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Examining the factors influencing cross-project knowledge transfer: An empirical study of IT services firms in China

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Abstract

Despite the significance of the knowledge initiatives at project level, our understanding of knowledge transfer between projects and of its influencing factors remains limited. Drawing on knowledge transfer and project management literature, we develop a theoretical model positing that cross-project knowledge transfer is influenced by project teams' transfer capabilities, project teams' relationship, project task context and project team context. We adopt mixed methods and empirically test the model in the context of Chinese IT services firms. Our data analysis reveals that cross-project knowledge transfer is affected differently by the capabilities of and governance efforts by the source and recipient teams. Our study concludes that project-based organizations and project managers will be able to better manage the complexity of cross-project knowledge transfer if they simultaneously consider the multiple dimensions of factors underlying the complex knowledge transfer process and be mindful of the source and recipient of knowledge in the project setting.

Keywords: Knowledge transfer; Cross-project; Project management; IT services; Project-based organization; Mixed methods research

1. Introduction

Organizations increasingly use knowledge worker teams to accomplish projects, and believe that teams can benefit from the accumulated knowledge and learning from other projects. When knowledge acquired and created within a project (referred to as "source project" or "base project") is transferred to and used by another project (referred to as "recipient project" or "new project"), cross-project knowledge transfer occurs (Newell and Edelman, 2008). Such cross-project knowledge transfer exerts a positive impact on project outcome, such as accelerating the project implementation process and improving project efficiency and service quality (Landaeta, 2008; Park and Lee, 2014; Petter and Vaishnavi, 2008). However, cross-project knowledge transfer is not always successful. For example, a source project team may find it difficult to document and store "lessons learned" in knowledge repositories (Newell and Edelman, 2008), while the recipient project team may find most of the project-related knowledge in the repositories outdated (Pemsel and Müller, 2012), or fragmented (Pemsel and Wiewiora, 2013). The problems associated with cross-project knowledge transfer have negative impacts on the development of organizational and project management capabilities, affecting organizational performance in the long term (Scarbrough et al., 2004). How to improve the transfer of knowledge across projects continues to challenge project-based organizations (PBOs), especially those relying on project teams to perform knowledge-intensive work.

However, managing knowledge transfer across projects remains to be a challenging and complex process, because of the temporary nature of projects. The disbanding of members at a project's completion leads to the fragmentation of project-based knowledge (i.e., knowledge stored in the transactive memory system of each disbanded member), increasing the risk of

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knowledge loss for the project-based organizations (PBOs). To make the matter worse, project teams often face time pressure to complete and deliver their projects. Under tight project deadlines, they become focused on project tasks rather than on knowledge transfer activities, causing a lack of cross-project learning (Davenport et al., 1998; Loo, 2002). Moreover, the members of a disbanded team often have little time and motivation to carefully reflect on their past experiences and to diligently document the lessons they learned for reuse in the future (Brady and Davies, 2004). The accumulated knowledge and valuable lessons learned throughout the project, if not effectively shared with other projects, can be regretfully lost.

Extant research on team knowledge transfer related information technology (IT) projects has primarily concerned the factors influencing knowledge transfer *within* the same IT project (Joshi et al., 2007; Ko et al., 2005). Project-related factors (i.e., time urgency) and the significant "projectized" characteristic (Meo et al., 2010) embedded in other factors may greatly influence knowledge transfer *across* IT projects, but their influences remain under-explored. For PBOs and project management, there are two important but under-studied questions to address: (1) *What are the main factors that may influence cross-project knowledge transfer within IT services firms?* (2) *How can these factors predict the effectiveness of cross-project knowledge transfer?*

Our study is informed by research on knowledge transfer and project management. Drawing upon prior studies on the characteristics of project management (Meo et al., 2010) and knowledge transfer in organizations (Argote and Ingram, 2000; Szulanski, 1996), we define *cross-project knowledge transfer* as the communication activities of knowledge from a source project to a recipient project so that the useful knowledge is absorbed and reused by the recipient project. In particular, our study examines if those factors impact on source project and recipient project differently.

We conduct our research in the context of IT services firms in China. This context is appropriate for addressing our research questions for two main reasons. First, IT services firms typically rely on project teams to develop products and provide services, whether building new software applications or implementing packaged systems. Consistent with McFarlan et al. (2012), we define IT services as consisting of software development and information technology services. Because IT services are based on integrating diverse knowledge domains (e.g., technology, business, and project management), the knowledge and learning accumulated by one IT services project thus become important knowledge sources for other projects. It is essential for IT services firms to efficiently and effectively share those project knowledge and learning. Yet, as most project teams in IT services are temporarily formed to achieve specific project goals under specified timeframes, the quick disbanding of team members at the completion of a project often causes the loss of useful project knowledge and limits its subsequent reuse (Disterer, 2002). Second, Chinese IT services market has undergone fast growth over the last decade and has paid increasing attention to knowledge transfer initiatives in organizations and at projects. According to a recent IBISWorld report (2013), the IT services industry in China has been growing at an annualized rate of 6.8% over the past five years, with expected total revenue of $100.4 billion in 2013, which is up 9.0% from the total revenue in 2012. For an IT services firm to grow into a major player in this burgeoning industry and to become competitive in the global IT marketplace, it must learn how to manage their project knowledge effectively.

The remainder of the paper is organized as follows. First, we review relevant literature on knowledge transfer to identify the main factors affecting the effectiveness of cross-project knowledge transfer and develop a research model with hypotheses. We then describe the mixed methods used in the study; we combine an empirical study based on survey data to test our hypotheses and a case study for an in-depth understanding of the complex phenomenon of cross-project knowledge transfer. Data analysis and findings are presented subsequently. We conclude the paper with a discussion of the implications of our findings and directions for future research.

2. Literature review and theoretic model

Our study of cross-project knowledge transfer is informed by extant research on knowledge transfer in organizations. Based on the established generic framework of the factors influencing knowledge transfer in the organizational context, we develop a theoretic model to incorporate the factors influencing cross-project knowledge transfer at project level.

2.1. Knowledge transfer in organizations

Organizational scholars have examined knowledge transfer from different perspectives. Most studies adopt the communication perspective and view knowledge transfer as a process of two sub-processes—sending knowledge and receiving knowledge—during which the source communicates knowledge with the recipient (Ko et al., 2005; Szulanski, 1996). Other scholars highlight the consequence of the process and the differences in contexts when examining knowledge transfer in organizations. For example, Argote and Ingram (2000) emphasize the importance of absorbing and applying the transferred knowledge, and define knowledge transfer as "the process by which one unit of an organization, such as a group or department, is affected by the experience of another." Singley and Anderson (1989) view knowledge transfer as the process of applying the knowledge acquired in one situation to another and highlight the role of context in knowledge transfer.

Furthermore, organizational scholars have conducted numerous studies to identify a set of key factors influencing knowledge transfer. Taking both communication process and context into account, Szulanski (1996) proposes four types of factors, including the characteristics of knowledge (i.e., causal ambiguity and unproven), the source (i.e., motivation and perceived reliability), the recipient (i.e., motivation, absorptive capacity and retentive capacity) and context (i.e., organizational management mechanism). Similarly, Gupta and Govindarajan (2000) adopt the perspectives of communication process and information flow, and propose an expanded list of five key elements: (1) perceived value of the knowledge from the source, (2) motivational

disposition of the source (i.e., their willingness to share knowledge), (3) transfer channels and their richness, (4) motivational disposition of the recipient (i.e., their willingness to acquire knowledge from the source), and (5) the recipient's absorptive capacity (i.e., their ability to acquire, assimilate and use knowledge). Cummings and Teng (2003) review the knowledge transfer research and summarize the antecedents of knowledge transfer into four dimensions, including the characteristics of knowledge, the source and the recipient, relationship between the source and the recipient, and transfer activities. In summary, the factors influencing knowledge transfer can be categorized into five dimensions: the characteristics of knowledge, the source and the recipient, the relationship between the source and recipient, transfer activities, and transfer context.

These five categories of influencing factors have also been evidenced in the field of IT services. For example, in their study of enterprise system use by the State Government of Queensland, Australia, Timbrell et al. (2001) find empirical evidences to support the significant effect of the characteristics of knowledge, the source and the recipient, arduous relationship between the source and the recipient, and barren organizational context on the transfer of best practices. Similarly, Ko et al. (2005) examine the knowledge transfer from consultants to client organizations in enterprise system implementations, and conclude the significant performance impact of the set of factors, including motivation of source and recipient, their encoding and decoding competence, shared understanding, and the arduous relationship. In the context of information systems development, Joshi et al. (2007) find empirical evidence to support the positive role that a knowledge source plays in team knowledge transfer.

The studies mentioned above and the five dimensions of the factors influencing knowledge transfer in the general context provide us with a good theoretical basis to empirically investigate cross-project knowledge transfer. Inheriting the generic characteristics of knowledge transfer, cross-project knowledge transfer also demonstrates its uniqueness, especially its "projectized" characteristic (Meo et al., 2010). Those characteristics unique to the project level must be taken into consideration in order for a project team to achieve effective cross-project knowledge transfer. Below we first draw upon project management studies for further insights, and then propose our theoretic model and corresponding hypotheses.

2.2. Cross-project knowledge transfer and its influencing factors

There are two types of cross-project knowledge transfer: knowledge transfer occurring between two concurrent projects and knowledge transfer between two sequential projects. The former refers to knowledge transfer between two parallel projects such that a new project begins to acquire knowledge from a base project before the base project has completed its task. The latter refers to knowledge transfer between two projects that complete at two points in time such that a new project begins to acquire knowledge from a base project after the base project is completed (Nobeoka, 1995). For the knowledge transfer between sequential projects, it becomes difficult to test the effectiveness of knowledge transfer from a certain base project because a new project tends to acquire knowledge from multiple base projects simultaneously, Therefore, in this study, we only focus on knowledge transfer between concurrent projects.

Extant studies have explored the factors influencing cross-project knowledge transfer. These factors include the tacitness of the transferred knowledge, the channels based on social interaction and enabled by information technology (Newell et al., 2006; Newell and Edelman, 2008), the source project team members' willingness to transfer knowledge (Disterer, 2002) and capability to reflect and integrate the to-be-transferred knowledge (Zedtwitz, 2002), the recipient project team members' willingness (Newell and College, 2004) and effort (Landaeta, 2008) to acquire and receive knowledge, trust between members from the source and recipient project teams (Park and Lee, 2014), project organization culture refusing to make mistakes (Disterer, 2002), cross-project learning infrastructure, system, procedures and rules (Mainga, 2010). Also, cross-project knowledge transfer is influenced by projectized factors. Some researchers (Lewis et al., 2005) point out that task similarity is the prerequisite for successful cross-project knowledge transfer, others (Newell and College, 2004; Park et al., 2008) suggest that time urgency of a project motivates a project team to seek knowledge from other project teams. Therefore, building upon the generic framework of knowledge transfer, we summarize the factors influencing cross-project knowledge transfer under six dimensions, including the characteristics of the transferred knowledge, the source and recipient project teams, the relationship between the two teams, transfer activities, project task context and project team context. The project task context includes contextual factors of task similarity and time urgency, while project team context refers to the management mechanisms for cross-project knowledge transfer at project level.

These six dimensions of factors are embedded in the definition of cross-project knowledge transfer. In the process of cross-project knowledge transfer, project knowledge is the object; the source and recipient teams are the actors; the relationship between the two actors is the tie to connect them in cross-project knowledge transfer; transfer activities are the necessary channels; the task context of the source and recipient projects is the background where cross-project knowledge transfer is situated; and the project team context includes the indispensable management mechanisms for bearing support. In other words, cross-project knowledge transfer is to transfer project knowledge from the source project team to the recipient with the good relationship through all kinds of transfer activities under the specific task context and the team context enabled by indispensable management mechanisms. As a result, the six dimensions of factors are essential to cross-project knowledge transfer. Because the characteristics of knowledge and transfer activities have been verified and discussed in information systems (IS) studies of IT projects (e.g., Joshi et al., 2007; Timbrell et al., 2001), we don't intend to examine the two dimensions. In addition, as cross-project knowledge transfer is a kind of collective activity driven by the organizational needs of implementation of IT projects, in this paper, we consider the capability of the source and recipient project teams instead of project teams' motivation.

In summary, we focus on the four dimensions of the influencing factors, namely the capability of the source and

recipient project teams, the relationship between two projects, project task context, and project team context. We believe that these four dimensions represent the key features associated with the knowledge transfer between projects, and they collectively influence the effectiveness of cross-project knowledge transfer. Fig. 1 depicts our theoretic model.

As shown in the model, project team's capability refers to source project team's transfer capability and the recipient project team's absorptive capability, which have been identified as important factors impacting knowledge transfer (Gupta and Govindarajan, 2000; Martin and Salomon, 2003; Szulanski, 1996). The relationship between source and recipient project teams is also regarded as an important factor which affects knowledge transfer in project context (Park and Lee, 2014). For project task context, we focus on task similarity between the source and recipient projects (Lewis et al., 2005) and teams' perceived time urgency (Newell and College, 2004; Park et al., 2008), both of which have been suggested as two important factors contributing to cross-project knowledge transfer. For project team context, we include knowledge governance efforts (Grandori, 2001) by both the source and recipient project team, which refer to teams' knowledge management mechanisms, as these mechanisms are found to support cross-project knowledge transfer (Mainga, 2010).

Our research objective is to empirically examine how these four dimensions of factors affect cross-project knowledge transfer. Below we discuss each of the dimensions and the corresponding hypotheses.

2.2.1. Project team's capability

Research on team behavior has suggested that the overall capability of a team to integrate the knowledge and skills of its team members is essential to the successful completion of team work (Stevens and Campion, 1994). Moreover, project teams' capability to manage and use the knowledge has been verified to play an important role in implementing non-IT projects (Teerajetgul et al., 2009). Based on these studies, we argue that both the source project team's capability to transfer knowledge and the recipient project team's capability to receive knowledge are important factors contributing to effective cross-project knowledge transfer.

Source project team's transfer capability refers to the source project team's ability to identify potential uses of its knowledge and the contingent conditions, to assess the needs and capabilities of the potential recipient, and to transmit knowledge so that it can be put to use in another location (Martin and Salomon, 2003). At the individual level, source's transfer capability is positively and significantly correlated with the effectiveness of knowledge transfer (Shu, 2006). Because a team's knowledge and ability are the integration of individual knowledge and ability (Nonaka, 1994; Stevens and Campion, 1994), we infer that the *source* project team's transfer capability has a significant correlation with the effectiveness of cross-project knowledge transfer. Thus, we hypothesize that:

Hypothesis 1 (H1). A source project team's transfer capability is positively related to the effectiveness of cross-project knowledge transfer.

Recipient project team's absorptive capability refers to the ability of a recipient project team to identify the value of new knowledge transferred from the source project, assimilate and apply the knowledge to its own project, according to Cohen and Levinthal's (1990) definition of absorptive capability. A prior study concludes that a high level of absorptive capacity of the project team is a necessary condition for successful project knowledge transfer because the recipient with a strong absorptive capacity can respond to external knowledge quickly, absorb and reuse it productively (Bakker et al., 2011). Empirical research in the IS field shows that the recipient's absorptive capacity has a positive impact on the process of knowledge learning in the implementation of enterprise resource planning (ERP) systems (Marabelli and Newell, 2009). Similarly, in the context of cross-project knowledge transfer, the strong absorptive capacity

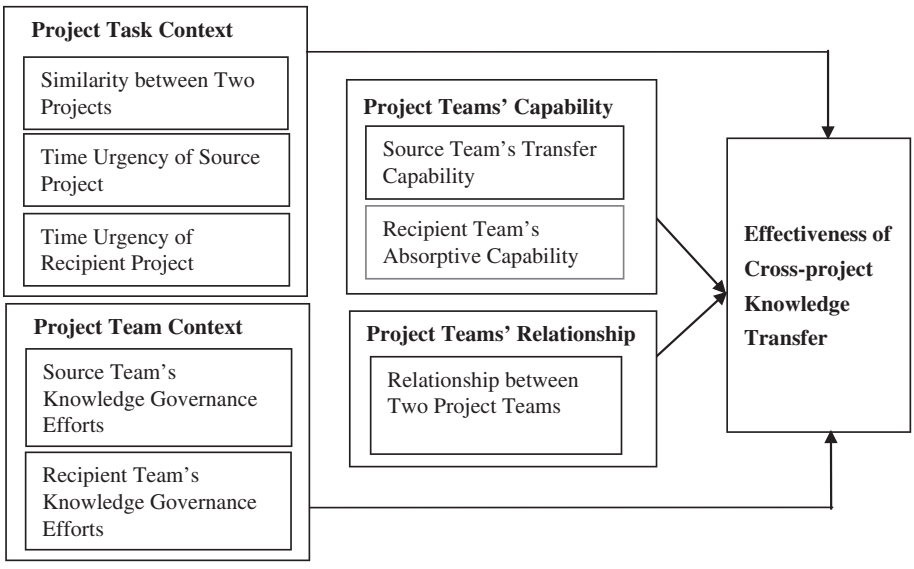

Fig. 1. Model of the factors influencing cross-project knowledge transfer.

of the recipient project team is likely to lead to effective knowledge transfer. Therefore, we predict:

Hypothesis 2 (H2). A recipient project team's absorptive capability is positively related to the effectiveness of cross-project knowledge transfer.

2.2.2. Project teams' relationship

Relationship between source and recipient project teams is defined as the cooperation and mutual trust between the source project team and the recipient project team, which is opposite to the meaning of arduous relationship (Szulanski, 1996). It's also an important team factor contributing to cross-project knowledge transfer. As transferring and absorbing knowledge require the source and recipient project teams to interact frequently, teams that maintain friendly cooperation can enhance their communication and understanding of knowledge, improving their project success. Conversely, an arduous relationship, especially a competitive relationship, between the source and the recipient has been found to hinder effective knowledge transfer (Ko et al., 2005; Szulanski, 1996). In fact, the relationship between the source and the recipient has been proved to impact the knowledge transfer in PBOs considerably (Enberg, 2012). Therefore, we predict:

Hypothesis 3 (H3). The relationship between two project teams is positively related to the effectiveness of cross-project knowledge transfer.

2.2.3. Project task context

Two situational factors in project task context, project similarity and perceived time urgency, have been suggested as two important factors affecting cross-project knowledge transfer (Newell and College, 2004; Park et al., 2008). *Project similarity* refers to the degree of task similarity between the source project and the recipient project or the similarity in the work flows and implementation methods embedded in executing the project tasks (Astley and Zajac, 1991). Task similarity between source and recipient projects is the precondition for cross-project knowledge transfer as it implies some similarity and correlation of the work flows and implementation methods, further implying that the two projects share common project knowledge (Fitzek, 1999). The greater the project task similarity is, the more common work experience the source and recipient project teams have (Park and Lee, 2014), and the more easily both teams can share a common understanding of knowledge (Newell et al., 2006). Thus we consider task similarity as a key project task context variable that has the potential to impact cross-project knowledge transfer, and predict:

Hypothesis 4 (H4). The similarity between two projects is positively related to the effectiveness of cross-project knowledge transfer.

Time urgency of the source and recipient projects is defined as a kind of time pressure for a team to achieve its expected project goals (Park et al., 2008). The time pressure to complete a project will affect the project team's attitude and actions. When project members are mindful of time pressures (e.g., deadlines for project milestones and final due date), they tend to focus primarily on product or service delivery rather than on knowledge transfer activities, which hinders the transfer of best practices across projects (Davenport et al., 1998; Loo, 2002). As perceived time urgency increases, the source project and recipient project may act differently in terms of their knowledge transfer endeavour. The *source* project team is likely to devote much more time and energy to completing their own tasks and less time to communicating with others and sharing lessons learned. That is, perceived time urgency hinders the source project team's knowledge transfer (Wiewiora et al., 2009).

By contrast, the perceived time urgency will create an urgent need for a recipient project to learn from its source project team. The project teams are usually not willing to acquire knowledge from other project teams in the same firm until they perceive an urgency for project completion (Newell et al., 2006). In other words, to solve difficult problems under time urgency, the recipient project teams are more likely to learn from the successful experience of the source project teams, rather than to "reinvent the wheel." Under this circumstance, time urgency of the recipient project becomes an important factor contributing to the effectiveness of cross-project knowledge transfer. Thus, we predict:

Hypothesis 5 (H5). Time urgency of a *source* project is negatively related to the effectiveness of cross-project knowledge transfer.

Hypothesis 6 (H6). Time urgency of a *recipient* project is positively related to the effectiveness of cross-project knowledge transfer.

2.2.4. Project team context

Source and recipient projects teams' knowledge governance efforts refer to the management efforts taken by both project teams to support cross-project knowledge transfer to pursue its best result, according to Grandori's (2001) definition of knowledge governance. Knowledge governance is becoming increasingly important in both theory and practice, as it plays an important role in temporary PBOs (Pemsel and Müller, 2012). Empirical studies have showed that formal elements of an organization and the organization's culture are important factors influencing the knowledge management success in PBOs (Lindner and Wald, 2011). A case study of four large Australian PBOs indicates that project sub-cultures have significant impact on project teams' willingness to share knowledge between projects (Wiewiora et al., 2013). Moreover, effective contract mechanism has been tested to motivate the source to transfer knowledge and the recipient to absorb knowledge, further promoting cross-project knowledge transfer and communication (Bosch-Sijtsema and Postma, 2010; Burgess, 2005). Based on the above reasoning, we predict that the source and recipient project teams' knowledge governance efforts will exert positive impacts on cross-project knowledge transfer. Therefore, we hypothesize:

Hypothesis 7 (H7). A *source* project team's knowledge governance effort is positively related to the effectiveness of cross-project knowledge transfer.

Hypothesis 8 (H8). A *recipient* project team's knowledge governance effort is positively related to the effectiveness of cross-project knowledge transfer.

3. Research methodology

3.1. Mixed methods

Research that aims to improve the understanding of organizational problems and their causes often requires a variety of methods (Mingers et al., 2013). As Mingers (2001) and Mingers et al. (2013) suggest, we adopted a mixed method approach to investigate the issues confronting PBOs and project managers in their cross-project knowledge transfer practice. Specifically, we adopted a mix of quantitative analysis with survey data and qualitative analysis with interview data as detailed below. Such a mixed method is desirable for conducting a rich exploration of linkages across variables more systematically (Mingers, 2001). For example, Newell and Edelman (2008) use both quantitative (survey) and qualitative (interview) methods when investigating the effective mechanisms in cross-project learning. Their study shows that incorporating both qualitative and quantitative data collection and analysis into a single study can increase the robustness of the results and allow the researchers to obtain a wider range of responders' perspectives.

Similarly, we combined quantitative and qualitative analysis in this study. We empirically tested our hypotheses by using data collected from surveying 30 pairs of IT services projects (i.e. a source project and a corresponding recipient project) in China. Subsequently, we interviewed two pairs of IT project teams in two different firms and analyzed the qualitative interview data to better interpret those results from quantitative analysis, especially providing explanations for those unsupported hypotheses. The mixed-method approach served our research objective for two reasons. First, we aimed at investigating multiple dimensions of the factors influencing cross-project knowledge transfer in the context of IT services firms, which have not been intensively studied and is largely exploratory. Second, when we used the data collected from survey instruments to empirically test our research hypotheses, we also relied on the qualitative data from interviews to interpret our statistical analysis results, especially to explore why some of the hypotheses were unsupported. Because the organizational knowledge transfer literature has given a strong indication that the context where knowledge transfer occurs is extremely important (Szulanski, 1996), qualitative interview data analysis in this study can help to extract valid and even previously unknown context information embedded in IT services practice to provide very good insight for those unsupported hypotheses. In this regard, the mixed methods allowed us to triangulate our findings from two types of data, thereby enhancing our in-depth understanding.

3.2. Survey instrument and quantitative data collection

We developed a survey instrument to collect data and test our model and hypotheses. The items of most constructs were adopted from prior research (as shown in Appendix A). To make the items match the local context in China, we made slight modifications based on our pre-testing of the survey instrument conducted at two software companies during March and April of 2011. During the development of the survey instrument, we conducted pilot tests to confirm its content validity by interviewing three IT project managers from the two pre-testing software companies to examine the wording of the measurement items, the consistency of the items with their underlying construct, and the ease of understanding by respondents (Moore and Benbasat, 1991). Then we developed a matching pair of questionnaires for the manager of a source project (questionnaire A) and the manager of its recipient project (questionnaire B) respectively. This multiple respondent strategy allowed us to overcome the bias of common method approach and improve data accuracy (Sethi and King, 1994). All items were anchored on a five-point Likert scale, ranging from (1) "strongly disagree" to (5) "strongly agree."

We mailed the questionnaires to 102 IT project managers who were interested in participating in this research study, along with information about the incentives for their participation. In the survey instructions, we specified that the IT project managers should first identify their projects as the source (or recipient) project, and then pass the paired questionnaire to the manager of its matching recipient (or source) project to complete. We believe that this emphasis on matching the source projects with the recipient projects would allow us to collect more useful paired data. But 72 of the mail respondents informed us that it was difficult for them to locate the managers of their partner projects due to employee turnover or missing contact numbers. Finally, we received 30 valid pairs of questionnaires, achieving a satisfactory response rate of 29% from the initial sample of 102 managers promising to fill out our questionnaires. The entire process of data collection showed that it was very difficult to have the paired questionnaires completed by the IT project managers, mainly due to the high turnover rate of IT staff. In fact, there were 60 project managers filling out 60 questionnaires, i.e. 30 pairs of ones.

These 60 projects span various regions and industries, providing us a good portfolio of projects representing IT services projects in China. Majority of the projects were located in the big cities, including Beijing, Shanghai, Tianjin, Shenzhen, and Xi'an, which were the hubs of IT services in China. In the sample of 60 projects (30 pairs), 22 of the total projects had the contract amount of more than 0.5 million RMB Yuan (about $80,000), followed by 20 of them with 0.1–0.5 million RMB Yuan, and 18 of them with less than 0.1 million RMB Yuan. The respondents' experience in managing IT projects include: more 15 years of experience (20% of the respondents), 11–15 years (23.3%), 6–10 years (28.3%), 3–5 years (21.7%), and less than 3 years (6.7%). Although relatively small, the data sample allows us to identify useful and reliable findings in relation to challenges and contributing factors in cross-project knowledge transfer.

4. Quantitative analysis and results

We used partial least square (PLS) method and PLS-Graph Version 3.0 to test the measurement model and the structural model, the two-stage analytical procedures recommended by Anderson and Gerbing (1988) and Hair et al. (1998). First, PLS is not restricted by the distribution requirements, makes minimal demands of the sample size (Campbell and Fiske, 1959) and has been effectively used in extant IS studies (e.g., Bock et al., 2005; Ho et al., 2003). And it is also suited to our relatively small sample size, i.e., 30 pairs of data. Second, PLS can avoid the serious problems of inadmissible solutions and factor indeterminacy, enabling us to explain whether there exist relationships among constructs (Fornell and Bookstein, 1982). This method is appropriate for our exploratory test to differentiate the impacts of the four dimensions of influencing factors on cross-project knowledge transfer in IT services firms.

Before we ran our model, we carefully processed the survey data. We matched the scores of paired questionnaires A and B and combined them into one data set. During this process, we averaged the data of the items of the latent variables from both questionnaires A and B, including "project team relationship" and "project similarity," and only kept the data of those items from the designated questionnaires A or B. Then we checked the processed data, and removed the items with low inter-item correlation or serious cross-loading problem.

We then tested the measurement model by assessing two types of construct validity, including convergent validity and discriminant validity. Consistent with Bagozzi and Phillips (1982), we checked convergent validity via three criteria: Indicator Reliability, Composite Reliability (CR), and Average Variance Extracted (AVE), and reported the results in Appendix B. Indicator reliability is satisfactory as our all items have achieved a loading higher than 0.63, confirming great construct validity (Tabachnick and Fidell, 2007), and all the loadings are significant at the level of 0.01. The CR of all latent variables ranges from 0.7763 to 0.954, well above the minimum required threshold of 0.6 (Ringle, 2004), and all latent variables have Cronbach's Alpha (CA) of higher than 0.7, confirming internal consistency (Churchill and Peter, 1984). Moreover, all latent variables have AVEs between 0.5365 and 0.8739, well over a recommended threshold of 0.5 (Fornell and Larcker, 1981). Therefore, the measurements of scales have satisfied convergent validity.

Discriminant validity is achieved if the square root of the AVE for each construct exceeds the correlation between itself and all other constructs (Fornell and Larcker, 1981). As shown in Table 1, the square roots of the AVE on the diagonal cells are larger than inter-construct correlations in the same rows and columns, indicating that items in the constructs are more closely aligned with themselves than with other constructs (Gefen et al., 2000). Thus we confirmed that the measurement scales in our study demonstrated acceptable discriminant validity.

With an adequate measurement model, we tested the structural model with PLS. The structure model is examined by two indexes: R^2 and the significance of path coefficients. In our study, R^2 is 0.936, well above the minimum required threshold of 0.4 (Ringle, 2004), indicating that the independent variables can sufficiently explain the variance in the dependent variable. Then we evaluated the path coefficients and their significance, and summarized the results in Fig. 2. Our data analysis has provided support for the significant impact of recipient project team' absorptive capability (H2), recipient project teams' knowledge governance effort (H8), similarity between two projects (H4), and time urgency of source project (H5) on cross-project knowledge transfer. To our surprise, the remaining hypotheses were not supported, suggesting the inconclusive findings on the influence of source project team' transfer capability, source project teams' knowledge governance effort, relationship between two project teams, and time urgency of recipient project on cross-project knowledge transfer. The mixed results from our PLS analysis required further investigation.

5. Case study and findings

The above statistical analysis only supported 4 of the 8 hypotheses. To search for explanations for these unsupported hypotheses and to gain further insights into the complex knowledge transfer phenomenon between IT services projects, we conducted case studies at two IT services companies in Beijing, China. The primary criterion for our case selection was that the company must be a project-based organization in the IT services sector. The two companies we chose for our case study were not from our original data sample, but both companies viewed cross-project knowledge transfer as a strategic necessity and had developed internal processes to promote this activity. Thus, the two companies became the suitable sites for our case study.

5.1. Research context and case analysis

Both companies chose a pair of concurrent projects for our interview. The first company (referred to as "ServiceA") is specialized in providing knowledge management applications while the second company (referred to as "ServiceB") provides software services. The two paired projects by the company of ServiceA were completed for two client firms in consumer goods industry (i.e., beer and soft drink). In the meantime, the paired projects by the second company, ServiceB, were for two client firms in real estate industry. Table 2 provides a summary of the case organizations and the paired projects.

We visited the two companies and conduct the interviews of two focus groups on the research site. We interviewed a total of nine persons from the two companies. The informants from ServiceA include the two project managers (PM) from the pair of projects, the regional manager of the firm and one key personnel from its project management office (PMO). PMO personnel provided data about PMO functions and their experience of interacting with the projects. In ServiceB, we interviewed five persons, including one project manager and one key technical staff from each project and the general manager overseeing both projects. At each interview, we asked the informants about their specific experience and insights regarding transferring knowledge across the two specific projects they were involved by

Table 1
Correlations among major constructs.

	ECKT	STC	RAC	R	PS	STU	RTU	SKG	RKG
ECKT	**0.741**								
STC	0.561	**0.732**							
RAC	0.664	0.194	**0.935**						
R	0.552	0.339	0.374	**0.807**					
PS	0.538	0.541	0.516	0.394	**0.773**				
STU	−0.402	−0.243	−0.026	−0.225	−0.109	**0.825**			
RTU	−0.511	−0.321	0.195	0.068	−0.545	0.114	**0.834**		
SKG	0.243	0.280	−0.216	0.326	−0.104	0.220	−0.039	**0.850**	
RKG	0.735	0.364	0.457	0.222	0.691	−0.059	0.598	−0.075	**0.800**

Note: The square roots of the AVEs are bold and on the diagonal.

raising questions related to our hypotheses and statistical results. During the interviews, we remained open-minded, preparing to absorb new insights from their interpretation. Each interview lasted approximately 3 hours. The content of the interviews was digitally recorded and transcribed for subsequent data analysis. In addition to collect information from key stakeholders in the cross-project knowledge transfer, we also collect information about company background and project documentation from public news release and company websites. Collecting and analyzing information from multiple sources allowed us to achieve data triangulation and to ensure the validity of the findings (Yin, 2009).

The analysis of the two case studies was an iterative process during which the data were constantly revisited, consistent with Yin (2009) and Miles and Huberman (1994). We started with the analysis of each case and identified if our predicted relationships from the research framework (especially those unsupported ones from the statistical analysis) existed in the case analysis. Then we compared the findings across the two cases (ServiceA and ServiceB) and combined the findings in relation to the themes of the hypotheses. During the analysis, we focused on an episode, the chunk of dialogues surrounding one topic, as the unit of our qualitative data analysis, and identified the underlying dimensions of all influencing factors. All the three authors involved in the coding of the qualitative data, each of the first two authors focusing on coding one company, and the third author comparing and accepting the coding data collected from both companies. Within each dimension of the influencing factors, if inconsistencies occurred among the data coded, the three coders discussed and resolved the coding disagreement. When needed, the managers from the research site were consulted for clarification. Triangulation across the different sources of primary and archival data revealed a high level of data consistency and enhanced the validity of our findings.

Compared with survey questionnaire, case studies facilitated our probing for richer detail and developing unique insights, which complements the analysis based on quantitative survey data. That is, multiple-methods of case studies and survey questionnaire allow us to triangulate our findings (Jick, 1979). Below we present the key findings of the case studies on the four projects.

5.2. Qualitative results

In this section, we analyze the interview data and examine in detail how each dimension of the factors – source and recipient project teams' capability, the relationship between both of the two teams, project task context, and project team context – influenced or failed to influence cross-project knowledge transfer. Findings of the interviews are highlighted in Table 3, with each dimension being elaborated below.

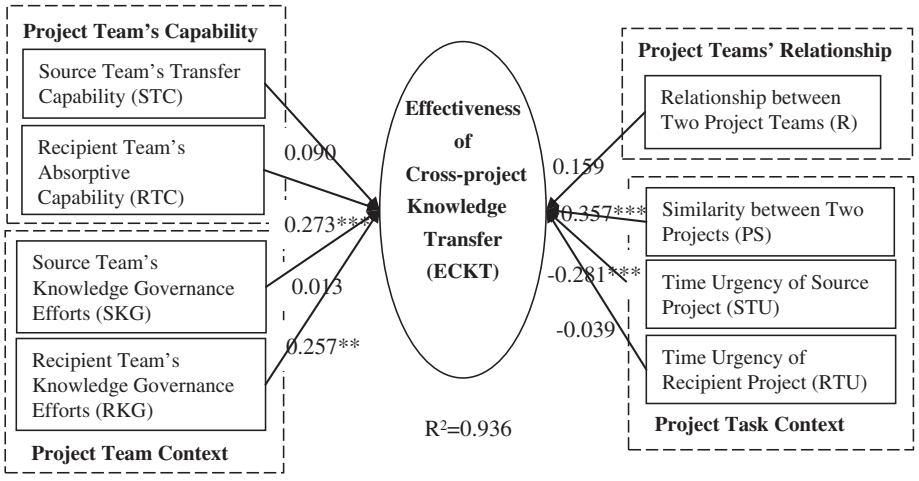

Fig. 2. Results of PLS analysis. (Note: a. *p < 0.10, **p < 0.05, ***p < 0.01; b. In total, just 4 of 8 our original hypotheses were supported in this figure).

Table 2
Summary of case organizations.

	Company ServiceA	Company ServiceB
Business area	A provider of knowledge management application solutions	A subsidiary of an International Software Group Co., Ltd.
Year of establishment	April 2001	August 1993 (successfully listed in the Hong Kong Stock Exchange in July 2005)
Company size	19 branches employing more than 1000 IT professionals and staff	3 subsidiaries with 9000 employees. 3000 IT professionals and staff in the Beijing subsidiary
Project type	Producers of consumer goods	Real estate clients
Source project	Client was a beer manufacturer (referred to as "A_Beer")	Client was a domestic real estate company (referred to as "B_EstateChina")
Recipient project	Client was a manufacturer of general beverage (referred to as "A_Beverage"	Client was a Singapore company (referred to as "B_EstateSingapore")

5.2.1. Impact of source's transfer capability and recipient's absorptive capability

According to our interviews, both companies have implemented standard procedures for source projects to summarize their lessons learned and to store their project summaries in organizational knowledge management systems. Those mechanisms and policies helped ensure the transfer capability of the source project teams. Moreover, both companies stressed that the recipient project teams' absorptive capability became essential for effective cross-project knowledge transfer. As the informant from ServiceA explained, "the effectiveness of cross-project knowledge transfer is mainly evaluated from the perspective of the recipient." As shown in the interviews (see Table 3), source's transfer capability and recipient's absorptive capability have exerted different extent of positive impacts on the effectiveness of cross-project knowledge transfer. One important reason was that technical staff and managers often paid more attention to knowledge transfer outcome associated with the *recipient* project team's absorptive capability, as compared to source project team's transfer capability.

5.2.2. Impact of dual relationship

Our interviews at ServiceA and ServiceB revealed that the relationship between two project teams was more complicated than we originally expected; it was a dual relationship, both co-operative and competitive. The competitive relationship between two project teams in the scenario (see Table 3) resulted from their competition for internal resources, such as human resources of experts. As a consequence, this competitive relationship hampered their effort in transferring knowledge between projects. On the other hand, when the relationship was friendly and co-operative, members of two project teams were more willing to transfer information and knowledge for each other. As a result of the dual relationship, the impact of the relationship between two project teams on the effectiveness of cross knowledge transfer may become uncertain and non-significant.

5.2.3. Influence of project similarity

The analysis of our interview data revealed that project similarity was often perceived as similarity in client business (e.g., industry sectors). This was illustrated by a PM from ServiceA (see Table 3). Furthermore, this linkage between project similarity and cross-project knowledge transfer outcome was related to the type of knowledge. When the to-be-transferred knowledge was related to the client, such as knowledge of business processes and operations, the industry similarity between the source and recipient projects became a significant predictor of cross-project knowledge transfer. By contrast, when the to-be-transferred knowledge was technology-oriented, such as knowledge of hardware, software or implementation methodology, then the influence of the project similarity diminished. In other words, the effect of project similarity on knowledge transfer was contingent on types of knowledge being transferred. As reflected in the comments by the general manger from ServiceB, it is important to categorize clients by their industry sectors and to categorize project knowledge (see Table 3).

5.2.4. Influence of project urgency at the source and recipient projects

According to the analysis of the interview data, the project task context of time urgency had different impacts on cross-project knowledge transfer (see Table 3). When facing time pressure to complete its project, the source project team lacked motivation to assist a recipient project with information and knowledge request. In contrast, when the recipient project team was under time pressure, it would perform an evaluation to determine the most effective approach to seek knowledge to resolve project-related problems. If recipient project teams perceived the benefit of learning from other projects, they would be motivated to seek knowledge from the source projects. Otherwise, they would not be motivated to do so, as one PM explained. To this end, the time urgency perceived by a recipient project team influenced the effectiveness of cross-project knowledge transfer under the condition that the knowledge transferred was useful for the recipient project. The emphasis on the value of the to-be-transferred knowledge has been echoed by project managers in PBOs in various industries, such as real estate, transportation and education (Pemsel and Wiewiora, 2013). Project managers felt responsible for their projects and cared about their project's performance such that they simply ignored knowledge sharing activities if they didn't see the direct value of them. However, when the recipient project teams perceived time urgency and evaluated the knowledge from the source project highly valuable, it thus became critical for an organization or its PMO to motivate the source project teams to participate in the cross-project knowledge transfer process, given the fact that it requires bilateral effort.

Table 3
Key findings from the case interview analysis.

Dimensions	Key findings	Evidential examples from the cases
Project teams' *capability*	The absorptive capability of the recipient project team became essential for effective cross-project knowledge transfer, as compared to source project team's transfer capability.	"Compared to the transfer capability of the knowledge source, the absorptive capability of the recipient has a direct and critical impact on the knowledge transfer outcome" (ServiceA, PM of the recipient project "A_Beverage").
Project teams' *relationship*	A dual relationship, both co-operative and competitive relation existed between the source and recipient project teams, which complicated the effect of team relationship on the cross-project knowledge transfer.	"Overall the relationships between our two project teams are friendly. However, the relationship can become competitive sometimes, such as for limited resources like internal experts" (ServiceA, PM of the recipient project "A_Beverage"). "This friendly atmosphere is very important (for cross-project knowledge transfer). If not, I'd rather work on our own tasks than answering other project members' questions" (ServiceB, PM of the source project "B_EstateSingapore").
Project *task* context: project similarity	Project similarity was perceived as similarity in client business (e.g., industry sectors); the effect of project similarity on knowledge transfer was contingent on types of knowledge being transferred.	"We normally look for (clients) in similar industries to market our IT solutions, and to showcase the commonalities between a prospective client (e.g., A_Beverage company) and an existing client (e.g. A_Beer company). The two companies are from the similar industry, operating under similar business models. In this case, the two projects (e.g. serving the two similar companies) can achieve effective knowledge reuse" (ServiceA, PM of the recipient project "A_Beverage"). "The essential knowledge for Project A may not completely appropriate for Project B. In this case, to categorize the types of clients and to categorize the accumulated knowledge become two important pre-requisites for matching source project knowledge with the client type in a focal (recipient) project" (ServiceB, General Manager).
Project *task context*: time urgency	The time urgency perceived by a *recipient* project team influences the cross-project knowledge transfer under the condition that the knowledge transferred was useful for the recipient project. However, the time urgency perceived by a *source* project negatively affects the cross-project knowledge transfer.	"From the perspective of the recipient project, the pre-requisite (of knowledge transfer) is to perform an evaluation: Is it better to try to figure out a problem by the project team itself or to learn from other project teams? Whatever way generates the maximum benefit, we will adopt that way" (ServiceA, PM of the recipient project "A_Beverage"). "If our project was under a tight schedule, the cross-project knowledge transfer would be problematic. Most members of our team would not be willing to spend time on transferring knowledge to another project; Rather, we would like to do our best to complete our scheduled tasks." (ServiceA, PM of the source project "A_Beer")
Project *team context*	The governance efforts by the *recipient* project team exerted stronger impacts on the effectiveness of cross-project knowledge transfer.	"In my opinion, we hold our regular (project) meetings and trainings, and distribute weekly summary, monthly summary and reports during project lifecycle. All of these have become part of our daily routines and culture. They are actually evidences of knowledge transfer across projects" (ServiceB, PM of the recipient project "B_EstateChina"). "As we mentioned before, the governance efforts made by the source were necessary, but the governance efforts made by the recipient should exert stronger impacts on the cross-project knowledge transfer since we paid more attention to the performance of the recipient project" (ServiceB, General Manager).

5.2.5. Impact of knowledge governance effort by the source and recipient project teams

As the analysis of our interview data revealed, knowledge governance effort in an organization played a positive and significant role in promoting cross-project knowledge transfer, because the governance effort facilitated the development of a systematic way of transferring knowledge across projects—via summaries, weekly reports, monthly reports, milestone reports in project routines, and so on. Without the implementation of knowledge governance effort, knowledge transfer between two projects would not take place automatically.

The governance efforts commonly adopted by both ServiceA and ServiceB included knowledge-sharing culture, evaluation system, standardization of documentations, support of central research institute, personnel rotation or designated boundary spanners. For example, the standardization of project documentation was described in details by the regional manager of ServiceA as follows:

> "*At the completion of each project, the project team provided a project review report, especially should be noted, we have knowledge-sharing culture and standard reporting templates to instruct their deliverables. All project documentations are categorized and stored. Key projects are reflected and summarized at company meetings*." [ServiceA, Regional Manager]

Likewise, informants from ServiceB shared the similar opinion with regard to the systems of knowledge governance at the firm level. The manager of the recipient project from ServiceB explained that knowledge transfer practices had been built into their daily work routines (see Table 3).

As IT services firms are performance-oriented, they have paid attention to the effect of knowledge transfer on project outcome. Prior studies (e.g., Landaeta, 2008) have found evidences to support the positive association between knowledge transfer and project performance. According to our analysis of interview data, the recipient project teams were motivated to seek knowledge from the source projects in an effort to improve their own project performance. Under these circumstances, the governance efforts made by the source projects were necessary, but the governance efforts made by the recipient exerted stronger impacts on the effectiveness of cross-project knowledge transfer, because those governance efforts at the recipient end directly affected the recipient's assimilation and application of the transferred knowledge.

6. Discussion and implications

In our investigation of cross-project knowledge transfer and its influencing factors, we combined quantitative analysis of survey data and qualitative analysis of interview data. The two methods complement each other and provide us an in-depth understanding of the impact of a variety of factors on cross-project knowledge transfer.

6.1. Discussion of research findings

Our study reveals the complexity of knowledge transfer across projects in IT services firms and highlights the importance of attending to multiple dimensions of factors when promoting effective knowledge transfer between two projects. In particular, PBOs should consider the project-related factors, such as project task context and project team context, when examining knowledge transfer initiatives in the project setting. Our study further suggests that organizations and PMOs need to consider the actors of cross-project knowledge transfer, i.e. recipient vs. source, and to deploy strategies to motivate them accordingly. The findings of the research extend prior studies on project-based learning (e.g., Bakker et al., 2011; Newell and Edelman, 2008; Pemsel and Wiewiora, 2013). Below we elaborate on the key findings from the analysis of quantitative and qualitative data.

6.1.1. Different impacts of source's transfer capability and recipient's absorptive capability

In cross-project context, it is the capability of the recipient project (not the capability of the source project) that exerts significant impact on the effectiveness of cross-project knowledge transfer. This is demonstrated by the supported Hypothesis 2 (H2) and unsupported Hypothesis 1 (H1). As shown in the interviews, the source's transfer capability and recipient's absorptive capability influence the effectiveness of cross-project knowledge transfer to different degrees. It is the absorptive capability of the recipient project team that determines the extent to which the recipient can assimilate and apply the acquired knowledge effectively. One important reason is that absorptive capability reflects the recipients' cognitive capacity to process information, and this capability further facilitates the process of knowledge recreation by the recipients (Alavi and Leidner, 2001).

6.1.2. Uncertain impact due to dual relationship

Our hypothesis (H3) predicted that a good relationship between the source and recipient project enhances the knowledge transfer between projects. However, the hypothesis was not supported by the survey data. Our subsequent interviews show that the relationship between the source and recipient project teams is both co-operative and competitive. Because of the dual relationship, the impact of the inter-project relationship on cross-project knowledge transfer becomes uncertain and non-significant. This finding is consistent with Enberg's (2012) study that shows competition and cooperation coexisting in knowledge integration in R&D projects. In particular, cooperation allows us to avoid unintended individual and collective knowledge leakages, and enables the development of a shared understanding of the process of project work, thus it constitutes the common foundation for knowledge integration in a competitive project context.

6.1.3. Positive influence of project similarity

The analysis of the survey data supported our prediction that project similarity is positively associated with the effectiveness of cross-project knowledge transfer (H4). This positive association was also evidenced in our case study. Furthermore, the analysis of our interview data reveals a contingent effect of project similarity such that the impact of project similarity on cross-project knowledge transfer is contingent on the types of knowledge transferred. When the knowledge is related to business or a client, the project similarity becomes a significant predictor of cross-project knowledge transfer. When the knowledge is related to technology, the impact of the project similarity on cross-project knowledge transfer diminishes. Combining the qualitative analysis of interview data with the quantitative analysis of survey data in this study allowed us to reveal the key information embedded in the context of cross-project knowledge transfer practices in the IT services industry.

6.1.4. Different influences of project urgency: the source vs. recipient

Our hypothesis predicts that project urgency at the *source* project hinders the effectiveness of cross-project knowledge transfer (H5), which receives sufficient support from our statistical analysis. However, to our surprise, the prediction that project urgency at the *recipient* project enhances the effectiveness of cross-project knowledge transfer (H6) was not supported. Our follow-up interviews further found that when a recipient project team was under time pressure, it would perform an evaluation on whether to acquire knowledge across projects or not, to determine the most effective approach to resolve a problem. Under the circumstances, managers and members on the recipient project team tend to rely on their own expertise and knowledge rather than seek knowledge from another project team, unless they believe that the source project can provide useful knowledge they need (Pemsel and Wiewiora, 2013).

6.1.5. Different impacts of knowledge governance efforts by the source and recipient

Our quantitative data analysis shows that there exist positive and significant knowledge transfer effects of knowledge governance efforts by the *recipient* project team (H8), but not by the *source* project teams (H7). Further, our interviews suggest that IT services firms, which are performance-oriented, encourage the recipient project teams to seek knowledge from a *source* project. Thus, the effectiveness of cross-project knowledge transfer is likely to benefit more from the governance efforts made by the *recipient project teams* than by the *source project teams*. To some extent, this explains why, in the statistical analysis of the survey data, governance efforts by the *recipient* project team are found to be a significant predictor on knowledge transfer while the governance effort by the source is not.

6.2. Theoretic contributions

Our study makes several important theoretical contributions. First, this paper extends the existing research by studying systematically the main factors influencing knowledge transfer across projects in IT services firms. Scarbrough et al. (2004) have noted that existing studies on knowledge sharing in the project environment tend to examine the project itself as the level of analysis, but relatively less attention is paid to cross-project knowledge sharing behaviors. Thus the study we reported here contributes to this under-explored but increasingly important project management area. We particularly focused on the unique factors in the project context, i.e. the "projectized" features. Specially, we have examined source and recipient project teams' capability, the relationship between the two teams, project task context, and project team context. Therefore, our research model can provide other scholars with systematic understanding of the factors influencing cross-project knowledge transfer and insight for further research on cross-project knowledge transfer in IT and non-IT contexts.

Second, findings of this empirical study extend studies on project management. For example, our data analysis shows that source project teams perceived time urgency and did not intend to spend much time on transferring knowledge across projects, thus hindering the knowledge transfer processes. This finding is consistent with Newell and Edelman (2008). Moreover, our data analysis further suggests that perceived time urgency of recipient project teams does not significantly affect their intention to participate in cross-project knowledge transfer because that impact depends on the recipients' perceived usefulness of the to-be-transferred knowledge.

In addition, this study contributes to the stream of literature by revealing a few important themes in project knowledge management for future research. For instance, we find that the relationship between source and recipient project teams has uncertain impact on the effectiveness of cross-project knowledge transfer because this relationship may be co-operative or competitive. This would lead us to further explore the interplay between the two kinds of relationship and cross-project knowledge transfer. Likewise, the different impacts of source and recipient project teams' knowledge governance efforts would motivate us to examine the governance mechanisms of cross-project knowledge transfer in depth.

6.3. Practical implications

Our data analysis reveals new insights into managing knowledge transfer between IT services projects through developing a comprehensive understanding of the major influencing factors and differentiating the impacts of the factors from the perspectives of the knowledge source and recipient. For example, as cross-project knowledge transfer was positively affected by the absorptive capability of the *recipient* project team, IT services firms should allocate more resources to develop the project teams' absorptive capability, such as providing customized skills training and creating more opportunity for recipient project personnel's communication. Although our data analysis showed that the recipient project team's knowledge governance effort is positively and significantly related to the effectiveness of cross-project knowledge transfer, it's very important for IT managers to reinforce the knowledge governance efforts by the *source* project team in order to promote cross-project knowledge transfer. The governance efforts can include designing systems of motivating and evaluating project personnel's knowledge sharing endeavors and deploying standards and templates to manage the process of knowledge codification and articulation. Over time, knowledge sources will develop the habit of transferring knowledge, involve in a "cross-project sharing" culture and undertake knowledge sharing "automatically".

Our data analysis reveals complex, dual relationships—co-operative and competitive—between project teams. When two projects are competing for the same pool of company resources, their competitive relationship hampers the knowledge transfer practices between them. Yet it is still possible for the projects to benefit from transferring knowledge and to maximize the utilization of resources, such as the resource of knowledge experts. Under these situations, PMOs are likely to play the bridging role to coordinate and support the cross-project knowledge transfer (Pemsel and Wiewiora, 2013). Our findings further suggest that IT services managers should carefully manage the dual relationship of co-operation and competition between two projects, and lead the projects in resolving resource allocation conflicts as they arise.

Another important finding of the study is that the effect of project similarity on cross-project knowledge transfer is contingent on the types of knowledge being transferred. When the to-be-transferred knowledge is related to the client, such as knowledge of business processes and operations, the industry similarity between the source and recipient projects becomes a significant predictor of the knowledge transfer. When the to-be-transferred knowledge is related to technology, this effect diminishes. This suggests that IT managers and project teams should pay more attention to the similarities of clients' business domains than to the similarities in tool or technology when implementing cross-project knowledge transfer initiatives. In this regard, Pemsel and Wiewiora (2013) indicate that organizations should strengthen the capabilities of PMOs to understand project managers' needs and to facilitate and broker knowledge transfer between projects.

Last but not the least, our survey data provided empirical evidence to show the negative influence of the urgency of the *source* project on cross-project knowledge transfer. In other words, the time pressure on a source project hampers the project team's willingness to transfer knowledge to other projects. To motivate the source project teams, project-based organizations should develop and implement some governance mechanisms, such as setting up reasonable project schedules and providing incentives for knowledge sharing practices.

7. Conclusions

Our study examined the challenges in and the factors contributing to knowledge transfer across projects in IT services firms, and provided useful insights in promoting knowledge management initiatives at project level. However, the generalizability of our findings may be limited by two issues. First, due to the difficulty in collecting data of paired IT services projects, we were only able to collect quantitative data from 30 pairs of data samples for our model testing. More data samples would help to strengthen the results of the survey data. Second, this research was investigated in the context of Chinese IT services firms, hence, the findings reported in our study should be applied to other countries and professional contexts with some cautions.

There are several important promising directions to extend our study. First, our study suggests that the effectiveness of cross-project knowledge transfer is significantly influenced by the knowledge governance efforts made by the recipient project teams, but not by the source project teams. Thus, how to build consensus-based systems and shared mechanisms covering the source and recipient project teams to govern and support cross-project knowledge transfer in PBOs, is worth further study. Second, the management of the relationship between projects is another important consideration with cross-project knowledge transfer. Our research has revealed the dual characteristic of co-operative and competitive between the source and recipient project teams and it leads to the uncertain impact on the effectiveness of cross-project knowledge transfer. Moreover, prior studies have found that project managers play an important role in this process, as they are positioned centrally in the social networks of IT projects (Petter and Randolph, 2009; Petter and Vaishnavi, 2008). Thus, it remains an interesting question to explore how project managers can take advantage of their positions in the social networks to promote cross-project knowledge transfer. Third, the data show that the evaluation of the usefulness of to-be-acquired knowledge influences the intention of the recipient project team to participate in cross-project knowledge transfer under time pressure. This implies another question worth studying, that is, how the usefulness of knowledge moderates the time urgency of the projects influencing the effectiveness of cross-project knowledge transfer. Lastly, effective collaboration and knowledge sharing among project members are often challenged by the knowledge boundaries arising across different disciplines and knowledge domains of individual members (Carlile, 2004). To this end, it is worth further investigation on how PBOs promote the communication and knowledge transfer across projects by designating a boundary spanner, i.e., a project liaison (Levina and Vaast, 2005; Ratcheva, 2009).

Managing project-based knowledge transfer will remain to be a challenging and complex process, because projects are temporary organizational forms by design. The study by Bakker et al. (2011) on project learning inter-organizational projects concludes that successful project knowledge transfer can never be accomplished by focusing on only one organizational factor; project managers should consider a multi-dimensional approach when coping with the complexity of project knowledge transfer. Therefore, our study not only provides further empirical evidence to demonstrate the complexity of knowledge transfer between projects within the same organizations but also identifies and tests the set of factors (including project factors such as project task context and project team context) that contribute to the cross-project knowledge transfer. In particular, our study concludes that the effect of the antecedents varied, to a large extent, depending on the project position (source or recipient). Project-based organizations and project managers will be able to better manage the complexity of cross-project knowledge transfer if they simultaneously consider the multiple dimensions of factors underlying the complex knowledge transfer process and be mindful of the source and recipient of knowledge in the project setting.

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Appendix A. Constructs and items

Constructs	Items	Literature source
Effectiveness of cross-project knowledge transfer (ECKT)	We perceive that transferring knowledge from source project benefits our team as follows: ECKT1. help our team implement project tasks more quickly. ECKT2. help our team achieve the project goals more effectively. ECKT3. help our team enhance the business value of the project.	Items are referenced by Newell and Edelman (2008) and Landaeta (2008)

(*continued on next page*)

Appendix A (*continued*)

Constructs	Items	Literature source
	ECKT4. help our team control project costs effectively. ECKT5. help our team provide service to meet customer's requirements.	
Source team's transfer capability (STC)	When provide knowledge to the recipient project team, our project team: STC1. is able to identify the value of knowledge we own. STC2. is able to perceive what knowledge is really needed for recipient project team. STC3. is able to transfer knowledge by using the channels (e.g. written text, graphics, video, face-to-face communication) that are convenient for recipient project team.	Items are self-developed by referencing Martin and Salomon's (2003) definition of transfer capability and are pre-tested at two software companies.
Recipient team's absorptive capability (RAC)	When transferring knowledge from the source project team, our project team: RAC1. is able to understand the knowledge transferred from the source project team. RAC2. is able to understand the use of knowledge transferred from source project team. RAC3. is able to use the knowledge from source project team to solve related problems.	Items are referenced by Szulanski (1996) and Ko et al. (2005).
Relationship between both project teams (R)	During the project implementation process, R1. our team and the other project team are familiar with each other. R2. our team and the other project team are willing to communicate with each other. R3. our team and the other project team trust with each other.	Items are referenced by Park and Lee (2014) and Ko et al. (2005). And they are the same in both questionnaires for the source and recipient project teams.
Project similarity (PS)	When our project team sharing knowledge with the other project team, our team and the other team: PS1. implement similar modules. PS2. use the same tools (such as software development tools or test tools). PS3. experience the same implementation steps.	Items are self-developed by referencing Astley and Zajac's qualitative investigation (1991) and are pre-tested at two software companies. They are the same in both questionnaires for the source and recipient project teams.
Perceived time urgency by source and recipient project teams (STU and RTU)	During the project implementation process, STU1/RTU1. our team perceives a very tight project schedule. STU2/RTU2. our team perceives a great pressure time to complete project tasks.	Items are referenced by Park et al. (2008). They are the same in both questionnaires for the source and recipient project teams.
Source project team's knowledge governance efforts (SKG)	During the project implementation process, SKG1. our project team assigns personnel to be responsible for knowledge transfer between projects. SKG2. our project team institutional system is conducive to transferring knowledge to the recipient project team. SKG3. our project manager supports knowledge transfer activities between projects.	Items are referenced by Gold et al. (2001) and Szulanski (1996).
Recipient project team's knowledge governance efforts (RKG)	During the project implementation process, RKG1. our project team assigns personnel to be responsible for knowledge transfer between projects. RKG2. our team institutional system is conducive to learning from the source project team. RKG3. our project manager supports learning from the source project team.	Items are referenced by Gold et al. (2001) and Szulanski (1996).

Appendix B. Convergent validity of the latent variables

Construct	Indicator	Loading	T-value	CA	AVE	CR
Effectiveness of cross-project knowledge transfer (ECKT)	ECKT1	0.7497	5.3603	.783	0.5498	0.8576
	ECKT2	0.8827	27.5327			
	ECKT3	0.7533	7.4741			
	ECKT4	0.6316	3.5746			
	ECKT5	0.6644	5.3629			
Source team's transfer capability (STC)	STC1	0.7507	5.7902	.726	0.5365	0.7763
	STC2	0.7277	2.7254			
	STC3	0.7186	4.4057			
Recipient team's absorptive capability (RAC)	RAC1	0.9106	9.4847	.923	0.8739	0.954
	RAC2	0.8992	13.2133			
	RAC3	0.9919	19.4962			
Relationship between two project teams (R)	R1	0.7406	3.6648	.728	0.6507	0.8478
	R2	0.8182	5.2771			
	R3	0.8569	4.8922			
Project similarity (PS)	PS 1	0.7613	8.1251	.731	0.5968	0.8156
	PS 2	0.8343	12.9366			
	PS 3	0.7175	5.7483			
Time urgency of source project (STU)	STU 1	−0.9028	−4.9437	.791	0.6800	0.8080
	STU 2	−0.7382	−2.7098			
Time urgency of recipient project (RTU)	RTU 1	−0.7711	−6.2215	.752	0.6952	0.8194
	RTU 2	−0.8921	−10.0221			

Appendix B (*continued*)

Construct	Indicator	Loading	T-value	CA	AVE	CR
Source project team's knowledge governance efforts (SKG)	SKG 1	0.7436	2.9292	.813	0.7224	0.8856
	SKG 2	0.8673	5.2651			
	SKG3	0.9284	4.9089			
Recipient project team's knowledge governance efforts (RKG)	RKG 1	0.7981	13.6561	.719	0.6396	0.8417
	RKG 2	0.8365	14.2321			
	RKG 3	0.7629	8.3685			

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