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International Journal of Project Management 35 (2017) 1466 – 1482

International Journal of Project Management

www.elsevier.com/locate/ijproman

Investigating the relationship between communication-conflict interaction and project success among construction project teams

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Received 20 February 2017; received in revised form 17 July 2017; accepted 11 August 2017
Available online xxxx

Abstract

This study aims to investigate the effects of communication-conflict interaction on the success of construction projects. The conceptual model was validated with empirical data via the structural equation modeling. The results showed that task conflict was positively related to project success, while enhanced communication among teams stimulated the positive effect of task conflict. Process conflict and relationship conflict affected each other and were negatively related to project success, leading to poor communication among teams. Additionally, communication willingness and formal communication were positively associated with the project success, whereas informal communication negatively affected project success. Therefore, it is necessary to enhance the communication willingness and effectively enhance the formal communication among various project teams during the implementation of construction projects. Efforts are required to establish the formal communication mechanism to take advantage of the positive effect of task conflict whereas mitigating the negative effect of process and relationship conflict.

Keywords: Project team; Communication; Conflict; Project success

1. Introduction

With the rapid development of construction industry, an increasing number of construction projects are undertaken in China, and the market competition become even more intense. Coupled with the increasing complex project environment, conflicts in construction projects have become a typical feature of the construction industry (Chen et al., 2014; Wu, 2013). The achievement of project success inevitably involves a large number of specialized project teams (e.g., owners, contractors, consultants, designers) with specific core competencies. A project team is characterized by diversity, multi-disciplinary knowledge, with dynamics and temporary features, while the ultimate goal of the project team is to achieve project success (Wu et al., 2017). Construction projects are featured with uncertainty, temporary, and fragmentation (Stark et al., 2014). With common goals of achieving the project success, project teams tend to be interdependent with each other, which may lead to conflicts (Wong et al., 1999). Furthermore, contracts of construction projects are inherently incomplete (Demirel et al., 2016). According to Consoli (2006), an incomplete contract is a crucial factor that leads to conflicts. Similarly, the last decade has witnessed the growing level of complexity in the construction technologies, and the increasingly specialized division of labor. These characteristics require a higher level of engagement and collaboration among project teams, which may lead to conflicts (Wu et al., 2017). Thus conflicts inevitably occur during

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http://dx.doi.org/10.1016/j.ijproman.2017.08.006
0263-7863/00

the process of construction projects. In construction projects, conflicts can be defined as mutual interactions among project teams due to different perspectives on project objectives (e.g., quality, time, cost, safety), as well as poor communication (Harmon, 2003; Wu, 2013). Examples of conflicts include confrontational relationship between teams, disputes on the task arrangement, conflicting objectives of teams. According to Ding (2012), losses can account for around 3%–5% of the total project investment due to failing to resolve or properly handling such conflicts. Similarly, project conflicts can lead to a confrontational relationship between teams and make it difficult to achieve project objectives (Jelodar et al., 2015).

Construction projects are typically characterized by high uncertainty, complexity and inter-organizational task interdependence, which makes communication ever more important (Badir et al., 2012). The knowledge background, cultural values and benefit demands of each project team vary, which often lead to conflicts (Buvik and Rolfsen, 2015). Communication provides project teams with efficient coordination to complete their task and reduce the risks for conflicts (Kennedy et al., 2011; Reed and Knight, 2010). During the project implementation, project teams are involved in resource exchange and information communication. Construction projects increasingly applied inter-organizational and multidisciplinary partnerships, highlighting the need for effective communication to realize timely delivery (Nielsen and Erdogan, 2007). Effective communication enables the project team to clearly understand each other's views, intentions, to explicitly determine the rights, responsibilities and benefits, and to facilitate teamwork (Otter and Emmitt, 2007; Tai et al., 2009). Poor communication, on the other hand, not only leads to asymmetric information between project teams, but also ferment confrontation between teams and lead to conflicts (Clark and Brennan, 1991).

A lack of strategic direction and objectives-related communication can lead to time and cost overruns, and reduction in profit (Brockman, 2014; Siew, 2015). If project teams can process and exchange information in an effective manner, the volume of unnecessary expenditure can be reduced. Therefore, it is worth investigating the interaction between communication and conflict, and the role of communication in navigating conflict and project success. This study aims to investigate the effects of communication and conflict on project success in construction projects. To date, vast majority of existing studies on conflict among project teams were conducted from the perspectives of management strategies, e.g. cooperative, competitive, and compromise strategies (Hemple et al., 2009). By contrast, the key elements of communication that may affect conflict among teams are largely overlooked. Very few of them adopted a multi-dimensional approach to analyze the effects of the communication-conflict interaction, as well as the transformation mechanism between different types of conflicts. Therefore, this study contributes to the existing body of knowledge by proposing a conceptual model and consequently validating the model with empirical evidence. In addition, functional and dysfunctional effects of conflicts in construction projects are examined, which is another theoretical contribution of this study.

2. Literature review

2.1. Team communication

Axley (1984) considered communication as metaphorical pipeline along which information is transformed from one individual to another. DeSanctis and Monge (1998) proposed that communication is the process of sharing and exchanging ideas, facts, feelings and opinions between two or more people. Loosemore and Muslmani (1999) suggested communication is a cyclical process where people continuously share information over time. Cheung et al. (2013) defined communication as a two-way process between the sender(s) and receiver(s) through commonly used media. Communications is, in general, the basic means through which project teams interact with the project counterparts (Orlikowski and Yates, 1994). By means of communication, project teams can exchange information and link each other to achieve project objectives (Tai et al., 2009). Similarly, Conrads and Lotz (2015) proposed that team communication was the activity by which team members convey information to each other in an appropriate manner, or active information exchange activities between teams. Gregory (2008) recognized team communication as a process of mutual understanding and collaboration among teams through knowledge interaction and information transmission. Matteson et al. (2014) pointed out that team communication included the exchange of information among teams as well as the interaction of thoughts and emotions, thus making it an activity of information transmission and emotional communication. Communication difficulties or disorders during the projects process can directly lead to a sharp increase in the volume of unnecessary expenditure (Hwang et al., 2014; Tai et al., 2009). Jergeas and Hartman (1994) highly recommended communications as a means of avoiding claims and disputes in construction projects. Walker (1995) indicated the use of bidirectional communications as a means of improving quality in construction projects. Carr et al. (2002) proposed that effective team communication was the basis for unity, cooperation and democratic decision-making in the process of project implementation. Deetz and Putnam (2001) claimed that team communication helps to coordinate and control the action of each project team. Kwofie et al. (2015) found that the main functions of team communication include control, motivation, emotional expression and information transmission. By influencing or inspiring others to act, effective communication is an indicator to measure the result of communications (Tai et al., 2009). The measurements include accuracy, timeliness, completeness, barriers and understanding (Porter and Lilly, 1996). It is well recognized that effective communication plays a key role in achieving the success of construction projects (Martin et al., 2014; Senaratne and Ruwanpura, 2016).

The construction project team has certain unique characteristics, such as temporary in nature, task-oriented, having different team goals, and inconsistent core competencies (Ibadov, 2015). Project teams require the collection, analysis and real-time communication of information for early warning of deviations from planned performance and timely decision-making for corresponding actions (Lee and Rojas, 2013). In the context of construction

projects, the role of communication is even more important because of its decentralized nature due to different responsibilities of various project teams, and different time to join the project (Tai et al., 2009). In addition, team communication is an effective means of conflict resolution (Senaratne and Ruwanpura, 2016). Differences in organizational structure and organizational scale, changes in project objectives may result in such conflicts (Zhao and Li, 2015). These conflicts need to be solved by means of coordination and communication (Azmy, 2012). Hence, communication between construction project teams can be defined as the process of information sharing, information exchange and information transmission across project teams during the whole lifecycle of the project. It refers to the frequency, effect, attribute, scope and transformation of information, and serves as a way to reduce the information asymmetry among project teams.

Communication is considered as a multidimensional phenomenon that can be conceptualized with a number of attributes (Badir et al., 2012) (see Table 1). One main stream of previous studies (e.g., Parker, 1980; Shohet and Laufer, 1991) categorized communications into formal and informal communication. Communication within construction projects includes not only progress meetings, document transmission, and the regular exchange of information among project teams; but also informal meetings and private conversations among team members (Butt et al., 2016). In construction projects, informal communication constitutes a significant share of the communications between project teams, which is important to the functioning of teams (Shohet and Frydman, 2003). Therefore, communication is divided into formal and informal communication in this study.

In social psychology, communication willingness can be defined as the intention for a project team to share their information (Ding et al., 2007). In the Chinese cultural context, project teams are not always willing to share their information without interpersonal trust (Diallo and Thuillier, 2005; Henderson et al., 2016). Additionally, the temporary, uncertain and fragmented nature of construction projects contributes to a decrease in the willingness of communication (Christensen et al., 2007). Project teams are typically characterized by different types of team members, complexity and inter-organizational task interdependence which makes communication ever more important (Badir et al., 2012). A strong willingness to communicate helps to enhance the exchange of information between teams (Hewage and Ruwanpura, 2009). Hence, communication willingness is essential to information processing, which is increasingly emphasized as an effective element of managing communication in construction projects (Christensen et al., 2007). Possessing different resources (e.g., personnel, technology, information), the diversity of project teams may lead to conflicts among teams (Henderson et al., 2016). For a project team, there are two overarching objectives: achieving project goals and its own benefits, which is an objective duality (Gunduz et al., 2015; Psychology and Gonz, 2016). The objective duality of the project team will generate varying subjective needs for communication, with only a certain degree of communication willingness leading to frequent communication activities across project teams (Roberts and Vinson, 1998). Therefore, communication willingness is a key factor determining whether conflicts can be resolved in a timely manner. This study defines communication willingness as the extent to which the project team communicates (on project, task or work related matters) and shares information with the other project teams participating in the project. Therefore, in this study, team communication consists of three dimensions: communication willingness, formal communication and informal communication.

2.2. Team conflict

Conflict is a complicated social and psychological phenomenon, and various definitions have been developed from 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. Snyder (1975) argued that conflict varies according to the ideas, beliefs and interests of different individuals. Wall and Callister (1995) proposed conflict as a process during which one party perceives his concerns are opposed or frustrated by the other. Gardiner and Simmons (1992) pointed out that conflict is a hostile emotion, and generates inconsistency with regard to goals and values among participants. Wang et al. (2012) defined conflict as a state or form, such as inharmonious phenomena of hostile actions, or a state of confrontation caused by differences between individuals in cognition or emotion (Wang et al., 2012). As for the effects of conflicts, it is generally proposed that conflicts have both

Table 1
Categorizations of aspects of team communication.

Authors	Main ideas
Putnam and Wilson (1982), Tjosvold and Sun (2002)	Cooperative communication, competitive communication, avoiding communication and independent communication
Mohr and Nevin (1990)	one way communication, and bilateral communication
Yamaguchi (2005)	Soft communication, hard communication and rational communication
Wiggers et al. (2008)	Task communication, personal communication and reactive communication
Parker (1980), Harcourt et al. (1991), Shohet and Laufer (1991), Shohet and Frydman (2003), Tai et al. (2009), de Blois et al. (2011)	Formal communication, and informal communication
Tesfaye (2011)	Participatory communication, supportive communication and developmental communication
Badir et al. (2012)	Communication intensity, frequency, and media richness
Nam and Kim (2012)	Communication frequencies, the degree of feedback and learning level
Cigrang et al. (2014)	Communication frequency, communication medium, communication mode and communication atmosphere
Butt et al. (2016)	Internal project communication and external communication

destructive and constructive effects on project performance. Panteli and Sockalingam (2005) argued that the effects of conflicts are determined by a number of factors such as the uncertainty of conflict occurrence, and the diversity of conflict types. The combination of these factors thus affects the project success to varying degrees. In addition, efforts were made to classify conflicts. Pinkley and Northcraft (1994) suggested that conflict includes substantive conflict and emotional conflict, which is caused by differences in tasks as well as the emotional confrontation among teams. Priem and Price (1991) pointed out that team conflict can be divided into social conflict and cognitive conflict, while social conflict is behavior-oriented and cognitive conflict is task-oriented. Similarly, conflict can be classified into collaborative conflict and competitive conflict due to different attitudes and strategies when handling conflicts (Hemple et al., 2009; Wong et al., 1999).

In construction projects, team conflict not only highlights the interaction among different project teams, but also relates to the difference between task and process arrangements among stakeholders (Jia et al., 2011; San Cristobal, 2015). In addition, conflicts derive from the interdependencies between project stakeholders, team diversity, and inadequate internal mechanisms, such as the lack of adequate communication mechanisms and an atmosphere of cooperation (Akiner, 2014; de Carvalho et al., 2015; Zhang and Huo, 2015). Common types of conflicts among teams in construction projects include task-oriented conflict and relationship-oriented conflict (Wu et al., 2017). The former is related to arguments around material interests, whilst the latter is associated with individual relationships and the relationships between teams. Amason et al. (1995) defined these two types of conflicts as cognitive conflict and emotional conflict. Cognitive conflict relates to project tasks, which results from inconsistencies among teams' knowledge structures, project positions and perspectives (He et al., 2014). Emotional conflict, also called affective conflict, indicates personal conflict, emerging from individual characteristics, interpersonal relationships and misunderstanding (Ensley et al., 2002). Jehn and Mannix (2001) defined task conflict as differences in the execution mode of the project task, objectives and results among teams; and relationship conflict as incompatibility between people, i.e. each team member feels a sense of tension, anger, hostility, discomfort and other negative emotions. Thus, task conflict is related to rational behavior, while emotional conflict is related to emotional behavior. Task conflict does not involve a tense relationship between teams, which is often characterized by different project teams' varying views, ideas and judgments as to how best to achieve the project's goals (Jehn and Bendersky, 2003). Relationship conflict reflects "an awareness of interpersonal incompatibility that includes affective components such as feelings of tension and friction (Chen et al., 2014)". Task conflict generally helps to improve team performance. However, team performance could be negatively affected if the level of task conflict is too high (Chen et al., 2014; De Dreu and Weingart, 2003; Hu et al., 2017). Relationship conflict is associated with lower performance (Peterson and Behfar, 2003). In addition, process conflict reflects the different opinions of each project team in regards to the arrangement of overall project tasks, which is closely related to the rights, responsibilities and benefits of project teams (Chen et al., 2014; Wu, 2013). Lee et al. (2015) suggested that task-related conflict served as a catalyst for collaboration, whereas process-related and relationship-related conflicts were detrimental to collaboration. Based on previous studies (Wu, 2013; Wu et al., 2017), team conflict is divided into three categories: relationship conflict, process conflict and task conflict. By contrast, task and process conflict are both task-oriented.

2.3. Project success

Construction projects, especially the large-scaled projects, usually attract significant public and political interest. These projects are typically characterized by large investment, long-term duration, high uncertainty, and complexity. In construction projects, a higher level of collaboration among project teams is essential to achieve the project success. Project success has drawn wide attention in the field of construction management research (Table 2). Recent developments have proposed multiple social factors to supplement traditional definitions of project success (Fahri et al., 2015; Williams, 2016). As shown in Table 2, there are various expressions for the concept of project success. This is primarily owing to the different opinions, ideas and benefits of various participants. Existing studies of project success combines project governance with project management, and are based on the perspective of the whole project life cycle. The combination of project success and project management success have become more and more closely related (de Carvalho et al., 2015). Similarly, project stakeholders has drawn a growing level of attention where the project success has been approached from various perspectives such as those of owners, contractors, and design units (Hughes et al., 2004). It can be observed that factors affecting project success vary according to the perspectives of different project participants, so as the criteria to measure project success. Thus, project success should be approached not only from the perspective of a specific sector, but also from the perspective of specific project participants.

In the context of a construction project, benefit demands vary across project participants. Therefore, differences exist between various stakeholders in the definition of project success criteria and key factors for project success (Chan et al., 2004). This study focuses on the effects of communication and conflict among construction project teams on the project success. Therefore, the inherent characteristics of construction projects are combined with the attributes of construction project teams to define the project success according to the dimensions of time and stakeholders. With regards to time, the evaluation of project success occurs mainly during the project implementation. Therefore, the effects of communication-conflict interaction on project success is concentrated in this stage. As for stakeholders, despite focuses, the evaluation criteria of project success are basically consistent. During the construction phase of the project, project success includes the improvement of soft elements (Wu, 2013). Hard indicators of project success include the quality, cost, duration, safety and other control objectives. Soft indicators of project success include the satisfaction of

Table 2
Definitions of project success.

Author	Definition
Pinto and Pinto (1991)	Project success covers quality, time, cost, and the satisfaction of project participants.
Shenhar et al. (1997)	Project success involves the project efficiency, the impact on the customer, business success and future success.
Dvir and Lechler (2004)	Project success is closely related to the formulation of the requirement norms and the formulation of technical norms.
Bryde and Robinson (2005)	Project success includes pre-success, successful completion and successful operation.
Kim and Reinschmidt (2011)	The main indicator of project success is customer satisfaction, with quality, duration, cost and other hard indicators being secondary indicators.
Sato and Chagas (2014)	There are five criteria for project success: efficiency, impact on customer, impact on team, business and direct success, and preparation for the future.
Berssaneti and Carvalho (2015)	Project success measurements includes iron triangle "time-cost-quality", and customer satisfaction
Joslin and Müller (2015)	Project success includes project efficiency, organizational benefits, project impact, stakeholder satisfaction, and future potential.
Jiang et al. (2016)	Project success measurements includes iron triangle, stakeholder satisfaction, and the potential cooperative opportunity
Carvalho and Rabechini (2017)	Project success contains project efficiency, impact on the clients, impact on the staff, direct business and success, environment damages reduction and preparation for the future.
Luo et al. (2017)	Project success includes time, cost, quality, health and safety, environmental performance, participants' satisfaction, user satisfaction, and commercial value.

stakeholders, the efficiency and effectiveness of project management, future collaboration opportunities, and the promotion of trust between parties.

3. Theoretical model and research hypotheses

3.1. The relationship between formal communication and team conflict

Formal communication is a form of communication that occurs according to the rules and regulations of the organization (Shohet and Frydman, 2003). Formal communication is featured with serious, binding and confidential (Johnson et al., 1994). The formal communication in construction project teams involves an exchange of information through the organization's official channels, including document delivery, work meetings, regular information exchange between project managers and team members, and so forth (Yamaguchi, 2005). In the context of formal communication, discussion and communication among project teams focus on the specific task on hand, and are beneficial to reaching a consensus and forming a unified opinion.

Construction projects are typically characterized by large investment, long-time duration, and numerous stakeholders (Tai et al., 2009). The communication environment of the project teams mainly involves the owners, contractors, the designers, the consultants, and government departments etc. The main purpose is to control the quality, schedule and cost of the project. For instance, 55% of team communication in construction projects is carried out through meetings (Fu et al., 2015). The meeting facilitates decision-making by creating active information exchange conditions for each project team. Similarly, the meeting helps to achieve collective judgment rather than simple information exchange, as well as aligning each party's goal with the project goals. The formal communication between teams often includes the project manager's communication with the project team about the specific content, objectives and tasks of each phase of the project, to ensure the smooth implementation of the project (Stempfle and Badke-Schaub, 2002). During the process of project implementation, any contradictions between project teams can be dealt with and resolved through formal communication channels (Avgar and Neuman, 2015). Therefore, it can be argued that the formal communication of project teams is negatively related to task conflict and process conflict.

In addition, formal communication between project teams is difficult to focus on psychological differences when the team members receive information, resulting in the project teams' inconsistent understanding or views of task and process. Moreover, the lack of emotional communication in formal channels may lead to incoherent or uncoordinated information received from team members, causing relationship conflict between teams. Therefore, it can be argued that formal communication is positively related to relationship conflict. In light of the above arguments, the following hypotheses were developed:

H1a. the formal communication negatively influences the task conflict;

H1b. the formal communication negatively influences the process conflict;

H1c. the formal communication positively influences the relationship conflict.

3.2. The relationship between informal communication and team conflict

Informal communication is based on social relationships, and arguably has nothing to do with an organization's rules and regulations (de Blois et al., 2011). It refers to information exchange activities based on channels derived from informal organizational systems or individuals (Karlsen, 2008). Informal communication is not limited by organizational structure or by the time and place in which the communication occurs. Information transmission can be vertical, horizontal with high efficiency. When people communicate with each other in a relaxed and friendly atmosphere, it is arguably easier to express their true thoughts. This, in turn, is arguably helpful in relieving the pressure of work and improving interpersonal relationships within an organization.

In the context of construction projects, informal communication refers to the exchange of views and information transmission outside the organization's formal communication channels (Shohet and Frydman, 2003). This type of communication is generated by interaction based on the social and emotional relationships between team members and teams, including private conversations, electronic mails, or informal meetings. Informal communication has the characteristics of openness, spontaneity, a high speed of information transmission, flexibility and multiple communication modes (Crespin-Mazet et al., 2015).

Owing to these flexible forms, informal communication can enable project teams to obtain information in a timely manner, as well as more authentically reflecting teams' opinions, thoughts and motivations compared to formal communication (Adnan et al., 2012). Therefore, when different views exist in project teams, project teams may adopt informal communication in order to receive more information and to better understand specific circumstances of the project tasks (McGregor and Peake, 2000). When there are differences in the arrangement of the key tasks of the project, informal channels can help teams to obtain information so as to stimulate more creativity, and to facilitate communication and discussion on the overall process as well as specific tasks, which ultimately lead to rich opinions and ideas.

Such communication can, however, also facilitate more differences in ideas, goals and methods; and different opinions in terms of project-specific objectives among project teams (e.g. the use of resources, capital allocation, task arrangements) (Mele, 2011). Informal communication may thus aggravate task conflict and process conflict among project teams. Therefore, it can be argued that informal communication among project teams is positively related to process conflict and task conflict. Meanwhile, the informal communication among project teams is easy to instigate within an open information communication atmosphere. As a result, the depth and extent of such communication can be adjusted conveniently. This is helpful for emotional communication among team members and can thus enable the formation of good relationships between teams (Turner and Müller, 2004). It can, therefore, be argued that informal communication between project teams is negatively related to relationship conflict. In light of these arguments, the following hypotheses were developed:

H2a. the informal communication positively influences the task conflict;

H2b. the informal communication positively influences the process conflict;

H2c. the informal communication negatively influences the relationship conflict.

3.3. The relationship between communication willingness and team conflict

Communication willingness plays a critical role in dealing with conflicts between project teams through different ways of communication (Henderson et al., 2016). During the process of resolving contradictions or differences, if a project team demonstrates a negative or hesitant attitude, they can only put forward views and opinions based on their cognitive framework and the information they are able to master. On the contrary, it is less likely that they understand the opinions and ideas of other teams by adding information or generating emotional resonance. These characteristics have a negative impact on team motivation and cohesion (Rico et al., 2009). Conversely, a high level of communication willingness will promote information exchange and knowledge sharing among teams, which in turn helps the project team to understand the specific circumstances of the project implementation. A high level of communication willingness helps to create a friendly and relaxed atmosphere in the organization, which promotes the information flow, the exchange of ideas and brainstorming within the organization, organizational innovation and improves the innovation performance (Ayoko, 2007). Likewise, a high level of communication willingness helps to facilitate the information and knowledge flow within the organization, and innovation activities in the organization's processes, management, and tasks (Breen et al., 2005).

The internal and external environment of the construction project team is complex, and the scope of conflict occurrence is wide. During the project process of the internal operation, differences often occur among teams because of project objectives, project planning, resource allocation and other issues. Project teams may also come into conflicts owing to project processes, the organizational structure and other issues. During the process of the external operation, conflicts often occur among teams because of benefits conflicts among participants (DeChurch and Marks, 2001). When conflicts occur between project teams and disagreements on arrangements of task processes, accordingly participants may have different views regarding the objectives, methods and other aspects central to the implementation of the project-specific tasks.

In light of these complexities, with a higher level of communication willingness among project teams, the teams are more willing to share their views and ideas, and to focus on the task content. This thus generates new ideas and opinions on the specific content of the project tasks and richer views on the arrangement of the overall task. At this point, disagreements on tasks between teams emerge (Wood et al., 2002). Therefore, the communication willingness of project teams is positively related to task conflict and process conflict. In addition, a higher level of communication willingness can cultivate trust and interdependence among project teams, and enhance the project team's capacity for mutual understanding, thus promoting the establishment of a harmonious interpersonal relationship between teams (Yu, 2010). Given these ideas, the following hypotheses were developed:

H3a. the communication willingness positively influences the task conflict;

H3b. the communication willingness positively influences the process conflict;

H3c. the communication willingness negatively influences the relationship conflict.

3.4. The relationship between team conflicts and project success

Different types of team conflicts have different effects on project success (Ensley et al., 2002; Calvo-Mora et al., 2015). Simons and Peterson (2000) proposed that relationship conflict exerted a negative impact on decision-making, thus affecting project success. The specific reasons behind this can be summarized as three aspects. First, relationship conflict will lead to team members hiding their real views and opinions, and so restrict the flow of information between teams. Second, relationship conflict will lead to an interpersonal tension, anger, hostility and other negative emotions among teams, thus compromising or destroying the relationships between project teams. Third, relationship conflict will reduce the teams' ability for mutual understanding, leading to a confrontation between teams and the escalation of conflict (Amason, 1996). In short, relationship conflict hinders the effective communication among teams, ultimately leading to a reduction in team performance and the quality of team decision making.

Process conflict refers to contradictions, opposition or disagreement with regard to the processual arrangement between project teams in the process of project implementation (Hu et al., 2017). Process conflict can easily occur in the process of task arrangement, sometimes caused by one of the project stakeholders, and sometimes caused by several parties. Process conflict relates to resources, status and responsibility of a project, such as the schedule, process planning and integration, and resource allocation (Jehn, 1995; Acharya et al., 2006; Camelo-Ordaz et al., 2014). Process conflict is prevalent in construction projects due to the unequal status of project participants, incomplete contracts, asymmetric information, and so forth. Through the study of process conflict, Jehn pointed out that process conflict will not only reduce team cohesion and affect project performance, but also lead to the reduction of cooperation fluency among the team, so that the team cannot cooperate effectively to complete the task (Jehn, 1995). Furthermore, process conflict is regarded as potentially interfering with team members' own individual tasks, thus affecting the overall project performance.

Task conflict occurs when project teams in the process of completing specific tasks differ with regard to the projects concepts, objectives and methods, and have different opinions about the specific project objectives (such as resource use, capital allocation, task arrangement) (Camelo-Ordaz et al., 2014). In the discussion of project tasks, a large number of new ideas and information will be created, which will inevitably lead to task conflict. It is generally recognized that task conflict can improve team performance and helps to achieve the project success (Chen et al., 2014; Wu, 2013). Amason (1996) claimed that task conflict could encourage a team to identify and discuss different views and opinions, and to deepen their understanding of the mission objectives (Amason, 1996). de Wit et al. (2013) argued the task conflict can strengthen teams' critical evaluation of the work plan and promote the implementation of the overall project tasks. Task conflict can enhance team cohesion and improve the relationship between teams, thus promoting the completion of unconventional tasks that have a high degree of complexity and uncertainty (Mooney et al., 2007). Therefore, the following hypotheses were developed:

H4a. task conflict positively influences the project success;

H4b. process conflict negatively influences the project success;

H4c. relationship conflict negatively influences the project success.

3.5. The relationship between different types of team conflicts

Task conflict may occur if a project team holds different opinions on project objectives, contents and responsibilities during projects implementation (Senaratne and Udawatta, 2013). Relationship conflict refers to incompatibility wrought by interpersonal relationships among project teams, and includes stress, anger, hostility, and other negative emotions expressed when they feel uncomfortable with each other (Chen et al., 2014). Process conflict refers to the conflict that occurs when a project team disagrees about the processual arrangements of the project tasks (Hu et al., 2017). These three types of team conflicts, in the context of a construction project, are not independent of each other. Rather, one type of conflict can often lead to another (Pinkley and Northcraft, 1994). During the process of project decision-making, the debate among project teams can often become intense, which can lead to each team member feeling the tension, anger, hostility, and other negative emotions. In such context, task conflict becomes a fuse for relationship conflict (Camelo-Ordaz et al., 2014). Compared with task conflict, process conflict involves the arrangement of tasks and the execution of specific work. Moreover, conflicts of interest among the project team will inevitably lead to relationship conflict (Wu, 2013). Therefore, it is more likely that process conflict leads to relationship conflict.

There is a lack of empirical research into the theory of the different types of conflicts, while it is difficult to measure the specific forms of conversion. These three types of conflicts may even appear in the same overall conflict between teams. For example, task conflict and relationship conflict are often closely linked, with the high correlation between them supported by many empirical data (Brockman, 2014). Even if a project team has different opinions about, or no consensus with regard to, the content of the task itself or the project's processes, the team members will inevitably add their own emotional reactions when task conflict or process conflict occurs (Anderson and Polkinghorn, 2008). In some cases, task conflict aiming at 'things' can even be transformed into relationship conflict aiming at 'people'. This is especially the case in the context of China, where people attach great importance to the face value or tone in which suggestions are made. Chinese people can more easily take these as a personal attack, especially when the status of project teams are not equal. Task conflict can easily inspire relationship conflict because personal judgment influences the decision making and misunderstanding of other members' motivation will transform debate over cognitive problems into

interpersonal incompatibility (Mooney et al., 2007). Therefore, the following hypotheses were developed:

H5a. task conflict and relationship conflict affect each other;

H5b. process conflict and relationship conflict affect each other;

H5c. task conflict and process conflict affect each other.

3.6. Theoretical model

Construction projects involve extensive information exchange among members of project teams (Cheung et al., 2013). Timely transfer of relevant information is critical for project success in light of the mutual interdependent nature of construction activities (Wong and Lam, 2011). Therefore, effective communication among project teams has become a critical issue to resolve various types of conflicts and to achieve the project success (Tai et al., 2009). If project teams are willing to share information, with the formal and informal communication channels, information can be exchanged timely and accurately throughout the project life cycle. Hence, there appears a close relationship among communication, conflicts, and project success. In light of this, this study has chosen communication as an antecedent of team conflicts, combined with the inherent characteristics of construction projects to examine the effects of team communication and conflicts on the project success. Consequently, a theoretical model of communication, conflicts and project success is developed (Fig. 1).

4. Variable measurement and pilot test

4.1. Questionnaire design

The variable measurement comprises three categories: (1) measurement of the independent variables of dimensions of communication; (2) measurement of the intermediate variables of types of conflicts; and (3) measurement of a dependent variable, i.e., project success. There are three types of sources of measured items. The first is a direct reference to the measured items in the literature that have been proven to be of high reliability and validity. The second source is that of modifying the existing items, with consideration of specific project teamwork. The last one includes the items that were designed based on on-site interviews with experts.

The items used to measure the willingness of communication were designed according to previous studies (Anderson and Narus, 1990; Ding et al., 2007) according to three key aspects: initiative, enthusiasm, and dependence. The items used to measure formal communication and informal communication was designed according to previous studies (Mohr and Spekman, 1994; Shohet and Frydman, 2003). The conflict measurement items were designed with reference to the literature (Amason, 1996; Chen et al., 2014; Hartwick et al., 2004; Jehn and Mannix, 2001; Wu et al., 2017). The project success measurement items were designed with reference to the literature (Jiang et al., 2016; Lu et al., 2016; Pinto et al., 2009). The measurement models provide the relationship between communication, conflict and project success (the observable variables), and their respective groupings (the latent variables) (Coltman et al., 2008). This present study is aligned with the reflective model, because an observed variable on measurements reflects the latent variables and plus an error (MacCallum and Browne, 1993), and the direction of relationships go from the latent variables to the observable variables (Carvalho and Rabechini, 2017).

Face-to-face interviews were conducted with experts to verify the factors derived from the literature review, and to ensure their applicability within the context of construction projects. Representatives from owners, contractors, consultants, and designers were interviewed to gather their professional comments on the appropriateness of measurements for communication, conflicts, and project success. A total of nine experts, who held positions such as project manager, department manager, professional manager, and project engineer were selected from different project teams. Two rounds of face-to-face discussion were conducted so that consensus views are arrived. The items in those scales were properly modified according to inherent characteristics of construction projects (Table 3). All variables were

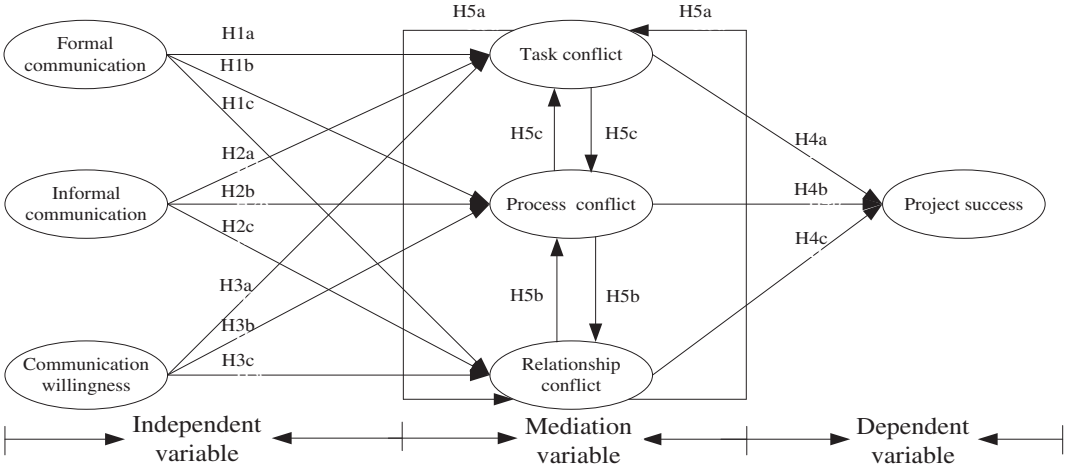

Fig. 1. Theoretical model guiding the empirical study.

measured using a five-point Likert scale (where 1 means "strongly agree" and 5 means "strongly disagree").

4.2. Data collection

As there was no sampling frame in this survey, a non-probability sampling plan was employed. This sampling plan can be used to obtain a representative sample (Patton, 2001, p. 242), and has been considered as appropriate because the respondents were not randomly chosen from the population, but were chosen based on their willingness to participate in the study (Wilkins, 2011; Zhao et al., 2013b). The survey sample was selected from medium and large scale construction projects in Shanghai, Jiangsu Province and Zhejiang Province in China, mainly comprising owner teams, contractor teams, and designer teams who had a cooperation period longer than six months. Potential survey respondents included project managers, department managers, professional managers, and project engineers etc. This is because they possessed effective communication competencies, and their behaviors had a significant impact on project success (Marzagão

Table 3
Measurement for communication, conflict and project success.

Variables	Measurement
Formal communication	The team can take effective methods in communication, such as charts, tables, lists, etc.
	The information-sharing between teams is very accurate through regular meeting
	The communication with other team is very timely through documents
	Teams can get enough information to make decisions at the right time
	Team members can adopt a simple and feasible evaluation in the process of communication
	Information platform provides adequate access to make everyone get the required knowledge
	Communication strategy can take into account the overall project plan
Informal communication	I can understand the information advantage of other teams' project experience
	Face-to-face communication is the best way of informal communication
	Team members can pay attention to cultural differences in the process of communication
	Communication strategies will consider applicability, flexibility and continuous improvement
	Leadership helps to reduce informal communication between teams
	Lack of negotiation skills can lead to communication barriers
Communication willingness	The frequency of communication with other team is very high, and the effects is also very good
	The team is willing to inform other teams events and change that may affect other teams
	Before communication, responsibilities between teams have been clearly defined
	Attention is payed to the construction of the trust mechanism in the process of communication
	The team can abide by integrity and do not deceive each other in the process of communication
	The team respect each other's feelings in the process of communication
Relationship conflict	The other party often creates problems for your party
	There are many personality clashes between your party and the other party
	There are many disputes between your party and the other party
	The other party often withhold information necessary for the attainment of your party tasks
	There is significant personal friction between your party and the other party
	There is significant tension between your party and the other party
	There is much emotional conflict between your party and the other party
Task conflict	There is much conflict about ideas for the project design and construction scheme
	There are always significant conflicts about ideas for the project goal setting
	There are significant conflicts about the task between your party and the other party
	There are a lot of different opinions between your party and the other party
	The other party often disagrees about opinions regarding the work being undertaken
	The other party often has disagreements about the task of the project you are working on
	The other party often has conflicting opinions about the task of the project you are working on
Process conflict	The other party always assists your party to accomplish your tasks
	Your party often assist the other party to accomplish their tasks
	There is much cooperation between your party and the other party
	There are many disagreements about who should do what during the project execution
	There is much conflict between your party and the other party about task responsibilities
	Your party often disagrees on the resource allocation during the project execution
Project success	This project progress follows schedule
	This project is within budget
	The project deliverable meets client's objectives
	This project has qualified acceptance and successful delivery
	The project can solve most problems encountered during the project execution
	The project process is satisfactory
	This project creates positive impacts on end users
	The owner is satisfied with the project results
	We are optimistic about the success of this project
	We are likely to cooperate with the other party again in the future
	The project satisfied the client's special requirements

and Carvalho, 2016; Rezvani et al., 2016). They played a critical role in communicating with multiple participants in construction projects (Ochieng and Price, 2010; Rwelamila, 1994). A total of 400 questionnaires were distributed to middle and senior managers through Email, and 357 responses were returned. The invalid questionnaires, which (1) left too many questions unanswered; (2) marked contradictory choices; or (3) were almost the same as others, were identified and removed. As a result, 310 effective responses were used for data analysis (Table 4). There was a response rate of 78%, which is considerable high compared with other studies of a similar nature (Le et al., 2014; Zhao et al., 2013a, 2015).

4.3. Reliability and validity test

The Corrected-Item Total Correlation (CITC) and Cronbach's α methods were employed to test the reliability and validity. CITC and Cronbach's α, a reliability coefficient, were used to clear all the variable measuring items. When the CITC is lower than 0.5, the item should be deleted. Cronbach's α was used to test internal consistency; this should not be lower than 0.7 (Havitz and Dimanche, 1997). A higher Cronbach's α indicates a stronger correlation between items and internal consistency. Then, the Kaiser-Meyer-Olkin (KMO) test and Bartlett test were adopted to check whether the factor analysis could be used. In this study, only variables with a KMO value >0.7 were tested by factor analysis. For single dimensional variables, we conducted a preliminary analysis on their convergent validity. For multi-dimensional variables, their validity was tested using certainty factor analysis. Variables with eigenvalues >1 were chosen as common factors, and items with a factor loading >0.5 were retained. The reliability and validity of all the variables were over 0.7 after the cleaning of measuring items, and all variables were significant. Therefore, the reliability and validity of the scale of this study are high, and the data could be further analyzed.

AMOS 21.0 was used to conduct a certainty factor analysis of the communication dimensions, types of conflicts and project success, in order to obtain the variables of construct reliability. Variable measurement items with standardized coefficients below 0.5 were removed. CR value >0.6 indicates good construct reliability. Average Variance Extracted (AVE) was used to examine convergence validity. An average AVE >0.5 indicates good convergence validity of the variable measurement items. Numerous indicators, such as Chi-square static χ^2, 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 reflect the goodness-of-fit. All the indicators in each category of variables met the requirements, and the standardized coefficients of all the questions were over 0.5. The construct reliability of each variable was >0.6, suggesting that the overall reliability of the measurement items and the internal consistency were high. The results of the certainty factor analysis showed the following:

1. For communication, the standardized coefficient was >0.6; all CR values were >0.6; all AVE values were >0.56, and the χ^2/df, GFI, AGFI, RMSEA, NFI, and CFI were 2.28, 0.85, 0.81, 0.098, 0.91 and 0.96, respectively.
2. For conflict, the standardized coefficient was >0.7; all CR values were >0.7; all AVE values were >0.65, and the χ^2/df, GFI, AGFI, RMSEA, NFI, and CFI were 2.13, 0.81, 0.87, 0.076, 0.91 and 0.97, respectively;
3. For project success, the standardized coefficient was >0.6; the CR value was 0.82; the AVE value was 0.75, and the χ^2/df, GFI, AGFI, RMSEA, NFI, and CFI were 2.56, 0.91, 0.86, 0.089, 0.89 and 0.93, respectively.

Table 4
Respondent and project profiles.

Characteristic	Category	Frequency	Percentage (%)
Work experience	<5 years	114	36.77
	6–10 years	158	50.97
	11–15 years	32	10.32
	16–20 years	4	1.29
	>20 years	2	0.65
Designation	Project engineer	59	19.03
	Department manager	85	27.42
	Project manager	81	26.13
	Professional manager	61	19.68
	Others	24	7.74
Project type	Public project	59	19.03
	industrial project	61	19.68
	Residential project	177	57.10
	Others	13	4.19

5. Model test and results analysis

SEM (Structural Equation Modeling) was employed to test the theoretical model because this tool has been recognized as an appropriate approach to analyze the relationships between variables (Le et al., 2014; Zhao et al., 2013b), and has been widely employed in various construction management studies (Lu et al., 2014; Liu et al., 2016; Zhao and Singhaputtangkul, 2016). The analytical results of the theoretical model are shown in Fig. 2 and Table 5. It can be observed that most fit indices met the requirements. χ^2/df was 2.13, not only lower than the upper limit of 5, but also lower than the stricter limit of 3. The RMSEA was 0.076, between 0.05 and 0.08; the NFI was 0.93, meeting the requirement. The IFI was 0.92, greater than the threshold of 0.9. However, the GFI and AGFI were 0.86 and 0.83 respectively, both lower than 0.9, indicating that the model fits could be improved. As shown in Table 5, it is evident that most of the hypotheses pass the test, except for H5a and H5c.

Model A takes team conflict as a mediating variable. However, the relationship between conflict and communication was not supported by the empirical study. Therefore, the types of team conflicts can be regarded as the independent variable and the communication dimension can be seen as the mediating variable, in order to construct the model B (Fig. 3) for comparison purposes. By analyzing the fitting index of the two models, it was found that model A was more effective than model B. Therefore, model A was more consistent with all hypotheses of this study.

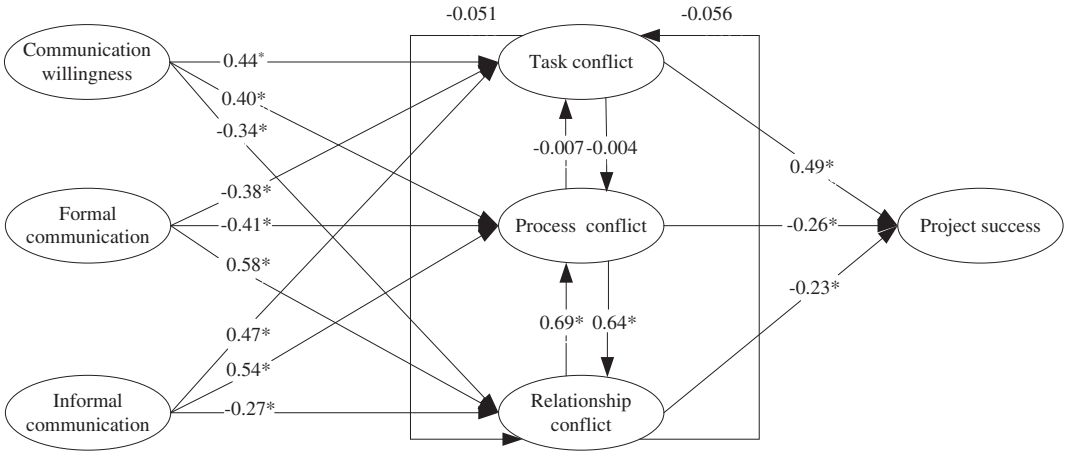

Fig. 2. Model A—Conflict dimension as a mediating variable.

6. Discussions

6.1. Relationship between communication and types of conflicts

Higher levels of communication willingness will enhance a team's work enthusiasm, the sense of belongings and team pro-activeness, ultimately generating more ideas and creativity to solve problems encountered in the process of projects. Project teams are more willing to communicate and express their capabilities to process information (Hewage and Ruwanpura, 2009; Reinders, 2014). Meanwhile, communication willingness helps to strengthen a team's emotional wellbeing, increase trust between members and build rapport relationships among teams, enable teams to cooperate for the accomplishment of project goals, thus helping to achieve the project success. Therefore, communication willingness positively affects the process and task conflict, and negatively affects relationship conflict.

In the context of formal communication, discussions between project teams tend primarily to concern specific project tasks, thus deepening the teams' understanding of these tasks and regulating team members' behaviors. Diverse information possessed by these teams leads to information on a certain task being distributed across project teams, thus causing information asymmetry. Through the formal communication channels between teams, each project team can timely grasp effective information on the project purpose and task, and comprehensively learn about the use of ongoing resources in order to optimize resource allocation and utilization, thus assuring a smooth process of the project. In addition, through the communication channels such as progress meetings, paper-based documents, the communication processes and information can be accurate, interpreted, relevant, and adequate on project processes and tasks. Therefore, effective formal communication reduces both task and process conflict. While in Chinese cultural context, a high frequency of formal communication, to some

Table 5
Results of theoretical model analysis.

Relationship between variables		Standardized coefficients	Hypotheses supported
The effect of mediating variables on dependent variables	Relationship conflict → project success	−0.234*	H4c: validated
	Process conflict → project success	−0.256*	H4b: validated
	Task conflict → project success	0.487*	H4a: validated
The effect of independent variables on mediating variables	Communication willingness → relationship conflict	−0.340*	H3c: validated
	Communication willingness → process conflict	0.402*	H3b: validated
	Communication willingness → task conflict	0.441*	H3a: validated
	formal communication → relationship conflict	0.577*	H1c: validated
	Formal communication → process conflict	−0.410*	H1b: validated
	Formal communication → task conflict	−0.380*	H1a: validated
	Informal communication → relationship conflict	−0.272*	H2c: validated
	Informal communication → process conflict	0.543*	H2b: validated
	Informal communication → task conflict	0.465*	H2a: validated
The effect of mediating variables on mediating variables	Task conflict → relationship conflict	−0.051	H5a: not validated
	Relationship conflict → task conflict	−0.056	
	Relationship conflict → process conflict	0.690*	H5b: validated
	Process conflict → relationship conflict	0.636*	
	Task conflict → process conflict	−0.004	H5c: not validated
	Process conflict → task conflict	−0.007	
Fit indices	$x^2/df = 2.13; RMSEA = 0.076; GFI = 0.86; AGFI = 0.83; NFI = 0.93; IFI = 0.92$		

Notes: * indicates $p<0.05$.

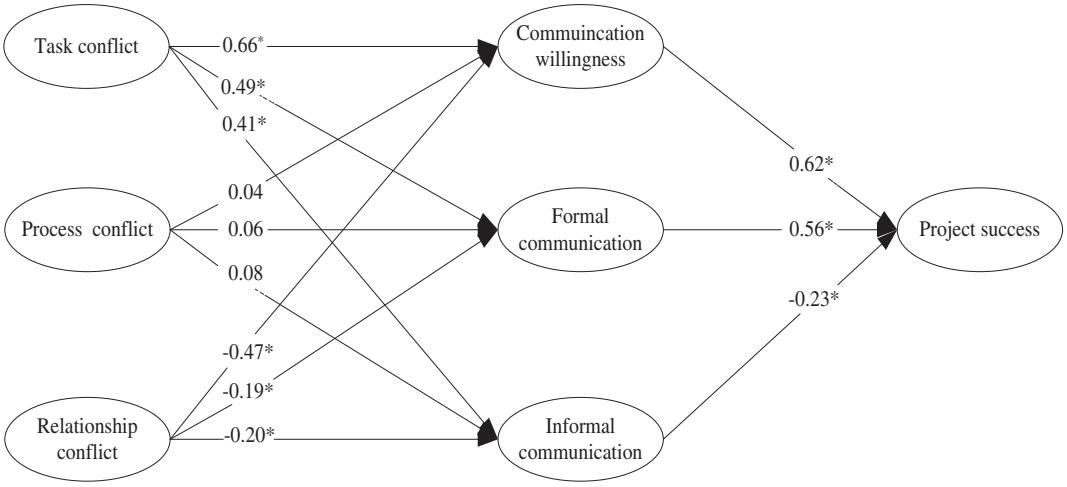

Fig. 3. Model B—Communication as a mediating variable.

extent, means distrust between project teams (Chen et al., 2005). If project teams cannot trust each other, they will be reluctant to share information, thus a tension may emerge (Cheung et al., 2013; Wu et al., 2017). Hence, a high frequency of formal communication is positively associated with relationship conflict.

Informal communication is casual with no fixed and controllable communication relationships, which can easily lead to the distortion of information. When a disagreement arises with regard to the processual arrangement of overall tasks during the process of finishing specific tasks, each team could obtain information on the overall process design, plan and integrity of the project via informal channels. Informal communication can enable project teams to obtain information in a timely manner, which formal communication provides with greater difficulty. Such information is more likely to authentically reflect teams' opinions, thoughts and motivations (Adnan et al., 2012). Therefore, informal communication positively influences on the process and task conflict, and negatively influences on relationship conflict.

However, the channels of informal communication are usually unstable, random and uncertain. Information distortion will lead to these project teams' misunderstanding of the work content and arrangement of overall tasks, with elements such as passiveness and discord occurring during the process of task allocation and process execution (Reed and Knight, 2010). Furthermore, intense relationship conflict between teams will reduce the level of trust between them, resulting in negative emotions among project teams, and a greater focus on the rivalry between teams. Both negative emotions and rivalry between project teams are detrimental to team communication. However, task conflict is then likely to reduce team members' rigid ideas, helping to generate new ideas and opinions, promoting communication between teams. Both task conflict and process conflict are task-oriented, and will evolve in the same direction (Chen et al., 2014). After the dimensions of communication are used as mediating variables (Model B), the influence of process conflict on communication willingness, formal communication and informal communication is not significant. The potential explanation is that task conflict in Chinese construction projects is mostly resolved before they expand to the process conflict.

6.2. Effects of communication on project success

The results showed that different dimensions of communication directly or indirectly affected the project success in construction projects. Communication willingness and formal communication positively influence the project success, while informal communication negative influences project success. In construction projects, strong communication willingness and effective formal communication are essential for the efficient coordination. Formal communication, which is usually task-oriented, provides a central forum for requesting and exchanging the information necessary for the successful completion of construction projects (Gorse and Emmitt, 2003). Project teams are not always willing to share their information without mutual trust, due to the Chinese cultural context (Diallo and Thuillier, 2005; Henderson et al., 2016). A high level of willingness to communicate using the correct mode of communication can engender a positive effect, and increase the exchange of information between teams, dilute the boundaries between them. Maintaining a high level of communication willingness between project teams helps the team to consider all useful opinions, coordinate and resolve conflicts and differences, and encourage new ideas, which in turn contributes towards the project success.

In this study, informal communication was found to be negatively related to project success. This contrasts with findings of previous studies focusing on design teams (Otter and Prins, 2002; Shohet and Frydman, 2003). This is mainly due to the lack of fixed and controllable relationships within the remit of informal communication. This type of communication can distort the truth, generate resistance to the overall processual arrangements and the allocation of project tasks. Information distortion will lead to these project teams' misunderstanding of the work content and arrangement of overall tasks. Misunderstandings of task arrangements are expensive in terms of time and resources and they also create passive feelings between project teams.

Information confusion can lead to time and cost overruns to complete the project, thus affecting the project success.

Recent studies have suggested that communication and project success in inter-organizational teams are curvilinearly related (Kennedy et al., 2011; Leenders et al., 2003; Patrashkova and McComb, 2004). These studies found an inverted U-shape relationship between communication and performance, but failed to pinpoint the reasons for this specific relationship. In this study, communication was classified into communication willingness, formal communication and informal communication to analyze their effects on project success. The results showed that different dimensions of communication have different impacts on the project success. Hence, with a joint effect on project success, the relationship between communication and project success may present an inverted U-shape. Therefore, this study makes an important theoretical contribution to current understanding of the relationship between team communication and project success, from a multi-dimensions perspective.

6.3. Relationship between different types of conflicts

The relationship between task conflict and process conflict is not self-evident because both of these two types of conflicts have a significant impact on the project success. Indeed, some researchers (De Dreu and Weingart, 2003; Hartwick et al., 2004) opt not to separate process conflict from task conflict, and only discuss task and relationship conflict in their research. Task conflict concentrates on specific and controlled objectives, such as resource utilization and distribution in the process of project implementation. By contrast, process conflict focuses on the arrangement of proceedings and on the plan and integrity of the process. Therefore, these two types of conflicts are usually not mutually connected. Consequently, task conflict and process conflict do not affect each other. It is also worth noting that task conflict and relationship conflict are not correlated with each other, which is inconsistent with many other studies (Chen et al., 2014; Hartwick et al., 2004). Compared with task conflict, process conflict is more likely to trigger relationship conflict, because it generally involves the execution of detailed work and anything related to benefits (Huang, 2010).

In construction projects, process conflict and relationship conflict are not independent. As for project process, project teams' disagreements on how to carry out specific task may cause the process conflict. If not solved properly, process conflict may deteriorate and lead to relationship conflict. A tense relationship between project teams will transfer the focus of the project processes onto relationship conflict. Relationship conflict will lead to the intense interpersonal relationship between project teams and provoke process conflict. Therefore, throughout the project implementation, process conflict and relationship conflict are intertwined closely, which poses collective impacts on the project success.

Some researchers suggested that different types of conflicts can mutually transform (Jehn and Mannix, 2001; Jehn et al., 2013; De Dreu and Weingart, 2003; Harmon, 2003), however not providing adequate empirical data to support this viewpoint. This research provides empirical evidence to bridge this knowledge gap, which is a theoretical contribution to the existing body of knowledge.

6.4. Effects of types of conflicts on project success

The results revealed that different types of conflicts impacted on project success in different ways. The effect of task conflict on project success was the most powerful and positively related to project success. This is followed by process conflict and relationship conflict, both of which was negatively related to project success. This is because, the more intense task conflict, the more frequent team interactions will become, and the deeper thinking about the task will be. Additional opinions, ideas and judgments relating to goals, decisions or task solutions will be put forward when specific tasks of the project are completed. This will facilitate communication between the project teams, thus contributing towards the project success. Meanwhile, task conflict enables the provision of constructive criticism and alternative scheme choices, reflecting project teams' true opinions and ideas. When the project team encounters complex problems, task conflict can provide the team scope with an opportunity of further thinking and help members to develop novel and creative problem-solving solutions, ultimately promoting the successful implementation of the project.

In the context of the Chinese construction industry, once the process of the project is arranged and determined, it is difficult to make significant changes (Wu, 2013). When the project teams complete the overall task and fulfilling project objectives, contradictions, oppositions, or disagreements will arise from the arrangement of these processes. It will lead to uncertainties of obligations and responsibilities, as well as doubt of each other's competencies. Disagreements on the allocation of project benefits will lead to the intensification of process conflict. This hinders the smooth progress of the project, which will have a negative effect on the project success.

A higher level of relationship conflict will shift the focus of the project to the relationships between teams, which restricts project team members' cognitive function and provokes opponent behaviors among project teams. This can additionally affect the process of the project and thus impedes the project success. In addition, given the close connection between process conflict and power, and between duties and benefits among project teams, it is very likely relationship conflict arises once the question of benefits allocation emerged. In other words, task conflict, as a constructive conflict, is beneficial to improve project success to some extent. By contrast, process conflict and relationship conflict have negative impacts on the project success.

7. Conclusions and implications

7.1. Conclusions

Chinese construction project teams are confronted with significant challenges such as prominent contradiction, poor communication, and a low production efficiency. Therefore, it is of great theoretical and practical significance to investigate

the effects of the communication-conflict interaction on project success. This study revealed that three dimensions of team communication affected the project success, out of which communication willingness have the strongest effect. This is because the project success consists of both hard indicators (e.g. quality, cost, schedule, safety), and soft indicators (e.g. project stakeholders' satisfaction, efficiency and effectiveness of project management).

This study verifies the functional effect of task conflict, which contributes to project success (Model A). Task conflict is helpful in enhancing the communication willingness and strengthening the communication effectivity between project teams. This is in turn conducive to the construction and improvement of communication mechanisms between the teams. Effective communication can enhance the transparency of information so that the project team can understand the current project status, the direction of future efforts; and improve team cohesion to ensure the realization of project success. Therefore, effective communication is helpful in unifying the project concept and teams' ideas, strengthening their recognition of work content, task process and rules and regulations, coordinating team behavior, and thus contributing towards the project success (Model B).

Relationship conflict and process conflict were found to be negatively related to project success. This is because they lead to frequently changing benefit demands, a reduction in communication willingness, and poor communication between project teams. It not only increases the possibility of conflict occurrence but also leads to negative behavior of project team which hinders the project success. Process conflict and relationship conflict were also found to affect each other. Process conflict involves the arrangement of project processes and the execution of specific tasks. As a result, relationship conflict between teams will emerge once project teams' interests are adversely affected. Following such relationship conflict, there is often a lack of communication willingness among project teams. This results in the deterioration of the relationship between project teams, which is not conducive to the realization of project success.

7.2. Practical implications

Team communication and conflict are soft factors that can affect the project success. As one of the soft elements, communication helps to coordinate team behavior, enhance information transparency and improve trust and dependence among project teams, thus positively contributing to the project success. As a constructive conflict, task conflict helps to stabilize project teams' benefit demands and facilitate trust and communication mechanisms among teams. However, process conflict and relationship conflict are detrimental to the communication between project teams, leading to a lack of trust and excessive benefit demands. They also lead to negative behaviors among project teams, which is not conducive to the project success. In light of this, the attention should be paid to the constructive side of task conflict by taking advantages of its positive effects. Similarly, the destructive impacts of process conflict and relationship conflict should be minimized. Together with facilitating the transition from destructive conflict to constructive conflict, the project is more likely to be successful. During the implementation of construction projects, each project team should actively coordinate its relationship with other project teams, take the correct measures to deal with potential problems, it resolve emerging conflicts, and prevent the occurrence of underlying conflict. Furthermore, would be a positive step to establish and improve the formal communication mechanisms among project teams on the basis of the equality of cooperation.

7.3. Limitations and future research

One limitation of this study is that it only considered the effects of project team communication on conflict evolution and project success. Dependent variables such as contracts, trust and interdependence have not been included in the model. Therefore, future research opportunities exist to include these variables in determining the impacts of communication-conflict interdependence on the project success. Similarly, communication and conflict behaviors among project teams are even more complex and are evolving. Future research could be conducted to explore the evolutionary mechanism driving the different dimensions of team conflict. Despite these limitations, the conclusions of this study provide useful inputs to develop effective conflict management strategies for construction project teams in a bid to achieve the project success.

Conflict of interest

There is no conflict of interest.

Acknowledgement

This study is supported by the National Natural Science Foundation of China (71561009 and 71301065), China Postdoctoral Science Foundation (2016M590605 and 2017T100477), Postdoctoral Science Foundation of Jiangxi Province (2016KY27), Social Science Planning Foundation of Jiangxi Province (16GL32), and Natural Science Foundation of Jiangxi Province (20171BAA218004).

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