3-1-2010

Understanding the Impact of Transactive Memory Systems on Project Team Performance: The Mediating Role of Knowledge Integration and Collective Mind

Kuang Ting Zheng
d964020001@student.nsysu.edu.tw

T.C. Lin

Jack Shih-Chieh Hsu

Neeraj Parolia

UNDERSTANDING THE IMPACT OF TRANSACTIVE MEMORY SYSTEMS ON PROJECT TEAM PERFORMANCE: THE MEDIATING ROLE OF KNOWLEDGE INTEGRATION AND COLLECTIVE MIND

Kuang-Ting Zheng
Dept. of Information Management
National Sun Yat-sen University
D964020001@student.nsysu.edu.tw

T.C. Lin
Dept. of Information Management
National Sun Yat-sen University
jackshsu@mis.nsysu.edu.tw

Jack Shih-Chieh Hsu
Dept. of Information Management
National Sun Yat-sen University
jackshsu@mis.nsysu.edu.tw

Neeraj Parolia
eBusiness and Technology Management Dept
Towson University
nparolia@towson.edu

ABSTRACT

This study aims at exploring potential mediators between transactive memory systems (TMS) and team performance. We argue that TMS facilitates knowledge integration and the forming of collective mind, which in turn, affect team performance. Collecting data from 205 project managers in Taiwan supports our hypotheses that knowledge integration and collective mind serve as mediator between TMS and team performance.

Keywords

Transactive memory systems, collective mind, knowledge integration, ISD team

INTRODUCTION

Information system development is a knowledge intensive work and the lack of knowledge or competence erodes the performance of ISD project (Gemino, Reich and Sauer 2007). Because of the high complex nature, team-based work style is adopted by organizations to increase the availability of knowledge. However, successful ISD does not only count on the existence of required knowledge but also the capability of blending them together (Faraj and Sproull 2001; Mitchell and Nicholas 2006). Effective problem solving requires members to synthesize their knowledge as well as align their actions.

Transactive memory system, i.e. knowing the location of knowledge and the way to access it, was recognized to have positive impact on teamwork. Most past researchers have focused on its impact on team performance directly and ignored that teamwork process influences the effect of TMS to final teamwork outcome. To advance our understanding about the role and impact of TMS within an ISD team, there is a need to explore its impact on teamwork process.

The purpose of this study is to understand how TMS impacts team performance via teamwork processes: knowledge integration and collective mind. The rest of this paper is organized as follows. In the second section, we first review past studies on knowledge integration, transactive memory system, and collective mind. Hypotheses are then developed. In the fourth section, method to examine proposed model is introduced. Research results and implications are followed by conclusion.

LITERATURE REVIEW

Transactive Memory Systems

Transactive memory system describes the active use of transactive memory by two or more people to cooperatively store, retrieve, and communicate information (Lewis 2003). In a team, TMS is a collective system for encoding, storing, and retrieving information that is distributed across members (Wegner 1995; Wegner, Giuliano and Hertel 1985). It can be viewed as a set of knowledge possessed by group members, coupled with an awareness of understanding of each other's knowledge. It is broadly accepted that TMS is critical for effective teamwork process and performance. TMS affects knowledge management within the team through three processes. First, the directory updating function allows group members to be aware of the location of special knowledge possessed by specific individual. Second, information allocation function represents the process of distributing knowledge to the members whose expertise is best suited for its storage. Third,

the retrieval coordination function shows how to retrieve needed information on any topics based on related knowledge from individual expertise in the memory system (Wegner 1995).

Knowledge Integration

Knowledge integration can be defined as the synthesis of individual team members' information and expertise through "social interactions" (Robert, Dennis and Ahuja 2008). Integration is not simply putting discrete pieces of knowledge together but, instead, teamwork processes are required to synthesize the knowledge held by different stakeholders and to create new knowledge or insight (Newell, Tansley, Huang, Surrey, Campus and Street 2004). In the information system development context, researchers referred integration to the process of coordinating specially expertise held by individuals or meld individually held information and know-how into a common stock of knowledge to solve problem and accomplish task in the project level (Mitchell and Nicholas 2006; Tiwana and McLean 2005). Knowledge integration is particularly important in highly interdependent tasks, e.g. ISD teamwork process. The effectiveness of system development is determined by team's ability in importing external knowledge and ability in synthesizing internal knowledge (Mitchell and Nicholas 2006).

Collective Mind

Collective mind is defined as "a pattern of heedful interrelations of actions in a social system" (Weick and Roberts 1993). It is different from TMS in the way that TMS indicates the knowledge of who knows what, that is the interconnection of different team members' knowledge, whereas collective mind implies the interconnection of the activities or actions of each team members (Akgün, Byrne, Keskin and Lynn 2006). With a collective mind, people in the same unit pay mindful attention to individual's contributing, representing, and subordinating behaviors which generate consequence to the system level. In the ISD context, each of these three components can be represented by team member's contribution to the project outcome, building internal model of the group, and puting team's goals ahead of individuals' goals.

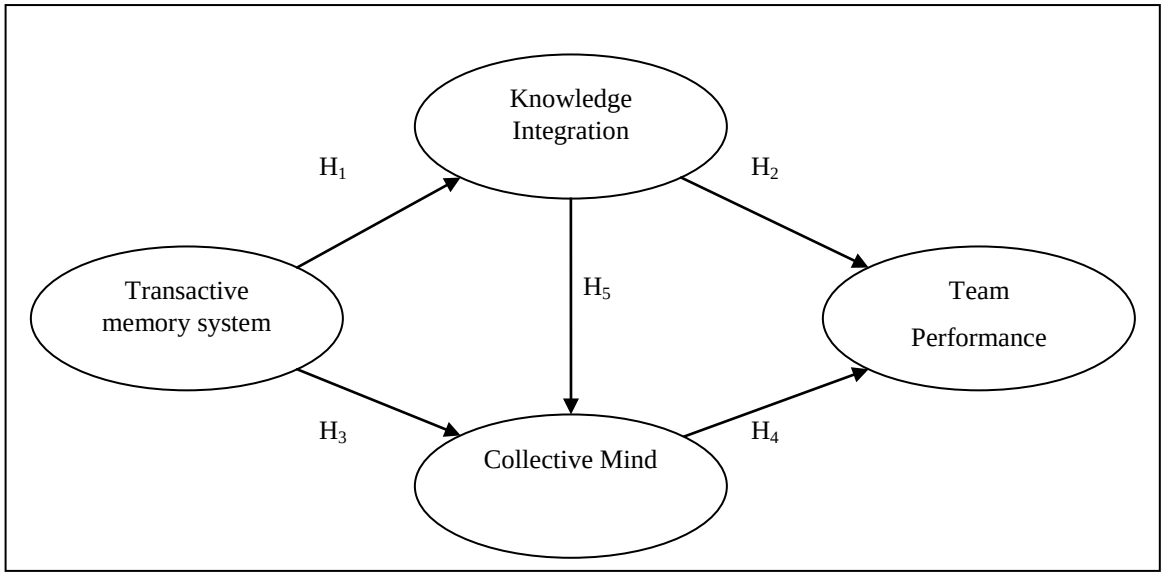

Figure 1 Research Model

Hypotheses

Knowledge integration can be viewed as a process of blending knowledge from various sources to form new knowledge. Experiment-based studies pointed out that TMS impacts team performance by increasing information search capability, enhancing learning, and promoting communication among team members (Lewis, Lange and Gillis 2005; Rau 2006). TMS contributes to knowledge integration from two dimensions. First, it reduces the effort required for knowledge exchange and transfer by creating the knowledge map within the team. TMS also contributes to greater team efficiency because members are able to anticipate each other's behavior by comprehending the knowledge and expertise possessed by each individual. Second, collective task or problem solving requires complementary knowledge possessed by different members. TMS, similar to a list of who knows what, enhances team's ability in bringing greater amount of knowledge into group level to bear on ISD tasks. Therefore, the effect of knowledge integration is constrained by the maturity of transactive memory within the team (Alavi and Tiwana 2002). Based on the above literature, we hypothesize that

H1: TMS has a positive effect on knowledge integration

The accomplishment of ISD is based on specialized knowledge possessed by team members as well as team's capability to integrate those diversified knowledge effectively. The integration process allows members to access, explore, and use information from different knowledge domains related to the project. In addition, a comprehensive understanding toward problems and different alternatives can be generated to solve problems. Therefore, team performance can be enhanced through the integration of knowledge. Team level empirical studies also conclude that knowledge integration within teams can reduce software defects (Tiwana 2004), increase creativity (Tiwana and McLean 2005) and improve the performance of product innovation teams (Lin and Chen 2006). Hence, we hypothesize that

H2: Knowledge integration has a positive effect on team performance

Collective mind is found in the heedful interrelation of group members (Akgün et al. 2006; Cross 2000). A collective mind allows team members to act as one unit by meshing self-consciousness and mental models of team members. A collective mind doesn't emerge automatically after including members in the ISD team. Some managerial interventions or team building activities are required. Researchers argued that TMS is one of the critical antecedents of collective mind. Two studies proposed a causal relationship between collective mind and TMS (Kanungo 2004; Yoo and Kanawattanachai 2001). Therefore, we hypothesize that

H3: TMS has a positive effect on collective mind

Collective mind is critical for the ISD teamwork because, with a collective mind, team members make their contributions to the joint outcome with attention and care, they have a global perspective of each other's tasks and responsibilities, and individuals carefully interrelate actions to each other to maximize joint performance. The recent studies on collective mind, for example Crowston and Kammereer (1998), noted that collective mind helps team members become more coordinated. Although, in an ISD project, actions such as analysis, programming, and testing are conducted by individuals, the results need to be integrated to form the final system. Team can work in a high quality manner when members have consensus on each other's role and responsibility. Moreover, Akgün et al. (2006) also found that collective mind improves team performance. Therefore, we hypothesize that

H4: Collective mind has a positive effect on team performance

The complex and rapid changing nature of ISD projects hint that teams are required to respond to environment in a timely and well coordinated manner. Initially, members of one team see problems from their own perspective and analyze possible causes based on their own expertise. During the knowledge integration process, members exchange knowledge or opinions to form new knowledge or comprehend each other's viewpoint. After integrating knowledge from individuals, members' understanding toward problems or tasks is not limited to individual level anymore. They can see problem from a higher level and see how different members should cooperate with each other in order to deal with problem efficiency and effectively. Therefore, we argue that with effective knowledge integration, members can form a collective mind easier.

H5: Knowledge integration has a positive effect on collective mind

RESEARCH METHOD

A survey research was conducted to examine proposed hypotheses. Project managers were selected to complete the survey because managers have a comprehensive view of the teamwork process and outcome evaluation (Zimmer, Henry and Butler 2007). A total of 205 surveys were returned. Table 4 shows the characteristics of our respondents. Among those respondents, 62% of them are male; over 92% of them has college or higher degree, about 60% of them has less than 10 years work experience.

Constructs

A total of 15 items obtained from Lewis (2003) were used to measure the specialization, credibility, and coordination of TMS within the team. A total of 4 items obtained from Tiwana and McLean (2005) were used to measure knowledge integration within the team. A total of 4 items obtained from Weick and Roberts (1993) were used to measure the extent to which individuals in the same team heedfully interrelate their actions. Project performance was measured using seven items adopted from existing scales (Henderson and Soonchul 1992) All above items were measured on a 5-point Likert scale, with anchors ranging from 1 (strongly disagree) to 5 (strongly agree).

Item reliability, convergent validity, and discriminant validity tests are often used to evaluate the measurement model in PLS. As indicated in table 1 and table 2, the composite reliability, Cronbach's alpha, averaged variance extracted (AVE), correlation matrix, and factor loadings indicate that all requirements are assured.

CONSTRUCTS	ITEMS	FACTORS		CONSTRUCTS	ITEMS	FACTORS	
		Loadings	ITC			Loadings	ITC
TMS-Specialty *CR=0.854* *Alpha=0.789* *AVE=0.540*	TMS-S1	.715	.527	**Knowledge Integration** *CR=0.903* *Alpha=0.857* *AVE=0.699*	KI1	.831	.654
	TMS-S2	.695	.557		**KI2**	.858	.752
	TMS-S3	.745	.603		**KI3**	.811	.679
	TMS-S4	.757	.606		**KI4**	.842	.716
	TMS-S5	.760	.542	**Team Performance** *CR=0.919* *Alpha=0.894* *AVE=0.654*	TP1	.816	.730
TMS-Credibility *CR=0.892* *Alpha=0.849* *AVE=0.625*	TMS-CR1	.684	.524		**TP2**	.865	.786
	TMS-CR2	.843	.740		**TP3**	.812	.744
	TMS-CR3	.835	.727		**TP4**	.783	.683
	TMS-CR4	.781	.656		**TP5**	.811	.694
	TMS-CR5	780	.640		**TP6**	.760	.656
TMS-Coordination *CR=0.868* *Alpha=0.773* *AVE=0.686*	TMS-CO1	.806	.612	**Collective Mind** *CR=0.901* *Alpha=0.854* *AVE=0.694*	CM1	.843	.703
	TMS-CO2	.850	.664		**CM2**	.828	.660
	TMS-CO3	.829	.555		**CM3**	.824	.698
TMS 2ND Order	TMS-Specialty	.652			**CM4**	.837	.716
	TMS-Credibility	.855					
	TMS-Coordination	.780					

Table 1. The Results of Factor Analysis

Variables	Mean	Std. Dev.	M3	M4	Correlation Matrix			
					TMS	KI	TP	CM
TMS	3.80	0.41	0.00	0.60	0.77			
Knowledge Integration	3.73	0.55	-0.39	1.15	0.59	0.84		
Team Performance	3.68	054	-0.23	1.24	0.51	0.61	0.81	
Collective Mind	3.57	0.64	-0.65	1.41	0.66	0.61	0.55	0.83
**M3: Skewness; M4: Kurtosis								
**The diagonal line of correlation matrix represents the square root of AVE								

Table 2. Descriptive statistics and correlation matrix

DATA ANALYSIS & RESULTS

Hypothesis testing was conducted through partial least squares regression analyses using PLS Graph 3.0. As indicated in Figure 2, all hypotheses are supported.

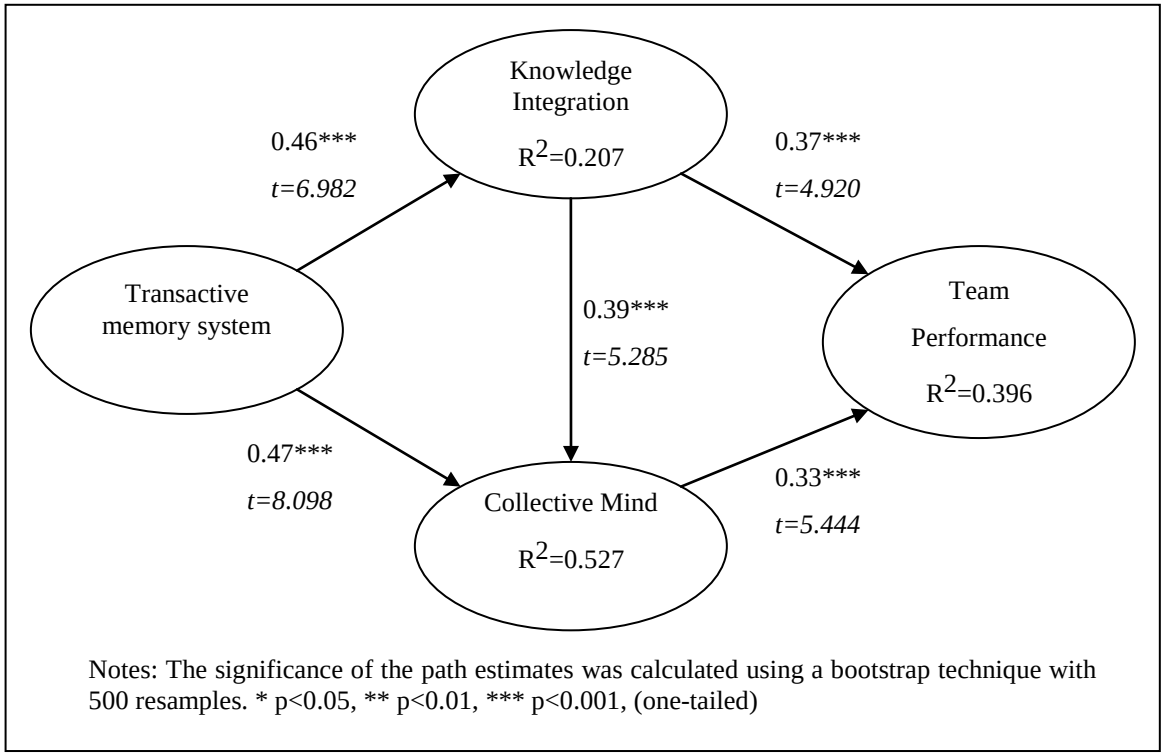

Figure 2 Results of the Mediated Model

CONCLUSION

The focus of this study is to examine the mediating role of knowledge integration and collective mind on team performance. Our survey of 205 ISD project managers confirmed all proposed hypotheses. Higher level of TMS within the team improves knowledge integration and collective mind, which in turn, lead to better performance. We add another perspective in understanding the role of TMS – it generates impact on team performance through facilitation of some teamwork processes, such as knowledge integration and collective mind.

Since the critical role of TMS has been identified, the formation of TMS within ISD team is determined as an important issue. Different approaches can be applied to foster TMS within the team in different teamwork dimensions. First, in the initial formation stage, training together provides a mean for members to develop TMS. Second, during the team work, task interdependence generates the need for interaction among members. Project managers or team leaders can incorporate interdependence into task design. Third, TMS can also be formed through informal communications during informal circumstances, such as parties. Informal communication without pressure allows members to build close relations which is one important antecedent of trust. Project managers or team leaders can nurture TMS within the team through these approaches. With a mature TMS, the team can integrate knowledge possessed by individuals to counter problems in task level and, then, improve teamwork performance.

REFERENCES

1. Akgün, A., Byrne, J., Keskin, H., and Lynn, G. (2006) Transactive memory system in new product development teams, IEEE Transactions on Engineering Management, 53, 1, 95-111.

2. Alavi, M., and Tiwana, A. (2002) Knowledge integration in virtual teams: The potential role of KMS, Journal of the American Society for Information Science & Technology, 53, 12, 1029-1037.
3. Cross, N. Engineering design methods: Strategies for product design, John Wiley & Sons, New York
4. Crowston, K., and Kammerer, E.E. (1998) Coordination and collective mind in software requirements, IBM Systems Journal, 37, 2, 227-245.
5. Faraj, S., and Sproull, L. (2001) Coordinating expertise in software development teams, Management Science, 46, 12, 1554-1568.
6. Gemino, A., Reich, B.H., and Sauer, C. (2007) A temporal model of information technology project performance, Journal of Management Information Systems, 24, 3, 9-44.
7. Henderson, J.C., and Soonchul, L. (1992) Managing I/S design teams: A control theories perspective, Management Science, 38, 6, 757-777.
8. Kanungo, S. (2004) On the emancipatory role of rural information systems, Information Technology & People, 17, 4, 407-422.
9. Lewis, K. (2003) Measuring transactive memory systems in the field: Scale development and validation, Journal of Applied Psychology, 88, 4, 587-603.
10. Lewis, K., Lange, D., and Gillis, L. (2005) Transactive memory systems, learning, and learning transfer, Organization Science, 16, 6, 581-598.
11. Lin, B.-W., and Chen, C.-J. (2006) Fostering product innovation in industry networks: The mediating role of knowledge integration, International Journal of Human Resource Management, 17, 1, 155-173.
12. Mitchell, R., and Nicholas, S. (2006) Knowledge creation in groups: The value of cognitive diversity, transactive memory and open-mindedness norms, Electronic Journal of Knowledge Management, 4, 1, 67-74.
13. Newell, S., Tansley, C., Huang, J., Surrey, T., Campus, J., and Street, B. (2004) Social capital and knowledge integration in an ERP project team: The importance of bridging and bonding, British Journal of Management, 15, S1, S43-S57.
14. Rau, D. (2006) Top management team transactive memory, information gathering, and perceptual accuracy, Journal of Business Research, 59, 4, 416-424.
15. Robert, J.L.P., Dennis, A.R., and Ahuja, M.K. (2008) Social capital and knowledge integration in digitally enabled teams, Information Systems Research, 19, 3, 314-334.
16. Tiwana, A. (2004) An empirical study of the effect of knowledge integration on software development performance, Information and Software Technology, 46, 13, 899-906.
17. Tiwana, A., and McLean, E.R. (2005) Expertise integration and creativity in information systems development, Journal of Management Information Systems, 22, 1, 13-43.
18. Wegner, D. (1995) A computer network model of human transactive memory, Social Cognition, 13, 3, 319-339.
19. Wegner, D., Giuliano, T., and Hertel, P. "Cognitive interdependence in close relationships," in: Compatible and incompatible relationships, Springer Verlag, New York
20. Weick, K.E., and Roberts, K.H. (1993) Collective mind in organizations: Heedful interrelating on flight decks, Administrative Science Quarterly, 38, 3, 357-381.
21. Yoo, Y., and Kanawattanachai, P. (2001) Developments of transactive memory systems and collective mind in virtual teams, International Journal of Organizational Analysis, 9, 2, 187-208.
22. Zimmer, J.C., Henry, R.M., and Butler, B.S. (2007) Determinants of the use of relational and nonrelational information sources, Journal of Management Information Systems, 24, 3, 297-331.