

# An Empirical Study on the Structural Relationship between Transactive Memory System, Knowledge Sharing and Innovation Capability: Evidence from Universities in China

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## I. Introduction

Knowledge is the powerful force urges social advancement. As the era of human development has been connected with the knowledge economy era which is on the basis of taking the data, information and knowledge

as the center, taking the creative and intellectual activity as the mainstay, and which is built on the basis of the produce, sharing, utilization and innovation of knowledge. In the era of knowledge economy, knowledge has gradually been replacing the land, capital and labor force to be the core source of the driving

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force and competitiveness of the development for individuals and organizations. The development of knowledge economy has given impetus in the development of knowledge management.

Knowledge management is not only the recording and presentation of the text information but is more embodied as the dynamic process of the knowledge transformation and innovation with the participation of individuals. With the continuous development of higher education and improvement of the science and technology, the management of knowledge in the colleges and universities is becoming much more important. However, the current present condition is that there is no difference with past as the universities manage the knowledge. So it's important for universities to manage the teachers who have knowledge. The university, with a set of knowledge production, dissemination, innovation and application as one, which shoulders the responsibility of the talent cultivation, scientific research, and social service, and also acts as a significant position of creating new knowledge, should strengthen the management of knowledge and knowledge creation.

Higher education mainly trains the applied talents. Here has talked about the “applied”, which should not just consider the inherited application, but should also include the creative application; and not just to apply the

existing knowledge, techniques and methods, but also continue to learn new knowledge, new technology and new methods, and creatively analyze new situations and solve new problems. Therefore, the higher education should be the innovative education, and the higher educational teachers should be innovative teachers. Therefore, while constructing the team of the teachers, not only the knowledge management should be strengthened, but also the teachers' innovation capability needs to bring the attention (Huang and Zeng et al., 2008).

Wenger (1987) asserted that the transactive memory system (TMS) is a kind of cooperative division system which is formed from team members, and used to obtain, store and utilize the information and/or knowledge from different domains. As a new research perspective of knowledge management (Lewis, 2003), TMS is highly concerned by lots of scholars in recent years. TMS is an effective way for the teams to manage knowledge. It can not only affect the progress that the teams complete the task (Hu, 2014), but can also provide the way for team members to know how to use their own knowledge and skills to complete the task. A highly efficient and stable TMS can reduce redundancy of team knowledge, and improve the utilizing efficiency. Based on the previous study, most research put much attention on either TMS or knowledge sharing. The combination of both

systems will contribute to a much more comprehensive analysis of knowledge management. And for the innovation capability, most of the research only focus on the individual capability of innovation, or the innovative performance. In this present study, we focus on the university teachers' innovation capability. We highlight that teachers' innovation capability, no matter the capability of teaching or managing the knowledge, could be proved when teachers work together as a team or group with a close and good relationship. And we explore the way to analyze teams' innovation capability by testing teams' level of the TMS and the strength of sharing knowledge. It is creative to explore university teachers' innovation capability development by combining the area of education and knowledge management. In addition, in this present study, exploring the influence of TMS on the university teachers' knowledge management, and putting knowledge sharing as the mediating role, own realistic significance to improve the teachers' innovation capability.

## II. Literature Review

### 2.1 Transactive Memory System (TMS)

TMS was first developed by Daniel Wegner

in 1985. TMS is information communication system that people in the team can encode, store and retrieval the different information and/or the knowledge, and which is developed on the basis of close relationships (Liew, 2003; Moreland et al., 1996; Moreland and Myaskovsky, 2000). TMS allows the team members to distribute and retrieval knowledge, for the specialization of labor which can be shared. Wegner et al. (1985) defined the TMS as the team members' cognitive division of the knowledge, and the combination of the shared consciousness about "who knows what". Meanwhile, TMS emphasizes that team members should clearly know who knows what kind of information, but not the information itself. And when we need the information, at least, we know whom we can ask for. However, the precondition is that team members should have a close relationship. TMS is different from the information system. The information system is considered as a technology that any individuals or organizations can learn and operate by collecting, processing, creating and also distributing the needed data into the networks of hardware and software (Kroenke et al., 2013). A good information system provides people or organizations an easy way to get information that they need by using the networks of hardware and software as well (Kroenke et al., 2013).

Wegner et al. (1985) also mentioned that

TMS is the sum total of the communication activities among the team members. Hence, each member of the team only needs to be responsible for their own specialization. And when the other team member needs some information, they can ask help from other team members. If do like this, it can help reduce the burdens of cognition for the members. And by the way, they can gain a wider specialized knowledge and information that no one can master by himself. Huang et al. (2013) state that personal knowledge and information can be provided directly through person-to-person communication by team members; and knowledge can also be provided indirectly by uploading it to a shared resource. So, in order to form a well-organized TMS, team members ought to have some communication activities and to label each other's' expertise.

Lewis (2003) states that even though transactive memory just touches upon the individual memory, the TMS indicates how team members can effectively utilize their own transactive memory to encode, store and retrieval the knowledge which belongs to the group. Meanwhile, Zhang (2007) defined TMS as a cooperative division of labor the team members in interdependent relationships were developed with respect to the encoding, storage, and retrieval of information from different substantive domains.

Based on the definition of TMS, Rau (2006) considered that the team members enhanced

their own memories through the communication among each other, and then shared two kinds of information with each other: (a) the team member's individual professional knowledge; (b) the other members' knowledge. And they also considered that these two dimensions of transactive memory positively influence the decision-making process. What's more, communication plays an important role in the influence of TMS in the group working (Wegner, 1987; Brandon and Hollingshead 2004).

Through the previous studies, it's not hard to find that most of the scholars did not differentiate the concepts between transactive memory and transactive memory system, and consider they both are unified. And this paper considers this same way, because when the team members stay together for some time, and they know well who knows what of each member, the TMS then exists (Moreland et al. 1999). By researching team's TMS development, it provides us a clear understanding of how the knowledge and information are utilized and coordinated by team members (Choi et al., 2010; Chung et al., 2015). And this helps team leader analyze the flow direction of members' knowledge and information effectively.

For the measurement of the interactive memory system, the previous researchers have used a variety of methods to measure, such as memory measurement, behavior observation, etc. Moreland et al. (2000) explored if a team

or group would regard the other members as the external memory by researching the comparative analysis between personal memory and collective memory. Most of the scholars widely utilize the scale that Lewis developed for TMS, and which contains three dimensions: (1) specialization: the degree of specialization and differentiation of team members (Zhang, 2007), (2) credibility: the beliefs of members' about the reliability of others' specialization, and (3) coordination: the ability if the team members can effectively work via utilizing others' knowledge (Lewis, 2003; Moreland, 1999; Moreland, 1996). And in this present study, we consider TMS as a mechanism for individuals with close relationships in one group to encode, store, and retrieve knowledge from each other to share with each other. For measuring TMS, we adopt Lewis's (2005) measuring scale. However, in order to achieve a clear and easy-understanding result, we only choose 6 items out of 13 original items.

## 2.2 Knowledge Sharing

Knowledge sharing is considered to be one of the most important aspects of knowledge management (Gupta et al., 2000; 강병영·김은정, 2007) and the success of knowledge management initiatives depends on knowledge sharing (Wang and Noe, 2010). Knowledge sharing is a process of knowledge management

(Alavi and Leidner, 2001), and which proposes to provide knowledge where it is needed, and then leading to the achievement of sustainable competitive advantage (Wang and Noe, 2010; Wijk et al., 2008). The outcome of knowledge sharing is the creation of new knowledge and innovation that would effectively improve the organization (Al-Hawamdeh, 2003). And the knowledge sharing is the process of acquiring knowledge for knowledge using in daily work to improve the collaboration and relationships among team members and to enhance the accumulation of knowledge for teams (Lee and Yu, 2011; 김상진·박용재, 2002).

“Knowledge management as a systematic effort to enable information and knowledge to grow, flow and create value. The discipline is about creating and managing the processes to get the right knowledge to the right people at the right time and help people share and act on information in order to improve organizational performance” (O'Dell and Hubbert, 2011). Senge (1997) states that knowledge sharing is different from the information sharing; he mentions that knowledge sender should not only share the knowledge but also help the knowledge receiver learn the knowledge. As the same, Nancy (2001) also considers that the knowledge sharing is a process of learning. Knowledge sharing is not just the knowledge transferring, its point is that after transferring the knowledge to the receiver and helps the

receiver to absorb knowledge and develop the knowledge. On the other hand, knowledge sharing is a process for individual to integrate all kinds of different but useful knowledge pieces provided by others (Chen et al., 2013). And the newly generated knowledge is much more powerful and innovative than the single and fragmentary knowledge piece (Chen et al., 2013).

Later, Hendriks (1999) further deepens the understanding of knowledge sharing. He states that knowledge sharing is not a process of selling the commodity, but a process of communicating. When one is learning knowledge from others, he himself should also recombine the knowledge which is shared by others. And we can find that while considering the process of knowledge sharing, there are two subjects should be considered: the knowledge sender and the knowledge receiver. Therefore, knowledge sender shares his/her knowledge, and the knowledge receivers would learn and absorb it in the group. Hence, knowledge sharing is a process of knowledge outputting. For TMS, as one already knows who knows the information or knowledge the one need, then the one will turn to that one in the group to get and learn the knowledge. And also, each member of the team encodes, stores and retrievals their own specific information or knowledge, and work together. Hence, the TMS is a way process of knowledge inputting. When the team focuses on both TMS and

knowledge sharing, they both could come into being a circle of transporting each one's knowledge inside the team.

From the previous study, so many scholars used different models to prove how to achieve a better result of knowledge sharing. And all theories have a common; that is they are all based on the understanding of knowledge and knowledge sharing to study. And among that, the SECI Model which is made by Nonaka and Takeuchi (1995) is considered as a representative.

For measuring the knowledge sharing, following the previous studies, we can see that different scholars utilize different related scales to measure. Hooff and Ridder (2004) divided knowledge sharing as two dimensions: 'knowledge donating, communicating to others what their personal intellectual capital is'; and 'knowledge collecting, consulting colleagues in order to get them to share their intellectual capital' (p. 118). King and Marks (2005) measure the knowledge sharing behavior through two independent dimensions, i.e., sharing frequency and sharing the effort. Li<sup>a</sup> (2010) consulted the scales of Zahraetal. (2000) and then created a new scale which just has one dimension, the knowledge sharing. This scale contains 7 items which are easy to understand and operate. This paper uses this same scale and which is corrected according to our actual situation.

### III. Research Model and Hypotheses

#### 3.1 Research Model

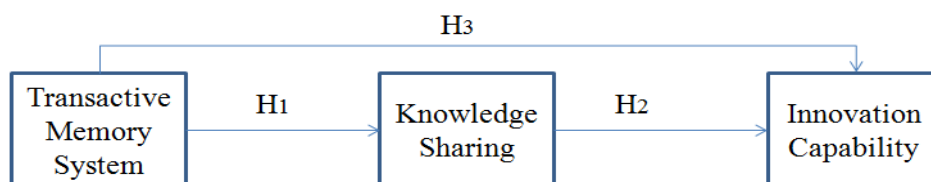
In this research, we highlight a few major factors which can explain large part of innovation capability based on the literature review so far.

#### 3.2 Hypotheses

Teachers are not only important workers in the field of education but also the important carrier of knowledge in our society. They undertake the great responsibilities as to create new knowledge and share the knowledge. Especially in recent years, with the new curriculum reformation in China, will promote the reformation of teaching methods. This requires the teachers break their original knowledge structure, and establish a diversified knowledge basic structure, and to abandon the idea that teacher just only “teach” the book to the students, but to grow into a scholar-teacher or research teacher. Under this situation, it is a need for the new innovation of curriculum

and economic and social development to excavate, store, use, and share the tacit knowledge from the teachers’ teams. This is also necessary for the school development and teachers’ professional growth. What’s more, the knowledge sharing and TMS are the two main contents of knowledge management. So the following is going to analyze the relationship between TMS, knowledge sharing and teacher teams’ innovation capability.

Chen et al. (2013) proposed a well-developed TMS was beneficial to the process of sharing knowledge among the group of people. Rau (2001), presented that in a team where exists the TMS, if the team members have a clear understanding of the knowledge that each has, and have a full trust and coordination with each other, which would promote the members help and support each other, thereby to increase the desire of knowledge sharing. Akgun and Byrne et al. (2005), through a large number of studies and research, have found that TMS can effectively promote the knowledge complementary and cooperative among team members, and also can enable members to share the tacit knowledge. So, the knowledge can be shared widely and roundly.



<Figure 1> Research Model

Borgatti and Cross (2003) pointed out six factors that will influence people to share knowledge. And among the factors, the one that is related to the TMS knows one's own and others' knowledge. Zhang (2007) also considers that the TMS can not only help us to make full use of our own techniques, but also spur us on to learning more knowledge from others; and not just promotes us distinguishing team members' knowledge, meanwhile, distinguishing our own knowledge. And when we specialize in some special knowledge, it would be much possible for us to share our specific knowledge to others.

TMS can actively promote the growth of knowledge sharing, and which can not only promote knowledge sharing but also can enable the knowledge maximum limit to display its potency through the knowledge sharing. Siemens considered that it will improve the knowledge sharing happen when you search the knowledge as you knew "what the team member knew". Based on the above arguments, we propose the following hypothesis.

H1: Transactive memory system has a positive effect on knowledge sharing.

We are living in a knowledge-based society in which knowledge available to the organizations is becoming a strategically important resource (Hooff and Ridder, 2004), some even consider it as the core competence and performance driver of the firms (Barquin, 2001; Lin et al.,

2014). Knowledge sharing is considered to be one of most important aspect of knowledge management (Gupta et al., 2000) and the success of knowledge management initiatives depends on knowledge sharing (Wang and Noe, 2010).

Kogut and Zander (1992) consider that the innovation is from that the team reshapes and create their knowledge resource. Exactly, the knowledge sharing provides the best chance to the team to reshape. Team members share their own knowledge and combine the knowledge with each other, thus sparking new ideas and creating much new and much better knowledge (Senge, 1997; Ghoshal, 1998). Meanwhile, Nonaka (1995) pointed out that sharing the knowledge effectively can make maximum use of the existing knowledge and improve the innovation capability. Knowledge sharing enhances the reciprocal transformation between the explicit knowledge and tacit knowledge and improves the knowledge innovation. Calantone et al., (2002) argued that Drucker (1954) was the first scholars to address the importance of innovation capability for the organization. He suggests that an organization has to be innovative to survive in the volatile environment.

The innovation capability that the authors discuss in this study refers to the universities teachers' capability to discover a feasible and effective teaching and educational method (Tang, 2004). The core of innovation capability



is innovative thinking (Xu, 2008). Innovative thinking refers to that a person with beyond the regular eye view to observe and consider a question from different perspectives, and then to put forward a different and new ideas, new solutions which can be tested to solve the problem (Shu, 2006). In this study, we consider the teachers' innovation capability could be developed through their innovative consciousness, personality, thinking, and skills (Li<sup>b</sup>, 2010).

Calantone et al. (2002) argued that Drucker (1954) was the first scholars to address the importance of innovation capability for the organization. He suggests that an organization has to be innovative to survive in the volatile environment. Innovation capabilities are seen as critical to achieving a superior innovation performance. Based on these arguments, the following hypotheses are formulated.

H2: Knowledge sharing positively affects innovation capability.

Nonaka and Takeuchi (1995) considered that the specialization knowledge influence the capability of the team and organization to utilize their knowledge asset. For the social participators, in order to accept, utilize and integrate effectively, usually they need to know what kind of knowledge that they need, and where the knowledge that they need is stored. Meanwhile, Fan et al. (2016) explored that TMS would nurture team members' innovation behavior and capability since team members

would encode, store, retrieve and communicate the knowledge and information of each other in the team when they are working together and executing the innovative task, and this is TMS requested. Hence, we suggest that TMS would have a significant influence on the team innovation of the knowledge.

TMS can improve the performance, that is because TMS can provide the team members to gain lots of knowledge in a wide range of areas, and it places stress on the emphasis on utilizing and integrating the professional skills, and then to maximize the members' knowledge value (Lewis, 2003). TMS will help to create the new knowledge while which is coordinating the knowledge and skills in different fields (Austin, 2003). Chiang et al. (2014) propose that a well-developed TMS can improve teammates to know well about each other's' specialized knowledge, provide and motivate teammates to learn and cooperate with teammates to accomplish a joint task. The transferring of tacit knowledge and the creative thinking are produced from the members' interacting (Wenger, 1995). Chiang et al. (2014) also mention that to develop a good TMS would help team members improve their efficiency in processing information and expand teammates' acquisition of knowledge. This evidence indicates that the TMS development should be positively related to the improvement of teammates' innovation capability. This study therefore proposes:

H3: Transactive memory system has a positive effect on innovation capability.

## IV. Research Design

### 4.1 Operational Definition and Questionnaire Design

<Table 1> shows us the operational definition of each concept and measurement for each

variable with related previous studies. The definition of TMS is adapted from Lewis (2003). Measurements of TMS are adapted from Lewis (2005) and Zhang (2007). The definition of knowledge sharing is adapted from Li<sup>a</sup> (2010). Measurements of knowledge sharing are adapted from Zahra et al. (2000) and Li<sup>a</sup> (2010). The definition of innovation capability is adapted from Tang(2004) and Li<sup>b</sup> (2010). Measurements of innovation capability are adapted from Li<sup>b</sup> (2010).

<Table 1> Operational Definition and Measurement of the construct

Variable	Operational Definition	Code	Items	Previous Studies
Transactive Memory System (TMS)	The extent to which individuals with close relationships in one group to encode, store, and retrieve knowledge from each other to share with each other.	TM1	Each person in the team owns a specialized knowledge of some aspect of our project.	Lewis (2005)
		TM2	I have knowledge about an aspect of the project that no other team member has.	
		TM3	Different team members are responsible for expertise in different areas.	
		TM4	I trusted that other members' knowledge about the project was credible.	
		TM5	When other members gave information, I don't need to double-check it for myself.	
		TM6	Our team worked together in a well-coordinated fashion.	
Knowledge Sharing (KS)	The degree to which individuals in one group share their tacit and explicit knowledge with each other to help learn more from the group.	KS1	We have the meeting for sharing and communicating the information.	Zahra et al. (2000); Li <sup>a</sup> (2010)
		KS2	We have the discussion face by face.	
		KS3	We have the formal analysis for our failure.	
		KS4	We have the formal analysis for our success.	
		KS5	We have the formal seminar for how to use what we have learnt.	
Innovation Capability (IC)	The extent to which university teachers discover effective educational method to improve the social laboratory achievements by developing their creative consciousness, personality, thinking and skills.	IC1	Our teachers are willing to accept the challenging teaching and management tasks.	Li <sup>b</sup> (2010)
		IC2	Our teachers will complete the task even they meet with many setbacks.	
		IC3	Our teachers can break away from the usual practice of positive thinking.	
		IC4	Our teachers have abundant knowledge, and they can guide students conduct research.	
		IC5	Our teachers can sort out and use the original theory creatively, and then share with other teachers.	

## 4.2 Sampling Design and Data Collection

In this present study, we designed a scientific questionnaire for the research. We analyze the data set and test research hypotheses by using SPSS 22.0 and Amos 22.0. The questionnaire is designed based on the measurements in <Table 1>. And the survey was conducted in China from July to October 2015. Altogether, we collected 201 responses from 14 universities in China by face-to-face interviews, E-mails, and the on-line survey. Responders are teaching groups' leaders. At the end, 191 responses were filtered out as the valid samples. Likert 5-point scale is utilized to measure the question items which is from 1 (strongly disagree) to 5 (strongly agree). We first estimate the reliability and validity through an exploratory factor analysis and then discriminant validity is tested to be adequate for the measurement model. Then, we test the research model fit and hypothesis. We first test the single path coefficient before mediator variable is added in the model, and then we test the path coefficients again after adding the mediator into the model. To compare the beta estimate, we suggest the mediating role.

## V. Empirical Analysis

### 5.1 Demographic Characteristics

The original file has 201 data which is gathered from 8 universities in Yunnan province and 6 in other provinces in China; and the responders were teachers who lead/guide a group or team in the universities. However, the result was not satisfied as expected. Therefore, in order to optimize the research result, the author got back and checked for invalid data again. Finally, 10 poor data were deleted, and run again through the statistics packages.

The demographic characteristics of these 191 responses are shown in <Table 2>. According to the table, we can get that there are 56.5% of males, and 43.5% of females who responded. For age, 26.2% of them are under 30 years old and 66.5% are between 31-40 years old; 6.3% are between 41-50 years old, and only 1% are over 50 years old. And that shows in universities the group leaders are in their 40s nowadays. For educational level, it's not hard to tell that in universities, the group leaders usually own a high-level education background (57.1% of Master's and 10.5% of Ph. D.).

What's more, for the working seniority, 48.7% of teachers have worked for 6-10 years, and only 1% who have worked over 30 years. About the group meeting experience, the question was asked as "how often a team meeting happens?" 49% of the teachers showed that they took a meeting each week. 24.6% took a meeting for once two weeks, and 14.1% of them took a meeting more than 2 times each week. However, there are also 6.3%

as once a month and 5.8% took a meeting only one time over one month.

<Table 2> Demographic Characteristics

Category	Range	Frequency	Percentage
Gender	Male	108	56.5%
	Female	83	43.5%
Age	Under 30	50	26.2%
	31-40	127	66.5%
	41-50	12	6.3%
	Over 50	2	1.0%
Education Level	College	0	0
	Bachelor	62	32.5%
	Master	109	57.1%
	Ph. D.	20	10.5%
Work Experience	Less than 3 years	11	5.8%
	3-5 years	43	22.5%
	6-10 years	93	48.7%
	11-20 years	38	19.9%
	21-30 years	4	2.1%
	Over 30 years	2	1.0%
Group Meeting Experience	≥2 times each week	27	14.1%
	Once a week	94	49.2%
	Once two weeks	47	24.6%
	Once a month	12	6.3%
	Once over one month	11	5.8%

## 5.2 Reliability and Validity

Three factors with eigenvalue over 1.0 are extracted from exploratory factor analysis by using SPSS software as shown in <Table 3>. Cronbach's Alpha is estimated to acquire the measure of reliability of a set of question items (Henson, 2001). A widely advocated level of adequacy for the coefficient alpha has been at least 0.70 (Cortina, 1993). From the <Table 3>, we can see that eigenvalue of three factors are extracted and all of the eigenvalue are over 1.0. And all of the constructs show a good reliability in the research. The Cronbach's alphas of three factors are well satisfied with all the values are over 0.7, which indicate the highly internal consistency of each construct.

<Table 3> Exploratory factor analysis and internal consistency

Variable	Item	Factor Loading			Eigenvalue	Cronbach's Alpha
Transactive Memory System (TM)	TM1	0.115	<b>0.752</b>	0.156	2.512	0.844
	TM2	0.214	<b>0.741</b>	0.181		
	TM3	0.018	<b>0.717</b>	0.093		
	TM4	0.052	<b>0.693</b>	0.145		
	TM5	0.076	<b>0.714</b>	0.133		
	TM6	0.147	<b>0.775</b>	0.148		
Knowledge Sharing (KS)	KS2	0.144	0.223	<b>0.804</b>	2.053	0.883
	KS3	0.098	0.151	<b>0.769</b>		
	KS4	0.173	0.179	<b>0.776</b>		
	KS5	0.104	0.165	<b>0.816</b>		
	KS6	0.109	0.111	<b>0.837</b>		
Innovation Capability (IC)	IC1	<b>0.859</b>	0.089	0.157	5.752	0.885
	IC2	<b>0.811</b>	0.124	0.148		
	IC3	<b>0.753</b>	0.171	0.137		
	IC4	<b>0.797</b>	0.052	0.071		
	IC5	<b>0.841</b>	0.110	0.098		

<Table 4> Discriminant Validity indices

Construct	Composite Reliability (CR)	Average variance extracted (AVE)	TM	KS	IC
Transactive Memory System	0.848	0.484	<b>0.696</b>		
Knowledge Sharing	0.885	0.606	0.463	<b>0.778</b>	
Innovation Capability	0.888	0.614	0.222	0.256	<b>0.784</b>

Diagonal value (in boldface) are the square root of AVE.

The <Table 4> shows the evidence of convergent and discriminant validity. The construct to attest the convergent validity as if the composite reliability (CR) is greater than 0.7, and the average variance (AVE) exceeds 0.5. Now, according to <Table 4>, all CR values of the constructs ranged from 0.848 to 0.888 that all exceed the acceptance level of 0.7, and the AVE values are rounded and greater than 0.5. Hence, the convergent validity is assured.

For the discriminant validity, of each construct, which is to test if each construct differs, AVE and inter-construct correlation are compared (Moutinho and Hutcheson, 2011). <Table 4> shows the diagonal value in boldface for each construct is higher than the off-diagonal elements representing correlation.

### 5.3 Hypothesis Test

The collected data was analyzed by structural equation modeling (SEM) of the AMOS software. And the SEM is calculated to exam the relationships between variables. We adopted AMOS 22.0 to analyze a reasonable fit to the model, which concluded a number of criteria, such as Chi square/degrees of freedom, Goodness-of-fit Index (GFI), Adjusted Goodness-of-fit (AGFI), Normed Fit Index (NFI), Comparative Fit Index (CFI), Root Mean Square Residual (RMR), and Root Mean Square of Approximation (RMSEA). <Table 5> shows the result of model fit of structural model. All values exceed to the thresholds, indicating goodness of measurement model.

<Table 6> shows that TMS has significant effect on innovation capability (0.391\*\*\*) before mediator (knowledge sharing) variable enter the model.

<Table 5> Model Fit Indices

	$\chi^2/df$	GFI	AGFI	NFI	CFI	RMR	RMSEA
Model Value	1.393	0.917	0.888	0.911	0.973	0.027	0.045
Recommended Value	$\geq 1, \leq 3$	$\geq 0.9$	$\geq 0.8$	$\geq 0.9$	$\geq 0.9$	$\leq 0.05$	$\leq 0.08$

<Table 6> Path coefficient

Path	Estimate	SE	C.R.	p	Result
TM → IC	0.391	0.095	4.110	***	Supported

TM: Transactive Memory System; KS: Knowledge Sharing; IC: Innovation Capability;  
 \*\*\* p<0.001

<Table 7> shows us the test result of hypotheses for the whole data set. Both of the factors such as the TMS and knowledge sharing are positively related to the innovation capability after the mediator (knowledge sharing) variable enters the model. TMS has positive significant influence on knowledge sharing (H1: 0.463\*\*\*), and on innovation capability (H2: 0.256\*\*) as hypothesized. Knowledge sharing also has a positive significant influence on innovation capability (H3: 0.222\*) as hypothesized in the model.

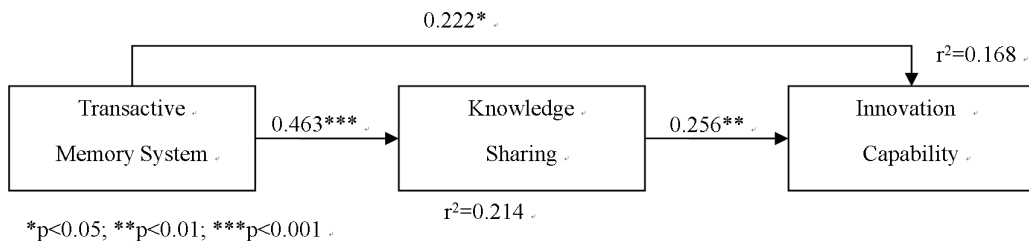
it shows that TMS has significant effect on knowledge sharing and knowledge sharing has a significant effect on innovation capability. The mediation in this present study is partial mediation as direct effect of TMS on innovation capability is still significant after knowledge sharing enter the model even though TMS is reduced from 0.391 to 0.222. Hence, TMS has significant direct effect on innovation capability, and significantly indirect effects on innovation capability through mediator variable knowledge sharing as well.

And based on the <Table 6> and <Table 7>,

<Table 7> Path coefficients and results of hypothesis test

Hypothesis	Path	Estimate	SE	C.R.	p	Result
H1	TM → KS	0.463	0.094	5.429	***	Supported
H2	KS → IC	0.256	0.071	2.843	0.004	Supported
H3	TM → IC	0.222	0.080	2.434	0.015	Supported

TM Transactive Memory System; KS Knowledge Sharing; IC Innovation Capability;  
 \*p<0.05; \*\*p<0.01; \*\*\* p<0.001



\*p<0.05; \*\*p<0.01; \*\*\*p<0.001

<Figure 2> Research Model Result

## VI. Implications and Conclusions

In summary, all of our hypotheses (H1 to H3) regarding the relationship between transactive memory system, knowledge sharing, and innovation capability were supported. Based on the analysis, we can see that TMS has a positive significant influence on knowledge sharing (H1: 0.463\*\*\*), and on innovation capability (H2: 0.256\*\*) as hypothesized. Knowledge sharing also has a positive significant influence on innovation capability (H3: 0.222\*) as hypothesized in the model. It also proves that TMS could prompt university teachers to accept the challenging teaching and management tasks, and to finish the work much more effectively. And meanwhile, the knowledge sharing effectively influences teams' innovation capability of developing creative consciousness, personality, thinking and skills. That proves the knowledge sharing plays an important role in this study as the mediating role. TMS is positively associated with the innovation capability. And the knowledge sharing also plays a significant role as a mediating value between them both. It's thus cleared that if our teachers could well communicate, exchange and collaborate with other teachers in the same group, the innovation capability among the teachers would be improved effectively.

### 6.1 Academic Implications

From academic perspective, the study contributes to the understanding of TMS and its features. And for most of the previous studies, TMS is always used as a mediating role to be researched (Akgun et al., 2005; Zhong et al., 2012; Zheng, 2015), the present study, however, explores the relationships between TMS as an independent variable and innovation capability. Nevertheless, few studies empirically researched the links between TMS and knowledge sharing.

Though there are some empirical studies researched on the TMS, few consider the university teachers as the research object. The present study enriches the survey respondents of this domain. The present study contributes to the combination of management subject and education subject. Especially while considering the measurement of teachers' innovation capability, we don't only focus on the creative consciousness and thinking of teachers', but also the personality and innovative skills of theirs. And this would help to broad the leaders' horizons to increase the teachers' innovation capability.

### 6.2 Practical Implications

In order to improve the university teachers' innovation capability, we should focus on training teachers' innovative consciousness,

shaping their innovative personality, initiating their innovative thinking, and practicing the innovative skills (Shi, 2002; Li<sup>b</sup>, 2010; 구철모와 남기찬, 2007). Transactive Memory System can impel group members to take full advantage of other members' knowledge and information. However, in order to increase the members' TMS operating, the group leader should create a friendly learning environment for teachers to know each other well and enhance the teachers' close relationships. Only under this good environment, can the leader well improve teachers to well understand what knowledge and information each teacher have, and well trust each other's professional knowledge. The present study empirically proved that TMS positively influence innovation capability. So, when the TMS is effectively worked, the innovation capability could be effectively improved. What's more, the present study also explored that knowledge sharing plays a mediating role in the relationship TMS impact on innovation capability. This states that if the teachers can effectively share their own knowledge with each other by meeting, communicating and discussing, the innovation capability of teachers would also be improved.

Based on the above discussion, the present study provides some suggestions. First of all, the group can develop some training and build a platform for knowledge sharing, to strengthen each teacher's core competence. To develop teachers' training will be helpful for teachers

to enhance their own professional knowledge and competencies. It is also a way to provide the teachers a chance to get them developed and makes better achievement in the working. And to build a good platform for knowledge sharing will be good to form a better cultural atmosphere for teachers to communicate and exchange the knowledge and information well. And this will provide a good environment for teachers to know well about each one's competence in the group.

Meanwhile, it's necessary to create some activities to encourage teachers to communicate and exchange the knowledge with each other. Fan et al. (2016) state that team members would like to prove their innovative behavior while working when they are "performing an innovation task". The group can plan to organize group meeting for teachers to communicate, and seminar for exchanging the knowledge, information and experience. To protect teachers' innovation interest is a must for school and also for teachers. Our teachers are willing to explore new knowledge and new information. However, happiness is just a subjective feeling of people, and it would be influenced by other factors. Especially for the college teachers, they may lose the happiness feeling or become upset when they meet the difficulties in the process of researching. So the teachers should learn how to cultivate their interest in research to foster the ability of innovation and practice. Fan et al. (2016) also



mentioned that the process of TMS would help team members to interact and trust other members because when members involved themselves in the mistakes while executing the innovative task, other team members can give them the emotional support. So, by doing that, it's good for helping teachers to form a trust on each other after they've already known each other's competence. The reward system, such as the financial incentives, is helpful to motivate the organization to share knowledge and reinforce the chance (Beer and Nohria, 2000). The teachers' group should also adopt some incentives to encourage teachers to share knowledge. To improve the innovation capability is not easy as a one-day thing. However, based on the TMS theory and knowledge sharing, teachers will have a clear understanding of how to train and operate their capabilities for innovation in the education and teaching. Meanwhile, the universities, as the organization of the teachers, also take the responsibility for improving teachers' innovation capability. For a friendly and harmonious academic atmosphere is needed for knowledge sharing.

### 6.3 Limitations and Future Research

There are some limitations in this study. First, the measurements of each variable are limited. In previous studies, many take full use of each measurement for testing each domain;

however, the present study didn't consider all of the measurements. Second, for researching on TMS and knowledge, it's necessary to measure the teachers' attitude, feeling, and what their competence is. However, these items are so subjective that it's hard to measure. What's more, the TMS and knowledge sharing are dynamic development process; the present study just considers the statistic process. Hence, in the further study, it's necessary to focus on a longitudinal study.

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**야오춘리양 (Yao Chunliang)**



현재 동국대학교 일반대학원 국제비즈니스협동과정 석사과정에 재학 중이다. 주요 관심분야는 지식경영, 사회적 자본, 혁신 및 전략경영 등이다.

**이영찬 (Young-Chan Lee)**



서강대학교 경영학사, 동대학원에서 경영학 석사 및 박사학위를 취득하였다. 현재 동국대학교 경주캠퍼스 경영학부 교수로 재직하고 있으며, *Annals of Management Science*, *The Open Operational Research Journal*의 Editorial Board, 한국경영학회 MIS 분야 대표 편집위원으로 활동 중이다. 주요 관심 분야는 기업 성과측정, 데이터마이닝, 복잡계 이론, 다기준의사결정 등이다.

<Abstract>

## **An Empirical Study on the Structural Relationship between Transactive Memory System, Knowledge Sharing and Innovation Capability: Evidence from Universities in China**

Chunliang Yao · Young-Chan Lee

### **Purpose**

The innovation capability nowadays has become increasingly prominent in the universities not only for schools but also for teachers. However, due to less attention to the knowledge utilization and management, also some objective constraints, which caused the low level of the innovation capacity for our universities teachers under the current development in China. Meanwhile, transactive memory system (TMS) and knowledge sharing are important contents in knowledge management. The combination of both systems will contribute to a much more comprehensive understanding and performance of knowledge management. The purpose of this study is to investigate the structural relationships between TMS, knowledge sharing, and innovation capability among Chinese university teachers' teams, and to propose the practical implication to integrate effectively internal knowledge of the team to improve innovation capability.

### **Design/methodology/approach**

In order to exam and verify the hypothesis proposed, we developed a questionnaire with 16 survey items, and each item comes with a five-point Likert-type scale. Hyperlink of online questionnaire was shared through WeChat. It's collected 201 responses from 14 universities in China, and the responders are teaching groups' leaders. And all together 191 responses were filtered out as the valid samples. And we analyze the data set and test research hypotheses by using SPSS 22.0 and AMOS 22.0.

### **Findings**

All hypotheses are supported. The results reveal that knowledge sharing plays an important role in this study as the mediating role. TMS is positively associated with the innovation capability.

And the knowledge sharing plays a significant role as mediating value between them, and influences the TMS's effect on innovation capability. It's thus cleared that if our teachers could well communicate, exchange and collaborate with other teachers in the same group, the innovation capability among the teachers would be improved effectively.

**Keywords:** Transactive Memory System, Knowledge Sharing, Innovation Capability, Chinese University Teachers



<국문초록>

## 분산기억체계, 지식공유, 그리고 혁신역량의 구조적 관계에 관한 실증연구: 중국 대학 사례를 중심으로

야오춘리앙 · 이 영 찬

### 목적

최근 대학에서도 혁신역량이 매우 중요해지고 있으며, 특히 교원의 혁신역량은 대학의 경쟁력에 매우 중요한 요인이 되고 있다. 그러나 중국 대학의 경우 아직까지 지식활용이나 관리에 대한 관심이 부족하여 대학의 혁신역량이 높지 않은 상황이다. 한편, 지식경영에서 분산기억체계와 지식공유는 매우 중요한 요소로서 이 두 요소를 잘 결합하여 실행하면 지식경영에 대한 포괄적인 이해와 성과에 기여할 수 있다. 본 연구의 목적은 중국 대학 교원을 대상으로 분산기억체계, 지식공유 그리고 혁신역량 간의 구조적 관계를 조사하며, 이를 통해 혁신역량을 향상시키기 위한 실천적 방안을 제안하고자 한다.

### 설계/방법론/접근

본 연구의 가설을 검증하기 위해 16개의 문항을 개발하였으며, 각 문항은 리커트 5점척도를 사용하였다. 설문지는 위챗을 통해 온라인으로 배포되었으며, 설문대상자는 중국 14개 대학의 교원 팀의 리더들이다. 총 201명으로부터 설문지가 회수되었으며, 이 중에서 유효한 설문지는 191개이다. 통계 분석과 가설검정을 위해 SPSS 22와 AMOS 22를 사용하였다.

### 시사점

가설검정결과 모든 연구가설이 채택되었다. 따라서 분산기억체계는 지식공유와 혁신역량에 정(+)의 영향을 미치며, 이 과정에서 지식공유가 분산기억체계와 혁신역량 간의 매개변수 역할을 한다는 것을 알 수 있다. 이는 동일 그룹 내의 중국 대학 교원들 간에 의사소통이 원활하고 동료들과 지식의 교환 및 협업이 활발할수록 혁신역량이 효과적으로 향상됨을 의미한다.

**키워드:** 분산기억체계, 지식공유, 혁신역량, 중국 대학 교원

\* 이 논문은 2015년 12월 3일 접수, 2016년 1월 27일 1차 심사, 2016년 3월 15일 2차 심사, 2016년 4월 5일 게재 확정되었습니다.