A STUDY ON THE MECHANISM OF TACIT KNOWLEDGE INTEGRATION: THE ROLE OF SOCIAL TIES AND TRANSACTIVE MEMORY SYSTEMS

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Abstract. *As a spread phenomenon, tacit knowledge integration has been attracting more attention because of the embeddedness in social activities and interactions. Our works, as a complement to previous research, investigate tacit knowledge integration based on social networks from transactive memory systems (TMS) perspective. We focus on ties dimension (expressive tie, instrumental tie, and tie strength) and nodes dimension (value similarity), and study the mechanism of social networks on tacit knowledge integration with TMS lens. The explorative results provide that: TMS has significant and positive effect on tacit knowledge integration directly; expressive tie, tie strength and value similarity have significant and positive impact on TMS directly; instrumental tie has no significant effect on TMS, but has negative impact on tacit knowledge integration directly.*
Keywords: Tacit knowledge, Knowledge integration, Social networks, Social interaction, Transactive memory systems

1. **Introduction.** With the approaching of information booming era, few works can be done by a single person in a modern enterprise. Individuals developing and possessing different knowledge especially tacit knowledge should communicate and make joint efforts with each other in working toward the same goal. Much more attention has been increasingly paid to knowledge one of most valuable assets in organization. Researcher further asserted that knowledge is power, but without the adequate management of that knowledge, the consequences for organizations could be devastating [1]. More and more researchers and practitioners have conducted knowledge management in an effort to capture, store, and disseminate knowledge effectively across organization. However, knowledge resides in human minds and tacit knowledge which is 90 percent of organization knowledge capacity is critical to organization's competitiveness [2,3]. Integrating the knowledge of many different individuals in the process of producing goods and services in organization is playing a critical and constructive role. Therefore, researchers have begun to pay more attention to integration for fragmented pockets of tacit knowledge, like expertise and specialized knowledge. Integration for fragmented pockets of tacit knowledge leverages individual and organization's performance and attracts more attention because of cognitive limitation and dispersancy of knowledge.

An increasing amount of evidence reveals that tacit knowledge integration is conducted by actors and embedded in social activities and interactions. Actors are known to acquire knowledge from their own interpersonal networks which extend beyond the formal organizational structures for knowledge collaboration [4,5]. Knowledge integration depends on how members know and integrate their individually owned knowledge; knowledge processes are ultimately about micro-social interactions among individuals [6]. Researchers presumed that organizations are social communities and combinative capability is to synthesize and apply current and acquired knowledge [7]. Tacit knowledge is embedded in human beings and social networks; moreover, the integration of tacit knowledge is conducted by individuals and determined by social connections or ties. Obstacles to an effective integration include lack of familiarity among individuals, distinctive thought worlds, disparities in verbal skill, insufficient conflict, unfamiliar language, and status differences [6]. Therefore, knowledge integration is "in essence a process of ... the management of social networks" [8].

Research on knowledge collaboration has found that individuals often develop and rely on their social networks in deciding with whom to collaborate and how to collaborate with each other [9], because it is unnecessary and impossible to master all knowledge and technology for one person. Individuals prefer to develop transactive memory systems (TMS) within their knowledge networks. Transactive memory systems are constituted by individuals using each other as a memory source [10], which provides a new perspective for interactive process of tacit knowledge integration. This study was undertaken to focus on social networks and TMS which are effective to explain tacit knowledge integration and synthesis in prior research. Using social networks, TMS and knowledge management theories, we argue that properties of social networks can increase the quality and relevance of tacit knowledge and concurrently improve the effectiveness of tacit knowledge integration. We propose that TMS most conducive to tacit knowledge integration depends significantly on the social networks involved. The conceptual model is described as Figure 1.
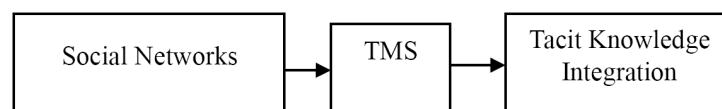

FIGURE 1. Conceptual model

2. Theoretical Fundamentals and Hypotheses.

2.1. **Knowledge integration.** As a much more widespread phenomenon of organization, knowledge integration has been studied both in research and industry. There are two main research streams of knowledge integration which are organizational capability perspective [7,11-15] and process perspective [16-20]. In addition, tacit knowledge is what the knower knows, which is derived from individual experience, embodies beliefs and values. Mostly, tacit knowledge can only be transferred and shared through up-close observation and demonstration, or hands-on experience [21], and has been recognized as actionable, even more the most valuable knowledge. Furthermore, tacit knowledge is the most important basis for the generation of new knowledge. For the purpose of clarity, we adopt the definition of tacit knowledge integration: an ongoing collective process of promoting individual tacit knowledge development by transferring and sharing tacit knowledge through communication and interaction for a successful project, task or work in organization [22].

Integration of pocketed and dispersed tacit knowledge emphasizes the economic value of specialization and the effectiveness for both organization and individuals. Within existent literatures [12,23], three measurements of knowledge integration have been presented which are efficiency, scope and flexibility. Efficiency of integration is the extent to which organization accesses and utilizes the tacit knowledge held by individual members. In order to utilize the specialized knowledge stored within every individual, it is vital that all members have a good understanding of each other's capability. Scope of knowledge integration refers to the breadth of tacit knowledge that the project draws upon. Flexibility of knowledge integration, finally, is the extent to which organization can access additional knowledge and reconfigure existing knowledge. In the next part of this research, we will measure tacit knowledge integration with efficiency, scope and flexibility.

2.2. **Transactive memory systems.** As the cooperative division of labor for remembering, learning, and communicating relevant knowledge [24,25], TMS is formed by individuals playing the role of external memory for others who, in turn, encode memories about the memories of others. Therefore, a TMS consists of the memory stores of particular individuals and any social interactions in which they participate [26]. Lewis proposed: a TMS describes the active use of transactive memory by two or more people to cooperatively store, retrieve, and communicate information; whereas transactive memory exists in the mind of individual, and a transactive memory system exists between individuals as a function of their individual transactive memories [27]. The TMS construct specifically focuses on utilizing and integrating distributed knowledge, for example expertise, making it an especially appropriate concept for understanding how individuals can optimize the value of relevant knowledge resource. Embedded in individuals' social activities and relationships, TMS delineates knowledge integration process and is the predictor and mechanism for interactive process of tacit knowledge integration [28,29].

TMS has three dimensions which are specialization, credibility, and coordination [27]. When individuals have developed transactive memory in practice, it causes knowledge of actors to be differentiated and specialized for certain goals [27,30]. Transactive memory occurs when individual understands what another one knows and uses that understanding to develop dissimilar but complementary knowledge. Thus, different actors are responsible for expertise in different areas, and the aggregate represents the extent to which members believe the process has developed the specialized and differentiated expertise characteristic of transactive memory. However, individuals will only develop different knowledge if they can rely on others to remember other task-critical information in TMS. Credibility referring to the quality and quantity of knowledge resource is constructive for the development of individual TMS. Credibility of TMS is also propitious to develop distinctly different knowledge resource for other reasons, such as a lack of understanding or communication about individuals' respective expertise domains. Credibility provides more rich and high quality knowledge, especially the ability of further knowledge seeking which all are necessary for tacit knowledge integration. Additionally, TMS includes the processes individuals use to combine their transactive knowledge [25]. Coordinated action depends on individuals having a good understanding of who has what knowledge and how that knowledge fits together, and this understanding also evolves as people develop the specialized knowledge and credibility perceptions characteristic of functional transactive memory. Based on prior analysis, we draw out the conclusion that TMS is posited to have a positive relation to tacit knowledge integration.

Hypothesis 1. TMS of individual promotes tacit knowledge integration.

2.3. **Social networks.**

Social ties. Social network is a powerful theory to explain social interaction and knowledge integration especially, which asserts that the world is made up of relationships and individuals and organizations are encircled by social networks [31]. Social activities promote interaction between people/objects and form multi-dimensional relationships [32]. As a complement to previous research that has emphasized the structure dimension of social networks, ties dimension and nodes dimension disclose the essence of interaction and the mechanism of knowledge integration.

Two broad types of social ties have been distinguished in social networks theory [33-37]. The first one is expressive ties, such as friendships, involving expressions of interpersonal affect. Expressive ties are sources of social support, provide a sense of identity and personal belonging, and serve to transmit normative expectations [38,39]. The other one is instrumental ties, such as work-related-advice ties, involving gathering information, advice, and resources necessary for accomplishment. Consequently, expressive ties are based on normative and affection, whereas instrumental ties are information and cognition oriented. Practically, integration of tacit knowledge requires high level of personal interaction through reciprocity exchange relationships which are strongly embedded within certain social networks. Therefore, the importance of social interaction and connections between individuals should be stressed in order to promote effectiveness of tacit knowledge integration.

Tacit knowledge is rooted in action, commitment, and involvement in a specific context [40], which is highly personal knowledge and is hard to formalize. Social ties facilitate tacit knowledge integration through above relation categories which are expressive ties and instrumental ties [38,39,41]. Research on social networks suggests that individuals who have mutually expressive ties provide support and assistance to one another [9]. Tacit knowledge integration is promoted by expressive ties providing a sense of organizational identity and personal belonging which are perception and motivations to assist and maintain a relationship. Actors may be willing to convey information about certain issues to those with whom they have instrumental ties [42,43]. Instrumental ties which mean information gathering and resources acquirement in workplace mostly leverage tacit knowledge integration through learning by doing.

Expressive ties and instrumental ties also may advance mutual-trust and cooperation because of organizational identity and individual reputation. Individuals are more likely to cooperate with a partner because if they do not cooperate, information of their uncooperative behavior and incredibility will spread to other social network members quickly and limit their ability to interact with them next time. Therefore, both expressive ties and instrumental ties incent coordination and credibility of TMS in their social networks.

Referring to social ties, the strength of ties has been attracting more attention. Tie strength, a concept ranging from weak ties at one extreme to strong ties at the other, characterizes the closeness and interaction frequency of a relationship between two parties [44,45]. Theories have been developed around both extremes of the tie-strength concept at the dyadic level with research findings to both strong and weak ties. Researcher has demonstrated the importance of strong ties in transferring tacit, complex knowledge across departmental boundaries in an organization [46]. Moreover, the relationship-specific heuristics and specialized language that develop between strong ties are conducive to conveying complex chunks of knowledge [9,47]. Withal, strong ties bind cliques of individuals and primarily convey affluent news, which facilitate the creation and maintenance of credibility and cooperation within networks because of the obligation and responsibility sense. Actors who interact with each other regularly are more likely to have similar perceptions than people who do not interact [48]. Strong ties cultivate the obligation and

responsibility perceptions which leverage mutual-trust and coordination of TMS. Above arguments lead to

Hypothesis 2. Expressive ties of individual promote TMS.

Hypothesis 3. Instrumental ties of individual promote TMS.

Hypothesis 4. Ties strengths of individual promote TMS.

Value similarity of individuals. Value similarity is the fundamental dimension of nodes homogeneity in social networks. Diversity of participants in workplace has been investigated in depth, such as social category diversity, value diversity, and informational diversity [49]. As the basic diversity of individuals, value diversity decreases satisfaction, intent to remain, and commitment to organization. Value diversity exists when individuals differ with each other in terms of what they think of real task, goal, target, or mission should be. In other words, individuals' similarity in goals and values enhances interpersonal relations and will likely decrease relationship conflict among members [49]. With high value similarity, individuals will have the same beliefs and criterions beneficial for specialization and communication with each other. Furthermore, considerable evidence points to the detrimental effects of value similarity on coordination. Consequently, we propose another hypothesis:

Hypothesis 5. Value similarity of individual promotes TMS.

3. Methodology.

3.1. **Survey sample.** This study involved a random survey of individuals working in the mainland of China. The survey was conducted over a period of three months. Data were collected from volunteers. All of the respondents are full-time professionals in a variety of industries. In our questionnaire (Chinese version), definition and several explanations had been provided in order to decrease misunderstanding. The context of team/project work has also been emphasized to match the definition of tacit knowledge integration. This research is pilot investigation and Table 1 lists the characteristics of the sample.

3.2. **Survey measures.**

Tacit knowledge integration. According to existent literature [12,23], three dimensions of knowledge integration are efficiency, scope and flexibility. To develop these measures (TKI), we adopt prior research items and modify several ones to adapt our research aims under team-work condition focusing on tacit knowledge integration of individual.

TMS. We measured transactive memory systems using the classic-item scale (TMS) developed by Lewis [27]. We asked individuals to rate individual TMS based on their own personal interactions with others during the latest project or task in organization. These questions are used to measure specificity, credibility and coordination of individuals' TMS.

Social ties. Expressive ties and instrumental ties were measured using two three-item scales (ET and IT) separately [50-53]. Respondents were inquired to recall and evaluate their social ties within knowledge networks during their latest project or task in organization. The strength of social ties (TS) has been measured with frequency, intimacy, and reciprocity developed by Granovetter [44].

Value similarity. After the preliminary analysis, in order to improve reliability, a three-item scale for value similarity (VS) has been developed based on the measurement of Jehn et al. [49].

All above items were measured using a 7-Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree). We conducted confirmatory factory analyses and tested hypotheses by testing the proposed path model with structural equation modeling tool (LISREL 8.70).

TABLE 1. Description of the sample

$N = 157$	Frequency	Percent	Valid Percent
Gender			
Female	51	32.5	32.5
Male	106	67.5	67.5
Age			
≤ 25	20	12.7	12.7
26-35	115	73.2	73.2
36-45	22	14.0	14.0
Tenure of current job			
≤ 1	11	7.0	7.0
1-3	30	19.1	19.1
3-5	36	22.9	22.9
5-7	27	17.2	17.2
7-9	13	8.3	8.3
≥ 9	40	25.5	25.5
Education level			
High school	0	0	0
College	18	11.5	11.5
Bachelor	102	60.5	60.5
Master or PhD	37	23.6	23.6
Job position			
Senior manager	3	1.9	1.9
Middle manager	29	18.5	18.5
Junior manager	48	30.6	30.6
Clerk	77	49.0	49.0
Total	**157**	**100.0**	**100.0**

3.3. **Results.** In empirical study, it's imperative that the reliability and validity of the research variables be rigorously tested. All of the above multiple items adopted have established acceptable reliability and validity level from past research. However, in an effort to improve the appropriateness of instrument items, some questions were slightly altered in wording and style. Factor analysis was conducted to establish convergent and discriminant validity of the constructs. Each multi-item construct was modeled as reflective (rather than formative) of the latent variable because we expected the items measuring each constructs to covary. The adjusted results for constructs are displayed in Table 2. Overall, factor analysis results indicate strong support for the construct validity of the structural variables. The value of Cronbach's alpha for all the extracted constructs and the measurement model fits are also presented in Table 2. As shown in Table 3, correlation of latent variables is described.

In general, our results showed details of structure model testing. Figure 2 is an adjusted graphical depiction of the LISREL analysis results. The hypothesized path between TMS and TKI is significant, supporting H1. As predicted, expressive tie, tie strength and value similarity have a significant impact on TMS (H2, H4, H5). Contrary to our expectation, the hypothesized path between instrumental tie and TMS is not significant (H3). However, instrumental tie has a significant and direct effect on tacit knowledge integration. In addition, the impact of instrumental tie on tacit knowledge integration is negative. Therefore, Hypotheses 1, 2, 4 and 5 are supported, but Hypothesis 3 is not supported.

TABLE 2. Reliability and validity of measurement model

Variable	Item	Cronbach's Alpha	X^2/d.f	IFI	NFI	CFI	GFI	RMSEA
Expressive Tie	ET1 ET2 ET3	.951						
Instrumental Tie	IT1 IT2 IT3	.949						
Tie Strength	TS1 TS2 TS3	.819						
Value Similarity	VS1 VS2 VS3	.923	1.93	0.98	0.97	0.98	0.83	0.077
TMS	TMS1 TMS2 TMS3 TMS4 TMS5 TMS6	.943						
Tacit Knowledge Integration	TKI1 TKI2 TKI3	.923						

TABLE 3. Correlation matrix of latent variables

	ET	IT	TS	VS	TMS	TKI
ET	1.00					
IT	−0.37	1.00				
TS	0.71	−0.39	1.00			
VS	0.68	−0.27	0.62	1.00		
TMS	0.79	−0.35	0.75	0.74	1.00	
TKI	0.78	−0.44	0.64	0.60	0.86	1.00

4. **Discussion.** This research focuses on individual social ties and TMS when confronting tacit knowledge integration to solve problems or create new knowledge. This study makes several contributions by identifying ways to increase integrative capabilities of individuals who must draw on social ties and TMS.

First, based on a review of the social network, TMS, and knowledge management literature, along with the results of a previous qualitative study, we propose a formal model of tacit knowledge integration. Second, TMS is playing a vital role in individual tacit knowledge integration and provides a new perspective for knowledge integration. TMS cultivates trust for ego-center knowledge network and promotes tacit knowledge integration [28]. This finding suggests us developing effective TMS for tacit knowledge integration. Third, as a complement to previous research that has emphasized the structure of social networks, we pay more attention to social ties and value similarity of nodes homogeneity for exploring the mechanism of tacit knowledge integration. Especially, a
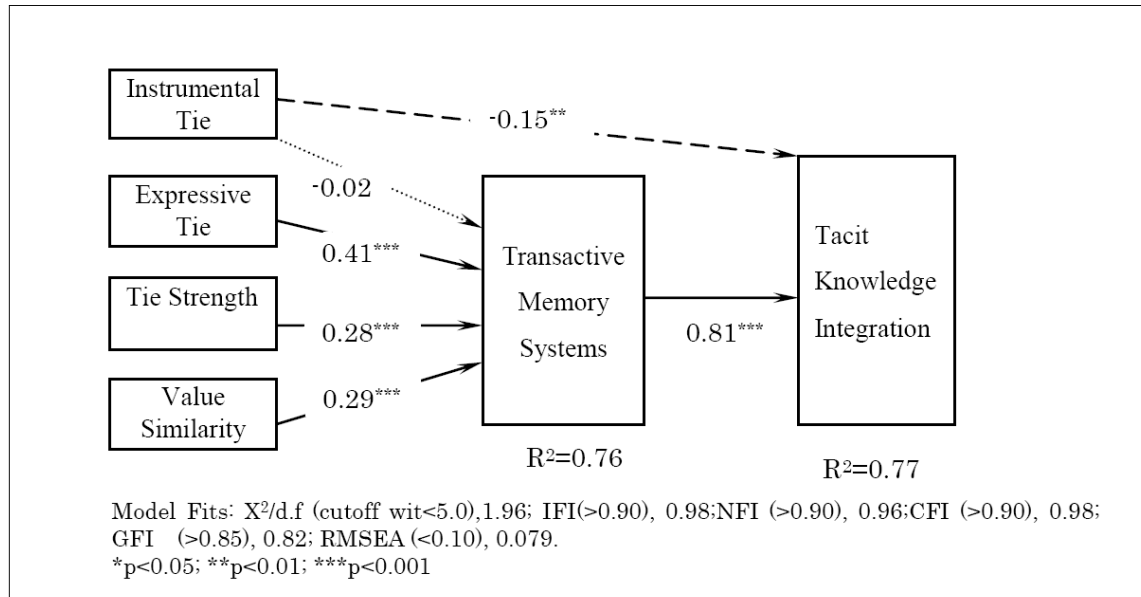
FIGURE 2. Results

point of interest in this work is the finding that information and cognition based instrumental tie is harmful to tacit knowledge integration direct. Although instrumental ties via social identity may lead to homophily [54-56] and promote knowledge management. The main effect of instrumental ties is hampering tacit knowledge combination because of benefit-oriented and calculating properties [57]. Individuals will be ware of instrumental peers and prevent special knowledge from leaking. Consequently, the development of tacit knowledge integration cannot reach high level. Finally, the preliminary research also suggests that expressive tie, tie strength and value similarity promote tacit knowledge integration mediating TMS. This finding also illuminates us the importance of social networks and reminds us that we should develop higher level of TMS for tacit knowledge integration.

In this research, the mechanism of tacit knowledge integration from social networks and TMS perspective has been described. Although the theoretical framework is mainly drawn from research literature, it provides some implications which are relevant to both academia and practice. First, this study provides researcher with a novel lens to explain and predict factors of social networks and TMS during knowledge integration procedures. This research also emphasizes the tie dimension and nodes dimension of social network and TMS which are playing a critical role in knowledge integration. This aspect of the study will help researchers better understand what and how social constructs continue to have profound effects on tacit knowledge integration. Second, this study is also a practical framework for managerial activities in which tacit knowledge integration is conducted. The results provided by this study will help managers with ability to distinguish and evaluate instrumental ties and expressive ties for development of TMS and tacit knowledge integration. The preliminary results suggest that affection-based expressive ties should be encouraged and promoted through social activities during work time. Organization should cultivate kernel value and train staff carefully for the goal of value similarity. Social interaction and activities which are conducive to TMS and tacit knowledge integration should be promoted.

Of course, as a new theoretical framework, this research that constructs socio-technical factors of social ties and TMS affecting knowledge integration is limited by some properties. Firstly, the theoretical framework is constructed from TMS perspective which is power for explanation of knowledge share, transfer and integration but not enough. There are also other factors on tacit knowledge integration which are not explicitly examined, such as managerial factors. This research just is conducted from a specific perspective and other new perspectives will be adopted in the near future. Secondly, to theorize this research, we draw on social networks and TMS theories. All constructs are based on our interpretation from integrative perspective. More practice should test this framework to improve and perfect our study.

5. **Conclusions.** Tacit knowledge integration is a developing collective process of promoting individual tacit knowledge development through social activities for a successful project, task or work. Individuals are known to seek knowledge from their own personal networks which extend beyond the formal organizational structures. Individuals will develop TMS in social interactions which have been recognized as the mechanism of knowledge integration. This paper describes knowledge integration based on social networks from TMS perspective. This research tentatively suggests that expressive ties and similar individual value should be cultivated and encouraged, instrumental ties must be avoided or decreased and TMS is also necessary when tacit knowledge integration is conducted. The results of study provide a novel mechanism for researching tacit knowledge integration which is playing a pivotal role in this turbulent environment. Finally, the theoretical framework offers strong potential to guide management practice, such as understanding and predicting tacit knowledge integration ahead of time or during procedures.

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