spare time to deliberately reflect on the encountered task conflict and collect more information to analyze the causes of task conflict, their attention will be focused on the current tasks instead of simply attributing to other parties (Konradt et al., 2015; Shin et al., 2017). In this way, the propagation of the negative effects of task conflict is regulated by task reflexivity. As such, the indirect negative effect of task conflict on project performance by project commitment is attenuated. Therefore, the following hypothesis is suggested:

H6: *Task reflexivity moderates the indirect effect of task conflict on project performance via project commitment, such that the indirect effect becomes more negative as task reflexivity decreases.*

Hypothesis 4 suggests that the benefits of task conflict will be leveraged by knowledge integration to improve project performance. In spite of the growth opportunity implicated in task conflict, conscious regulation processes are necessary to transform opportunities into gains (van den Berg et al., 2014; Suifan et al., 2020). When project parties carry out systematic reflection, they can identify which opportunities they can utilize as well as how to make full use of these opportunities (Nederveen Pieterse et al., 2011;

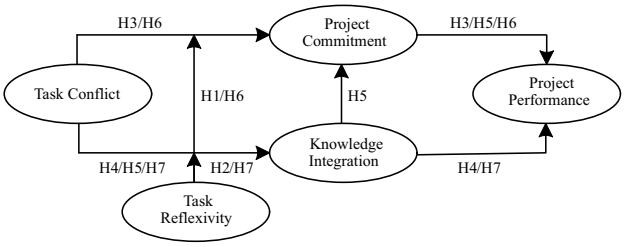

Figure 1. Conceptual model

Yang et al., 2020a). Furthermore, a comprehensive analysis of diverse information can produce synergized effects and distill even unexpected value, which in turn transform risks into opportunities and benefits (De Dreu, 2007). In contrast, if project parties don't reflect when task conflict occurs, although knowledge activities are embedded in task conflict, they can't recognize the potential value of these knowledge activities. As a result, the integration of different strands of information and knowledge becomes even impossible. In this situation, task conflict just involves task discussion among project parties and may even escalate into interpersonal conflicts (van den Berg et al., 2014). Hence, the following hypothesis is formulated:

H7: *Task reflexivity moderates the indirect effect of task conflict on project performance via knowledge integration, such that the indirect effect becomes more positive as task reflexivity increases.*

Based on the above hypotheses, this study proposes the following conceptual model, as shown in Figure 1.

4. Method

4.1. Measurement development

Multi-item measurement scales derived from the existing literature were used to develop a structured questionnaire. Besides, we employed the backward translation approach to ensure consistency between the Chinese and original English versions of measurement items with the assistance of two professors and three doctoral candidates in construction project management. Specifically, the dependent variable, task conflict (TC), was measured by the four-item scale from Wu et al. (2017a). The project commitment (PCM) four-item scale was designed with reference to the research of Hoegl et al. (2004). The four-item scale used to measure knowledge integration (KI) was based on the research of A. Mehta and N. Mehta (2018). The three-item scale for task reflexivity (TR) was adapted from Schippers et al. (2007). Finally, project performance is defined as the perception of accomplishments and achievements of project goals (Lu et al., 2019). The traditional three key indicators, i.e., quality, cost, and time are included. Besides, recent studies argued that customer requirements and stakeholders should be considered (Lu et al., 2019; Zhu et al., 2021), thus being adopted in this study. In consequence, a five-item instrument (including quality, cost, time, fulfillment of the client's requirements, and stakeholder satisfaction) was used to measure project performance (PP). Besides, previous research argued that complex construction projects are more likely to experience cost overruns and schedule delays (Denicol et al., 2020). In this way, project duration and project cost, which could approximately reflect the complexity of projects, are set as control variables.

Furthermore, interviews with experts in construction project management were conducted to ensure the appropriateness, intelligibility, and sensitivity of these items. A total of seven experts from five companies, including the project manager, department manager, and project engineer, participated in the interview. To resolve disagreements among these experts, we sent the revised version of the survey items to each expert to achieve their approval. After three rounds of revisions, they reached a consensus on the final version of the survey items. Each item was measured by a seven-point Likert scale. The final version of these survey items is listed in the Appendix (Table A1).

4.2. Data collection

We first conducted a pilot study involving 30 respondents from the Master of Engineering Management (MEM) students majoring in construction management at a Chinese University. We performed confirmatory factor analysis to test the validity of all constructs by SPSS 25. Kaiser-Meyer-Olkin (KMO) values of the 5 constructs all exceed 0.8 and statistically significant ($p < 0.0001$). Then, factor analysis indicated that all factor loadings are higher than 0.7. The calculated Cronbach's alpha coefficients of all constructs exceed 0.7 (Cohen, 1988). Consequently, the validity of all constructs is satisfactory in the pilot study. Then, the questionnaire was distributed to construction professionals to report the condition of the last completed project they managed. We sent the link to the online survey to alumni of two renowned universities, who were involved in the construction industry. A total of 400 questionnaires were distributed to these alumni from 53 construction companies, and 256 responses were returned. After removing invalid responses, 206 valid questionnaires were left, thereby yielding a valid response rate of 51.5%. The 50 invalid questionnaires resulted from incomplete data and short answer time (less than 1 minute). The descriptive information of the sample respondents and projects is given in Table 1.

As the survey was self-administered, this study employs two tests to eliminate potential common method bias. First, Harman's single-factor method is used to test the data by estimating a model in which all the model indicators are loaded on a single factor (Podsakoff et al., 2003). The results show no serious common method bias with a bad fit with the data ($\chi^2(170) = 1387.9$, $p < 0.001$, CFI = 0.604, TLI = 0.557, RMSEA = 0.187). Second, the common method factor approach suggested by Podsakoff et al., is employed to examine the data (Podsakoff et al.,

Table 1. Descriptive information of respondents and projects (*N* = 206)

Measure	Item	Frequency	Percentage
Gender	Female	69	33
	Male	137	67
Education	Junior college or below	25	12
	Undergraduate	137	67
	Master or above	44	21
Project duration	6 months or below	32	15
	7~12 months	41	20
	13~18 months	30	15
	19~24 months	24	12
	25 months or above	79	38
Project cost (RMB)	50 million or below	69	33
	51~100 million	35	17
	101~1000 million	65	32
	1001 million or above	37	18
Project type	Building construction	89	43
	Infrastructural construction	57	28
	Others	60	29

Notes: RMB stands for the legal currency of China, similar to dollar in the US. Building construction includes civil, public, and industrial buildings. Infrastructural construction includes transportation, airports, ports, bridges, communications, water conservancy construction. Others includes construction not included in the above two types of projects.

2003). Compared to the baseline model (five-factor model), the addition of the common method factor doesn't improve the fit of the model greatly (CFI: 0.946 vs. 0.963, TLI: 0.936 vs. 0.950, RMSEA: 0.071 vs. 0.063). In this way, common method bias is not a significant issue in the data.

5. Data analysis and results

5.1. Reliability and validity

We first analyze the measurement model to test the validity and reliability of constructs. As shown in Table 2, the standardized factor loadings of all items are slightly less than or greater than the acceptable level of 0.7, indicating the items in this study are reliable (Chin, 1998). Then, Cronbach's α and composite reliability are calculated to assess the reliability (Fornell & Larcker, 1981). The constructs' Cronbach's α range from 0.879 to 0.906 and composite reliability range from 0.876 to 0.910, all exceeding the 0.7 thresholds. Furthermore, values of the average variance extracted (AVE) ranging from 0.639 to 0.772 are above 0.50 (Flynn et al., 1990). Finally, to test the discriminant validity, models combining different constructs and the baseline model (including TC, TR, PCM, KI, and PP) are compared.

As shown in Table 3, the goodness-of-fit (GOF) of the baseline model is better than other models, thereby establishing good discriminant validity. We also examine variance inflation factors (VIF) to test for potential multi-collinearity. The analysis results suggest that multicollinearity is not a significant problem as the highest value of VIF (4.89) is below 5 (Hair et al., 2016).

5.2. Hypothesis testing

In this study, we adopted multi-item instead of single-item measurement scales to ensure construct validity and reliability. The items in a multi-item measurement scale all reflect the construct to be measured (Tabachnick & Fidell, 2013). In this way, as previous research suggested, we calculated the scale of each construct as the average of its multiple items (Jia et al., 2024; Tarakci et al., 2016). Then, a series of ordinary least squares regression analyses were conducted by PROCESS v3.5 in SPSS, which was developed by Hayes (2013) to examine various mediation and moderation effects and has been widely used in various disciplines. As the two control variables don't significantly influence project performance, the reported results thus don't include them.

The results of moderating effects testing (Hypothesis 1 and 2) are presented in Table 4. The results of model 1 in Table 4 show that the coefficient for the interaction of task conflict and task reflexivity is significant and positive (B = 0.12, $p < 0.001$), supporting hypothesis 1. To illustrate this relationship, following Cohen's suggestion (Cohen et al., 2003), we plot the interaction in Figure 2. Figure 2 indicates that when task reflexivity is low, the effect of task conflict on project commitment is negative, whereas this effect becomes positive but not significant when task reflexivity is high. The results of model 2 in Table 4 show that the coefficient for the interaction of task conflict and task reflexivity is significant and positive (B = 0.08, $p < 0.01$), indicating support for Hypothesis 2. Similarly, the interaction is plotted in Figure 3. Figure 3 shows that when task

Table 2. Results of reliability and validity test

Constructs	Items	Loadings	Cronbach's alpha	Composite reliability	Average variance extracted
TC	TC1	0.758	0.898	0.899	0.692
	TC2	0.873			
	TC3	0.810			
	TC4	0.879			
TR	TR1	0.771	0.906	0.910	0.772
	TR2	0.919			
	TR3	0.937			
PCM	PCM1	0.697	0.894	0.898	0.689
	PCM2	0.883			
	PCM3	0.836			
	PCM4	0.890			
KI	KI1	0.774	0.879	0.876	0.639
	KI2	0.837			
	KI3	0.795			
	KI4	0.789			
PP	PP1	0.820	0.899	0.902	0.647
	PP2	0.797			
	PP3	0.777			
	PP4	0.809			
	PP5	0.820			

Table 3. Results of discriminant validity test

Model	χ^2	df	χ^2/df	CFI	TLI	RMR	RMSEA
Baseline model	324.9	160	2.0	0.946	0.936	0.087	0.071
Single-factor model	1387.9	170	8.2	0.604	0.557	0.364	0.187
Two-factor model	945.8	169	5.6	0.747	0.716	0.269	0.150
Three-factor model 1	810.6	167	4.9	0.790	0.762	0.205	0.137
Three-factor model 2	1229.0	167	7.4	0.654	0.607	0.360	0.176
Four-factor model 1	419.9	164	2.6	0.917	0.903	0.105	0.087
Four-factor model 2	737.4	164	4.5	0.813	0.784	0.212	0.131
Four-factor model 3	423.4	164	2.6	0.916	0.902	0.100	0.088

Notes: Baseline model: IMTBS, KI, PCO, PCM, PP; Single-factor model: TC + TR + PCM + KI + PP; Two-factor model: TC + TR, PCM + KI + PP; Three-factor model 1: TC, TR + PCM + KI, PP; Three-factor model 2: TC + TR + PCM, KI, PP; Four-factor model 1: TC, TR, PCM + KI, PP; Four-factor model 2: TC, TR + PCM, KI, PP; Four-factor model 3: TC, TR, KI, PCM + PP.

Table 4. Moderating effect test (unstandardized estimates)

Variables	Knowledge integration		Project commitment	
	Model 1		Model 2	
	Estimate	SE	Estimate	SE
constant	6.00***	0.76	3.38***	0.68
TC	–0.57**	0.18	–0.48**	0.15
TR	–0.16	0.14	–0.28*	0.11
KI			0.69***	0.05
TC × RE	0.12***	0.03	0.08**	0.03
R^2	0.26		0.56	

Notes: N = 206. *p < 0.05, **p < 0.01, ***p < 0.001.

reflexivity is high, the effect of task conflict on knowledge integration is positive, while this effect becomes negative when task reflexivity is low.

The results of the mediation analysis are exhibited in Table 5. We employ the bootstrapping technique (random sampling with 10000 resamples) to analyze the mediating effects among the constructs. The indirect effect from task conflict to project performance by project commitment is negative and significant (B = –0.046, CI [–0.116, –0.010]), thus supporting Hypothesis 3. The indirect effect from task conflict to project performance by knowledge integration is positive and significant (B = 0.053, CI [0.005, 0.131]), thus supporting Hypothesis 4. The serial mediating effect between task conflict and project performance by knowledge integration and project commitment is also positive and significant (B = 0.119, CI [0.046, 0.239]), thereby supporting Hypothesis 5.

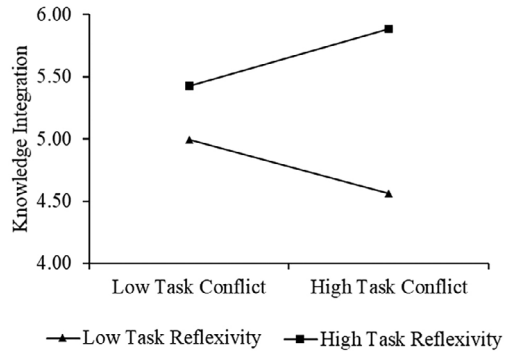

Figure 2. The moderating effect of task reflexivity on task conflict for knowledge integration

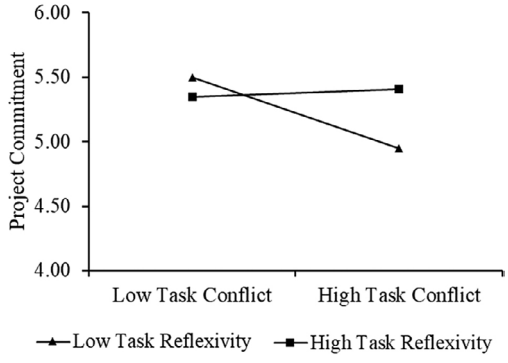

Figure 3. The moderating effect of task reflexivity on task conflict for project commitment

Further, two post hoc analyses are conducted. First, we examine the significance of the total indirect effect from task conflict to project performance. Results in Table 5 suggest a positive and significant relationship (B = 0.125, CI [0.016, 0.252]). Second, we examine the significance of the total effect (direct and indirect effect) from task conflict and project performance. Interestingly, the total effect is not significant (B = 0.081, CI [–0.038, 0.203]).

The conditional indirect effects are also examined by using a bootstrapping resampling technique (10,000 samples). The results in Table 6 show that for low level of task reflexivity (one standard deviation below the mean value), the indirect effect of task conflict on project performance by project commitment is negative and significant (B = –0.155, CI [–0.283, –0.043]), whereas the indirect effect becomes positive (B = 0.069, CI [0.009, 0.137]) when task reflexivity is high (one standard deviation above the mean value). Hence, Hypothesis 6 is supported. Similarly, for low level of task reflexivity (one standard deviation below the mean value), the indirect effect of task conflict on project performance by knowledge integration is negative but not significant (B = –0.049, CI [–0.126, 0.024]), the indirect effect becomes positive and significant (B = 0.052, CI [0.017, 0.092]) when task reflexivity is high (one standard deviation above the mean value). As such, Hypothesis 7 is supported.

Table 5. Mediating effect test

Path	Effect	*p*	95% Bootstrapping confidence interval (CI)	
			Lower bound	Upper bound
TC→PCM→PP	–0.046	0.046	–0.116	–0.010
TC→KI→PP	0.053	0.030	0.005	0.131
TC→KI→PCM→PP	0.119	0.001	0.046	0.239
Total indirect effect	0.125	0.027	0.016	0.252
TC→PP (Direct effect)	–0.044	0.212	–0.120	0.028
Total effect	0.081	0.168	–0.038	0.203

Table 6. Moderated mediation effect of task reflexivity

Path	Moderator: Task reflexivity	Effect (SE)	95% Bootstrapping confidence interval
TC→PCM→PP	Low (–1 SD)	–0.155* (0.062)	[–0.283, –0.043]
	Medium (Mean)	–0.043 (0.036)	[–0.119, 0.025]
	High (+1 SD)	0.069* (0.032)	[0.009, 0.137]
TC→KI→PP	Low (–1 SD)	–0.049 (0.038)	[–0.126, 0.024]
	Medium (Mean)	0.002 (0.022)	[–0.043, 0.043]
	High (+1 SD)	0.052** (0.019)	[0.017, 0.092]

6. Discussions and implications

In summary, the proposed seven hypotheses in this study all receive empirical support. Next, we will discuss the findings in this study and corresponding theoretical and managerial implications.

According to self-regulation theory, the moderating effects of task reflexivity are derived. It is found that task reflexivity can alter the direction from task conflict to knowledge integration. Specifically, when task reflexivity is high, task conflict facilitates knowledge integration, whereas task conflict will hamper knowledge integration when task reflexivity is low. This suggests that task reflexivity in construction projects plays a decisive role in the utilization of task conflict. The deliberate regulation process affords a systematic information processing mechanism and thus synergizes scattered efforts (De Dreu, 2007; Nederveen Pieterse et al., 2011). Besides, task reflexivity is found to mitigate the negative effect of task conflict on project commitment. This signifies the critical role of task reflexivity on emotion regulation (van den Berg et al., 2014), which prevents the propagation of bad emotions induced by task conflict. The two findings verify the effectiveness of self-regulation theory in the construction project context. Task reflexivity is found not only to mitigate the negative effect of task conflict but also to be able to leverage the potential opportunities hidden in task conflict. To be specific, task reflexivity orients participants' attention to project tasks and departs from disorders, otherwise, the project can't be advanced and uncertainty persists, which continually induces negative emotions and decreases psychological bonds with the project. This finding provides empirical evidence for the argument that task reflexivity is of great value for construction projects (Elbanna, 2015; Wu et al., 2017d).

Moreover, although previous research has attempted to investigate the buffering factors that change the strength between task conflict and corresponding outcomes, inconsistent conclusions are derived. While a collaborating conflict management strategy is found to moderate the link between task conflict and project-added value, trust, as the indication of such a strategy, is shown no buffering effect on this link (Khosravi et al., 2020; Wu et al., 2017c). Besides, a collaborating strategy lacks practical clarity. In this way, from a self-regulation perspective, this study examines the moderating role of task reflexivity in the relationships between task conflict and project commitment as well as task conflict and knowledge integration. The confirmed moderating effects verify task reflexivity as an effective means to mitigate the negative effects of task conflict, thus contributing to the development of conflict management strategy. Specifically, sparing time for task reflexivity is recommended for managers. During this time window, managers should conduct a comprehensive analysis of project goals, strategies, and methods as well as reflect upon the sources of task conflict and potential solutions (De Dreu, 2007; Shin et al., 2017).

The total indirect effect of task conflict on project performance suggests that task conflict generally benefits instead of hampers construction project performance. The implication is that task conflict in construction projects is not as bad as imagined. Managers should renew their understanding of task conflict in construction projects. They should actively manage task conflict instead of just trying to avoid it. Otherwise, although some risks accompanied by task conflict may be avoided, the corresponding opportunities are also missed. However, the transformation of task conflict is important and deserves managers' attention. Together with previous research, organizational learning and knowledge activities are primary mechanisms that transform task conflict into benefits (Jia et al., 2021; Mu et al., 2021). Similar to Lu and Guo's (2019) findings, task conflict has a direct negative association with project commitment. Yet, if task conflict can be transformed into knowledge integration, task conflict can positively affect project commitment indirectly. The insignificance of the total effect from task conflict to construction project performance also implies how to transform task conflict makes a big difference.

Project commitment and knowledge integration are two mediators derived from uncertainty management theory; hence, the significant mediating effects confirm uncertainty management theory in the construction project context. Besides, this study provides explanations for the mixed results in the existing literature concerning the influence of task conflict on construction project performance. Although some scholars have investigated the effects of task conflict on construction project performance, most of them focused on either positive or negative mechanisms (Jia et al., 2021; Lu & Guo, 2019; Wu et al., 2017a, 2017b). Correspondingly, their respective explanations are contradictory to some extent. The adopted uncertainty management theory dissolves such contradictions and affords a novel perspective for our understanding of task conflict and its effects on construction project performance. For construction managers, they should caution against the transformation of task conflict. Managers should encourage each party to express their viewpoints and ideas objectively instead of emotionally. It is important to regulate their emotions to avoid conflict escalation (van den Berg et al., 2014).

It is also found that task conflict won't benefit project performance unless the level of task reflexivity is high. A moderate level of task reflexivity can avoid the negative effects of task conflict but not help utilize task conflict. Interestingly, the indirect effect of task conflict on project performance by project commitment is positive and significant when task reflexivity is high. A plausible explanation is that reflexivity helps identify solutions that each party is satisfied with, as a result, project parties are willing to engage in the project and are responsible for the collectively derived solutions. The moderated mediation analysis provides nuanced and insightful knowledge on the link between task conflict and construction project performance,

whereas previous research has largely ignored in the construction field. Specifically, we not only figure out how task conflict can be transformed into project performance but also clarify under what conditions these transformation processes are more effective. Taken together, a holistic picture of the link between task conflict and construction project performance is drawn in this study.

Generally, managers should view task conflict as an opportunity to change and learn. The increasing complexity of construction projects makes their possessed knowledge insufficient to deal with uncertainties during the course of projects. As such, in a learning-by-doing manner, managers can make full use of task conflict and thus contribute to both their individual experience enrichment and the conducted project.

7. Conclusions

Adopting an uncertainty management perspective, this study comprehensively investigates the relationship between task conflict and performance in construction projects. The conducted integrative model reveals that knowledge integration positively links this relationship (effect size = 0.053), project commitment negatively links this relationship (effect size = –0.046), and task reflexivity decides the direction and strength of the relationship between task conflict and project performance. For low level of task reflexivity, the effects of task conflict on project performance by project commitment and knowledge integration are –0.155 and –0.049, respectively. For high level of task reflexivity, the effects of task conflict on project performance by project commitment and knowledge integration are 0.069 and 0.052, respectively. In this way, this study affords a holistic understanding of the link between task conflict and project performance, thus providing valuable insights into conflict management for construction managers.

According to the findings in this study, we propose two policy recommendations. Firstly, it is recommended to adopt a strategy that focuses on both prevention and learning to manage task conflict because what task conflict will arise is uncertain, whereas the occurrence of task conflict is certain. Prevention practices include contract design and resource preparation, in this way, negative emotions arising from uncertainty could be mitigated. Learning practices include self-regulation activities and knowledge transfer, in this way, diverse opinions and viewpoints could be synthesized. Secondly, third-party involvement is recommended to resolve task conflict because conflict is inherently emotional, consequently, it is difficult for participants to analyze task conflict rationally and self-regulate themselves. Besides, compared with the participants themselves, the third party is believed to be fair, thus likely to induce cooperative behaviors and improve the resolution efficiency of task conflict.

Although this study has conducted an integrative model that considers both positive and negative mechanisms that link task conflict and construction project performance, there could still exist other mediators, which can be further investigated. Besides, this study confirms self-regulation processes as a critical means to mitigate the negative effects of task conflict as well as leverage the benefits of task conflict in construction projects. Except for task reflexivity, other self-regulation processes such as feedback could also be examined in the future (DeShon et al., 2004). Investigating the moderating effects from other theoretical perspectives is also a potential direction. What's more, the used data in this study is cross-sectional, whereas task conflict occurs within each episode (Cronin & Bezrukova, 2019). Therefore, longitudinal studies and case studies are recommended to further explore the dynamics of task conflict in the life span of construction projects. In addition, project performance in this study is measured by the respondent's perception, which may limit the relevance to construction practice. Adopting objective performance indicators is encouraged in future studies to further improve practical relevance. Finally, the collected data from China not only fits the research topic in this study but also affirms the proposed theoretical model. Besides, the theoretical rationale of this study is based on broad engineering management literature. Therefore, findings in this study, to some degree, can be extended to other countries, especially developing countries. However, it is still a limitation that the data is collected only from China. In this way, future research is encouraged to extend the generalizability of findings in this study with data from other countries.

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Data availability statement

Some or all data, models, or code that support the findings of this study are available from the corresponding author upon reasonable request.

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APPENDIX

Table A1. Measurement items

Construct	Item	Measure
Task conflict	TC1	There are always significant conflicts about ideas for the project goal setting.
	TC2	There are significant conflicts about the task among all parties.
	TC3	There are many different opinions among all parties.
	TC4	Project parties often have disagreements about tasks of the project on which other parties are working.
Project commitment	PCM1	Each party feels fully responsible for achieving the common project goals.
	PCM2	This project has the strong commitment of all parties.
	PCM3	Each party is committed not only to their teams, but to the overall project.
	PCM4	Each party values to be part of this project.
Knowledge integration	KI1	Each party pools their expertise to solve project-related problems jointly.
	KI2	Many creative ideas and schemes come from the discussions among all parties.
	KI3	Project parties frequently build on each other's ideas, skills, and expertise to develop new project-related knowledge for decision-making.
	KI4	Project parties often gain new insights by sharing their ideas with each other.
Task reflexivity	TR1	The methods used by the project to get the job done are often discussed.
	TR2	We regularly discuss whether the project is working effectively.
	TR3	Project parties often review the project objectives.
Project performance	PP1	The project results, or deliverables, are in line with the client objectives.
	PP2	This project is within the budget.
	PP3	This project is on schedule.
	PP4	The construction and deliverables quality are in accordance with the standard.
	PP5	The participants of this project maintain good cooperation.