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Understanding the role of behavioural integration in ISD teams: an extension of transactive memory systems concept

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Abstract. *The transactive memory system (TMS) has been considered as one critical element for effective teamwork. However, viewing TMS as a second-order construct that mixes cognitive (specialty and credibility) and behavioural (coordination) components leads to confusion and increases the difficulty in interpreting study results. This study follows the concept proposed by one recent study and attempts to distinguish between behavioural and cognitive components. Furthermore, drawing on the need for diverse members to be integrated behaviourally, we also attempt to extend the TMS research stream by proposing a more comprehensive behavioural component of TMS. We argue that to obtain better teamwork outcomes, information system development (ISD) team members need to integrate the expertise possessed by each individual, make decisions jointly and interlink all individual actions. In light of this, our study aims to replace coordination with team behavioural integration, a more comprehensive behavioural consequence of cognition and explore the critical role of behavioural integration in ISD teams by understanding its impact on ISD teamwork project team performance. The study result, based on data collected from 205 information system project managers, supports our hypotheses that expertise specialty, credibility and their interaction positively affect team behavioural integration. This, in turn, leads to enhanced project team performance.*

Keywords: transactive memory systems, team behavioural integration, ISD project team, knowledge management, project team performance

INTRODUCTION

Transactive memory system (TMS) recently has been proposed as a critical antecedent of teamwork process and performance. It is treated as a second-order construct that includes two cognitive (specialisation and credibility) and one behavioural (coordination) components (Moreland, 1999; Lewis, 2003; Akgün *et al*., 2005). However, the value of including both cognitive and behavioural dimensions in one second-order construct is debatable. Although doing so simplifies the research model and allows for a more comprehensive perspective in terms of the TMS construct, the difficulty in interpreting the real meaning of this construct is increased. For example, researchers have difficulty arguing whether performance is a function of the cognitive component of TMS, behavioural components of TMS or both. To resolve the issues raised earlier and align with the emerging trend to distinguish cognitive from interaction process in team study, Kanawattanachai & Yoo (2007) asserted that not all dimensions have a direct impact on project team performance and empirically demonstrated that expertise specialisation and credibility (cognitive dimension) lead to better coordination (behavioural dimension), which, in turn, contributes to a better project team performance.

However, given that information system development (ISD) is a knowledge-intensive process that includes several knowledge-related activities, consideration of coordination alone is limited and inadequate. The complex nature of software project requires people with diverse knowledge (such as systems analysis, systems design, database management, network administration and project management) to form a team. Successful teamwork relies on the extent to which members can integrate their knowledge and expertise (Newell *et al*., 2000; 2004), coordinate and synthesise their actions (Nidumolu, 1996; Yoo *et al*., 2007) and form shared understanding through a joint decision-making process (Cockburn & Highsmith, 2001; Staples & Webster, 2008). Project success will be compromised if any one of these three elements is missing. However, despite the interrelated nature of these three issues, past research has tended to examine each issue separately. Knowledge management-based studies highlighted the importance of expertise coordination or integration within the ISD team (Faraj & Sproull, 2000; Tiwana & McLean, 2005; Yoo *et al*., 2007). Participative decision-making theory-based studies demonstrated the key role of joint decision-making (Bruine de Bruin *et al*., 2007). Behavioural coordination-based studies demonstrated the importance of coordinated or interrelated actions (Nidumolu, 1995; 1996).

To the best of our knowledge, it is apparent from the extant literature that when researchers attempt to explore the antecedents of project team performance, they adopt only one of these three perspectives. In light of this, there is a need to examine the extent to which project team performance is enhanced when team members are integrated behaviourally. We adopt the concept proposed by Hambrick (1994) and argue the critical role of behavioural integration for contemporary ISD teams. A team can be regarded as integrated behaviourally only when members integrate the expertise possessed by individuals, make decisions jointly and form a collective mind with respect to goal and actions (Weick & Roberts, 1993; Brockmann & Anthony, 1998; Newell *et al*., 2000; Yoo *et al*., 2007). Absence of any one of these three components increases the level of difficulty with respect to achieving high performance.

In sum, the first purpose of this study is to explore the critical role of behavioural integration (which includes joint decision-making, expertise integration and collective mind) in an ISD team by understanding its impact on ISD teamwork performance. The second purpose is to advance TMS research by proposing a more comprehensive behavioural consequence of the cognitive dimension of TMS. This is achieved by arguing that the specialty and credibility of expertise leads to better behavioural integration in ISD teams. In answering these questions, this study contributes to ISD research by highlighting the importance of behavioural integration in a contemporary dynamic ISD context. That is, in addition to working in a coordinated manner, members of one team have to be integrated behaviourally to achieve a higher level of performance. In addition to the direct relationship between cognitive and behavioural dimensions of TMS, we also hypothesise that behavioural integration is affected by the interaction effect of the two constructs in the cognitive dimension.

The remainder of this paper is organised in the following way: in the second section, we review past studies on TMS and team behavioural integration. This is followed by the development of our hypotheses in the third section. In the fourth section, the method for examining the proposed model is introduced. Finally, the research results and implications are followed by discussion.

LITERATURE REVIEW AND THEORETICAL BACKGROUND

In this section, the way in which we aligned our research purposes with the extant literature is explained. In this respect, first, we reviewed the literature on TMS and pinpointed the need for separating this mixed concept into two components: cognitive and behavioural. Following the approach proposed by Kanawattanachai & Yoo (2007), this study took into consideration the causal relationship between cognitive and behavioural components. We then focused on team behavioural integration, the new behavioural component proposed. The definitions of three dimensions of team behavioural integration were provided and their importance with respect to the ISD team was emphasised. Finally, arguments for hypotheses were provided.

TMS

Transactive memory refers to cognitive interdependence, which conceptualises how people in close relationships may depend on each other for acquiring, remembering and generating knowledge (Wegner *et al*., 1985). Memory is a place where individual knowledge is stored. Transactive memory may be viewed as knowledge about the memory system of another person (Lewis, 2003). People develop transactive memory by using other people as external memory storage locations. They cooperate with each other to accomplish tasks by having complementary knowledge and knowing the areas of expertise of one another.

In contrast to transactive memory, which depicts knowledge about the memory system of another person, TMS '*describes the active use of transactive memory by two or more people to cooperatively store, retrieve, and communicate information*' (Lewis, 2003). In a team, TMS is a collective system for encoding, storing and retrieving information that is distributed across members (Wegner *et al*., 1985; Wegner, 1995). It can be viewed as a knowledge set possessed by group members, coupled with an awareness of who knows what. TMS includes two components: an organised store of knowledge that is contained entirely in the individual memory systems of the group members and a set of knowledge-relevant transactive processes that occur among group members. The process through which team members encode, store and retrieve information from each other is called the transactive process (Wegner *et al*., 1985).

It is broadly accepted that TMS is critical for effective teamwork process and performance. For example, it is a significant predictor of problem-solving (Lin & Lin, 2001), team viability (Lewis, 2004), goal achievement and group development (London *et al*., 2005), group learning (Lewis *et al*., 2005), coordination (Ren *et al*., 2006), process effectiveness (Akgün *et al*., 2006) and team result (Cruz *et al*., 2007). In addition, TMS is linked to knowledge retention, knowledge transfer, knowledge creation, knowledge sharing and information gathering (Argote *et al*., 2003; Weber & Camerer, 2003; Mitchell & Nicholas, 2006; Oshri *et al*., 2008).

TMS can be broken down into three parts, namely the differentiated structure of members' knowledge, members' beliefs about the reliability of other members' knowledge and effective, orchestrated knowledge processing (Moreland, 1999). On the basis of this concept (Lewis, 2003), an instrument containing specialisation, credibility and coordination (three dimensions to measure TMS) was developed and adopted by many researchers to understand its impact on team performance (Akgün *et al*., 2005). In the following, Kanawattanachai & Yoo (2007) advanced this research stream by hypothesising the causal relationship among the three elements of TMS. They distinguished the behavioural aspect of TMS, coordination, from the other two cognitive components and suggested a causal relationship between cognitive and behavioural components; that is, both expertise specialisation and credibility impact positively on coordination. This cognitive behaviour relationship is widely recognised in team cognition literature. Researchers have since argued that higher levels of team cognition lead to better teamwork process, which, in turn, results in improved project team performance (e.g. Marks *et al*., 2002; Mathieu *et al*., 2005; Akgün *et al*., 2006). On the basis of this notion, the present study attempts to examine the relationship between the cognitive dimensions of TMS and team behavioural integration.

Moreover, we attempt to advance the TMS research stream by replacing expertise coordination with team behavioural integration, constituting the three components of joint decision-making, expertise integration and collective mind. We believe that a more comprehensive behavioural construct should be used to thoroughly understand what teamwork processes are affected by the cognitive components of TMS.

Team behavioural integration: a more comprehensive behavioural component

Team behavioural integration refers to '*the degree to which the group engages in mutual and collective interaction*' (Hambrick, 1994). Hambrick also conceptualised behavioural integration as a meta-construct that contains three elements of management team process. In this study, as indicated previously, three major knowledge-related activities (expertise integration, collective mind and joint decision-making) are needed for ISD project teams to perform effectively. In the following, we review separately these three dimensions of behavioural integration.

Expertise integration

The first dimension of behavioural integration is the quantity and quality of information exchange among team members. Hambrick (1994) argued that in a management team, each member represents a perspective from different functional areas. It is necessary for the information possessed by individual members to be exchanged so that the team can generate a comprehensive understanding of problems and develop strategies or generate solutions accordingly. However, simply exchanging information or knowledge is insufficient for a contemporary teamwork environment, especially for ISD teams (Mitchell & Nicholas, 2006). The dynamic, rapidly changing and highly complex nature of ISD projects requires members not only to share expertise but also to integrate their expertise or knowledge to create task-level knowledge to effectively diagnose problems, generate alternatives and implement solutions effectively (Tiwana & McLean, 2005).

Expertise integration can be defined as 'the synthesis of individual team members' information and expertise through social interactions' (Robert *et al*., 2008). Researchers relate integration to the process of coordinating special expertise held by individuals or moulding individually held information and know-how into a common stock of knowledge to solve problems and accomplish tasks at the project level (Newell *et al*., 2000; Tiwana & McLean, 2005; Mitchell & Nicholas, 2006; Yoo *et al*., 2007). Expertise integration is particularly important in highly interdependent tasks, e.g. the ISD teamwork process. The effectiveness of integration is determined by the team's capacity to sense required knowledge, to know the location of knowledge, to know how to access it and to be able to blend various forms of knowledge (Robert *et al*., 2008). The ability to integrate knowledge from various sources strengthens interior culture and improves working efficiency (Grant, 1996; De Boer *et al*., 1999). Teamwork performance is determined by a team's ability to import external knowledge and to synthesise internal knowledge (Newell *et al*., 2000; Mitchell & Nicholas, 2006; Yoo *et al*., 2007).

Collective mind

Collaborative behaviour belongs to the social dimension of behavioural integration. It is defined as 'helping each other' and 'making things easier for each other' (Simsek *et al*., 2005). In this study, the collective mind concept is adopted to represent collaborative behaviour within the ISD team. Although the term 'mind' refers to the cognitive-level concept in general, Weick & Roberts (1993) noted that mind is located in activities such as playing football, driving a motor vehicle and playing chess. They define the collective mind within a group as 'a pattern of heedful interrelations of actions in a social system'. It contains three components: contribution, representation and subordination. Contribution refers to actions that are constructed and taken by actors within the system, representation indicates actors' understanding that the system is composed of connected actions by themselves and others and subordination reflects the interrelation of actions taken by actors within the system. With a collective mind, people in the same unit pay mindful attention to individuals' contributing, representing and subordinating behaviours, which generate consequences at the system level. In the ISD context, each of these three components can be represented by team members' contributions to the project outcome, their shaping of the internal model of the group and their placing of the team's goals ahead of personal goals.

Collective mind is critical for ISD teamwork because it is the basis for resolving conflicts, negotiating with stakeholders, ensuring that members of development staff share a consistent understanding of the design and providing communication among contending groups. That is, with a collective mind, team members make their contributions to the joint outcome with attention and care and have a global perspective of each other's tasks and responsibilities. In addition, individuals carefully interrelate actions with each other to maximise joint performance. By viewing the ISD team as a system, individuals possess heterogeneous expertise with each knowing part of what the team as a whole knows. A collective mind within the ISD team does not emerge automatically once the ISD team has formed. Instead, repeated interactions and communications among the individual team players are necessary (Faraj & Sproull, 2000).

Joint decision-making

The definition of joint decision-making is the degree to which team members jointly make decisions about key issues in system development. From the sociological perspective, the exchange of information is achieved through social interaction and collaborative mechanisms (Sheremata, 2000). Joint decision-making is one such mechanism where team members collaboratively make decisions related to teamwork processes and task contents. This mechanism provides an avenue for the sharing of richer information through socialisation and articulation (Nonaka & Takeuchi, 1995). Joint decision-making reduces the need for explicit exchange of post-decision coordination and synchronisation information and can extend to areas such as joint marketing programmes, strategic planning, the sharing of technical skills, demand development and new idea creation (Austin *et al*., 1997). Team members engaged in joint decision-making are able to develop a deeper understanding of the needs of their partners, which results in richer communication between them. This, in turn, increases their awareness of the team (Van De Ven *et al*., 1976). In essence, joint decision-making among team members enhances information acquisition and assimilation capacity. To foster agility, team members need to make decisions collaboratively; the person who makes the decision is not as important as collaboration on information to make informed decisions (Cockburn & Highsmith, 2001).

In sum, this behavioural integration concept, at a certain level, can be applied in the contemporary ISD context, which requires the development team to react rapidly to external changes. These three processes should be considered simultaneously rather than as individual constructs (Hambrick & Finkelstein, 1995; Sagie & Aycan, 2003).

The research model in Figure 1 is based on the review of TMS and team behavioural integration literature. As shown in the model, this study attempts to contribute to the TMS research stream by proposing a more comprehensive behavioural component than that proposed in the original TMS, by showing the mediating role played by the behavioural component

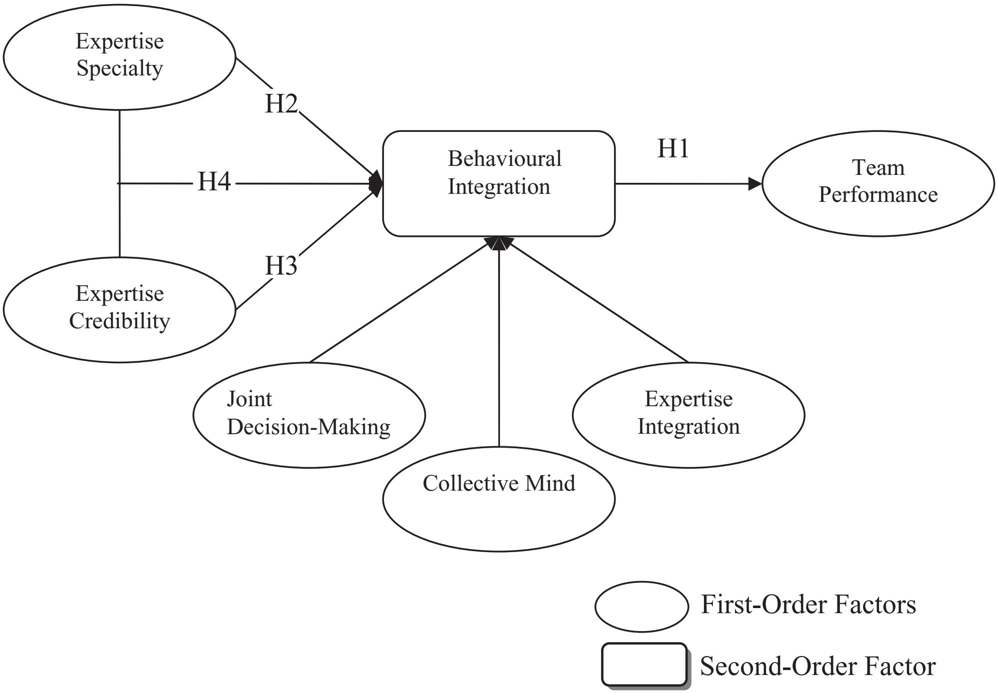

Figure 1. Research model.

in the relationship between the cognitive components of TMS and project team performance and by proposing and examining the interaction effect of expertise specialty and credibility on team behavioural integration.

Hypotheses

Behavioural integration enables teams to respond to the market, to create competencies, to develop strategies, to increase productive innovation intensity, to improve decision quality and to make better use of knowledge alternatives (Hambrick, 1998; Carmeli & Schaubroeck, 2006). With those developed advantages, organisations with a behaviourally integrated top management team are able to react to external change in a timely manner (Hambrick & Finkelstein, 1995). Since most ISD work is carried out by teams, behavioural integration is critical for ISD team as well. In the following, we describe how the three components of behavioural integration relate to performance individually.

The purpose of expertise integration is driven by specialisation and the linking mechanisms to coordinate specialised resources (Grant, 1996). Two benefits can be obtained through the integration process. First, a comprehensive understanding of the problem can be obtained during the integration process. Individuals diagnose problems from their limited perspectives due to constrained cognitive ability. A comprehensive view of the problem can be generated by collecting inputs from all team members. Second, different alternatives, approaches and ideas trigger the generation of a variety of solutions. In addition, empirical studies show that expertise integration is the basis for competitive advantage and dynamic capability (Grant, 1996). Team-level research concludes that expertise integration within teams can reduce software defects (Tiwana, 2004), increase creativity (Tiwana & McLean, 2005) and improve the performance of product innovation teams (Lin & Chen, 2006). Therefore, the likelihood of a team being able effectively to accomplish the predefined goal is increased when the team is able to integrate the expertise of individuals.

The impact of the collective mind on project team performance has been proposed and validated by theorists (e.g. Yoo & Kanawattanachai, 2001). Conflicts can be avoided and resources can be utilised effectively when members take others' actions into consideration while making decisions. This requires members to generate a higher level of understanding of teamwork. In addition to performing their own tasks, members need to develop a full picture of team tasks so as to generate a collective mind. With a collective mind, the team can avoid unnecessary work, reduce useless communication and maximise the outcome of effort. As a result, tasks can be accomplished more efficiently.

Participative decision-making theory indicates that members are more committed to an outcome when it is derived collectively. Participative decision-making also leads to satisfaction, loyalty, productivity and positive leader–member relationships (Bruine de Bruin *et al*., 2007). A more cooperative and less competitive environment will be created when members make decisions together because the process creates a sense of belonging for each individual (Sagie & Aycan, 2003). Project team performance is improved when members are more cohesive (De Dreu & Van Vianen, 2001). Hence, we hypothesise that

H1: Team behavioural integration is positively associated with project team performance.

Many studies refer to TMS as a knowledge map that correctly lists the location of knowledge. In contrast to past studies, a specialty perspective is adopted in this study. The specialty concept includes knowing not only the location but also the distinctiveness of expertise possessed by individual members. It implies that people in one team have various types of expertise, and those with the required knowledge can be contacted when that specific knowledge is required. The major benefit of expertise specialty is that teamwork can be more efficient when members do not have to expend additional effort in searching for information (Lewis, 2004). Specialty contributes to team behavioural integration in a number of ways.

First, it facilitates knowledge exchange and integration within the team (Alavi & Tiwana, 2002). Empirical studies associate a knowledge map with the ability to retain (Liang *et al*., 1995; Argote *et al*., 2003; Weber & Camerer, 2003), transfer (Argote *et al*., 2003; Weber & Camerer, 2003) and create knowledge (Weber & Camerer, 2003; Mitchell & Nicholas, 2006). With a knowledge map, team members can easily integrate their specialised knowledge and bring it to bear on the team task. Since expertise integration is a process of blending knowledge from various sources to form new knowledge, effective expertise integration requires members to know who possesses, as well as how to access, the required knowledge and expertise when they are needed. The effect of expertise integration is constrained by how well members in one team know the location of required knowledge.

Second, many studies define collective mind as the connection between TMS and team performance (Yoo & Kanawattanachai, 2001; Akgün *et al*., 2006). The difference between TMS and collective mind is that TMS indicates the knowledge of who knows what, that is, the interconnection of different team members' knowledge, whereas collective mind implies the interconnection of the activities or actions of each team member (Akgün *et al*., 2006). In order to promote the effectiveness of teamwork performance, a team needs a collective mind to interrelate its actions in performing the task heedfully in addition to TMS, which can assist in knowing who knows (Yoo & Kanawattanachai, 2001). We also believe that as a part of behavioural integration, a collective mind plays an important mediating role between TMS and project team performance.

Joint decision is adopted by flat organisations and fast reaction teams to promote more timely reactions to external changes as a variety of expertise and opinions can be aggregated to enrich input. Knowing the location and the way to access expertise allows members to integrate and apply knowledge in a coordinated manner while making decisions jointly. Since a significant proportion of required knowledge for joint decision-making is tacit, the expressing or sharing of tacit knowledge relies on the forming of a socially shared understanding of the task, the team and the distribution of expertise (Weick & Roberts, 1993). We believe that having a complete knowledge directory not only allows experts within the team to be consulted in an efficient manner, it also helps the team to develop sound decision-making from broader perspectives.

In sum, knowing the specialty and location of expertise possessed by each team member contributes to a better teamwork process through enhancing communication efficiency, reducing the effort required for knowledge exchange and transfer, making decision jointly and allowing members to anticipate each other's behaviour by being familiar with the knowledge and expertise possessed by each individual. Therefore, we hypothesise that

H2: Expertise specialty is positively associated with behavioural integration.

Within the context of a trusting relationship, people are willing to interrelate their actions with others heedfully (Anderson & Narus, 1990). Empirical research also shows that a shared understanding between IS developers and line customers can be strengthened by the presence of mutual trust (Nelson & Cooprider, 1996). Social network studies have indicated that cohesiveness is an important antecedent of similar attitude. For example, one's perception of distributive and interactional justice is affected by the strength of the expressive ties of an individual with other people in the same organisation (Umphress *et al*., 2003). Team research also concludes that a cohesive group or a pair of structurally equivalent actors generates similar attitudes (Burkhardt, 1994).

Expertise integration requires not only a certain level of heterogeneity but also the credibility of expertise. The lack of credibility of the source of knowledge is a major barrier to knowledge exchange; the source of knowledge must be trustworthy so that the recipient will adopt it without hesitation (Szulanski, 1996). If such credibility is not present, receivers have to expend effort on evaluating the correctness of transferred knowledge before adopting it. Therefore, credibility can speed up the integration process.

Expertise credibility is also critical for the joint decision-making context for the following reasons: first, since correct information is an important factor for joint decision making (JDM), a certain level of trust of knowledge sources speeds up the decision-making process. Second, the complexity of interaction among members can be reduced by having a high degree of expertise credibility (Luhmann, 1979). Third, trust is the basis for social exchange, cooperating with others and knowledge-sharing activities (Bock *et al*., 2005). It is easier for team members to work cooperatively and conscientiously when the level of trust among them is high (Huemer *et al*., 1998). Therefore, we hypothesise that

H3: Expertise credibility is positively associated with behavioural integration.

Empirical studies such as research into knowledge coordination by Kanawattanachai & Yoo (2007) confirm the direct effect of expertise specialty and expertise credibility on team behavioural dimension activities. Researchers also suggest that TMS can generate greater influence on the teamwork process when both specialty and credibility are high (Lewis, 2004; Lewis *et al*., 2005; Akgün *et al*., 2006). This implies an interaction effect between specialty and credibility. However, to the best of the present researchers' knowledge, no studies to date have attempted to explore the interaction effect of expertise specialty and expertise credibility. We argue that in addition to the main effects, interaction has a positive impact on team behavioural integration. That is, the effect of expertise specialty is stronger when credibility is high. Thus, we hypothesise that

H4: The interaction between expertise specialty and expertise credibility is positively associated with behavioural integration.

RESEARCH METHOD

A survey study was conducted to examine the proposed hypotheses. Since behavioural integration is difficult to attain in a young team, we limited our sample to those teams with at least a 3-month history. To truly reflect the transactive memory, behavioural integration and performance of each project team, we decided that the best key informant for our study would be the project manager. An ISD team was considered appropriate for this study because of the rapid environmental and technological changes characteristic of contemporary business. Behavioural integration is required for ISD teams to react promptly to environmental change. In addition, several methods were adopted to increase validity and to avoid measurement errors. We obtained the instrument from past research and modified each item to fit our research purpose. The modified items were reviewed by two professors, three PhD students and several practitioners. A pilot study with 30 master-level students from the field of information system concentration was then conducted to assure validity of constructs and quality of items. The students were asked to read and answer each item carefully based on their ISD teamwork experience, such as homework assignment or term project. The exploratory factor analysis results revealed a precise number of factors and showed all items to be located in the expected factors. Some items were refined based on feedback to eliminate possible vagueness or confusion in the question items. The respondents' confidentiality was assured to eliminate potential bias, such as social desirability.

In the data collection phase, a two-step approach was taken to collect the required data. First, students on the part-time Master of Business Administration (MBA) programme (Management Information System (MIS) concentration) of one university located in southern Taiwan were invited to facilitate data collection for the study. The minimum requirement for attending this programme is 5 years of work experience in the information technology (IT) industry or MIS department in any organisation. Therefore, most students enrolled on this part-time MBA programme are system analysts, directors, project managers or managers in the MIS department of their organisations. A total of 80 students were contacted for their willingness to facilitate data collection, of which 65 responded positively. Those 65 students were also asked to provide the number of ISD teams in their organisations. Project managers were selected to complete the survey on the basis of their comprehensive view of the teamwork process and outcome evaluation (Zimmer *et al*., 2007). The final pool contained 360 project managers. Second, assigned to each willing student participant were packages containing survey questionnaires and envelopes, and varying in size according to the number of ISD teams in the participating organisation. Responses from 235 project managers, who responded to the questionnaire based on their experience of the most recently accomplished project (e.g. transaction process systems, management information systems, decision support systems or enterprise resource planning, etc.), were then collected during the period of December 2007 and January 2008. After removing 30 incomplete or useless questionnaires, a total of 205 were included in the following analysis, yielding a 57% response rate. Among those respondents, 61.5% were male and 38.5% were female. More than 92% possessed a college or higher degree, and more than 90% belonged to teams with fewer than 20 members. Table 1 shows the detailed demographic information.

Constructs

Behavioural integration includes three dimensions: collective mind, expertise integration and joint decision-making. *Collaborative mind* is defined as the degree to which team members jointly and heedfully interrelate their actions. We use Weick & Roberts' (1993) *collective mind* (four items) to represent the state of coordination among team members. *Expertise integration* refers to the synthesis of existing knowledge and gained knowledge within the ISD team (Robert *et al*., 2008). A total of four items obtained from Tiwana & McLean (2005) were used to measure expertise integration within the team. *Joint decision-making* refers to the degree to which members make decisions jointly. A total of five items, developed by the authors on the basis of the definitions and descriptions provided by Subramani & Venkatraman (2003) and Zaheer & Venkatraman (1995), were used to measure joint decision-making within the team.

Table 1. Descriptive statistics of respondents' characteristics (n = 205)

Measure	Categories	n (%)
Gender	Female	150 (73.2)
	Male	55 (26.8)
Education	High school	15 (7.3)
	University	148 (72.2)
	Graduate school	42 (20.5)
Team size	1–5	56 (27.3)
	6–10	77 (37.6)
	10–20	54 (26.3)
	More than 20	18 (8.8)
Participant time (year)	3–6 months	67 (32.68)
	6 months–1 year	73 (35.61)
	1 year–2 years	62 (30.24)
	Over 2 years	3 (1.46)

Expertise specialty refers to the level to which one member's knowledge is distinct from that of other people. *Expertise credibility* refers to the degree to which one member's knowledge is correct and can be trusted by other people in the same team. A total of 10 items obtained from Lewis (2003) were used to measure the specialisation (five items) and credibility (five items) of expertise within the team. Project *team performance* refers to the extent to which the project team accomplished system development tasks within a predefined budget and schedule. In this study, ISD project team performance was measured using six items adopted from existing scales (Henderson & Lee, 1992; Jones & Harrison, 1996) that tapped into subjects' perceptions of project team performance in terms of schedule, budget and work quality. All of the aforementioned items were measured on a 5-point Likert scale, with anchors ranging from 1 (strongly disagree) to 5 (strongly agree).

Since we collected both independent and dependent variables simultaneously from the same respondent, common method variance (CMV) might be a concern in this study (Podsakoff *et al*., 2003). The Harman's single factor test was implemented to ensure that there was no significant method effect on the predefined causal relationship. The exploratory factor analysis shows that more than two factors can be derived, the first factor explaining 33.9% of variance. The confirmatory factor analysis indicates that the model fit improved significantly after dividing indicators into six factors compared with a single factor ($\chi^2_{\text{difference}} = 1148.91$; $\chi^2_{0.01,15} = 30.58$). In addition, the impact of method variance was tested by creating one method variable (with all used indicators) and linking it to both independent and dependent variables (Podsakoff *et al*., 2003; Pavlou & Gefen, 2005). The impact of this method variable is insignificant, suggesting that the common method bias problem should not be problematic in this study.

Reliability and validity

Item reliability, convergent validity and discriminant validity tests are often used to evaluate the measurement model in partial least squares (PLS). Reliability can be assured through composite reliability, Cronbach's alpha and factor loading. Factor loadings higher than 0.7 may be viewed as highly reliable, while factors with loadings lower than 0.5 should be dropped. Convergent validity should be assured when multiple indicators are used to measure one construct. This can be examined by item–total correlation (ITC), composite reliability and averaged variance extracted (AVE) by constructs (Fornell & Larcker, 1981). For convergent validity to be necessary, ITC should not be lower than 0.3 and composite reliability should be higher than 0.7. Moreover, a square root of the AVE of less than 0.707 means that the variance captured by the construct is less than the measurement effort, and that the validity of a single indicator and construct is questionable (Fornell & Larcker, 1981). For discriminant validity to be required, the correlation between construct pairs should be lower than 0.90 and the square root of AVE should be higher than the interconstruct correlation coefficients (Fornell & Larcker, 1981). All assurances are met as shown in Tables 2 and 3. Descriptive statistics can also be found in Table 3.

Behavioural integration as a second-order formative construct

The multidimensional nature of behavioural integration makes it a formative second-order construct (Petter *et al*., 2007). Although each first-order construct measured with reflective indicators and a series of measures were used to assess the quality of measurement, it was still necessary to examine the appropriateness of treating behavioural integration as a second-order formative construct. A series of activities adopted from Pavlou & El Sawy (2006) was used to verify the existence of a second-order formative construct. First, the relative weights of the first-order constructs are all significant. Second, the moderate level of correlation coefficients among variables indicates that a reflective model seems less likely. Third, a strong and significant mediating effect of second-order constructs between first-order constructs and dependent variables (project team performance) shows that behavioural integration may represent three first-order constructs with similar predictability but with more compactness. Finally, using regression analysis on the three first-order constructs with performance, low multicollinearity, exhibited by the low variance inflation factor value, indicates that these three dimensions represent different meanings and should not be treated as reflective (Figure 2).

DATA ANALYSIS AND RESULTS

Direct effect

Hypothesis testing was conducted through PLS regression analyses using PLS Graph 3.0 (Soft Modeling, Inc., http://www.plsgraph.com/). The results indicate that all hypotheses are supported as demonstrated in Figure 3. First, project team performance is strongly affected by team behavioural integration. A total of 45.2% variance of project team performance can be explained by behavioural integration. Second, as expected, both expertise specialty and credibility have significant positive effects on team behavioural integration. The interaction of

Table 2. The results of factor analysis

Constructs	Indicators	Factors	
		Loadings	ITC
Expertise specialty	Each team member had specialist knowledge of some aspect of our project.	0.71	0.56
CR = 0.857	Each team member had knowledge about an aspect of the project that no other team member had.	0.71	0.57
Alpha = 0.793	Different team members were responsible for expertise in different areas.	0.77	0.62
AVE = 0.546	The specialist knowledge of several different team members was needed to complete the project deliverables.	0.77	0.61
	Each team member knew which team members had expertise in specific areas.	0.74	0.51
Expertise credibility	Our team members were comfortable accepting procedural suggestions from other team members.	0.67	0.49
CR = 0.891	Our team members trusted that other members' knowledge about the project was credible.	0.85	0.73
Alpha = 0.846	Our team members felt confident to rely on the information that other team members brought to the discussion.	0.82	0.71
AVE = 0.621	When other members gave information, each team member wanted to double-check it him/herself. (reversed)	0.81	0.71
	Our team members did not have much faith in other members' 'expertise' (reversed)	0.79	0.63
Expertise integration	Members of this team synthesised and integrated their individual expertise at the project level.	0.83	0.67
CR = 0.914	Members of this team spanned several areas of expertise to develop shared project concepts.	0.87	0.76
Alpha = 0.875	Members of this team were able to see clearly how different pieces of this project fitted together.	0.83	0.70
AVE = 0.727	Members of this team competently blended new project-related knowledge with what they already knew.	0.89	0.79
Project team performance	The amount of work the team produced	0.83	0.75
CR = 0.923	The efficiency of team operations	0.86	0.78
Alpha = 0.899	The team's adherence to the schedule	0.83	0.76
AVE = 0.667	The team's adherence to the budgets	0.77	0.67
	The quality of work produced by the team	0.82	0.72
	The effectiveness of the team's interactions with people outside the team	0.79	0.68
Collective mind	Our team members had a global perspective that included each other's decisions and the relationship among them.	0.82	0.68
CR = 0.900	Our team members carefully interrelated actions with each other in this project.	0.82	0.67
Alpha = 0.852	Our team members carefully made their decisions to maximise overall team performance.	0.84	0.71
AVE = 0.693	Our team members had developed a clear understanding of how each member should be coordinated.	0.84	0.70
Joint decision-making	Our team members set task goals together.	0.84	0.73
CR = 0.904	Our team members developed task strategies together.	0.85	0.75
Alpha = 0.867	Our team members diagnosed problems together.	0.83	0.72
AVE = 0.654	Our team members collected required data together.	0.79	0.66
	Our team members evaluated team performance together.	0.75	0.58
Team behavioural integration (second order)	Expertise integration	0.85	–
	Collective mind	0.83	–
	Joint decision-making	0.82	–

CR, composite reliability; Alpha, Cronbach's alpha; AVE, averaged variance extracted; ITC, item-total correlation.

Table 3. Descriptive statistics and correlation matrix

					Correlation Matrix			
Variables	Mean	Std. Dev.	M3	M4	EL	EC	BI	TP
Expertise specialty	4.13	0.47	0.03	0.00	0.74*			
Expertise credibility	4.01	0.49	0.28	–0.08	0.45	0.79*		
Behavioural integration	3.71	0.49	0.09	1.40	0.34	0.40	0.83*	
Project team performance	3.73	0.53	–0.04	0.85	0.29	0.31	0.67	0.82*

*The diagonal line of the correlation matrix represents the square root of AVE.
M3, skewness; M4, kurtosis.

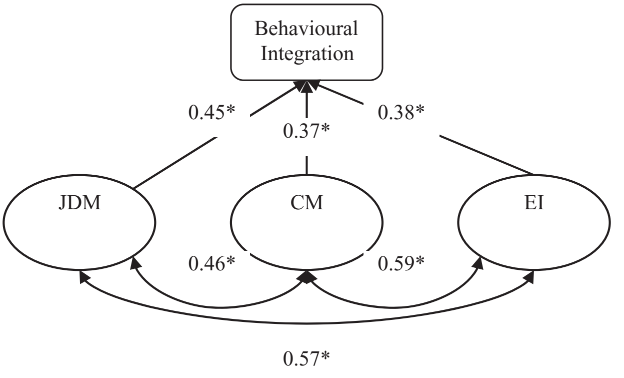

Figure 2. Behavioural integration as a second-order formative construct. * p < 0.05

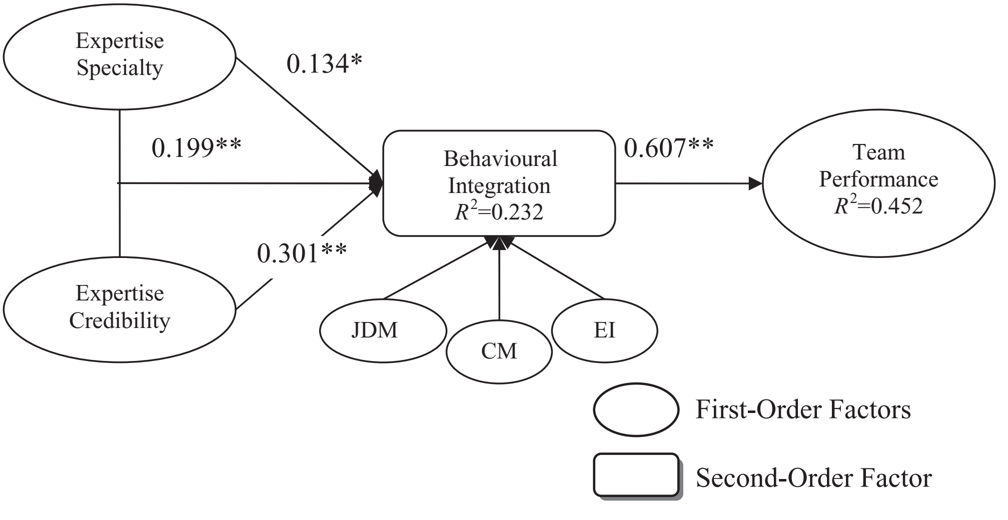

Figure 3. Path analysis result. *$p < 0.05$; **$p < 0.01$

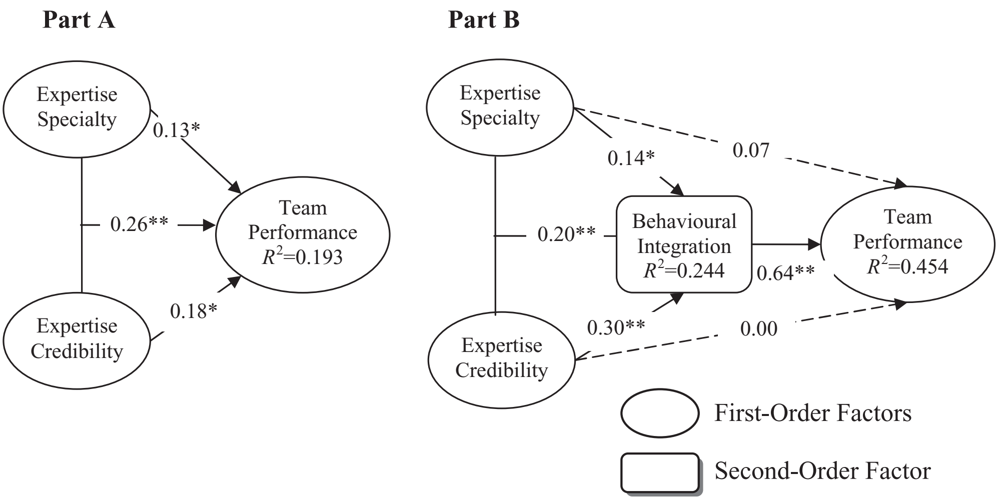

Figure 4. The mediating effect of behavioural integration. *$p < 0.05$; **$p < 0.01$

expertise specialty and credibility also has a positive and significant impact on team behavioural integration. The two cognitive dimensions of TMS and their interaction account for almost 23.2% variance of team behavioural integration.

Mediating effect

Since the indirect effects of two cognitive components on project team performance were hypothesised and tested in our study through the lens of team behavioural integration, further examination was required to understand the mediating role of team behavioural integration. We followed the three steps proposed by Baron & Kenny (1986) to test the aforementioned relationship. As indicated in Part A of Figure 4, the impact of expertise specialty and credibility on project team performance is positively significant. Part B of Figure 4 shows the result of a fully mediating effect. That is, the impacts that expertise specialty and credibility have on project team performance disappear when team behavioural integration is added into the model.

Interaction effect

Although the structural model in the PLS graph shows a positive and significant result for the interaction term, a moderated multiple regression (MMR) analysis was used to test the proposed interaction effect of user review from the effect size perspective (Carte & Russell, 2003). The results of the tests are also shown in Table 4.

In the same vein as the coefficient test, the MMR test result shows that the proposed hypothesis that *the interaction between expertise specialty and expertise credibility is positively associated with behavioural integration* (H4) is supported at a 0.5 significance level (see Table 4).

Table 4. Interaction effect

Dependent variable: behavioural integration		
	Direct effect	With interaction
Independent variable	Model 1	Model 2
Expertise specialty	0.18*	0.13*
Expertise credibility	0.35**	0.30**
Expertise specialty *expertise credibility		0.20**
R^2	$R_1^2 = 0.213$	$R_2^2 = 0.243$
R^2 difference		0.030*

*$p < 0.05$; **$p < 0.01$.
The F-value of the R^2 difference is estimated by $((R_2^2 - R_1^2)/(df_2 - df_1))/((1 - R_2^2)/(n - df_2 - 1))$.

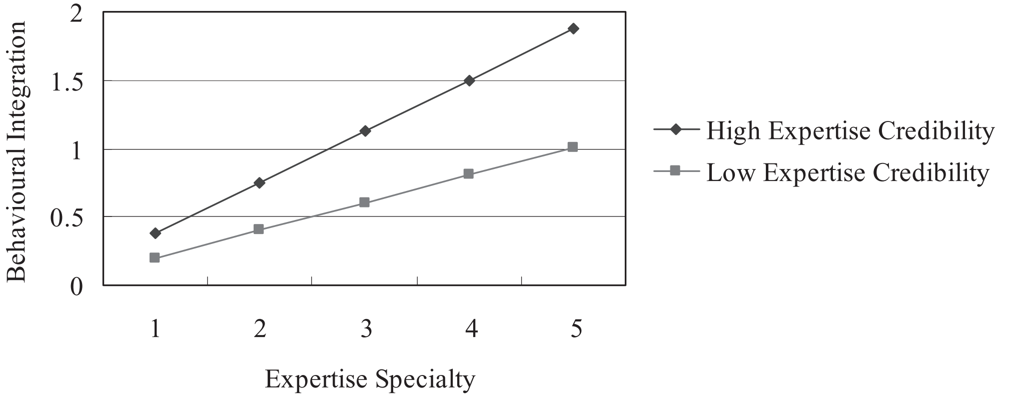

Figure 5. Interaction effect diagram.

The moderating effect diagram is shown in Figure 5. The results indicate the following: expertise specialty has a positive effect on behavioural integration irrespective of the level of credibility; although the slope for different levels of credibility is positive, it is much steeper under high expertise credibility; when expertise specialty is low, a similar level of behavioural integration can be observed at different levels of credibility; and as the level of expertise specialty increases, much higher behavioural integration can be found for high degrees of expertise credibility compared with that found in the context of low degrees of expertise credibility.

DISCUSSION AND CONCLUSION

The foci of this study are to understand how ISD team behavioural integration affects project team performance and to explore how two cognitive components of TMS and their interaction (expertise specialty and credibility) lead to team behavioural integration. Our survey of 205 ISD project managers confirms all proposed hypotheses that expertise specialty, credibility and their interaction have positive effects on team behavioural integration, which, in turn, leads to better project team performance.

Implications for researchers

First, we successfully demonstrated that ISD teams perform better when members are behaviourally integrated. This implies that simply considering one or two of these three elements when attempting to understand teamwork behaviour is an inadequate approach for teams to counter problems and challenges during the ISD process. Insufficient expertise integration reduces the capacity to understand the particular problem in hand; the lack of collective mind diminishes the efficiency of action-taking and a cohesive teamwork climate can not be attained when decisions are not made jointly by all members. Hence, future research in team coordination or integration should take these three dimensions simultaneously into consideration to obtain a more comprehensive view.

Second, although TMS has received tremendous attention in organisational studies (Lewis, 2004; Lewis *et al*., 2005), most researchers have regarded it as an important antecedent of knowledge-related activities, such as communication and expertise coordination. As a consequence, its impact on other teamwork activities has been largely neglected. We extend this research stream by further showing that the behavioural component is not limited to expertise coordination; rather, it also includes other team activities. That is, knowing the location of expertise indeed facilitates other behavioural activities, such as joint decision-making and the forming of a collective mind, within the team. Future research should further explore the impact of TMS based on the outcome of this study.

Third, the behavioural component is affected by the other two cognitive dimensions of TMS and their interaction. This finding confirms the concept proffered by previous studies that the impact of TMS on the teamwork process of performance is higher when both expertise specialty and credibility are high (Lewis, 2004; Lewis *et al*., 2005; Akgün *et al*., 2006). Although this view has been proposed for a period of time, the present study is the first to examine the interaction effect between specialty and credibility. As shown in Figure 5, the gap between high and low credibility increases as the level of specialty increases. This provides a clear picture for understanding the internal structure of TMS. Future research should go on to explore the extent to which ‘knowing who knows what’ can better affect team behaviour and the conditions under which this occurs.

Fourth, the fully mediating role of behavioural integration with respect to the relationship between the two cognitive components of TMS and project team performance confirms Kanawattanachai & Yoo’s (2007) study finding that not all components of TMS dimensions have immediate effects on project team performance. Although some early experiment-based studies pointed out that TMS had a direct impact on team performance (Wegner *et al*., 1985; Ren *et al*., 2006), the way in which knowing the location of knowledge positively transforms the teamwork process becomes clear. This finding provides further evidence to support a twostage (from cognitive to behavioural) research model for TMS studies. Therefore, future researchers are encouraged to explore other potential mediators.

Implications for practitioners

First, team behavioural integration positively affects project team performance. To enhance team capability, project managers must ensure that members form task-level expertise to counter problems by synthesising their expertise, develop a clear understanding of how they should coordinate with each other, adopt a global perspective on decisions, understand how actions of members are interrelated to each other and make decisions together to maximise team performance. To create a cohesive team, it is better for team leaders to include all members when setting task goals, developing strategies, monitoring progress, analysing problems and evaluating performance. Project managers are advised to conduct certain interventions to achieve the aforementioned goals. Managerial interventions, such as team building or team development, are required before a team can really function or achieve higher performance.

Second, a project team is a combination of individuals with different backgrounds. Knowing the location of knowledge and being able to access it is critical for project team performance. Project managers should perform activities to foster the emergence of TMS within the ISD team. Member selection is the first and most convenient approach to enhance TMS within the team since members who worked together frequently in the past tend to know each other better. After the team has been formed, the team leader can promote TMS through face-to-face or online interactions (Lewis, 2004). Interventions, such as initial training, team building and informal social gatherings, should be adopted to promote interaction and in turn, build the TMS. In addition, managers might consider setting up job rotation and a back-up mechanism to allow members to become familiar with each other's roles, job content and expertise. Furthermore, for new members who join the team after it has been initially formed, team leaders should pay more attention on their socialisation process. This is the key for new members to understand the role of each team member, the common language used in the team and the way in which members interact with each other.

Third, in addition to the awareness of expertise specialty, credibility serves as an important antecedent of team behavioural integration. Moreover, the positive impact of interaction between specialty and credibility implies that the highest level of integration can be achieved when both specialty and credibility are high. Practically, credibility facilitates the knowledge interchange activities by reducing the needs for validating the received information. Insufficient trust serves as one critical barrier that blocks the effective flowing of knowledge within an organisation. People tend to abandon or obtain information from the secondary source to confirm the correctness of received information when trust of the original source is absent. Our results confirm this concept. Although specialty can enhance knowledge-level interactions within the team by reducing the cost in searching for needed knowledge, this effect is intensified when members trust the knowledge sources since the validation of the credibility of sources and knowledge itself is unnecessary. Therefore, in addition to fostering members' understanding of each other, project managers should provide a context for members to validate their understanding of each other's knowledge.

Finally, project managers can adopt information and communication technologies to support the forming of TMS and enhance behavioural integration within the ISD team. For example, Knowledge Management System can be used to store and share knowledge contributed by all of the team members. Project managers or leaders can use expert yellow pages to help members locate and find the experts or knowledge. Tools such as Blog, Facebook or Bulletin Board System can be used to build a social network, which forms the basis of communication and coordination among team members and which boosts those members' trust in the expertise of one another. Group support systems can be used to support joint decision-making when members are not in the same location. Workflow software and groupware can be used to support collective actions by enhancing members' coordination. Other Web 2.0 tools, such as Wiki, Blog, Social Network, Really Simple Syndication and Tag, can be used for opinion and information exchange, which is indispensable for expertise integration and for further problem solving.

Limitations

Although we contribute to team research and TMS literature by providing additional solid evidence, this study is not without limitation. First, although we designed our survey carefully, and the results of the Harman's single factor test showed 'common method variance' not to be a potential issue in our study, future researchers are encouraged to collect data from different sources or different time slots to avoid the risk of CMV and to enhance research validity. If such studies are not feasible, researchers may collect variables that can be used to validate the potential disturbance of CMV (Pavlou & Gefen, 2005). Second, perceived data from the project manager were used to represent the whole team. Although the manager of one team is qualified to represent most of the teamwork process, data collected from each individual team member are still preferred. Third, although the relationship between expertise specialty and credibility, on the one hand, and team behavioural integration, on the other, was hypothesised and confirmed in this study, some may argue for a reversed relationship between these two types of variables. Besides the explanatory reasoning provided in the literature review section, the relationship in question may be examined through multiple wave data. Therefore, future research studies with longitudinal data are encouraged to clarify this issue.

Finally, although IT was not included directly in the research model, we believe that IT can be used to support the forming of TMS or to enhance behavioural integration within the ISD team. The forming of transactive memory can be enhanced through the process of revealing one's expertise to members through information and communication technologies. Future research may benefit from incorporating IT into the research models to explore the impact of IT on cognitive and behavioural variables.

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REFERENCES

Akgün, A.E., Byrne, J., Keskin, H., Lynn, G.S. & Imamoglu, S.Z. (2005) Knowledge networks in new product development projects: a transactive memory perspective. *Information and Management*, **42**, 1105–1120.

Akgün, A.E., Byrne, J.C., Keskin, H. & Lynn, G.S. (2006) Transactive memory system in new product development teams. *IEEE Transactions on Engineering Management*, **53**, 95–111.

Alavi, M. & Tiwana, A. (2002) Knowledge integration in virtual teams: the potential role of KMS. *Journal of the American Society for Information Science and Technology*, **53**, 1029–1037.

Anderson, J.C. & Narus, J.A. (1990) A model of distributor firm and manufacturer firm working partnerships. *Journal of Marketing*, **54**, 42–58.

Argote, L., McEvily, B. & Reagans, R. (2003) Managing knowledge in organizations: an integrative framework and review of emerging themes. *Management Science*, **49**, 571–582.

Austin, T.A., Lee, H.L. & Kopczak, L.R. (1997) *Unlocking Hidden Value in the Personal Computer Supply Chain*. Andersen Consulting, Downingtown, PA, USA.

Baron, R.M. & Kenny, D.A. (1986) The moderator–mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, **51**, 1173–1182.

Bock, G.-W., Zmud, R.W., Young-Gul, K. & Jae-Nam, L. (2005) Behavioral intention formation in knowledge sharing: examining the roles of extrinsic motivators, social–psychological forces, and organizational climate. *MIS Quarterly*, **29**, 87–111.

Brockmann, E.N. & Anthony, W.P. (1998) The influence of tacit knowledge and collective mind on strategic planning. *Journal of Management Issues*, **10**, 204–222.

Bruine de Bruin, W., Parker, A.M. & Fischhoff, B. (2007) Individual differences in adult decision-making competence. *Journal of Personality and Social Psychology*, **92**, 938–956.

Burkhardt, M.E. (1994) Social interaction effects following a technological change: a longitudinal investigation. *Academy of Management Journal*, **37**, 869–898.

Carmeli, A. & Schaubroeck, J. (2006) Top management team behavioral integration, decision quality, and organizational decline. *Leadership Quarterly*, **17**, 441–453.

Carte, T.A. & Russell, C.J. (2003) In pursuit of moderation: nine common errors and their solutions. *MIS Quarterly*, **27**, 479–501.

Cockburn, A. & Highsmith, J. (2001) Agile software development: the people factor. *Computer*, **34**, 131–133.

Cruz, N.M., Perez, V.M. & Ramos, Y.F. (2007) Transactive memory processes that lead to better team results. *Team Performance Management*, **13**, 192–205.

De Boer, M., Van Den Bosch, F.A.J. & Volberda, H.W. (1999) Managing organizational knowledge integration in the emerging multimedia complex. *Journal of Management Studies*, **36**, 379–398.

De Dreu, C.K.W. & Van Vianen, A.E.M. (2001) Managing relationship conflict and the effectiveness of organizational teams. *Journal of Organizational Behavior*, **22**, 309–328.

Faraj, S. & Sproull, L. (2000) Coordinating expertise in software development teams. *Management Science*, **46**, 1554–1568.

Fornell, C. & Larcker, D.F. (1981) Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, **18**, 39–50.

Grant, R.M. (1996) Toward a knowledge-based theory of the firm. *Strategic Management Journal*, **17**, 109–122.

Hambrick, D.C. (1994) Top management groups: a conceptual integration and reconsideration of the 'team' label. *Research in Organizational Behavior*, **16**, 171–213.

Hambrick, D.C. (1998) Corporate coherence and the top management team. *Strategy and Leadership*, **25**, 24–30.

Hambrick, D.C. & Finkelstein, S. (1995) The effects of ownership structure on conditions at the top: the case of CEO pay raises. *Strategic Management Journal*, **16**, 175–193.

Henderson, J.C. & Lee, S. (1992) Managing I/S design teams: a control theories perspective. *Management Science*, **38**, 757–777.

Huemer, L., von Krogh, G. & Roos, J. (1998) *Knowledge and the Concept of Trust*. Sage, London, UK.

Jones, M.C. & Harrison, A.W. (1996) IS project team performance: an empirical assessment. *Information and Management*, **31**, 57–65.

Kanawattanachai, P. & Yoo, Y. (2007) The impact of knowledge coordination on virtual team performance over time. *MIS Quarterly*, **31**, 783–808.

Lewis, K. (2003) Measuring transactive memory systems in the field: scale development and validation. *Journal of Applied Psychology*, **88**, 587–603.

Lewis, K. (2004) Knowledge and performance in knowledge-worker teams: a longitudinal study of transactive memory systems. *Management Science*, **50**, 1519–1533.

Lewis, K., Lange, D. & Gillis, L. (2005) Transactive memory systems, learning, and learning transfer. *Organization Science*, **16**, 581–598.

Liang, D.W., Moreland, R. & Argote, L. (1995) Group versus individual training and group performance: the mediating role of transactive memory. *Personality and Social Psychology Bulletin*, **21**, 384–393.

Lin, B.-W. & Chen, C.-J. (2006) Fostering product innovation in industry networks: the mediating role of knowledge integration. *International Journal of Human Resource Management*, **17**, 155–173.

Lin, F.-R. & Lin, S.-C. (2001) A conceptual model for virtual organizational learning. *Journal of Organizational Computing and Electronic Commerce*, **11**, 155–178.

London, M., Polzer, J.T. & Omoregie, H. (2005) Interpersonal congruence, transactive memory, and feedback processes: an integrative model of group learning. *Human Resource Development Review*, **4**, 114–135.

Luhmann, N. (1979) *Trust and Power*. Wiley, Chichester, UK.

Marks, M.A., Sabella, M.J., Burke, C.S. & Zaccaro, S.J. (2002) The impact of cross-training on team effectiveness. *Journal of Applied Psychology*, **87**, 3–13.

Mathieu, J., Heffner, T., Goodwin, G., Cannon-Bowers, J. & Salas, E. (2005) Scaling the quality of teammates' mental models: equifinality and normative comparisons. *Journal of Organizational Behavior*, **26**, 37–56.

Mitchell, R. & Nicholas, S. (2006) Knowledge creation in groups: the value of cognitive diversity, transactive memory and open-mindedness norms. *Electronic Journal of Knowledge Management*, **4**, 67–74.

Moreland, R.L. (1999) Transactive memory: learning who knows what in word groups and organizations. In: *Shared Cognition in Organizations: The Management of Knowledge*, Thompson, L., Levine, J.M. & Messick, D.M. (eds), pp. 3–31. Lawrence Erlbaum Associates, Hillsdale, NJ, USA.

Nelson, K.M. & Cooprider, J.G. (1996) The contribution of shared knowledge to is group performance. *MIS Quarterly*, **20**, 409–432.

Newell, S., Swan, J.A. & Galliers, R.D. (2000) A knowledge-focused perspective on the diffusion and adoption of complex information technologies: the BPR example. *Information Systems Journal*, **10**, 239–259.

Newell, S., Tansley, C. & Huang, J. (2004) Social capital and knowledge integration in an ERP project team: the importance of bridging and bonding. *British Journal of Management*, **15**, 43–57.

Nidumolu, S. (1995) The effect of coordination and uncertainty on software project performance: residual performance risk as an intervening variable. *Information Systems Research*, **6**, 191–219.

Nidumolu, S.R. (1996) A comparison of the structural contingency and risk-based perspectives on coordination in software-development projects. *Journal of Management Information Systems*, **13**, 77–113.

Nonaka, I. & Takeuchi, H. (1995) *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*. Oxford University Press, New York, NY, USA.

Oshri, I., Fenema, P.V. & Kotlarsky, J. (2008) Knowledge transfer in globally distributed teams: the role of transactive memory. *Information Systems Journal*, **18**, 593–616.

Pavlou, P.A. & El Sawy, O.A. (2006) From IT leveraging competence to competitive advantage in turbulent environments: the case of new product development. *Information Systems Research*, **17**, 198–227.

Pavlou, P.A. & Gefen, D. (2005) Psychological contract violation in online marketplaces: antecedents, consequences, and moderating role. *Information Systems Research*, **16**, 372–399.

Petter, S., Straub, D. & Rai, A. (2007) Specifying formative constructs in information systems research. *MIS Quarterly*, **31**, 623–656.

Podsakoff, P.M., MacKenzie, S.B., Jeong-Yeon, L. & Podsakoff, N.P. (2003) Common method biases in behavioral research: a critical review of the literature and recommended remedies. *Journal of Applied Psychology*, **88**, 879–903.

Ren, Y., Carley, K.M. & Argote, L. (2006) The contingent effects of transactive memory: when is it more beneficial to know what others know? *Management Science*, **52**, 671–682.

Robert, J.L.P., Dennis, A.R. & Ahuja, M.K. (2008) Social capital and knowledge integration in digitally enabled teams. *Information Systems Research*, **19**, 314–334.

Sagie, A. & Aycan, Z. (2003) A cross-cultural analysis of participative decision-making in organizations. *Human Relations*, **56**, 453–473.

Sheremata, W.A. (2000) Centrifugal and centripetal forces in radical new product development under time pressure. *Academy of Management Review*, **25**, 389–408.

Simsek, Z., Veiga, J.F., Lubatkin, M.H. & Dino, R.N. (2005) Modeling the multilevel determinants of top management team behavioral integration. *Academy of Management Journal*, **48**, 69–84.

Staples, D.S. & Webster, J. (2008) Exploring the effects of trust, task interdependence and virtualness on knowledge sharing in teams. *Information Systems Journal*, **18**, 617–640.

Subramani, M.R. & Venkatraman, N. (2003) Safeguarding investments in asymmetric interorganizational relationships: theory and evidence. *Academy of Management Journal*, **46**, 46–62.

Szulanski, G. (1996) Exploring internal stickiness: impediments to the transfer of best practice within the firm. *Strategic Management Journal*, **17**, 27–43.

Tiwana, A. (2004) An empirical study of the effect of knowledge integration on software development performance. *Information and Software Technology*, **46**, 899–906.

Tiwana, A. & McLean, E.R. (2005) Expertise integration and creativity in information systems development. *Journal of Management Information Systems*, **22**, 13–43.

Umphress, E.E., Labianca, G., Brass, D.J., Kass, E. & Scholten, L. (2003) The role of instrumental and expressive social ties in employees' perceptions of organizational justice. *Organization Science*, **14**, 738–753.

Van De Ven, A.H., Delbecq, A.L. & Koenig, R.J. (1976) Determinants of coordination modes within organizations. *American Sociological Review*, **41**, 322–338.

Weber, R.A. & Camerer, C.F. (2003) Cultural conflict and merger failure: an experimental approach. *Management Science*, **49**, 400–415.

Wegner, D.M. (1995) A computer network model of human transactive memory. *Social Cognition*, **13**, 319–339.

Wegner, D.M., Giuliano, T. & Hertel, P.T. (1985) Cognitive interdependence in close relationships. In: *Compatible and Incompatible Relationships*, Ickes, W. (ed.), pp. 253–276. Springer Verlag, New York, USA.

Weick, K.E. & Roberts, K.H. (1993) Collective mind in organizations: heedful interrelating on flight decks. *Administrative Science Quarterly*, **38**, 357–381.

Yoo, Y. & Kanawattanachai, P. (2001) Developments of transactive memory systems and collective mind in virtual teams. *International Journal of Organizational Analysis*, **9**, 187–208.

Yoo, Y., Lyytinen, K. & Heo, D. (2007) Closing the gap: towards a process model of post-merger knowledge sharing. *Information Systems Journal*, **17**, 321–347.

Zaheer, A. & Venkatraman, N. (1995) Relational governance as an interorganizational strategy: an empirical test of the role of trust in economic exchange. *Strategic Management Journal*, **16**, 373–392.

Zimmer, J.C., Henry, R.M. & Butler, B.S. (2007) Determinants of the use of relational and nonrelational information sources. *Journal of Management Information Systems*, **24**, 297–331.

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