Title	The impact of external and internal group activities on transactive memory systems formation and functioning
Author(s)	Peltokorpi, Vesa
Citation	Hiroshima University Management Review , 22 : 3 - 16
Issue Date	2021-03-27
DOI	
Self DOI	10.15027/50776
URL	https://ir.lib.hiroshima-u.ac.jp/00050776
Right	Copyright (c) 2021 by Author
Relation	

■論文

The impact of external and internal group activities on transactive memory systems formation and functioning

Vesa Peltokorpi

Abstract

Transactive memory systems (TMS) theory has attracted increasing attention in the scholarly fields of cognitive, organizational, and social psychology; communication; information science; and management. TMS theory and research, focusing primarily on internal group activities, have paid scant attention to external group activities. This paper contributes to TMS theory and research by a set of proposals on the influence of internal and external group activities on TMS formation and functioning. More specifically, I propose that external group activities, depending on their intensity, influence TMS formation and functioning in project groups.

Keywords: External Activities; internal activities; transactive memory system

Introduction

The increased usage of organizational groups and teams can explain the renewed interest in group cognition (Peltokorpi & Hood, 2017). Among the theories of group cognition, transactive memory systems (TMS) theory (Wegner, 1986) has gained more popularity in terms of conceptual extensions and research (for reviews, see Peltokorpi, 2008; Peltokorpi & Hood, 2017). TMS theory maintains that groups develop a cognitive division of labor with respect to encoding, storage, and retrieval of task-based information, each member specializing in different information domains (Wegner, 1986). Members of groups with efficient differentiated TMS have shared awareness of who knows what, being able to draw on the information held by other members as needed (Wegner, 1986).

TMS theory and research have largely treated work groups as closed entities, overlooking the fact that they are interdependent parts of organizations (Peltokorpi, 2014; Thompson, 1967). In particular, the influence of external group activities on TMS formation and functioning needs to be elaborated since the original theory has often been extended from intimate couples to work groups without adequate explanations (Peltokorpi, 2008). Scholars have thus assumed that group members have collectively all information they need to complete their complex and interdependent tasks. A linkage between external group activities and TMS is important because group processes cannot be fully understood solely by internal activities (Anscona & Caldwell, 1988). This paper draws on open systems and contingency theories to describe the impact of external and internal activities on TMS. Through these theoretical perspectives, groups are open and living systems continuously interacting with their environment (McGrath, Arrow, & Berdahl, 2000). Hereinafter, the terms work group and team are used interchangeably to refer to a group of people in an organization with clearly defined membership, who are responsible for a shared product/service (Hackman, 1987).

This paper is structured as follows. The fol-

lowing, second section describes TMS theory. The third section discusses internal and external activities in work groups. The fourth section draws from open systems and contingency theories to provide the rationale for internal and external activities on TMS. The fifth section discusses the different effects of external and internal activities on TMS. The sixth section presents a set of proposals of external and internal activities on TMS, and the seventh section provides theoretical and practical implications.

Transactive memory systems theory

TMS theory was originally developed to describe a cognitive division of labor in intimate couples (Wegner, 1986), but has been applied to other types of dyads, student groups, work groups, and organizations (Peltokorpi, 2008, 2012; Peltokorpi & Hood, 2017). TMS theory maintains that groups act as memory units whereby its members collectively develop a shared cognitive system for managing information over time as all members learn about each other's' expertise areas. Groups develop a cognitive division of labor because of their need for increased information processing capacity and limitations of individual cognition to successfully complex tasks. To rely on other group members as external cognitive aids, all members need to have shared awareness (i.e., shared mental models) where the needed knowledge is located and able to retrieve it in a timely manner (Peltokorpi, 2008; Wegner, 1986).

TMS is formed and functions through the overlapping encoding, storage, and retrieval phases, each phase tapping group members' expertise perceptions (Wegner, 1986). TMS formation begins when group members learn something about other members' expertise domains. During the encoding phase, stereotypes (e.g., age, gender, and race) may influence expert inferences. Expertise domain information can also be gained through explicit expertise indicators (e.g., diplomas), written communication, roles, and from other people. Knowing that a certain member has accessed specific information, accessed it for a long period of time, or accessed it recently, can also serve as the basis for expertise inferences (Peltokorpi, 2008). In work groups, expertise areas can be assigned explicitly. Because expert inferences through indirect sources tend to be subject to error and exaggeration, interpersonal interaction is the most accurate way to determine experts, allowing individuals to discuss and demonstrate their expertise and state their potential lack of expertise in certain areas (Wegner, 1986).

TMS are formed and function efficiently when all domain experts accept responsibility for the encoding, storage, and retrieval of new information in their expertise areas. This combined with the shared awareness of expertise enable group members to support each other's expertise by directing new information to domain experts. Depending on group size and specialization, similar information items can be stored simultaneously by one/several people. Transactive retrieval occurs when group members collaboratively seek to retrieve uniquely held information. If not possessing the needed information, members may retrieve it by identifying an expert through the appropriate location information. In well-functioning differentiated TMS, location information is equally shared among all group members and can therefore be understood as a shared awareness of "who knows what" (Wegner, 1986).

Well-functioning TMS provide various benefits to individuals and groups. Foremost is the expansion of an individual's expertise, gained through the awareness and access to others' expertise domains. The ability to use other group members as external cognitive aids reduces each group member's cognitive load (Peltokorpi, 2008; Wegner, 1986). At the same time, this provides a larger pool of information to the group through increased specialization. Another important advantage is that all members gain ac-

cess to novel information that is created through integrations occurring within the transactive process. In some support, research suggests that student and work groups with well-functioning TMS complete their tasks more efficiently (Peltokorpi, 2008; Peltokorpi & Hood, 2017). Because the focus in the present paper is on the impact of external and internal group activities on TMS, work groups with well-functioning TMS are assumed to perform their tasks efficiently.

In contrast, the possible drawbacks of TMS are caused by the increased complexity added to an individual's memory by directories to external memory systems (Wegner, 1986). For example, members of poorly constructed TMS might not be aware of real domain experts. Faulty expert recognition can direct information away from true domain experts. Possible are also situations when expertise allocation does not allow efficient processing of external information because incoming information does not fall to any group members' expertise domains. Domain expertise might also be in dispute causing confusion from and to whom information should be allocated and retrieved (Peltokorpi, 2008). When clear group expectations regarding circumstantial knowledge responsibility are not developed, problems can also arise. Furthermore, a well-developed TMS can make groups overconfident to the internal knowledge they possess, potentially decreasing groups' decision-making capability and performance (Wegner, 1986).

TMS are developed in groups that need to complete interdependent and complex tasks (Wegner, 1986). In particular, scholars have argued that knowledge-intensive project groups develop TMS because of their need for specialization and cognitive division of labor (Faraj & Sproull, 2000). Such groups have a high level of knowledge intensity and their tasks to be composed of separated but interdependent parts that require frequent interactions in teams. Their task efficiency requires well-developed internal and external group activities (Ancona & Caldwell, 1988). Yet, TMS theory and research have typically treated work groups as closed systems and focused on internal activities, and research on project groups focuses on external activities. Instead of focusing either on internal or external activities, I propose that both of them matter and need to be considered in discussions on TMS formation and functioning.

Internal and external group activities

Internal activities occur within group boundaries (Choi, 2002), defined as imaginary lines of demarcation separating group members from nongroup members (Guzzo & Dickson, 1996). Boundaries are important to the definition of groups and to the psychology of being a member of the in-group versus the out-group. Internal group activities can further be divided into interrelated task interactions (i.e., interactions that relate to a group's task) and socio-emotional interactions (i.e., interpersonal interactions that occur within the group; Bales, 1950). For example, communication in project groups includes interactions among members who work close one another, collaborate daily on project tasks, and are supervised by the same individual.

External activities refer to task-relevant activities directed toward the group environment to manage its relationships with numerous external actors (Choi, 2002). Groups can have a range of external activities. For example, Ancona and Caldwell (1988) identified external activities, including gathering information and resources, scanning, feedback-seeking, and informing. In addition to the information seeking and transfer-based external activities, prospective new and ex-group members beyond the group boundaries can affect group processes and performance (Moreland & McMinn, 1999). Although task and socio-emotional interactions, as well as internal and external activities, can

be conceptually separated, they are often interdependent and inseparable in organizational groups (Choi, 2002).

Assuming that group boundaries well-defined and closed, TMS theory and research focus mainly on the effect of internal group activities on TMS formation and functioning. In this paper, I focus on information exchange – the extent to which group members share information through interpersonal communication within and beyond their group boundaries – because it is identified as the most important activity on the formation, functioning, maintenance of group TMS (Peltokorpi & Hood, 2019; Wegner, 1986). Interpersonal communication is also an important medium through which information is shared, transferred, and processed in organizations (March & Simon, 1958). Among various ways to share information, face-to-face communication among group members also reduces faulty transmission and enables the formation of accurate expert inferences in group TMS (Wegner, 1986).

In contrast, research in project teams suggests that gatekeepers (i.e., individuals who communicate more often overall and with people outside their specialty) have external activities and bring information in and disperse it to other members, as well as that the frequency of external communication facilitates project group performance (Katz & Tushman, 1981; Tushman & Katz, 1980). The importance of external communication to innovation success is also well documented in product development research (Allen, 1971; Ancona & Caldwell, 1992). For example, Allen (1971) found that high performing research and development (R&D) teams communicated more frequently with others external to the team than low performing teams. Research in new product development teams further shows that group technical diversity has a positive impact on budget and schedule performance and innovation through external communications (Ancona & Caldwell, 1992). Groups having external interactions are also found to be more efficient and perform better in the long-term (Katz, 1982; Peltokorpi & Hasu, 2015).

Surprisingly, only three scholars have discussed the impact of external activities on TMS. First, Anand. Manz, and Glick (1998) argued that organizational groups engage in external activities to locate and retrieve information. Second, Austin (2003) proposed that TMS consists of task and external relationship dimensions. In addition to the knowledge and skills relevant to the group task, Austin argued that an awareness of other members' external relationships is another type of TMS. The impact of external relationship and task TMS on group performance is similar because members with relationships to external stakeholders provide their groups with access to needed knowledge resources. In the same paper, Austin's analysis with 27 groups in apparel and sports goods firms shows that task and external TMS were positively related with group performance in terms of external and internal evaluation and goal attainment. Third, Peltokorpi (2014) found in a case study that a Japanese team-based organization has interlinked TMS and that group and organization-level mechanisms are used to coordinate these TMS interactions. While suggesting that organizational groups have external interactions, scholars have not discussed how external activities affect TMS.

In summary, although TMS and project team research suggest that internal and external activities are important and provide process and performance-related benefits in groups, their focus has respectively been on internal and external activities. In TMS theory and research, groups are treated at best as systems that absorb information from their environment. In contrast, project team research describes groups to reduce task uncertainty through external activities. Due to these differences, I next draw on contingency and open systems theories to discuss the effect of external activities on

TMS.

Contingency and open systems theories

Contingency and open systems theories focus on boundary issues and external activities (Argote, 1982; Thompson, 1967). The core tenet of open systems theory is that groups depend on their environment as a condition of survival for critical resource inputs and disposal of its outputs. Because groups have no one best way to solve all task-related problems, the best way to organize is contingent on the diversity and uncertainty of the tasks being performed by groups. Since external group activities entail reaching out to critical constituencies in the environment, these activities can be perceived as a response of groups to their dependence on other systems or as a proactive stance toward managing their interdependencies. Through contingency and open systems theories, groups can be regarded as interdependent information-processing organisms that operate in complex and dynamic environments.

From the contingency and open systems theory perspectives, task-related information processing in groups can be understood partly as a way to reduce environmental uncertainty. Since group internal information-processing capacity needs to be matched to the task environment, TMS formation and functioning cannot be completely understood without considering internal and external group activities and their interactions. Although internal information processing capacity and decision making can be enhanced by composing groups with members from various functional areas, groups need also to engage in external activities to bring in novel and diverse information to make effective decisions and perform well. Although providing benefits, external group activities may also have negative effects on TMS.

The impact of external and internal group activities on TMS

In this section, I formulate a set of proposals on the impact of external and internal group activities on TMS. I also propose that group and task characteristics affect TMS formation and functioning. More specifically, I propose that group diversity, group leadership, group size, task interdependence, task complexity, and group norms affect the relation between external activities and TMS. Figure 1 shows my conceptual model and proposals.

Curvilinear effects of external group activities on TMS

I expect external activities to hinder TMS formation and function for three reasons. First, frequent external activities can be an indication of low within-group identification – a perception of oneness with or belonging to a group – hindering TMS formation and functioning. Although TMS theory and research assume that all members agree on group membership and boundaries and are willing to accept domain ex-

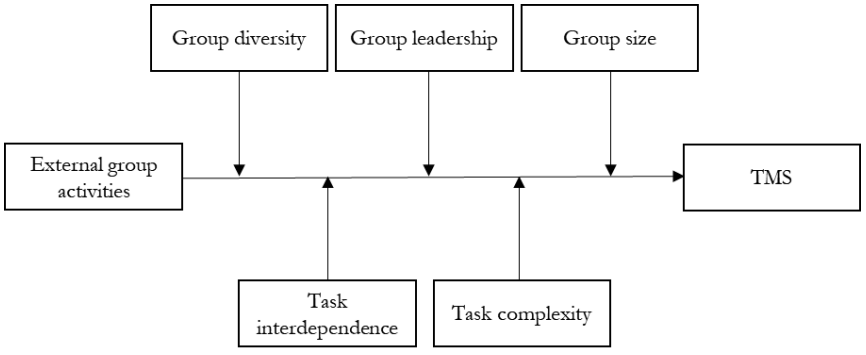

Figure 1. Conceptual model and proposals

pert responsibility, research shows that members of organizational teams remain loyal to their former work groups and organizational units (Thomas-Hunt, Ogden & Neale, 2003), decreasing group identification. In particular, this is likely to occur in cross-functional project groups because their members often present different departments, and coordination with one's home departments is important. External activities are also argued to be detrimental to group cohesiveness (Keller, 2001) and group identity (Mortensen, 2004). At the same time, there can be a "dark side" to strong team identity in real organizations. Identification with their immediate groups makes members feel that their in-group is special and distinct from others (Haslam, 2001). When cooperation with other groups is at stake, the risk of inter-group conflict arises. Thus, a balance between identification with the team and with the organization as a whole is needed.

Second, frequent external activities can increase faulty expert inferences by creating holes in group expertise networks. Because people engaging in frequent external activities have less time to interact with other group members, they can have a less accurate understanding of within-group expertise in comparison to the ones who interact mainly with other group members. Due to the low amount of within-group interactions, the coordination and credibility of information embedded in its members can be hampered by members' different awareness of whom they can and cannot rely on for information (Mortensen, 2004). As long as group members do not know about others' expertise areas and how to benefit from this meta-knowledge through interactions, the expertise information held by its members can remain underused. In such situations, group members hold different, but important information about a given problem, but cannot utilize this information efficiently due to information asymmetries. External activities can consequently lead to low shared consensus of within-group expertise, underutilization of within-group knowledge, and overlapping domain expertise.

Third, a high task role differentiation and specialization can increase external activities at the expense of internal activities. Instead of the often-assumed increased interdependence through task specialization in the TMS literature (Peltokorpi, 2008), a study in software development teams suggests that increasing task role differentiation decreases internal interactions (Levesque, Wilson & Wholey 2001). In the same study, mental models on group's work and each other's expertise did not converge over time perhaps because of low internal interactions. An increasing task specialization can also hinder TMS formation and functioning because knowledge overlaps are found to increase interpersonal communication (Clark & Brennan, 1991) and accountability among group members (Lerner & Tetlock, 1999).

Given that work groups have internal and external activities, tensions from both types of activities might arise in TMS formation and functioning because group conditions that promote one type of activities may do so at the expense of the other. Because groups often have limited resources, such as personnel and time, external activities can reduce resources available to internal activities and vice versa. In some support, inter-group literature suggests that work groups can be under-bounded (i.e., having many external ties but an inability to coalesce and motivate members to pull together their external knowledge) or over-bounded (i.e., having high internal loyalty and a complex set of internal dynamics but an inability to reach out to the external world; Sherif, 1966). While groups isolated from their outside environment may not have requisite information diversity, they are likely to develop fine-grained TMS.

While frequent external activities might have negative effects on TMS, research in student groups (e.g., Liang, Moreland, & Argote,

1995; Moreland, Argote, & Krishnan, 1996) and work groups (e.g., Austin, 2003; Rau, 2005; Peltokorpi & Manka, 2008) provide consistent evidence that internal activities are positively related with group TMS and group performance. For example, experimental studies suggest that student groups executing AM radio assembly tasks perform better if they have been trained together and that this improved performance could be attributed to TMS (Liang et al., 1995; Moreland et al., 1996). A field study of 27 groups in apparel and sporting goods firms also shows that group TMS accuracy had positive effects on group performance (Austin, 2003), and a study in 111 bank teams that the awareness and dispersion of expertise in TMS were positively related to financial performance (Rau, 2005).

At the same time, project teams with balanced internal and external activities are found to be more effective than groups that have one of these activities (Allen, 1977; Ancona & Caldwell, 1988). Thus, a moderate frequency of internal interactions can enable group members to locate, share and retrieve information, and to develop accurate expertise inferences. For group members to use TMS to store and retrieve information, they need to focus attention on the group because they use a significant amount of their cognitive resources to request and share expertise. Yet, a moderate frequency of external activities can ensure that groups have requisite information and knowledge variety to complete complex tasks. In support, a study shows that engineers in R&D organizations spend as much time consulting with experts external to their organizations as they do with internal experts (Allen, 1977). Further, a study in software development teams suggests that knowledge of "who-knows-what" is more important to team effectiveness than the possession of specific domain expertise (Faraj & Sproull, 2000). Thus, we formulate the following proposition:

Proposition 1: External group activities have an inverted-U relationship with TMS

Group Diversity

Diversity in groups has visible (e.g., gender) and non-visible (e.g., expertise) dimensions (Milliken & Martins, 1996). Paying little attention to group diversity except for task expertise, TMS theory and research assumes that group members are motivated to share information with each other, allowing groups to pool and store more information. At the same time, diversity research provides evidence that communication among diverse group members tends to be due to low social integration, distrust among members, and low group commitment (Milliken & Martins, 1996). In contrast, group homogeneity increases group members' well being and group identity, and group members feeling good about their group tend to spend more time thinking and talking about the group and its task, enhancing TMS formation and functioning.

While diversity in visible attributes can hinder internal activities and TMS, for example, due to faulty expertise inferences and reduced communication, diverse group members are shown to have more external connections and activities than homogeneous group members (Ancona & Caldwell, 1992). These activities can allow group members to develop their expertise and to be recognized as domain experts. At the same time, reduced internal activities can have negative effects on TMS formation and functioning. For example, Cramton (2001) found that incomplete or uneven information exchange increase frustration and conflicts in groups. Extensive external activities can leave some group members' expertise underutilized, increasing frustration among the underutilized experts.

Group members also differ in non-visible attributes. For example, a project group can be composed primarily of members with low levels of task expertise (e.g., novices in a new project). Large differences in group members' expertise can hinder internal interactions and TMS be-

cause more experienced members need to have external activities to complete the project successfully. Further, research suggests that differences in task expertise tend to increase focus on commonly held information in groups (Wittenbaum, Hubbell, & Zuckerman, 1999). When expertise diversity increases to a high level, it also becomes more difficult to coordinate between group members. When expertise diversity increases, group members can also become increasingly alienated from each other and an even greater effort to coordination is required so that members can leverage on the benefits of expert diversity (Faraj & Sproull, 2000).

Proposition 2: Group diversity moderates the inverted U-shaped relationship between external group activities and TMS; the relationship will be stronger when group diversity is high.

Group leadership

Group leaders coordinate within and between-group interactions, keep groups focused on problems at hand, facilitate communication, stimulate decision-relevant contributions, and keep them active during discussion (Fleishman, Mumford, Zaccaro, Levin, Korotkin, & Hein, 1991). They are also shown to engage in boundary management activities (Allen, 1971; Ancona & Caldwell, 1990; Peltokorpi & Hasu, 2015). To link group leaders to external activities and TMS, I draw on Fleishman et al.'s (1991) typology that divides group leadership activities into information search and structuring, information use in problem-solving, and managing personnel and material resources. Information search and structuring refers to group leader's search, acquisition, evaluation, and organization of information regarding team goals and operations. Information sources exist within/beyond group boundaries. In part due to their work roles, group leaders often link groups to their external environment (Allen, 1971; Ancona & Caldwell, 1990; Peltokorpi & Hasu, 2015). For example, group leader strategies are found to influence the types and frequency of external communication (Ancona, 1990).

Information use in problem-solving is leader's application of the acquired information to problem-solving helping groups to attain their goals (Zaccaro, Rittmtan & Marks, 2001). Group leaders translate assigned missions into workable plans that utilize team resources and accomplish objectives for the team (Fleishman et al., 1991). Research shows that effective planning help teams to develop shared mental models, leading to increased communication efficiency and coordinated performance (Stout, Cannon-Bowers, Salas & Milanovich, 1999). Furthermore, group leaders assign tasks to members who are likely to accomplish them most efficiently, creating links between tasks, expertise, and people (TEP; Brandon & Hollingshead, 2003). This knowledge allocation occurs when groups perform more efficiently by planning explicitly for differential task expertise (Wegner, 1995).

Personnel resource management is obtaining, coordinating, monitoring, and motivating members under leader's command (Zaccaro et al., 2001). Leaders in project groups are in the key position of seeing the whole picture or understanding how different sources of task expertise fit together. Leaders can facilitate information sharing by linking unconnected group members and informing "who knows what" (Peltokorpi & Hasu, 2016). By linking unconnected members, leaders increase network density within groups. A dense group has higher numbers of connected members (given group size), helping groups to integrate or bridge members for easier information sharing and distributed information storage (Austin, 2003). In sum, group leaders take the responsibility of conducting external activities to link the group to external stakeholders and assist internal activities by creating accurate TEP linkages.

Proposition 3: Group leadership moderates the inverted U-shaped relationship between external group activities and TMS; the relationship will be stronger when group leadership is high.

Group size

Group size as the number of group members is also expected to affect external activities and TMS. For example, Shaw (1971) proposed that increased group size introduces opposing forces that have different effects on groups. While larger groups have more cognitive resources at their disposal, they can also experience problems with information diffusion, control, and coordination. As group size increases, it takes longer for new information to reach all members of the group and for the group to achieve high TEP accuracy. From the control perspective, large groups present also greater coordination and control problems. The larger the group size, the greater is the chance that there are goal and information asymmetries between group members.

Computer simulations also suggest that TMS is contingent on group size. For example, group size is found to harm expert recognition accuracy and knowledge differentiation (Palazzolo, Serb, She, Su, & Contractor, 2006), suggesting that larger groups have difficulties to form TMS (Palazzolo, 2005). It is harder for members in large groups to emerge or be recognized as experts. Larger groups can also have multiple experts for specific knowledge domains, making it difficult for group members to identify who the experts are and to transfer information with them. As TMS involves more people, coordination cost increases because the cognitive division of labor is finer with the increase in size in complex task conditions where no single group member has all information required to perform the task. However, small groups can have problems forming TMS since individual members need to specialize in several information domains. Small groups may thus need to have external activities to complete tasks successfully.

Proposition 4: Group size moderates the inverted U-shaped relationship between external group activities and TMS; the relationship will be weaker when the group size is small.

Task interdependence

Task interdependence – the degree of task-driven interactions among group members – (Shea & Guzzo, 1987) describes relationships among group members (Wageman, 1995). At the low level of task interdependence, members do not need to interact to a great extent with one another to integrate their task contributions. In contrast, at the high level of task interdependence, the work arrangements require that members work together closely to accomplish the task (Wageman, 1995). Each group member has to contribute to collective tasks because the withdrawal of anyone in the group may jeopardize the group's success.

TMS theory and research assume groups to have high task interdependence, and that task interdependence is positively related to internal interactions and TMS (Peltokorpi, 2008). TMS is unlikely to be formed unless group members are interdependent and motivated to attend to what others know in the group (Hollingshead, 2001). In laboratory studies on TMS, participants were interdependent; each member's outcome was tied to the performance of other members. Through task-based interactions, group members learn who have relevant knowledge for the task at hand. For example, if one member demonstrates competence in Java programming, others start to rely on those members for tasks related to that computer language. As a result, each member focuses on one part of the task and becomes increasingly incapable to take the roles of others.

However, project groups are often interdependent with their environment (Choi, 2002). The overall group-environment interdependence is determined by the total amount of resources

(e.g., personnel and knowledge) to be transacted across the group boundary to complete a group task (Druskat & Kayes, 1999). In particular, knowledge-intensive project groups are interdependent with external actors. Because high external task interdependence and interactions can have negative effects on TMS, I formulate the following proposal:

Proposition 5: Internal task interdependence moderates the inverted U-shaped relationship between external group activities and TMS; the relationship will be weaker when internal task interdependence is strong.

Task complexity

TMS theory and research generally assume task complexity facilitates TMS formation and functioning due to increased internal activities. For example, Lewis (2003) stated that tasks need to be complicated enough for members to rely on each other to have all the different information necessary for completing a joint task. Although TMS scholars have overlooked external activities, project team research highlights the importance of external activities for the successful completion of complex tasks (Ancona & Caldwell, 1992; Campion, Papper, & Medsker, 1996). The amount of internal resources is linked to external activities because group members access how much, if any, outside resources are needed for the successful project completion. If the group lacks resources, its members can seek useful external contacts to remedy the perceived deficit. Task complexity can thus increase internal and external interactions to a given point. However, internal activities can enhance TMS only to a given point because high internal activities make groups subject to common information. That is why complex tasks encourage group members to have external interactions to acquire information. At the same time, extensive external activities may hinder TMS due to reduced internal interactions and overreliance on within-group expertise.

Proposition 6: Task complexity moderates the inverted U-shaped relationship between external group activities and TMS; the relationship will be weaker when internal task interdependence is strong.

Theoretical and practical implications

This paper provides a set of propositions on how internal and external group activities may affect TMS formation and functioning. Although these activities are interrelated and influence virtually every work group, TMS theory and research have overlooked external activities. A focused paper on external activities is important because group boundaries in TMS theory and research are perceived to be impermeable and outsiders as unimportant. Although this is understandable considering that TMS was developed to describe a cognitive division of labor in intimate couples (Wegner, 1986), organizational groups are closely intertwined with their environment (Thompson, 1967) with the effect that external group activities can influence TMS in work groups.

Instead of assuming only internal activities to explain TMS formation and functioning, the propositions suggest also the importance of external activities. In contrast to laboratory studies with artificial tasks and clearly defined boundaries (Liang et al., 1995), experts in real work groups are often are located beyond the group boundaries. Therefore, TMS does not need to be confined within the group boundaries. Instead of assuming that TMS follow well-defined group boundaries, organizations can be assumed to have multiple subgroups (Anand et al., 1998) and TMS (Peltokorpi, 2014) with different degrees of overlap.

Although the propositions suggest that both internal and external activities matter, their interactions and influence on TMS formation and functioning is complex because the amount of external activities is relational to task demands and internal resources of the group. This makes it difficult to predict to which ex-

tent work groups rely on external information. The interrelation of internal and external interactions can also have either competing or complementary effects on TMS. Although frequent internal activities enable groups to form TMS and motivate domain experts to specialize through external activities, they can lead to too high specialization and make within-group interactions difficult.

The propositions can provide interesting avenues for future research. One potential area of interest is the relationship of external activities with group TMS and group performance. While improved group performance has predominately been attributed to group TMS (Peltokorpi, 2008), little is known about the effects on external group activities. In product development research, where external group activities are found to have a positive impact on group performance (Allen, 1977; Keller, 2001), the key point is that functional diversity has beneficial effects on group performance mainly through increased external communication. The competing or complementary impact of external activities and group TMS on group performance should be examined in future research.

Future research could also examine the possible trade-off between internal and external activities during the project life cycle. In terms of communication, Stork (1991: 180) explained that "individuals' communication patterns will become increasingly constrained by the groups of which they are members.". Due to individual information-processing limits, individuals try to deal with the problem of information overload by considering a limited set of interaction partners within the organization. Individuals can develop strong intragroup communication at the expense of external activities and intergroup communication. An opposite pattern can take place when group members experience a low identity with other group members or projects.

In future research, network analysis could provide a more accurate presentation of group TMS than hierarchical regression models in which group boundaries are often closed. Alternatively, scholars use computational modeling to examine various conceptual linkages to add precision to theory building (Palazzolo et al., 2006; Ren, Carley, & Argote, 2006). Unfortunately, the modeling techniques provide a partial knowledge of social interactions in groups/organizations because they are based on the assumptions of rational agents and perfect information flows. The findings thus need to be verified with real humans in real-world situations with various tasks before anything certain can be concluded for certain.

For practitioners, the propositions indicate that both internal and external activities need to be managed to maximize the efficiency of TMS. As noted by Sundstrom, De Meuse, and Futrell (1990: 130): "The group boundary needs continual management to ensure that it becomes neither too sharply delineated nor too permeable, so that the team neither becomes isolated nor loses its identity". While external activities help to bring new information to groups, they can also disturb group TMS formation and functioning due to the decreased utilization and coordination of group expertise.

Work group expertise also needs to be coordinated. Coordination refers to integrating team members' activities to ensure task accomplishment within established temporal constraints (Cannon-Bowers et al., 1995). A lack of or a failure in coordination between group members could prevent the group from carrying out the established steps or procedures for doing the work. This situation causes what Steiner (1972) called "process losses," which refer to a difference between actual productivity and potential productivity. By coordinating their actions, group members ensure that tasks are sequenced, synchronized, integrated, and completed within established temporal constraints without duplicating or wasting efforts (Cannon-Bowers et al., 1995).

Clear roles can also provide the needed clarity and enable group members to contribute to group TMS. Mission analysis at the group and individual level can clarity group members' roles and have a positive impact on TMS. Team mission analysis ensures that all members understand the group's purpose and have a shared vision of it, which is important for team members who have not worked together before. When group members analyze the group purpose within the organization, they seek and process information about what the group has to accomplish and about the conditions for doing so. Also, they identify their preferences and competencies to figure out what contributions each group member can make to the mission. A thorough mission analysis makes it easier for members to focus their attention and efforts on what is important from the perspective of the group's raison d'etre.

Acknowledgments: A previous version of this paper was presented in the annual Academy of Management conference in the USA.

References

Allen, T. J. (1971). Communication networks in R&D laboratories. *R&D Management*, 1, 14-21.

Allen, T. J. (1977). *Managing the flow of technology*. MIT Press: Cambridge.

Anand, V., Manz, C. C. & Glick, W. H. (1998). An Organizational Memory to Information Management. *Academy of Management Review*, 23(4), 796-809.

Ancona, D. G. (1990). Outward bound: strategies for team survival in the organization. *Academy of Management Journal*, 33, 334-365.

Ancona, D. G. & Caldwell, D. F. (1992). Bridging the boundary: external activity and performance in organizational teams. *Administrative Science Quarterly*, 37: 634-665.

Ancona, D. G. & Caldwell, D. F. (1988). Beyond task and maintenance: defining external functions in groups. *Group and Organization Studies*, 13: 468-494.

Argote, L. (1982). Input uncertainty and organizational coordination in hospital emergency units. *Administrative Science Quarterly*, 27(3), 420-434.

Austin, J. (2003). Transactive Memory in Organizational Groups: The Effects of Content, Consensus, Specialization, and Accuracy on Group Performance. *Journal of Applied Psychology*, 88(5), 866-878.

Brandon, D. P. & Hollingshead, A. B. (2004). Transactive Memory Systems in Organizations: Matching Tasks, Expertise, and People. *Organization Science*, 15(6), 633-644.

Campion, M. A., Papper, E. M. & Medsker, G. J. (1996). Relations between work team characteristics and effectiveness: a replication and extension. *Personnel Psychology*, 49, 429-452.

Choi, J. N. (2002). External activities and team effectiveness: review and empirical development, *Small Group Research*, 33(2), 181-208.

Clark, H. H., & Brennan, S. E. (1991). *Grounding in communication*. In L. B. Resnick, J. M. Levine, & S. D. Teasley (Eds.), *Perspectives on socially shared cognition* (p. 127–149). American Psychological Association.

Costa, P. T. & McCrae, R. R. (1992). *Revised NEO Personality Inventory*. Odessa, FL: Psychological Assessment Resources.

Crampton, C. D. (2001). The mutual knowledge problem and its consequences in geographically distributed teams. *Organization Science*, 12(3), 346-371.

Druskat, V. U. & Kayes, D. C. (1999). The antecedents of team competence: towards a fine grained model of self-managing team effectiveness. In R. Wageman (Ed.), *Research on Managing Groups and Teams: Context* (pp. 201-231), Stanford: JAI.

Guzzo, R. A. & Dickson, M. W. (1996). Teams in organizations: recent research on performance and effectiveness, *Annual Review of Psychology*, 47, 307-338.

Faraj, S. & Sproull, L. (2000). Coordinating Expertise in Software Development Teams, *Management Science*. 46(12), 1554-1568.

Fleishman, E. A., Mumford, M. D., Zaccaro, S. J., Levin, K. Y., Korotkin, A. L. & Hein, M. B. (1991). Taxonomic efforts in the description of leader behavior: a synthesis and functional interpretation, *Leadership Quarterly*, 2(4), 245-287.

Hackman, J, R. (1987). The design of work teams. Handbook of Organizational Behavior, 315-342.

Haslam, S. A. (2001). *Psychology in organizations: The social identity approach*. Thousand Oaks, CA: Sage

Hollingshead, A. B. (2001). Cognitive interdependence and convergent expectations in transactive memory. *Journal of Personality and Social Psychology*, 81(6), 1080-1089.

Katz, R. (1982). The effects of group longevity on project communication and performance. *Administrative Science Quarterly*, 27, 81-104.

Keller, R. T. (2001). Cross-functional project groups in research and new product development: diversity, communications, job stress, and outcomes, *Academy of Management Journal*, 44(3): 547-555.

Lerner, J. S., & Tetlock, P. E. Accounting for the effect of accountability. *Psychological Bulletin*, 125, 255-275.

Levesque, L. L., Wilson, J. M. & Wholey, D. R. (2001). Cognitive diverge and shared cognitive models in software development teams. *Journal of Organizational Behavior*, 22, 135-144.

Lewis, K. (2004). Knowledge and performance in knowledge-worker teams: longitudinal study of transactive memory systems. *Management Science*, 50(11), 1519-1533.

Lewis, K. (2003). Measuring transactive memory systems in the field: scale development and validation. *Journal of Applied Psychology*, 88(4), 587-604.

Liang, D. W., Moreland, R. L. & Argote, L. (1995). Group versus Individual Training and Group Performance: The Mediating Role of Transactive Memory. *Personality and Social Psychology Bulletin*, 21, 384-393.

McGrath, J. E., Arrow, H., & Berdahl, J. L. (2000). The study of groups: past, present and future. *Personality and Social Psychology Review*, 4, 95-105.

Milliken, F. J. & Martins, L. L. (1996). Searching for common threads: understanding the multiple effects of diversity in organizational groups. *Academy of Management Review*, 21, 402-433.

Moreland, R. L., Argote, L., & Krishnan, R. (1996). *Socially shared cognition at work: Transactive memory and group performance*. In J. L. Nye & A. M. Brower (Eds.), *What's social about social cognition? Research on socially shared cognition in small groups* (p. 57–84). Sage Publications, Inc.

Moreland, R. L. & McMinn, J. G. (1999). Gone but not forgotten: loyalty and betrayal among ex-members of small groups. *Personality and Social Psychology Bulletin*, 25(12), 1476-1486.

Mortensen, M (2004). Antecedents and consequences of team boundary disagreement. Academy of Management, New Orleans, August 6-11.

Palazzolo, E. T. (2005). Organizing for information retrieval in transactive memory systems. *Communication Research*, 32(6), 726-761.

Palazzolo, E. T., Serb, D. A., She, Y, Su, C. & Contractor, N. S. (2006). Coevolution of Communication and Knowledge Networks in Transactive Memory Systems: Using Computational Models for Theoretical Development. *Communication Theory*, 16, 233-250

Peltokorpi, V. (2008). Transactive memory systems, *Review of General Psychology*, 12(4), 378-394.

Peltokorpi, V. (2012). Organizational transactive memory: review and extension, *European Psychologist*, 17, 11-20.

Peltokorpi, V. (2014). Transactive Memory System Coordination Mechanisms in Organizations: An Exploratory Case Study, *Group & Organization Management*, 39(4), 444-471.

Peltokorpi, V., & Hasu, M. (2015). Moderating Effects of Transformational Leadership between External Team Learning and Research Team Performance Outcomes. *R&D Management*, 45(3), 304-316.

Peltokorpi, V., & Hasu, M. (2016). Transactive memory systems in research team innovation: A moderated mediation analysis. *Journal of Engineering and Technology Management*, 39(1), 1-12.

Peltokorpi, V., & Hood, A. (2019). Communication in theory and research on transactive memory systems: A literature review. *Topics in Cognitive Science*, 11(4), 644-667.

Peltokorpi, V. & Manka, M-L. (2008). Antecedents and the performance outcome of transactive memory in daycare work groups, *European Psychologist*, 13, 103-113.

Rau, D. (2005). The influence of relationship conflict and trust on the transactive memory: Performance relation in top management teams. *Small Group Research*, 36, 746-771.

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(5): 671-682.

Shaw, M. E. (1971). *The psychology of small group behavior*. Group dynamics: McGraw Hill.

Shea, G. P., & Guzzo, R. A. (1987). Groups as human resources. In K. M. Rowland & G. R. Ferris (Eds.), *Research in personnel and human resources management* (Vol. 5, pp. 323–356). Greenwich, CT: JAI Press.

Sherif, M. (1966). *Group conflict and cooperation*. London: Routledge and Kegan Paul.

Steiner, I. D. (1972). *Group process and productivity*. London: Academic Press.

Stork, D. (1991). A longitudinal study of communication networks: Emergence and evolution in a new research organization. *Journal of Engineering and Technology Management*, 7, 177-196.

Stout, R. W., Cannon-Bowers, J. A., Salas, E. & Milanovich, D. M. 1999. Planning, shared mental models, and coordinated performance: an empirical link is established, *Human Factors*, 41(1): 61-71.

Sundstrom, E., Demeuse, K. P. & Futrell, D. (1990). Work teams: applications and effectiveness. *American Psychologist*, 45: 120-133.

Thomas-Hunt, M. C., Ogden, T. Y. & Neale, M. A. (2003). Who's really sharing? Effects of social and expertise status on knowledge exchange within groups. *Management Science*, 49(4), 464-477.

Thompson, J. D. (1967). *Organizations in action: Social science bases of administrative theory*. New York, NY: McGraw-Hill.

Tushman, M. L. & Katz, R. (1980). External communication and project performance: An investigation into the role of gatekeepers. *Management Science*, 26, 1071-1085.

Wageman, R. (1995). Interdependence and group effectiveness. *Administrative Science Quarterly*, 40(1), 145–180.

Wegner, D. M. (1995). A Computer Network Model of Human Transactive Memory. *Social Cognition*, 13(3), 319-339.

Wegner, D. M. (1986). Transactive Memory: A Contemporary Analysis of the Group Mind. In B. Mullen & G. R. Goethals (Eds.), *Theories of Group Behavior* (pp. 185-208), New York: Springer-Verlag.

Wittenbaum, G. M., Hubbell, A. P., & Zuckerman, C. (1999). Mutual enhancement: Toward an understanding of the collective preference for shared information. *Journal of Personality and Social Psychology*, 77(5), 967–978.

Zaccaro, S. J., Rittman, A. L. & Marks, M. A. (2001). Team Leadership, *Leadership Quarterly*, 12, 451-483.