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Transactive Memory Systems: A Catalyst for the Cooperation of Industries, Universities and Research Institutions in Regional Innovation Systems

Bih-Huang Jin[1], Chih-Yun Wu[1] & Chin-Jou Huang[1]

[1] Department of Business Administration, Tunghai University, Taiwan

Correspondence: Bih-Huang Jin, Department of Business Administration, Tunghai University, Taiwan. E-mail: bihuang@go.thu.edu.tw

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Abstract

Transactive memory system (TMS) refers to the knowledge storage in individual's memory. Members in the organization rely on the knowledge network, and they have to utilize their knowledge and expertise to achieve shared goals. TMS consists of three parts: specialized team knowledge, mutual trust between members, and organized task processes (Lewis, 2003). Past research focused on the group level inside the organization. In the current study, TMS is applied to a higher level - inter-organizational situation. We attempt to explore if this mechanism may exert an effect on the performance of inter-organizational cooperation in regional innovation systems (RIS).

Data is collected from the industries in central Taiwan, which is a developing RIS. The main purpose of this paper is to reveal the implicit mechanism of inter-organizational cooperation. The results show that TMS is indeed a catalyst of organizational level collaboration. This research provides a new perspective to evaluate industrial cooperation, and the difference between the effects of these three dimensions is further discussed as well.

Keywords: transactive memory systems, inter-organizational cooperation performance, moa, regional innovation system, innovation platform

1. Introduction

Industrial cluster and regional development has recently gained increased attention. A competitive industry not only brings great economic achievements, but also enhances the international competitiveness. The central Taiwan, which is a developing RIS, including electronic, mechanical, and medical industries, had great impact and importance on economic geography and regional development. Firms in a region combine the resources, technology, human resource and other factors, and cooperate with other organizations, so that develop a regional innovation system. In the central Taiwan, there are many technology developments and diffusion between firms, research institutions, universities and government, the interactions between the participants in innovation process form the RIS. The geographical proximity improve the interaction of internal and external of organizations, and help organizational learning and form a shared regional culture, norms and values. Through an interactive form of knowledge networks can improve the knowledge, skills transfer, storage, the quality of transfer and new product creation.

In the knowledge economy, knowledge, technology and innovation in the industry have enough effect to the economic performance and competitive position. Through the promotion of knowledge, technology transfer and diffusion in the region can enhance the competitiveness of the RIS. When organizations face a task that requires knowledge and skills that cannot be handled by the organization itself, the organization can seek the support of other partners in the region. The knowledge and technology transfer happened through inter-organizational cooperation on production; the interaction between these organizations will accumulate and become the memory of the organization. Organizations can develop their professional knowledge by using and sharing organizational memory, and establish trust between members through inter-organizational cooperation, so that they can combine and coordinate their expertise fast and efficient. Transactive memory system (TMS) can express those features above, which is widely used to explain how members in the organization rely on each other in a

knowledge network, and how they use their professional knowledge and skills to achieve mutual goals.

Lewis (2003) tried to capture a whole picture of TMS. This conceptual framework comprises three parts: the first one is specialization, indicating specialized knowledge from team members; the second is credibility, trust between team members and their reliance on each other's expertise; and the last one is coordination, which means fluent and organized task processes. Past studies focused mainly on the group level inside the organization. However, little work has been done on the organization level. TMS mechanism is discussed to inter-organizational situation in the current study. This is an interesting issue worth to investigate, and our research purpose is to explore if TMS exerts an impact on the effectiveness of inter-organizational cooperation in regional innovation systems (RIS), to capture how members' collaboration may work in RIS. We collect the data from the industries in central Taiwan, which is a developing RIS, including electronic, mechanical, and medical industries. The main purpose of the current study is to reveal the implicit mechanism of inter-organizational cooperation, and provides a new perspective to evaluate industrial cooperation, and the effects of these three dimensions.

2. Theoretical Background

2.1 Innovation System

Innovation is widespread in modern times. Ongoing product and process improvements are prerequisites for sustainability and competitive advantage both in nations and in regions. It is important to know how to create innovations and how to initiate successful innovation processes. (Andersson & Karlsson, 2006) indicated that innovations are the automatic result of continuous and prolonged inter-firm collaboration and interaction.

The concept of Innovation Systems (IS) is based upon the interactive model of innovation which is first proposed by Lundvall (1985), is used to describe the interactive relationship in production system between technology research institutions, research laboratories and its customers. (Gregersen & Johnson, 1996) indicated that the ability of this system (regional or national economy) to generate innovations depends on two factors: one is the performance of individual actors, including firms, universities, institutions, etc., and the other is their interaction shown as parts of a system.

Innovation networks are one of the most important category of business networks (Cooke, Gomez Uranga, and Etxebarria，1997). In the learning process firms may need external support; in order to get an access, they need to assimilate themselves into a system that makes these external resources available. Explore the concept of innovation system could be traced back to the concept of "industrial district" originates from the work of Marshall in the early twentieth century, when he identified the extent to which small firms develop a competitive advantage over large firms. Industrial districts can be regarded as a specific form of cluster, the inter-industrial relationships are locally thickened and reasonably stable over time, and firms in industrial districts are small, specialized, and rooted in a given territory. The main mechanisms that lead to the development of such districts involve a high degree of cooperation, primarily between small firms, institutions, and external organizations, and the innovation and learning result from cooperation, mutual dependence, and trust among local actors. As the transportation developed rapidly, industrial districts became clusters are shared and complementary with geographical proximity and have linkages between them (Doloreux, 2002) . This concept can be used to describe the industries in central Taiwan, clusters emphasis that firms create and maintain competitive advantage s not only rely on internal resources of the firms itself, but also more rely on external resources within the region. Porter considered that the construction of the cluster is a the key to create competitiveness of national industry, the cluster is a knowledge base of industrial innovation, and also an important basis for building innovation systems, their share the value chain through the production network that they established together, and the innovation diffusion.

2.2 The Regional System of Innovation: Concept and Core Elements

National innovative system (NIS) is the linkages among public and private sector network, and exchanges, promote, modify, and diffuse the development of new technology. Lundvall (1992) presents the core elements, which are (1) the internal organization of firms, (2) the inter-firm relationship, (3) the role of the public sector, (4) the institutional set-up of the financial sector, (5) R&D intensity and R&D organizations. These elements play an important role in the innovation process. National innovation system is an innovative mechanism, combined with the public sector (government and research institutions) and private sector (industry and firms) in order to achieve the generation and diffusion of knowledge and technology exchange, transfer, and enhance economic efficiency(Doloreux, 2002; B. Lundvall, 1992) .

The concept of regional innovation system (RIS) originated from national innovative system (NIS) regional

systems as a subset of a national system. Cooke, Uranga, and Etxebarria (1998) described an regional innovation system is interactions and learning between firms and other organizations, and consists of a production structure and an institutional infrastructure. The three aspects of Cooke's (1997) definition: (1) interactive learning: corresponds to the interactive processes by which knowledge is combined and made a collective asset of different actors within the productive system. (2) milieu: is regarded as an open territorialized complex, which involves rules, standards, values, and human and material resources. (3) embeddedness: includes all of the economic and knowledge processes created and reproduced inside and outside firms (Cooke et al., 1998; Doloreux, 2002).

Autio (1998) based on social perspective to discuss RIS, this perspective refers to a interactive innovation model, particularly appropriate for networks of SMEs and facilitated by geographical proximity. It implies a view of the process of innovation as a social process in which interactive learning is predominant and socially embedded. RIS emphasized on promoting interaction and cooperation relations through links within the region, flexibility, innovation support, networking and interactive learning to produce organizational innovation, helping companies build competitive advantage.

Autio (1998) provides a schematic illustration of the structuring of regional innovation systems. An RIS is made up by two subsystems embedded in a common regional socioeconomic and cultural setting: (1) The knowledge application and exploitation sub-system: comprises the companies, customers, suppliers, competitors as well as their industrial cooperation partners. (2) The knowledge generation and diffusion sub-system: as the second main building block of a RIS consists of various institutions that are engaged in the production and diffusion of knowledge and skills. Key elements include public research institutions, technology mediating organizations as well as educational institutions and workforce mediating organizations. Additionally, Todtlmg and Trippl (2005) include the regional policy dimension neglected in Autio's model. Policy actors can play a powerful role in shaping regional innovation processes, provided that there is sufficient legal competencies and financial resources to formulate and implement innovation policies.

An RIS involves interactions between private and public sectors in a systematic way, and a systemic pattern of interactions is expressed in order to increase and enhance the localized learning capabilities of a region. An innovation network supported by infrastructures emphasizes the importance of interaction and collaboration between knowledge providers and the business sector. Regional policy makers should therefore try to establish networks between research universities and firms, and also try to establish a well-functioning university-industry-government relation in order to have high performance in innovation process. In addition, tacit and non-codified knowledge has been recognized as of importance in the innovation process while closeness, trust and face-to-face contacts are prerequisites (Doloreux, 2002).

An RIS is established on innovation interactions. It emphasizes knowledge transfer and learning systems, and is importance in knowledge-based economy. By innovation interactions, organizations can improve productive and competitiveness. An RIS consists of knowledge and information flows and network and cooperation, these inter-organizational interactions play an important role in the process of enhance RIS. While Cooke's definition provides a general picture of what an RIS actually is, it does not merely emphasize the main components and dynamics that comprise an RIS. Doloreux (2002) present four basic elements of RIS, and discuss below: (1) Firms are considered as learning organizations which interact with other firms and institutions that share their environment. (2) Industrial research and development, universities, governments, and other institutions can influence the creation, development, transfer, and utilization of technologies. (3) Knowledge infrastructure means the physical and organizational infrastructure needed to support innovation. It consists of innovative support structures that promote technology diffusion or are oriented toward developing new and profitable industrial activities at the regional level. Also consists of public technology transfer and innovation advisory agencies which provide technical support and information to knowledge-based firms. R&D institutions, such as universities, research institutes, and national laboratories, comprise the third form of knowledge infrastructure. (4) Innovative policies are developed to support regions' endogenous potential by encouraging the diffusion of technologies on a regional scale, including providing financial incentives for innovation efforts, technology-diffusion policies, and initiatives; promoting programs and new technology-based firms; and creating and maintaining intangible assets that favor innovation and the transfer of technology

2.3 Internal Mechanisms within Regional Innovation Systems

Doloreus (2002) underlines the principal mechanisms evolving the RIS approach. It describes an RIS's principal internal dynamics which can also explain the efficiency and success of the system. These internal dynamics mechanisms including (1) Interactive learning: refers to an interactive process of knowledge generation shared

by innovator participants (firms and institutions). Innovation arises among SMEs via active participation in innovation networks and cooperation with other firms and organizations. (2) Knowledge production: Shared knowledge is an important aspect of RIS because it helps increase its interactive learning capabilities. It requires a high degree of trust among actors. (3) Proximity: is related to the benefits generated by the forces of spatial agglomeration. Rich agglomeration economies provide enterprises engaged in interactive learning Geographical agglomerations of firms, as in industrial districts, located in the same region and being communities of firms sharing a common socio-economic environment can be beneficial to sharing tacit knowledge. (4) Social embeddedness: It means personal relations and networks. Such relations result from an anticipation that interactions will lead to profitable growth. Within an RIS, embeddedness is mostly concerned with the relation between interactive and collective learning and the nature of knowledge exchanges between firms and institutions (Doloreux, 2002) .

2.4 Regional Innovation Systems & Knowledge Flows

Past research about innovation and interactive learning mainly emphasized the importance of local networks, pointing out inter-firm collaboration and knowledge flows may lead to technological dynamism. Dynamic economic regions can be described as relentless local social interaction and knowledge circulation. There would be strong connections to outside experts and partners, inter-regionally or internationally. Gertler and Levitte (2005) present four factors that improve the performance of RIS development: (1) Gertler and Levitte paid particular attention to internal resources and capabilities of the firm, as well as local and global flows of knowledge and capital. Access to resource and knowledge is highly related to firms' competence to do research, and then leads to commercialization of such research, and knowledge spillovers from universities are keys to firm start-ups. (2) In a knowledge-intensive RIS, the performance of innovation cooperation is closely related to knowledge flows, the most important input to the generation of successful new products is highly educated people. (3) The main participants of innovation cooperation within RIS, including firms, universities, research institutions, technology transfer institutions, etc. Government policy can stimulate the development of innovation cooperation within the region, these interactions can form a specific geographical embedded of the value network. (4) Local relational linkages and expertise are critical to support innovation, especially when firms are going to raise capital. The clearest suggestion of this comes in our finding that local/relational linkages are especially important for raising capital.

Innovation cooperation within RIS have success in commercializing the outputs of research in order to get benefit through the interactive of knowledge flows (Autio, 1998). Knowledge flow is the element to strengthen the RIS. Knowledge flow is defined as the transfer of expertise (e.g., skills and capabilities). The type of expertise transferred refers to share and exchange knowledge intra-organizations and inter- organizations, thus have accumulated to generate knowledge and the effect of diffusion. Knowledge flow can carry out through some ways such as the movement of persons, the interaction between public institutions and firms, industry-university partnerships, and interactions with other organizations (Gupta & Govindarajan, 1991). According to the research of Gupta and Govindarajan (2000), they provided that (1) knowledge outflows from a subsidiary would be positively associated with value of the subsidiary's knowledge stock, its motivational disposition to share knowledge, and the richness of transmission channels; and (2) knowledge inflows into a subsidiary would be positively associated with richness of transmission channels, motivational disposition to acquire knowledge, and the capacity to absorb the incoming knowledge. (3) The knowledge stock has value when organizations create knowledge that cannot be copied, and the knowledge shared are highly relevant with members of the network. The more knowledge shared inter- organizations, the higher value the knowledge stock have, and the more interest the members of the network have and to transfer. (4) If the knowledge-sharing organization who would like to hold the exclusive advantage of information, then it will result in decreased motivation of knowledge sharing. If firms want to hold the exclusive right of information, this high degree of self-interest will reduce the effect of knowledge diffusion. (5) The more knowledge transfer channels exist, the more organization can able to gather a variety of information to enhance the knowledge flow inter- organizations, therefore, the more inter-organizational knowledge transfer channels, the higher degree of their knowledge flow. (6) The knowledge inflow outside the organization may not have value or high relevance, are not helpful for organizational development, and may reduce the motivation to acquire knowledge. (7) Relevance of knowledge will affect the ability to absorb knowledge, the better the absorptive capacity of the organization is, the better it will enhance the effectiveness of knowledge flow (Gupta & Govindarajan, 2000).

3. Hypotheses and Research Model

3.1 Transactive Memory Systems (TMS)

Transactive memory systems (TMS) were conceived by Wegner (1987), who observed that members of groups tend to rely on one another to obtain, process, and communicate information from distinct knowledge domains. TMS is related to other models that explain team performance in terms of members' knowledge and thinking processes. According to transactive memory theory, group members divide the cognitive labor for their tasks, with members specializing in different domains. Members rely on one another to be responsible for specific expertise such that collectively they possess all of the information needed for their tasks. TMS are thought to facilitate quick and coordinated access to deep, specialized knowledge, so that a greater amount of task-relevant expertise can efficiently be brought to bear on team tasks.

Wegner, Erber, and Raymond (1991) termed this system of cognitive interdependence as TMS. Transactive memory is influenced by knowledge about the memory system of another person. The way that one person stores, encodes, and retrieves may be different from that of others, depending on information accessibility of another one's memory. Transactive memory serves as a function of a person's evaluation about the knowledge possessed by another one and about the availability of that knowledge. This kind of memory consists of one's knowing about what another person knows, as well as the content of knowledge resulting from that understanding (Liang, Moreland, & Argote, 1995).

Transactive memory works in the mind of an individual, whereas a transactive memory system exists between individuals as a bridge of individuals' transactive memories. Group transactive memory consists of both the pool of group members' transactive memory, and members' knowledge of what others know. To get a step further, TMS describes the active use of transactive memory by two or more actors to cooperatively and coordinately store, retrieve, and transfer information. Like the dyad-level TMS, a group-level TMS works when members actively use their own transactive memories to utilize other members' knowledge to achieve a shared goal (Lewis, 2003).

The effect of group TMS team performance was confirmed in past laboratory studies. Research by Moreland and colleagues (1999) demonstrated that group members who were trained to develop the specialized knowledge may work together to recall a greater volume of task-related information. In contrast, group members who were trained separately to develop overlapping task knowledge may recall less information finally (Hollingshead, 1998a; Liang et al., 1995; Richard L. Moreland, 2006; Moreland & Myaskovsky, 2000a). Those empirical results show that TMS may describe how team members synergize their collective knowledge.

3.2 Measures of TMS

There were three ways to measure TMSs in dyads and groups in empirical studies, including recall, behavior observation, and self-reports about members' expertise. And recall measures were used most frequently on dyads (Hollingshead, 1998b; Wegner, 1987; Wegner et al., 1991), inferred from the quantity, content, and structure of what actors remembered individually and with their partners. Moreland and colleagues also adopted direct measures of members' knowledge and beliefs (Liang et al., 1995; Moreland, 2006; Moreland & Myaskovsky, 2000b). According to the characteristics, TMSs could be categorized into members' knowledge (specialization), the reliability of other members' knowledge (credibility), and organized knowledge processing (coordination).

These three dimensions described above were suited for experimental studies. However, recall measures depend on tasks being identical across comparison teams and on tasks having known solutions; there may be limitations for assessing TMS in field settings. Organizational teams often deal with problems with no unique or known solutions, and their tasks are different across projects and teams, which makes those measurement strategies inappropriate for field settings. (Faraj & Sproull, 2000) used self-report items about the location and the presence of expertise, as well as members' willingness to exchange knowledge, to capture expertise coordination in software development teams. The concept of expertise coordination is quite similar to TMS (Faraj & Sproull, 2000; Lewis, 2003).

Accordng to Lewis (2003), a measure of TMSs should be theoretically corresponding to concept of TMSs developed by Wegner's (1987), comprising transactive memory itself and the cooperative processes. Besides, the measure must be suitable to field settings, feasible to administer and applicable to various groups and tasks. Thus, self-reports of manifestations may meet these objectives (Lewis, 2003).

Transactive memory works when a person understands what others know and then develop different but complementary knowledge. Thus, it makes members' knowledge to be specialized and differentiated. Specialized knowledge itself is not sufficient for innovation; if lack of understanding or communication, members may

probably develop overlapping knowledge. To build up differentiated expertise, specialization and credibility need to coexist, because members can focus on different knowledge when they rely on other actors to remember and retrieve other task-relevant information. Furthermore, TMS also include the coordinated processes which members use to combine and reorganize their transactive knowledge. Coordination follows members' understanding of who possesses what knowledge and how this knowledge fits each other. Finally, coordinated processes are combined with specialization and credibility to work as a whole transactive memory system.

3.3 The Effect of TMS (Group- Organization- Inter-Organization)

TMS theory was originally developed for dyads in close relationships, memory performance of 118 individuals who had been in close dating relationships for at least 3 months was studied (Wegner et al., 1991). A transactive memory system is interesting precisely because it connects disparate minds. The fully integrated transactive structure is, in a sense, a deterioration of the richness and complex connectedness of individual minds that can be found in a group. Liang et al. (1995) pay attention to the task performance of laboratory work groups whose members were trained together or alone was investigated. The results indicated that group training improved group performance primarily by fostering the development of transactive memory systems among group members. Hollingshead (2001) designed a factorial that controlled expectations about the partner's knowledge (similar or different from the participant's) and cognitive interdependence, the degree to which participants' outcomes depended on whether they recalled the same or different information as their partner. These findings may help to explain the impact of previous experience and relationships on the development of transactive memory.

Anand et al. (1998) extends and adapts the model of transactive group memory to organizations. These works argue that information technology needs to be complemented by organization-level processes related to organizational memory. Several experiments (Hollingshead, 1998b, 2001; Richard L. Moreland, 2006) have shown that groups perform tasks better if their members are trained together rather than apart. The performance benefits of group training have been attributed to the development of transactive memory systems. (R.L. Moreland & Myaskovsky, 2000b) examined if such benefits come from better communication among group members. The results indicated that the answer is no. If being trained separately, group members had no chance to communicate with others. Compared to the groups whose members were trained apart, those groups whose members were trained together performed significantly better. Lewis's (2003) TMS research has identified three indicators of the level of development of a TMS (1) expertise specialization, (2) competence-based trust, and (3) expertise coordination. The more developed the TMS, (a) the greater the tendency for groups to delegate responsibility and specialize in different knowledge domains, (b) the higher the beliefs about the competence or the validity of a member's expertise, and (c) the higher the ability of team members to coordinate their work efficiently based on the knowledge of who knows what. Sharma and Ghosh (2007) used the Lewis' scale to test the teams of various sizes was selected randomly from Information and Technology companies heated in four different cities of India. Data on TMS were collected from team members whereas team leaders gave ratings on team performance. Overall results showed that small and medium size teams performed better than large size teams and TMS had greater impact on team performance in small and medium size teams(Sharma & Ghosh, 2007).

Existing TMS theories suggest that the best way to construct, evaluate, and use a TMS is through shared face to face experiences such as joint training (Liang et al., 1995; R.L. Moreland & Argote, 2003). When team members are trained together, rather than apart, they are able to better locate, integrate, and use each other's skills and knowledge. However, with ad hoc problem-specific collaborations, there is little time for joint training, and the collaborators may not have previously shared experiences. Jarvenpaa and Majchrzak (2008) investigated the relationships between security personnel in the private and public sectors, and identified the U.S. Federal Bureau of Investigation (FBI) InfraGard program as an appropriate source of respondents for survey. InfraGard encourages ad hoc collaborations of security professionals between private and public units, and it consists of an e-mail distribution list of individuals cleared to receive high-security information about security-related threats or potential threats, as well as discussion threads and regional chapter meetings to encourage individuals from various organizations to collaborate and share knowledge in response to specific security threat information. TMS literature has largely assumed that members have an interest in acting on the knowledge that the group believes they have (Hollingshead, 1998; Lewis, 2003; Liang et al., 1995; Moreland et al., 1999; Moreland & Myaskovsky, 2000). However, such congruence of knowledge and action cannot be assumed in mixed-motive networks where members often have no interest in participating in certain sharing activities. Therefore, in mixed-motive collaborations, antecedents for the development of a TMS must extend beyond joint training. They measured transactive memory using the 10-item scale developed by Lewis(2003), and asked individuals to rate

their network's TMS based on their own personal interactions with others outside their employing organizations. They found that TMS may also be used to describe individuals' mental models of their ego-entered networks. The TMS of an individual's ego-centered network may affect her ability to coordinate with others in her network (Jarvenpaa & Majchrzak, 2008).

Past empirical studies provide strong evidence of the positive effects of transactive memory for group performance (Wegner et al., 1991). Past laboratory studies have also consistently shown TMSs to predict higher performance in couples' recall and work team performance (Hollingshead, 1998b; Lewis, 2003; Liang et al., 1995; Moreland & Myaskovsky, 2000b). But there are little studies to discuss how TMS influence on the performance of inter-organizational cooperation in regional innovation. Although a TMS is a group-level phenomenon, it exists as a function of the structure, content, and credibility of members' individual knowledge, implying that it may be appropriately measured at the individual level. A key concern is whether it can be accessed from an aggregation of individual members' responses to the scale. In other words, is a sum or average of member responses a meaningful team-level indicator of the TMS construct? Thus, this paper expected that the TMS scale would also be positively related to performance of inter-organizational cooperation in regional innovation.

Hypothesis 1: Specialization will be positively associated with inter-organizational cooperation performance.

Hypothesis 2: Credibility will be positively associated with inter-organizational cooperation performance.

Hypothesis 3: Coordination will be positively associated with inter-organizational cooperation performance.

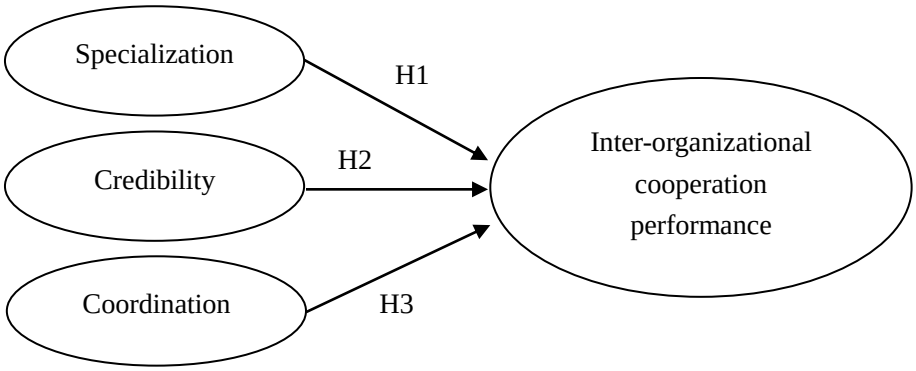

Figure 1. Research Model

4. Methodology

4.1 Sample & Measurement Tools

Data is collected from the industries in central Taiwan, and we got 164 samples, most of samples are the executives in their companies, the second are engineers, and they exactly understand the situation about the company's research and policy of cooperation. That is appropriate for the requirements of the sample. Most of them are small and medium enterprises, with less than 100 employees. They participated in the cooperation for over 3 years in average, and 50 firms co-work with other units under formal contracts. Finally, 162 samples are included, and the effective response rate is 98.8%.

Transactive memory system was assessed by a scale developed by Kyle Lewis (Lewis, 2003). In this scale transactive memory is described as the memory that is influenced by the memory system of another person. This scale measures specialization, credibility, and coordination behaviors that reflect the cooperative memory characteristics of TMS. We modify the scale based on the situation in central Taiwan, so that it can become more appropriate to the research purpose.

There were 5 items in each of the subscale. A respondent needs 5 to 10 minutes time to complete the scale. Organizational members rated this scale on a 5-point scale. All the items used disagree-agree format in which 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree, except three items for which the scoring was reversed. Alpha reliabilities of the specialization, credibility and coordination were found to be high for both constructs (0.69, 0.78, 0.67). The three constructs' reliabilities are close to 0.7, it means that the constructs' consistency is acceptable.

Table 1. Measures of specialization, credibility coordination, and performance

Constant	Cronbach's Alpha
Specialization	0.69
Credibility	0.78
Coordination	0.67
Inter-organizational cooperation performance	0.89

4.2 Results

The results of regression are discussing the relevance between the three constructs of TMS and inter-organizational cooperation performance. The hypotheses are tested by OLS regression. The dependent variable is inter-organizational cooperation performance of RIS and three interactive effects are tested separately.

Specialization is included but not reaches statistical significance ($\beta = 0.091$, $p > 0.05$), which indicates H1 is not supported. Credibility is included and reaches statistical significance ($\beta = 0.360$, $p < 0.05$), which indicates H2 is supported. Coordination is included and reaches statistical significance ($\beta = 0.272$, $p < 0.05$), which indicates H3 is supported.

Table 3. The results of regression

Inter-organizational cooperation performance		Beta	t	Sig.
TMS	(Constant)		3.717	0.000
	Specialization	0.091	1.115	0.267
	Credibility	0.360	4.368	**0.000**
	Coordination	0.272	3.437	**0.001**

5. Discussion and Conclusion

We try to apply the concept, TMS, into a higher level – regional innovation systems, to check if how the cooperative partners perceived each other may influence cooperative performance. According to the present survey results, credibility and coordination are positively associated with inter-organizational cooperation performance. However, specialization does not exert significant effect, which reminds us that, TMS may be a help to cooperation performance, but different sub dimensions should be taken into consideration. "Specification," denoting the evaluation of the knowledge and expertise of cooperative partner, may not be so important as "credibility" and "coordination." In other words, objective competency may be a point when choosing cooperative partner, nevertheless, the key points still lie in affective trust and interaction quality, which should not be neglected.

The other goal of this paper is to develop and validate TMS measures in inter-firm level, which would illustrate how TMS become a catalyst for inter-organizational cooperation in regional innovation systems. And the result reveals that TMS is positively related to the inter-organizational cooperation performance, realizing a positive effect of affective trust and smooth coordination between partners. The *alpha*s of specification, credibility, and coordination reach an acceptable level, which means, to some extent, there is internal consistency. However, three *alpha*s are still lower than .80, indicating that modification and validation is still needed in the future.

This research provides a number of managerial implications. First, the research provides some guidelines for policymakers to decide how to design cooperation mechanisms in managing the cooperative performance within regional innovation systems. Second, the empirical results show that the impact of specialization is less than credibility and coordination. This implies that's a firm's adoption decision of outside partner should consider the effect of credibility and coordination, instead of focusing on the specialization. For instance, the electronics company Merry in central Taiwan has developed human resource in the region by cooperating with the universities for many years. Not only did Merry donate the electric-acoustic laboratory to the university, but also provided intern opportunity in order to gain the expertise of human resource, and get more trust in their knowledge to enhance the credibility. With the frequently communication between Merry and cooperative

universities, it would improve the coordination of the cooperation. Thus, most of the R&D team members of Merry are training by cooperation with universities in central Taiwan; it helps Merry controlling the fundamental core technology.

6. Limitations and Future Research

Some limitations should be noted when applying the study findings to explain the catalyst of inter-organization cooperation. First, the sample size for our study was not large enough to make strong inferences about how TMS operate in different types of teamwork between organizations. Further research with larger samples and varied cooperation types is needed to validate the TMS scale and examine how TMS differs among cooperation types. Because of basic characteristics of central Taiwan industrial cluster, most of the samples comprise small and medium enterprises. Our implication should not be generalized to all cooperation in different firm size. Interviews and case study can be conducted on large enterprises to fill this gap.

Second, the measure presented here is a first step toward understanding how researchers examine cooperative memory systems and how they help organizations achieve superior performance. Further research need to establish the scale of the TMS as well as its applicability in different types of organizations.

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