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KNOWLEDGE SHARING CULTURE, PROJECT TEAM INTERACTION, AND KNOWLEDGE SHARING PERFORMANCE AMONG PROJECT MEMBERS

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ABSTRACT

Knowledge sharing is recognized as one of the leading factors contributing to the sustainable competitive advantage in organizations. It is especially critical for project management organizations to share knowledge among project members within an organization in order to avoid similar mistakes, improve work efficiency, and reduce failure risk. The implementation of knowledge sharing in project organizations, however, is far from simple due to the decentralization and fragmentation of the project teams and complexity of knowledge required. This paper aims to explore the mechanism to improve knowledge sharing performance (KSP) with a specific focus on knowledge sharing culture (KSCu) and project team interaction (PTI). In this study, KSCu is grouped into four measures, i.e. knowledge sharing strategy (KSS), knowledge sharing climate (KSC), knowledge sharing incentive (KSI) and organizational members trust (OMT). KSP is measured with both knowledge sharing behavior (KSB) and knowledge sharing outcome (KSO). The research hypotheses and theoretical model were formulated through literature research and theoretical analysis. Then, this study applied a structured questionnaire survey that was conducted in 78 Chinese engineering management organizations. In addition to validity analysis, reliability analysis and correlation analysis, this study tested the hypotheses based on structural equation model analysis. The empirical research results showed that there is a significant positive correlation between KSCu and KSP, and PTI can play a critical mediating role that drives KSCu to higher KSP. The results also confirmed the positive relationship between KSB and KSO. The research findings indicated that establishing a good KSCu through strengthening the KSS, KSC, KSI and OMT within engineering management organizations, and promoting the PTI can effectively improve KSP among project members.

KEYWORDS: Knowledge sharing culture; Project team interaction; Knowledge sharing behavior; Knowledge sharing outcome

1. INTRODUCTION

Knowledge is one of the most important and valuable organizational resources contributing to sustainable competitive advantage (Nonaka and Takeuchi, 1995). Nowadays,

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organizations that can obtain and apply valid and useful knowledge effectively are generally expected to perform more successfully (Allameh et al., 2014). Knowledge management is regarded as a key measure for a company to create an organizational competitive advantage at present (Issa and Haddad, 2008). The company with more developed knowledge management ability will use intellectual capitals more efficiently and consequently will be more creative and perform better (Darroch, 2005). Therefore, since various organizations urgently need to improve organizational performance and core competitiveness on a continual basis, they should do so through implementing the effective means of knowledge management that have been developed in the 21st century knowledge economy era.

Knowledge sharing is the most crucial component and stage of knowledge management (Issa and Haddad, 2008; Mansoori et al., 2012). Hence, the success of knowledge management initiatives significantly depends on knowledge sharing (Wang and Noe, 2010). Knowledge sharing can promote organizational learning and eventually affect the organizational performance (Yang, 2007). This also implies that managers in organizations can improve organizational performance by enhancing the knowledge sharing among members (Wang et al., 2014). Understanding that the knowledge sharing effect directly determines the overall knowledge management effectiveness, an increasing number of researchers and business managers are now attempting to promote knowledge sharing performance within their organizations.

In recent years, construction projects have become more complex, dynamic and interactive situations (Teerajetgul and Charoenngam, 2006). Project members in various project management organizations, such as project contractors, project management companies, real estate development companies, engineering consulting companies and so on (hereinafter referred to as the project management organizations) need to master and utilize vast quantities of knowledge during modern construction projects. Among this knowledge includes ideas in management, technology, economy, law, computer, psychology, sociology, and organizational behavior etc.. Organizations in the construction industry belong to knowledge-intensive organizations which are highly dependent on the skills and expertise of their professionals and staff, and heavily rely on their employees to apply knowledge in order to deliver service, products, and create value (Arriagada and Alarcón, 2014; Zhang and Ng, 2012). Knowledge sharing can extenuate the influence of construction project complications (Cooke, 2013), and in order to cope with complex tasks employees in construction firms need to share knowledge and expertise within and between groups (Ribeiro, 2009). Therefore, project management organizations need to be aware of the advantages of knowledge sharing initiatives and practices (Chen and Mohamed, 2010; Ribeiro, 2009; Robinson et al., 2005), and it is important for project managers to address and develop appropriate methods of knowledge sharing (Fernie et al., 2003).

As the project management organization undertakes many different projects with different project schedules, in different locations, the knowledge created through the effort to resolve problems on one project can generally be applied to other existing projects or future projects (Dulaimi, 2007). Thus it is even more important to promote the knowledge sharing performance (KSP) among project members in different project teams working different projects within the project management organization in order to solve various engineering problems, avoid similar mistakes, reduce failure risk and improve work efficiency.

It has been widely recognized that the organizational culture within an organization is closely related to the KSP among organization members (Al-Alawi et al., 2007; Wiewiora et al., 2013). But for the project management organization, the matrix organizational structure is

generally adopted while many different projects are undertaken, and there is a relatively independent feature for each of project team due to the dispersion of the construction site, which is not conducive to the knowledge sharing among the project members in different project teams. Therefore, the knowledge sharing culture (KSCu) seems more important for project management organizations rather than other organizations hoping to achieve efficient knowledge sharing among project members. However, it remains unclear whether or not the KSP among project members can be promoted though strengthening project team interaction (PTI). Therefore, this paper aims to explore the mechanism to improve KSP, with a specific focus on KSCu and PTI. And this research is expected to investigate the influence of KSCu on KSP among project members, and try to verify the mediating effect of PTI between KSCu and KSP among project members within the project management organization.

2. THEORETICAL BACKGROUND

2.1. Knowledge sharing and knowledge sharing performance

Knowledge sharing is defined as 'the provision or receipt of task information, know-how and feedback regarding a product or procedure' (Cummings, 2004). Knowledge sharing can occur between or among individuals, within or among teams, and within or among organizations. This study focuses on the knowledge sharing issue within the project management organization.

Knowledge sharing can facilitate the transformation of individual knowledge to organizational knowledge (Yang, 2007). According to Allameh et al. (2014), knowledge sharing can affect organizational performance significantly. And the research results of Rao et al. (2015) also confirmed this conclusion. Knowledge sharing has become one of the central economy drivers of the 21st century (Gupta, 2008).

Although construction projects have a unique disposable characteristic, there is much common knowledge which is applied to different projects. Regarding engineering management organizations, project teams are generally temporary and short-lived, so when project teams are dismissed, plenty of knowledge may be lost. For this reason, it is very important to share knowledge accumulated in one project with other project teams and prevent the "reinvention of the wheel" in other projects (Ruuska and Vartiainen, 2005). Therefore, project managers and team leaders should realize that knowledge sharing between project teams can enhance project management efficiency (Mueller, 2012), and they should pay attention to effective knowledge management initiative in order to capture, share and apply the knowledge even after project teams are dismissed (Dulaimi, 2007). However, due to the organizational characteristic of dispersion and dynamic, as well as the complexity of knowledge, the implementation of knowledge sharing in project organizations is far from simple. It is crucial to establish a knowledge sharing environment for the purpose of successfully sharing the useful and innovative knowledge among the different project teams (Bashouri and Duncan, 2014).

Organizational performance is a combination of behaviors by an individual or team and the results that they produce (Broad, 2006). In other words, organizational performance is composed of behavior performance and result performance (Baldauf and Cravens, 2002). Referencing this definition, in this study KSP refers to the knowledge sharing behavior among project members and the influences on the project members and whole organization caused by the knowledge sharing behavior. Therefore, the authors suggest that KSP is composed of the knowledge sharing behavior (KSB) i.e. the behavior performance and knowledge sharing outcome (KSO) i.e. the result performance. The former refers to the individual behavior to share knowledge with others within the organization. The latter refers to the effect and achievement of

KSB that relates to the formation of knowledge sharing habits, the overall quality improvement of project members, the cohesion reinforcement in the organization, and the promotion of management level and economic benefits of the organization, etc.

2.2. Knowledge sharing culture

Knowledge management needs an environment that allows employees to capture, share, utilize and create knowledge to improve performance in the construction firm (Ribeiro, 2009). These environment are abstract and generally associated with organizational culture. The organizational culture has both direct and indirect effect on KSB of employees, hence organizations are required to emphasize the cultural features in developing human resource practices which will facilitate knowledge sharing (Wang and Noe, 2010). Culture has a most significant influence on the knowledge sharing among dispersed projects with limited time and money (Siakas et al., 2010). So, Rao et al. (2015) suggested that managers should foster organization learning and KSCu in order to support the knowledge sharing within the organization (Rao et al., 2015). Furthermore, Ding and Ng (2009) that architectural design organizations should set up KSCu to achieve a more positive attitude toward knowledge sharing from architects.

Some studies explored the organizational culture types, and pointed out that organizational culture types can influence KSB positively or negatively, depending on the culture types which included ones such as clan, adhocracy, market and hierarchy (Suppiah and Sandhu, 2011) or innovative, competitive, bureaucratic and community (Cavaliere and Lombardi, 2015). Another study focused on the relationship between the culture background of employees and knowledge sharing. The results from this study indicated that team members with different culture backgrounds, due to different ethnicities, genders, national culture or functions, can cause a context of cultural complexity that might negatively influence knowledge sharing (Sackmann and Friesl, 2007). KSCu mentioned by this study is known as a unique culture that positively relates to knowledge sharing within the organization. Officially, it is defined as "the culture which has a decisive role to promote the knowledge sharing among the organizational members within the organization."

In existing literatures, organizational culture factors mainly include: trust, climate, communication, information systems, teamwork/collaboration, openness, learning orientation, management support, rewards/incentive and organizational structure which are related to knowledge sharing in organizations (Al-Alawi et al., 2007; Gupta, 2008; Islam et al., 2015; Mueller, 2012). For example, knowledge sharing depends on an organizational environment with high trust and reward for KSB (Gupta, 2008). Considering all the factors about organization culture and organization environment, and according to the characteristics of knowledge sharing in project management organization, this study builds the key KSCu elements from four dimensions. These dimensions include the knowledge sharing strategy (KSS), knowledge sharing climate (KSC), knowledge sharing incentive (KSI) and organizational members trust (OMT).

2.2.1 Knowledge sharing strategy

In today's business world, knowledge management is a major competitive strategy (Arriagada and Alarcón, 2014). The knowledge management strategy mainly relates to the policies and institutions about knowledge management for the purpose of achieving a high level of project quality within a limited time and budget in the construction industry (Tan, 2015). Since knowledge sharing is the core part of knowledge management, KSS can be considered the component of knowledge management strategy that is most important. Companies can improve

the organization performance or innovative performance through implementing KSS (Rao et. al., 2015; Spencer, 2003).

When implementing KSS, organizations ought to formulate scientific and standardized knowledge management schemes or regulations. Additionally they should establish a specialized knowledge management system or similar system, and own the definite methods and approaches to share knowledge. This will serve as the foundation to facilitate knowledge sharing among organizational members.

2.2.2 Knowledge sharing climate

Organizational climate refers to a relatively tacit infrastructure of ideas that shape our thoughts, behavior and perception in our business environment (Gupta, 2008). There is a highly significant correlation level between climate and KSB (Reyes and Zapata, 2014). The research findings of Sackmann and Friesl (2007) revealed that knowledge sharing is only possible to occur when new project members are welcomed emotionally as valuable contributors to a project. Bock et al. (2005) researched and confirmed that organizational climate affect individuals' intentions to share knowledge. In addition, friendly learning environments enable KSB to be more effective (Sorakraikitikul and Siengthai, 2014).

Generally, if there is a good organizational learning environment, communication mechanisms, work relationships, and members all respect knowledge and knowledge holders or contributors in the organization, KSB will more likely occur. For example, Hooff and Ridder (2004) found that a constructive communication climate can positively influence knowledge sharing. Furthermore, team climate (Xue et al., 2011) or organizational KSC(Radaelli et al., 2011) can directly influence the KSB significantly or play a mediating role.

2.2.3Knowledge sharing incentive

It should be understood that the underlying mechanism for knowledge sharing is rather based on a trading process. This implies that employees won't generally share their knowledge to others for free, so knowledge sharing can be considered as a business transaction process (Barachini, 2009). Appropriate incentives in the project management organizations can facilitate the knowledge sharing process among the project members (Levitt et al., 2012; Teerajetgul and Charoenngam, 2006). Therefore, firms should build and improve their rewarding and incentive systems about knowledge sharing to achieve the ideal knowledge sharing performance.

2.2.4Organizational members trust

A trustful environment is a key factor to effective knowledge sharing in project teams (Ma et al., 2008), and the whole knowledge sharing process only properly works in a trustful atmosphere (Barachini, 2009). According to Mueller (2012), the first cultural value that influences knowledge sharing between project teams is trust. Furthermore, the research findings of Jain et al. (2015) indicated that trust is all positively related to knowledge sharing. So we have reasons to believe that the OMT is one of the most important cultural elements about knowledge sharing in project management organizations.

2.3. Project team interaction

Organization units include departments and project teams in project management organizations with a matrix organizational structure. Project teams are relatively independent among each other generally due to scattered construction sites. This relationship is usually not conducive to efficient knowledge sharing among the project members in different project teams. But enhancing the interaction among project teams can effectively solve this drawback. Team interaction mainly includes communication and collaboration among different teams (Yang et al., 2012). Project team leaders and members can share knowledge with other project teams by

transferring boundary objects, interchanging team members and direct interaction (Mueller, 2012). In addition, projects often continue only for short periods, which means that project members must continuously change their work situations (Koskinen, 2003). During this process project members can share their ideas, information, experiences and lessons with other members from other project teams.

In this study PTI refers to the communication, collaboration and exchange among project members in different project teams. Therefore project management organizations may take measures to promote work contact and strengthen learning exchange activities among different project teams and departments. Additionally they could arrange one person to undertake multiple projects simultaneously, or implement the exchange about staff positions frequently. All of which can foster knowledge sharing between different project teams and departments.

3. THEORETICAL MODEL AND RESEARCH HYPOTHESIS

3.1. Knowledge sharing culture and knowledge sharing performance

Knowledge management initiatives are only efficient and successful when they are in accordance with the cultural concepts of the company (Davenport et al., 1998). Industry culture, through its influence on financial rewards and organizational knowledge culture, may decide the success or failure of organizational knowledge sharing initiatives (Cockrell and Stone, 2010). Existing researches showed that an organizational culture supporting knowledge sharing can lead to more effective achievements within an organization (Lai and Lee, 2007; Wiewiora et al., 2013), and top managers can facilitate KSB of employees by developing appropriate type of organizational culture (Shao et al., 2015). KSCu as a unique culture style with a decisive role to promote the knowledge sharing will produce an important influence on the KSB as well as outcome among the project members within the project management organization. Therefore, the following hypotheses are proposed:

Hypothesis 1: KSCu has a significant positive impact on KSB;

Hypothesis 2: KSCu has a significant positive impact on KSO.

3.2. Knowledge sharing culture and project team interaction

According to the research findings of Connelly and Kelloway (2003), organizational environment is conducive to social interaction. And the research of Mueller (2012) indicated that a knowledge culture can promote the communication and cooperation among different project teams. So creating a KSCu within the project organization can facilitate a good working environment, provide more opportunities for communication and cooperation among project members, and ultimately promote the interaction between or among project teams and organizational units. Therefore, the following hypothesis is proposed:

Hypothesis 3: KSCu has a significant positive impact on PTI.

3.3. Project team interaction and knowledge sharing performance

Generally employees are more likely to share knowledge with their friends, and social interaction can increase the possibility making friends among colleagues, hence social interaction can contribute to knowledge sharing among employees (Connelly and Kelloway, 2003). Similarly, for the project management organization, the situations where the project members can interact face-to-face with each other, can reinforce knowledge sharing (Koskinen, 2003). Via the interaction among project teams, employees from different project teams can communicate directly with each other, which is conducive to promoting knowledge transfer and absorption between the teams. The research findings of Jo (2011) indicate that member interaction can significant improve both for team-related and for task-related shared mental model. Furthermore,

according to Yang et al. (2012) PTI including team communication and collaboration are positively associated with project performance. Therefore, the following hypotheses are proposed:

Hypothesis 4: PTI has a significant positive impact on KSB;

Hypothesis 5: PTI has a significant positive impact on KSO;

3.4. Knowledge sharing behavior and knowledge sharing outcome

KSB within the organization is a convenient means to obtain and absorb the required knowledge for the project members and resolve problems efficiently, so the overall ability and diathesis of organizational members can be improved, the organizational cohesion can be reinforced, and the formation of knowledge sharing habits can be promoted. As a consequence, management level and economic benefits of the organization will be improved. Therefore, the following hypothesis is proposed:

Hypothesis 6: KSB has a significant positive impact on KSO.

On this basis, the influence model of KSCu on KSP among project members based on the mediating effect of PTI is established shown as figure 1.

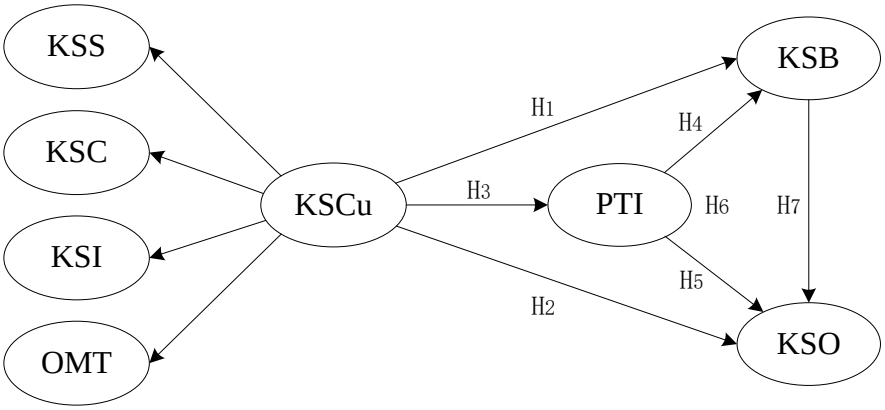

Figure 1. Theoretical model

4. METHODOLOGY

4.1. Measures and instruments

All of the scales of our study were drawn or adapted from existing literature. Taking into account the organizational structure and characteristics of knowledge sharing in project management organizations, we pay more attention to enhancing our understanding to the context and core conceptual attributes of scales, then modify and refine the wording of items to ensure the clarity of the questions. The final questionnaire included seven scales with a total of 29 items.

According to the theoretical analysis of the foregoing literature, the measurement scale of KSCu has four dimensions including KSS, KSC, KSI and OMT. The scale of KSS was measured by four items which were adapted from Tan (2015). For the scale of KSC with four items, we referenced and simplified the scale of Bock et al. (2005). KSI was measured by the three items scale adapted from Al-Alawi et al. (2007). OMT was measured by the three items scale according to existing instruments (Mooradian et al., 2006; Wickramasinghe and Widyaratne, 2012). The scale of PTI with five items was adapted from Jo (2011) and Yang et al. (2012). The measurement scale of KSP has two dimensions including KSB and KSO. KSB was measured drawing from the scale of Casimir et al. (2012), Zhang and Ng (2012) and Shao et al. (2015). The scale of KSO with five items was adapted from Anantatmula and Kanungo (2006), Reychav and Weisberg (2009) and Migdadi (2009). According to the measurement scales above, the

authors developed a survey questionnaire that included seven scales with a total of 29 items, the questionnaire items are shown in Appendix I.

4.2. Sample and data collection

Most of the empirical research on knowledge sharing has used case study or quantitative methodologies. The authors adopted a structured questionnaire survey method to test the hypotheses. The survey sample involved project members from various project management organizations including real estate development companies, project management companies, construction contractors, supervision management companies and other companies in the construction sector in China.

Since the questionnaire was initially written in English, authors translated the original instrument into Chinese following the Chinese context. We asked two professors to examine the face validity of the measurement items and made a basic modifications. Then we conducted a pilot test by selecting several project management engineers to take the survey, and found they were able to answer all the questions definitely. After a pilot and revision, the final questionnaire was developed for data collection. A five-point Likert scale ranging from 1 (totally disagree) to 5 (totally agree) was used for all of the items.

The survey was conducted in 78 Chinese project management organizations from March to May 2015. With a total of 500 questionnaires distributed, 353 professionals responded which gave a response rate of 70.6 percent and there are 290 effective responses, the effective response rate is 82.15 percent. Table 1 shows the demographic information of the respondents. It indicates that the respondents have a good educational background (i.e., 80% with bachelor degree or above), and the respondents also have adequate working experience (i.e., 75.86% of them have worked more than 2 years).

Table 1. Demographic information of respondents

Variable	Categories	Number of cases	Frequency (%)
Gender	Female	52	17.93
	Male	238	82.07
Age	≤25	49	16.9%
	26-30	117	40.34%
	31-35	79	27.24%
	36-40	22	7.59%
	＞40	23	7.93%
Education	High school graduate	7	2.41%
	Certificate or associate degree	51	17.59%
	Bachelor degree	178	61.38%
	Postgraduate	54	18.62%
Working experience	≤2years	70	24.14%
	3-5years	94	32.41%
	6-10years	73	25.17%
	＞10years	53	18.28%
Job position	Project team staff	146	50.34%
	Project team leader	51	17.59%
	Department staff	68	23.45%
	Department leader	25	8.62%
Organizational	Real estate development company	58	20.00%

type	Project management company	44	15.17%
	Construction contractor	115	39.66%
	Supervision management company	51	17.59%
	Others	22	7.58%

4.3. Data analysis methods

In this study the data analysis methods include confirmatory factor analysis (CFA) and structural equation modeling (SEM) using the statistical analysis software of Statistical Product and Service Solutions (SPSS) 17.0 and Analysis of Moment Structures (AMOS) 21.0 respectively. CFA was used to confirm the reliability, validity and fitness of the factorial structure of constructs, and SEM was used to provide support for the hypotheses and conduct a path analysis.

5. RESULTS

5.1. Confirmatory factor analysis

For the purpose of confirming the validity of the overall measurement model confirmatory factor analysis (CFA) were performed. The validity which was tested in our study included convergent validity and discriminant validity.

Convergent validity can be tested by assessing the factor loadings which should be significant at the 0.01 level and exceed 0.6, composite reliabilities (CR), which should exceed 0.8, and the average variance extracted (AVE), which should be more than 0.5 for all constructs (Fornell and Larcker, 1981). In addition, we assessed the construct reliability adopting the Cronbach's alpha coefficients which should be higher than 0.70 (Wang et al., 2014). CFA led us to exclude the item KSB2 from the KSB scale because the loading value is 0.352, and the final values of the factor loading, AVE, CR and Cronbach's alpha of every construct are shown in Table 2. We can see that all of the factor loadings values are higher than 0.6 and significant at the 0.001 level. Moreover, most of the CR values exceed 0.8 except the scales OMT with lightly smaller values, except the scales OMT most of AVE values are higher than 0.5, and all Cronbach's alpha coefficients reach the level 0.7. Therefore, the results indicate that the model sufficiently meets the convergent validity and reliability criteria.

Table 2. Construct Validity and Reliability

Construct	Item	Cronbach's alpha	Factor loading	CR	AVE
KSS	KSS1	0.886	0.773	0.884	0.655
	KSS2		0.778		
	KSS3		0.866		
	KSS4		0.817		
KSC	KSC1	0.824	0.757	0.819	0.533
	KSC2		0.793		
	KSC3		0.606		
	KSC4		0.749		
KSI	KSI1	0.886	0.860	0.906	0.764
	KSI2		0.898		
	KSI3		0.863		
OMT	OMT1	0.669	0.653	0.672	0.406
	OMT2		0.617		
	OMT3		0.642		

PTI	PTI1	0.826	0.687	0.834	0.503
	PTI2		0.722		
	PTI3		0.832		
	PTI4		0.668		
	PTI5		0.620		
KSB	KSB1	0.757	0.552	0.771	0.461
	KSB3		0.676		
	KSB4		0.654		
	KSB5		0.810		
KSO	KSO1	0.881	0.788	0.888	0.612
	KSO2		0.725		
	KSO3		0.798		
	KSO4		0.774		
	KSO5		0.825		

Note: KSS: knowledge sharing strategy; KSC: knowledge sharing climate； KSI: knowledge sharing incentive; OMT: organizational members trust; PTI: Project Team Interaction; KSB: knowledge sharing behavior; KSO: knowledge sharing outcome.

Discriminant validity can be assessed by two criteria: the square root of the AVE of each latent variable from its indicators exceeds the correlation coefficients between the same construct and any other construct (Chin et al., 2003). On the other hand, the AVE for each construct should be higher than the squared correlation between the same construct and any other construct (Fornell and Larcker, 1981). This study selected the former criteria. The means, standard deviations, and correlation coefficients among variables are shown in table 3. The diagonal italic values are the square roots of AVE of each construct. From table 3 we can find that the diagonal elements are all higher than their respective off-diagonal elements, which indicates that the measurement model has favorable discriminant validity. Furthermore, as can be seen from the table 3, the correlation coefficients between variables are all positive, which indicates the existence of significant positive correlation and a close relationship between the variables.

Table 3. Descriptive Statistics and Correlation Analysis (N=290)

Variables	Mean	S.D.	KSS	KSC	KSI	OMT	PTI	KSB	KSO
KSS	3.377	0.783	***0.809***						
KSC	3.611	0.704	0.669**	***0.730***					
KSI	3.097	0.917	0.722**	0.603**	***0.874***				
OMT	3.812	0.584	0.309**	0.372**	0.229**	***0.637***			
PTI	3.422	0.613	0.595**	0.698**	0.608**	0.356**	***0.709***		
KSB	3.630	0.565	0.567**	0.592**	0.594**	0.451**	0.607**	***0.679***	
KSO	3.422	0.694	0.598**	0.724**	0.631**	0.398**	0.736**	0.733**	***0.782***

Note: *Significant at the 0.05 level (two-tailed), * *significant at the 0.01 level (two-tailed).

According Hair et al. (1998) we assessed the measurement model fit by evaluating:

- Absolute fit measures, including observed normed $\chi 2$ ($\chi 2$/df), Root-mean square residual (RMR), goodness-of-fit index (GFI) and root mean square error of approximation (RMSEA);
- Incremental fit measures, including normed fit index (NFI), incremental fit index (IFI), tacker-lewis index (TLI) or nonnormed fit index (NNFI), adjusted goodness-of-fit (AGFI) and comparative fit index (CFI);

- Parsimonious fit measures, including parsimony goodness-of-fit index (PGFI), parsimony normed fit index (PNFI) and parsimony comparative fit index (PCFI).

The fitness indices of measurement model are shown in Table 4. We can see that all fit indices meet satisfactory levels (Fang et al., 2015; Tohidinia and Mosakhani, 2010; Wang et al., 2014). Therefore, we can determine that the measurement model fits the survey data well, in other words, the survey data properly supports the measurement models. Thus the measurement models are suitable for testing the research hypotheses.

Table 4. Overall Fit Indices of Total Conceptual Model

Fit index	Scores	Recommended cut-off value
Absolute fit measures		
χ^2/df	2.013	$\leq 2^a$; $\leq 5^b$
RMR	0.035	≤ 0.05
GFI	0.862	$\geq 0.9^a$, $\geq 0.8^b$
RMSEA	0.059	$< 0.08^a$; $< 0.1^b$
Incremental fit measures		
NFI	0.878	$\geq 0.9^a$, $\geq 0.8^b$
IFI	0.935	≥ 0.9
TLI/NNFI	0.921	≥ 0.9
AGFI	0.823	$\geq 0.9^a$, $\geq 0.8^b$
CFI	0.934	≥ 0.9
Parsimonious fit measures		
PGFI	0.675	≥0.5,The higher, the better
PNFI	0.738	≥0.5,The higher, the better
PCFI	0.786	≥0.5,The higher, the better

Notes: Acceptability: [a]acceptable; [b]marginal

5.2. Structural equation modeling analysis and hypotheses testing

In order to test the hypotheses, we constructed a structural equation model via the software of AMOS 21.0. The critical ratio (C.R.) and p value are used as two indices to test the significance of proposed hypotheses. To be statistically significant ($p < 0.05$), C.R. needs to be higher than 1.96 (Allameh et al., 2014).Table 5 and Figure 2 show the results of hypothesis testing of the structural relationship among the latent variables. We can see that all of the C.R. values are higher than 1.96. The first three hypotheses involve the relationships between KSCu and KSP and PTI. The effects of KSCu on KSB and KSO are both significant (β=0.612, $p < 0.001$; β=0.229, $p < 0.05$), which support H1 and H2, and the effect of KSCu on PTI is significant (β=0.840, $p < 0.001$), so H3 is supported. For the relationship of PTI and KSP, the effects of PTI on KSB and KSO are significant (β=0.242, $p < 0.05$; β=0.324, $p < 0.001$), thus, H4 and H5 are supported. The significant effect of KSB on KSO is 0.431 ($p < 0.001$), then H6 is supported. The empirical test results showed that all the hypotheses proposed by this paper were totally verified.

Table 5. Hypothesis Testing Results

Hypothesis	**Path**	**Path coefficient β**	**C.R.**	**p**	**Remarks**
H1	KSCu→ KSB	0.612	4.386	***	Supported
H2	KSCu → KSO	0.229	2.071	0.038	Supported
H3	KSCu → PTI	0.840	9.689	***	Supported
H4	PTI → KSB	0.242	1.966	0.049	Supported

H5	PTI → KSO	0.324	3.357	***	Supported
H6	KSB → KSO	0.431	3.512	***	Supported

Note: *Significant at the 0.05 level (two-tailed), **significant at the 0.01 level (two-tailed), ***significant at the 0.001 level (two-tailed)

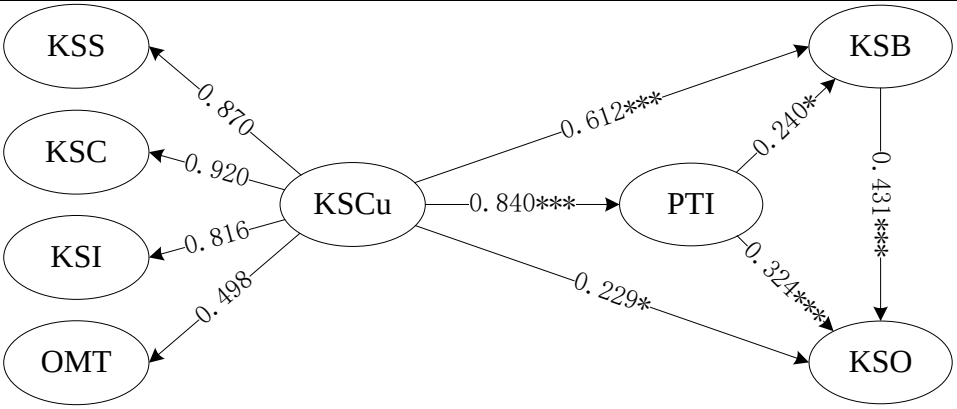

Figure 2. Research model and results of hypothesis test

To reveal the mediating role of PTI further, indirect influence effects and total influence effects were calculated shown in table 6. Research results suggest that although the direct influence effects of KSCu on KSB and KSO are 0.612 and 0.229 with a relatively low effect, the total influence effects of KSCu on KSB and KSO are 0.814 and 0.860 which is a very high effect mostly because of the strong influence effect of KSCu on PTI which achieved 0.840. And the total influence effects of PTI on KSB and KSO are 0.242 and 0.427. Furthermore, all the influence paths are significant. So according to MacKinnon at al. (2002), we can determine that PTI can play an important mediating role between the effects of KSCu on KSP.

Table 6. Influence effects analysis between variables

Path	Direct effects	Indirect effects	Total effects
KSCu→ KSB	0.612	0.202	0.814
KSCu → KSO	0.229	0.631	0.860
KSCu → PTI	0.840	--	0.840
PTI → KSB	0.242	--	0.242
PTI → KSO	0.324	0.103	0.427
KSB → KSO	0.431	--	0.431

6. DISCUSSION

6.1. Summary of findings

This paper aims to explore the mechanism to improve KSP within the project management organization, with a specific focus on the KSCu and PTI. The study has three key findings through literature research and empirical analysis.

First, there is a significant positive correlation between KSCu and KSP among project members within the project management organization. The direct influence effects of KSCu on KSB and KSO are 0.612 and 0.229.

Second, PTI can play a crucial mediating role between the influence of KSCu on KSP which is a new finding in the field of knowledge management and fill the knowledge gap, this

finding reflects the differences between project management organizations and other types of organizations about knowledge sharing. The final total influence effects of KSCu on KSB and KSO reach 0.814 and 0.860 because of the strong mediating role of PTI between KSCu and KSP. We find that KSCu can affect the PTI strongly with a high influence effect (β=0.840), therefore, KSCu can positively improve the PTI in project management organizations which is beneficial in promoting the KSP among project members.

Third, KSB among project members is positive related to KSO in the project management organization. In addition, KSB can play a mediating role between the influence of KSCu on KSO. The influence effect of KSB on KSO is 0.431. Through KSB, organizations can obtain formation of knowledge sharing habits, the overall quality improvement of organizational members, cohesion reinforcement in the organization, and the promotion of management level and economic benefits of the organization, etc.

6.2. Theoretical implications

The existing literatures have acquired plenty of achievements in the research area of knowledge sharing. While knowledge sharing characteristics are different for different organizational types, it is important to have a further study and discussion focusing on the specific organization types. This paper proposed to improve the KSP through building a good KSCu and enhancing PTI in project management organizations, and developed the corresponding measurement instruments including KSCu, KSP and PTI.

In this study, based on the literature research KSCu of project management organizations is grouped into four measures, i.e. KSS, KSC, KSI and OMT, and KSP is measured with both KSB and KSO. In addition, the measurement scale of PTI has five aspects items, and PTI reflects the difference about the influence factors on knowledge sharing between the project management organizations and other types of organizations.

The research results proved the importance effect of KSCu on the KSP within the organization, which is consistent with the viewpoints of McDermott and O'Dell (2001) and Wiewiora et al. (2013), Also, this study tested the important mediating role of PTI between the influence of KSCu on KSP which is an outstanding theoretical contribution to project management organizations.

6.3. Practical implications

Within project management organizations which usually have a matrix organizational structure in the construction sector, the project teams have a dispersed characteristic due to the dispersion of the construction sites. This aspect may lead to difficulties in the knowledge sharing among the project members in different project teams or departments. Therefore, establishing a good KSCu from KSS, KSC, KSI and OMT in project management organization, and strengthening PTI can effectively promote KSP among project members. These research results can provide a reference for all types of project management organizations, not only for China. But they can also provide a reference for any other country with a similar situation and enable them to take proper measures to improve KSP within any organization in the construction sector.

6.4. Limitations and future research

The measurement scale in KSCu proposed by this study only covered partial crucial cultural elements in project management organizations. Whether or not other cultural elements can also play an important role in knowledge sharing, such as innovation, openness, learning orientation, management support, and so on, still need to be further tested.

The research model in this paper only involved the factors about organizational environment and culture, without considering the individual behavioral factors. In the future

research, the individual behavioral factors variables such as knowledge sharing attitude, knowledge sharing willingness, and knowledge sharing motivation can be added to the research model.

Survey data in this study is just from China and the sample size is not large enough, furthermore, the types of project management organizations are not distinguished. Therefore, if conditions permit the research scope and sample size should be expanded and the specific analysis should be executed for the different types of project management organization.

7. CONCLUSION

For the matrix organizational structure of project management, knowledge sharing among project members in different project teams and departments in the construction sector play an important role in order to improve work efficiency, avoid similar mistakes, and reduce failure risks of the projects. Generally, the project teams that undertake the specific project management tasks are relatively independent because the construction sites are scattered, which can cause a barrier to knowledge sharing among the project members in different project teams. Therefore, the issue of how to improve the knowledge sharing among the project members should be paid more attention to in the construction sector.

This paper aims to explore the mechanism to improve KSP, with a specific focus on KSCu and PTI. Through theoretical research and empirical analysis in this study, we can draw the following conclusions: (1) KSCu can affect the KSB and the KSO within a project management organization significantly and positively. This indicates that it is necessary to construct an appropriate culture circumstance for knowledge sharing among project members in the project management organization. (2) PTI can play a complete mediating role between KSCu and KSP among project members. Strengthening the PTI can overcome the defect of relative independence between project teams. (3) KSP includes the behavior performance and outcome performance i.e. KSB and KSO, and there is a significant positive correlation between the KSB and KSO, so the expression of the KSB and KSO should be attached importance to synchronously for project management organizations. (4) For the purpose of improving the KSP, various project management organizations can establish a good KSCu from strengthening KSS, KSC, KSI and OMT. (5) For various project management organizations, adopting effective measures to strengthen the PTI can effectively promote KSP among project members, and the measures mainly concern promoting the work contact among different project teams and departments, strengthening communication frequency between project members from different project teams and departments, arranging one person to undertake multiple projects simultaneously, and purposefully implementing the exchange about staff positions.

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APPENDIX I.

Questionnaire items in measurement scales

Constructs	Code	Measurement items	Sources
Knowledge sharing strategy	KSS1	There are a set of scientific and standardized knowledge management programs or regulations in your organization	Lindner and Wald (2011); Tan (2015)
	KSS2	There is a specialized knowledge management system facilitating knowledge sharing or analogous system (such as information management systems, enterprise networks etc.) in your organization	
	KSS3	Leaders can advocate and practice by example knowledge sharing activities in your organization	
	KSS4	There are specific ways and means about knowledge sharing in your organization	
Knowledge sharing climate	KSC1	There are regular professional training or organizational learning in your organization	Bock et al. (2005)
	KSC2	There are good communication mechanism and environment in your organization	
	KSC3	There are fair environment and good interpersonal relationships in your organization	
	KSC4	Knowledge, knowledge holders and contributors can be respected in your organization	
Knowledge sharing incentive	KSI1	You are more likely rewarded on teamwork and collaboration rather than merely in individual performance	Al-Alawi et al. (2007)
	KSI2	The knowledge sharing rewards available are effective in motivating staff to spread their knowledge	
	KSI3	You are rewarded for sharing knowledge and experience with other project members	
Organizational members trust	OMT1	You trust and approve the work ability and professional level of other project members within the organization	Mooradian et al. (2006); Wickramasinghe and Widyaratne (2012)
	OMT2	You trust that other project members would lend you a hand without fob if you needed it	
	OMT3	You trust other project members would try and help you out if you got into difficulties at work	
Project team interaction	PTI1	The work contact and learning exchanges is close among different project teams in your organization	Jo (2011); Yang et al. (2012)
	PTI2	The work contact and learning exchanges is intimate between project teams and departments in your organization	
	PTI3	Project members from different project teams and departments communicate each other frequently in your organization	
	PTI4	You can be allocated to another project team or department by your organization because of the work or project requirement	
	PTI5	Sometimes you can be arranged to undertake multiple	

		projects simultaneously by your organization because of the work or project requirement	
Knowledge sharing behavior	KSB1	You frequently share your skills and expertise with other project members	Casimir et al. (2012); Zhang and Ng (2012); Shao et al. (2015)
	KSB2	You frequently consult other project members the required knowledge when you meet project problems	
	KSB3	You frequently communicate the new management methods, tools, processes, experience and knowledge of engineering technology with other project members	
	KSB4	You frequently guide and help the new or younger project members with little work experience	
	KSB5	You frequently provide your expertise on knowledge management system to share them with other project members	
Knowledge sharing outcome	KSO1	You have formed a habit to share knowledge with other project members in your organization actively and timely everyday	Anantatmula and Kanungo (2006); Reychav and Weisberg (2009); Migdadi (2009)
	KSO2	Knowledge sharing is achieved between project members belong to different project teams in your organization	
	KSO3	The overall quality and management level of yours are increased significantly	
	KSO4	There are strong organizational cohesion and good partnership a in your organization	
	KSO5	The whole management level and economic benefits in your organization have more competitive advantage than your competitors.	

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