Transactive Memory Directories in Small Work Units

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Abstract: Despite the increased importance for companies to control their intangible assets, little empirical research has been made on the linkages between single and distributed cognition in organizations. In this paper, the transactive memory concept (Wegner, 1987) is extended and adapted to examine the antecedents and consequences of directory formation in the Nordic subsidiaries in Japan. Value congruence, psychological safety, organizational commitment, and interpersonal- and electronic communication are proposed to have a positive impact on directories. The
directories are proposed to have positive linkage with service capital. Regression analyses show that the most of the independent variables have a statistically significant relationship with directories. Further, interpersonal communication mediates the impact of value congruence and psychological safety to directories. Directories were also found to have a positive relationship with the service capital.

**Keywords:** Directories; transactive memory; communication

Knowledge creation and transfer are essential sources of a firm’s sustainable competitive advantage. In order to stay competitive, companies need to manage their tangible and intangible knowledge assets. One important part of the knowledge management, therefore, is to create linkages between various knowledge domains, whether they are individuals, teams, or departments. In most companies information technology has been utilized to link knowledge seekers with knowledge domains. However, technical pathways are not enough. The knowledge about social networks and expertise also affects the ability for groups and organizations to utilize their knowledge assets (Nonaka & Takeuchi, 1996). Actors in these social domains simply need to know what kind of knowledge is available and where it is located in order to access, retrieve, and combine it efficiently.

Pathways, or directories, linking internal and external knowledge, enable groups and organizations to act as transactive memory systems, where each actor with a distinctive role as a knowledge repository is able to access knowledge from appropriate domains (Wegner, 1987). Directories are the foundation for knowledge creation because people can not retrieve external knowledge without pathways linking it to internal knowledge. The formation of the directories, through social interaction or information technology, is subject to the actors’ social and technical resources
Both of these dimensions are subject to vary in organizations according to the level of information technology, demographics, motivation, and social-emotional climate. Whereas the technical dimension is under increasing interest by scholars and practitioners, personal knowledge and its externalization is the foundation for directories and knowledge creation (Nonaka & Takeuchi, 1996).

Transactive memory research provides evidence that the linkages between internal and external cognition exist and have a positive impact on the performance (Hollingshead, 1998a, 1998b; Liang, Moreland & Argote, 1995; Moreland, Argote & Krishnan, 1996; Moreland & Myosakovskiy, 2000; Rau, 2001; Rulke & Rau, 1997; Wegner, 1987, 1995; Wegner, Erger & Raymond, 1991). The studies show that transactive memories are likely to be formed in teams/dyads that have shared experiences, common language, and joint decision-making. Although the researchers have provided valuable information on various dimensions of transactive memory, to our knowledge, no empirical research has examined the factors that have an impact on directory formation and its consequent impact in organizations. This paper seeks to contribute to the transactive memory research by providing answers to the following questions: (1) What factors promote directories in small work units acting as a part of a global organization? (2) What benefits do directories offer to these small work units? The hypotheses are tested with 111 employees in ten Nordic sales subsidiaries in Japan.

This paper is divided into three sections. The first section starts with a brief explanation of transactive memory and the role of directories. The reviewed literature indicates that directories are more complex in large social entities than in dyads/groups due to hierarchy, location, power, and so on. In the second section, several hypotheses are developed based on the previous research. The basic assumption behind the hypotheses is that the favorable composition and social-emotional climate improves the social interaction, and thus, consequently also the directories. Also, the electronic communication and motivation will positively influence directories. The directories, in turn, reduce individual cognitive load due to specialization, allowing a wider range of information from diverse domains, and thus enabling organizations to respond accurately and fast to environmental stimuli. The following section deals with methodological issues. The results, implications, and limitations are discussed in the concluding sections.
Transactive Memory

Transactive memory is a combination of the knowledge possessed by actors and a collective awareness of ‘who knows what’ (Wegner, 1987). The idea behind the concept is that people in close interaction are able to enact as a single memory system with differentiated responsibility for remembering different portions of common experience. In the system, individuals know the locations, rather than the details of common events, and rely on one and another to contribute missing details that cue their own retrieval. This is possible because actors have learned about another’s areas of experience and/or have become dependent on one and another for acquiring, remembering, and generating knowledge. Therefore, if a question is imposed towards an actor who is a well-integrated part of a transactive memory network, this person often is able to answer (after consultation with other network members) with information well beyond his/her cognitive limits. This is possible because individual cognition is connected to external memories by directories, which enables people to rely on one and another to contribute missing details that cue their own retrieval. The system allows actors to share two types of information, both important to the performance: the knowledge possessed by a particular person and an awareness of ‘who knows what.’ By this account, individual memory systems can become involved into larger, organized memory systems that have distributive cognitive properties that are not traceable to the individuals (Wegner, Erger & Raymond, 1991).

Directory formation, or learning what others are likely to know, enables actors to allocate and retrieve information from collectively recognized experts. The simplest, and often most inaccurate, way to form directories is stereotyping. Research shows that one simply expects different areas of memory storage from a woman than from a man (Ross & Holmberg, 1988). According to Wegner, Erger and Raymond (1991), more advanced ways to form directories are negotiated entries, perceptions of the relative expertise, and access to information. The negotiated entries simply mean that a person agrees to accept the responsibility of certain domains of knowledge and will be known as a repository of relevant items. The social interaction enables actors to create a perception of relative expertise in a given social domain. Expert recognition is a continuous knowledge inventory process over time. For example, in a transactive memory network with three employees A, B, and C, employee A’s perception of how
knowledgeable employee B is, regarding a particular computer software, might increase by directly asking employee B questions and finding that employee B is a good source of information. However, employee A’s perception of employee B’s expertise may decrease after communicating with employee C, who proofs to be more knowledgeable about the topic than employee B. Lastly, network position may enable some actors to have a better access to information than the other ones. In a stable environment, the directories are over time due to contain idiosyncratic information, informing actors about the existence and location of external information, as well as the means of retrieving such information (Wegner, 1987). The search process may occur through a series or strong and weak social ties and/or through information technology.

Directory formation becomes more difficult, the greater the size of a given social entity. The first problem is related to explicit coordination (verbal agreements or formally adopted plans). This difficulty arises not from the number of actors per se, but rather from the horizontal and vertical communication processes (Wittenbaum, Vaughan & Stasser, 1998). Since organizational hierarchies rely on the vertical downward communication, primarily through routines, orders, and directives, it is not likely that the upper echelons have perfect knowledge of expertise at the lower ranks. Due to this, large organizations may have several overlapping transactive memories based on hierarchical layers/specialization (Anand, Manz & Glick, 1998; Kieser & Koch, forthcoming). As organizational information is chunked into a variety of domains, employees specializing into one or two domains maintain directories through interaction concerning the knowledgeable people in other domains. In the original concept, social entities were considered as transparent with perfect information flows (Wegner, 1987). This allows actors to consult each other, as they are perfectly aware who possesses the relevant knowledge. This has given room to criticism that the role of tacit and explicit knowledge has not been separated the original concept due to the close interpersonal interaction (Anand, Manz & Glick, 1998). Further, imperfect social interaction patterns due to diversity, geographical distance, and lack of trust may decrease pathway accuracy and cause problems for actors to transfer tacit knowledge (Jackson, 1996; Nonaka & Takeuchi, 1996).

Technological advancements and the extension of the original concept gives room to divide the directories further into interpersonal- and technical dimensions (Moreland, 1999). The interpersonal dimension deals with social processes, which
enable actors to locate a specific person in the organization and then to obtain the needed information. This interaction may occur within or beyond the focal transactive memory structure due to social networks and information technology. Directories created by social interaction are important due to the tacit knowledge transfer (Hansen, 1999; Nonaka & Takeuchi, 1996). The technological dimension explains how the needed information is obtained through the use of information technology. The information technology enables actors to engage into search activities and to form temporary or permanent information networks both within and without firm boundaries. Using the network terminology, the interpersonal dimension presents the strong ties, whereas the technical dimension presents weak ties in intra- and extra unit patterns of connections (Granovetter, 1973). These two dimensions overlap in most contemporary organizations.

**Hypotheses**

The literature review indicates that directories in organizations are more complicated than in dyads/groups due to structural and psychological factors. For example, since the directories require intense interpersonal communication (Hollingshead, 1998b; Rulke & Rau, 1997; Moreland, Argote & Krishnan, 1996; Wegner, 1987), several intertwined factors, such as organizational demographics, commitment, and social-emotional climate affect the form and accuracy of directories in a given social domain. Thus, I propose that value congruence (Meglino & Ravlin, 1998) and psychological safety (Edmonsson, 1999) promote transactions among individual actors, which increases the awareness of ‘who knows what’ and consequently the company’s ability to respond customer requests accurately. Further, information technology is proposed to play a complementary role in directories, due to its increased influence on the organizational interaction, geographical boundaries in international business, the need for external knowledge, and the linkages with external actors. Lastly, organizational commitment is proposed positively relate towards the directories because of the linkage transfer of internalized knowledge (e.g., Dawes, van de Kragt & Orbell, 1988; Frey & Bohnet, 1995), and the stability of directories (Moreland, Argote & Krishnan, 1996; Wegner, Erger & Raymond, 1991). The hypothesized linkages are shown in figure one.
The model shows that value congruence and psychological safety are the antecedents to interpersonal communication, which mediates their relationship to directories (hypotheses one, two, and four). Further, electronic communications and organizational commitment are proposed to have a direct impact on directories (hypotheses three, five). It is also proposed that directories have a positive impact on service capital (ability to respond customer requests accurately)(hypothesis six).

Value Congruence

Social identity- and transactive memory theories indicate that diversity in readily detectable- (e.g., age, gender, and race) and underlying (e.g., attitudes and values) attributes shape social interaction patterns (Tajfel & Turner, 1986) and directory formation (Wegner, 1987). These theoretical conceptualizations are confirmed in literature reviews, which indicate that diversity in most cases has a detrimental impact on affective processes, such as interpersonal communication (c.f., Milliken & Martins, 1996; Williams & O’Reilly, 1998). Whereas the results on the readily detectable attributes are fairly consistent, little certain can be said about the impact of values on social interaction and transactive memory directories due to a lack of empirical research.

Values have a strong and permanent impact on social interaction and directory formation in groups/organizations (e.g., Dose & Klimoski, 1999). Empirical studies indicate that people tend to begin the social categorization process with readily detectable attributes because they are subject to visual cues. Attitudes and values are likely to play a more important role in the long run because their assessment tends to require more extensive social interaction and information processing. For example, Polzer, Milton, and Swann (2002) found that the negative effect of the readily detectable attributes were attenuated when individuals were interpersonally congruent, suggesting that similarity in perspectives can moderate the effects of differences in readily detectable attributes. Further, Van der Vegt (2002) found a clear negative link between attitudinal diversity and social integration in work groups. These studies suggest that when individuals share common attitudes and values,
people are motivated to form transactive directories based on negotiated entries.

The detrimental impact of value diversity on directory formation and management is based on limited intergroup interaction and cognitive differences (Anand, Manz & Glick, 1998; Erez & Earley, 1993; Tajfel & Turner, 1986). For example, a field study in a medium-size software company indicates that value diversity may create a barrier to the accurate assessment of relative expertise (McDonald & Ackerman, 1998). The study illustrates vividly how a foreign software engineer had a completely different view from his American counterparts regarding the clients’ future needs and problems. Limited interaction with the foreign employee may provide distorted views of relative expertise due to the value differences; despite the fact that this person is an expert in particular medical software. Researchers further assert that values provide a strong basis for in-group and out-group categorization, especially in cross-cultural organizations (Erez & Earley, 1993).

Since much of the empirical work on transactive memory has been conducted using intimate couples in a controlled environment, only two experimental studies have linked diversity with transactive memory structures (Myaskovsky, 2001; Rau, 2001). First, research shows that gender diversity does not have a significant impact on transactive memory in temporary groups (Mosakowski, 2001). Group members that were trained together, rather than apart, strengthened the positive feelings among same-gender groups, but weakened positive feelings among mixed-gender groups. Second, Rau, (2001) in an authentic field study, found that underlying attributes (functional background and industry expertise) are not statistically related with transactive memory in top management teams. Taken together, the studies suggest that whereas diversity may not have a direct impact on transactive memory, it might have an indirect impact through social interaction processes such as interpersonal communication. Hence, as value congruence facilitates the interpretation and classifying environmental events in similar ways and the easiness of interpersonal communication (Dose & Klimoski, 1999; Meglino & Ravlin, 1998), it is also proposed to assist directory formation and management.

**Hypothesis 1 (H1):** Value congruence is positively related to directories.
Psychological Safety

Psychological safety is defined as a shared belief that environment is safe for interpersonal risk taking (Edmondson, 1999). This refers to a social-emotional climate where actors are not rejected or punished for expressing their ideas and speaking up. As a consequence, psychological safety deviates from cohesion, which has shown to reduce willingness to disagree or challenge others’ views (Janis, 1982). The examination of the direct impact of a social-emotional climate on the directories has not gone beyond the assertion that transactive memory flourishes in social environment where people, know, trust, like, help, and rely on each other, and where they appreciate each other’s unique abilities and contributions (Wegner, 1987). This might be due to concentration of research on intimate couples, which, in principle, should have developed an environment for open communication.

Research shows that a social-emotional climate has a positive impact on information sharing (e.g., Larson, Foster-Fishman & Keys, 1994), because people often fail to externalize and/or overweigh commonly shared information in decision-making (Stasser & Titus, 1985). The overemphasis of common knowledge takes place either due to psychological conformity towards commonly held opinions (concern to agree on an answer than on coming to the correct answer), and/or natural tendency for people not to share personal information in psychologically unsafe environment. The imperfect information sharing may lead to exaggeration or inaccurate retrieval cues because people do not have complete knowledge who is an expert in a given information domain (Wegner, 1987). This simply makes it hard for people to direct and retrieve information to the right domains, leaving transactive memory systems underdeveloped. Taking into account the above findings, it can be asserted that pathway accuracy and expert recognition is most developed in a psychologically safe environment.

**Hypothesis 2 (H2):** Psychological safety is positively related to directories.

Organizational Commitment
Organizational commitment refers to a binding of the individuals to the behavioral acts that results when individuals attribute an attitude of commitment to themselves after engaging in behaviors that are volitional, explicit, and irrevocable (Salancik, 1977). The definition indicates that an individual’s commitment to the organization is a fairly loose psychological construct because it deals with the organization as a whole, rather than with a narrower focus such as job, role, or supervisor. The important parts of organizational commitment to the current research are information sharing (Dawes, van de Kragt & Orbell, 1988; Frey & Bohnet, 1995) and the impact of turnover (Moreland, 1999; Moreland, Argote & Krishan, 1996; Wegner, Erger & Raymond, 1991) to transactive memory.

In many organizations, the structure and operating premises decrease actors’ commitment to share their knowledge. Research on expertise transfer shows that organizational attributes, such as extensive competition, strict control, and hierarchy, decrease information sharing (Cicourel, 1990; Hinds & Pfeffer, forthcoming). An interesting assertion is that enforced competition among employees/units actually increases the cost for individuals to share their knowledge (Hinds & Pfeffer, forthcoming). Without reciprocity, information sharing in competitive environment means sharing power – and one is not motivated to share information if the related costs are higher than the consequent benefits. Furthermore, whereas formal hierarchies serve the purpose of coordinating and increasing the efficiency of organizational information flows, research shows that it may decrease information sharing (e.g., Cicourel, 1990). For example, research on communication patterns in operating room teams shows that nurses and other low status employees often were reluctant to share their expertise and advice with surgeons (Cicourel, 1990). This is because surgeons were reported to respond negatively to advise from the lower status team members. This finding is parallel to the research showing that participation and personal relationships are foundations for intrinsic motivation and transfer of internalized knowledge (e.g., Dawes, van de Kragt & Orbell, 1988; Frey & Bohnet, 1995).

Researchers have long provided evidence that low organizational commitment increases employee turnover (see a review by Reichers, 1985). As efficient transactive memory systems are characterized by low redundancy (i.e., each member has unique information stored in his/her memory), they are vulnerable to employee turnover (Dess & Shaw, 2001). Personnel instability (caused by either a new member entering
the system or an old member leaving the system) would take away certain expertise or bring in a different set of expertise and therefore change ‘the distribution of task-relevant knowledge’ in the system (Moreland, 1999:7). Moreland, Argote, and Krishnan (1996) examined whether a transactive memory system would be transferred from the group in which it was developed to a group composed of different members. Results indicated that transactive memory did not transfer to groups composed of different members. Similarly, Wegner, Erger & Raymond (1991) found that imposing division of labor on an ongoing dyad that had already developed its own knowledge ‘who is good at what’ hurt the performance of the dyad. Given that strongly committed employees share information and have an interest in remaining with the organization, one might expect that they will have a heightened interest to know ‘who knows what’ in the organization.

**Hypothesis 3 (H3):** Organizational commitment is positively related to directories.

**Interpersonal Communication**

Interpersonal communication plays an integral role in the manner in which knowledge is learned and retrieved in transactive memory systems (Hollingshead, 1998a, 1998b; Wegner, Erger & Raymond, 1991). Since part of the transactive memory directory concept resembles communication networks, the present study combines the information richness theory with the network perspective to explain how collective understanding of relative expertise is created and maintained in groups and organizations. Linkage of transactive memory research with network and knowledge management research (e.g., Hansen, 1999; Nonaka & Takeuchi, 1996) shows that face-to-face communication contributes to the directory development and updating in two interrelated ways. First, interpersonal communication helps to discern whether the needed information is shared, unique, or not know by anyone in a given social entity. Second, information richness theory asserts that the strong ties provide a rich medium to transfer knowledge (Daft & Lengel, 1986).

The most accurate directories are created though interpersonal communication because the strength of social ties determines how much tacit knowledge can be transferred (Granovetter, 1973; Hansen, 1999; Nonaka & Takeuchi, 1996). This form
of knowledge is transferred most efficiently through strong ties, which are built through time, emotional intensity, and reciprocity (e.g., Wegner, Erger & Raymond, 1991; Hollingshead, 1998a, 1998b). The weak ties enable to scan a wide amount of information, which, however, are hard to transfer due to inadequate ‘bandwidth’ or carrying capacity. These differences between strong and weak ties are illustrated in a recent research, which shows that project teams in a large electronic company use weak ties to search useful knowledge from other subunits (Hansen, 1999). Thus, weak ties speed up projects when knowledge is not complex, but slows them down when the knowledge to be transferred is highly complex. This study shows that directories are developed and maintained through weak and strong ties. The difference lies in the pathway accuracy. Whereas the frequency of communication may help actors to identify a large amount of possible knowledge repositories, the depth of communication can be linked with tacit knowledge transfer. Therefore, the cost of weak ties can be poorly developed directories and lowered pathway accuracy.

The logic of strong and weak ties can be elaborated to explain why pathway accuracy may remain at a sub-optimal level in groups/organizations. It can be assumed that internal pathways are most inaccurate among people who are working together for the first time and/or in groups/organizations subject to a strong in-group/out-group categorization. In both cases, transactive directories are poorly formed within the collective unit due to redundant knowledge and faulty perceptions of the relative expertise. In some cases, people may even have a stronger extra-unit communication ties due to social exclusion or lack of relevant expertise. It can be conceptualized that optimal transactive memory directories, within a given work unit, consist of a series of strong and weak ties. It is likely that negotiated entries are created within work units through frequent social interaction due to shared corporate identity and performance assessment, whereas the perceptions of relative expertise and access to information may exist either within or beyond the collective boundaries. In summary, in a well-developed transactive memory system, each individual possesses different areas of expertise, but can assess the knowledge that others possess by accurately identifying who is knowledgeable in different areas (Wegner, 1987).

While communication frequency facilitates the information exchange, the effective pathway formation depends upon the type of interactions. The information richness theory (Daft & Lengel, 1986) states that face-to-face interaction provides the richest
medium for interaction due to nonverbal communication and paralinguistic cues (eye contact, body language, tone of voice, etc.) and the possibility for instant feedback. While Anand, Manz and Glick (1998) assert that the media richness theory deviates from the transactive memory; several researchers have linked the depth of information exchange to the transactive memory concept. Indeed, compared to face-to-face interaction, electronic mail has several weaknesses such as different transmission and feedback time lags as well as constraints on the channels or modalities by which information can be transmitted (e.g., non-verbal cues are absent in computer-mediated communication). In a recent study, distributed workers were found to have less overlapping in their mental representations, in terms of the task and work context, than co-located workers (Hinds, 2000). Further, intimate couples perform better in a face-to-face knowledge-pooling task in comparison to strangers (Hollingshead, 1998b). The intimate couples also scored significantly better on the knowledge task when they had an access to either nonverbal or paralinguistic communication cues.

The above studies provide evidence that strong ties provide more accurate path way accuracy than weak ties, and that face-to-face interaction is more efficient way to exchange complex information than computer mediated interaction. It is important to note that transactive directories are not static, but dynamic and constantly evolving through communicative interaction. The core of the system is the strong ties that enable to transfer tacit knowledge, accurate expert recognition, and to create shared belief structures and negotiated entries (e.g., Klimoski & Mohammed, 1994). The weak ties provide opportunities to update directories through expert recognition and link several transactive memory systems. It can be further asserted that weak ties may develop over time to strong ties, depending on the location of the employee and a need for complementary knowledge. Furthermore, focal actors can be linked to several other employees through strong ties and a disappearance of strong linkages may disturb transactive memory structures (Moreland, 1999; Moreland, Argote & Krishnan, 1996). Since perceived similarity and favorable social-emotional climate facilitate the development of strong ties (and to some degree of weak ties), interpersonal communication can be asserted to have a mediating role with value congruence and psychological safety.

**Hypothesis 4 (H4):** Interpersonal communication mediates the relationship between value congruence and psychological safety on directories.
The information technology supports rapid and cost-efficient communication across vast distances and time zones. The role of information technology has increased especially in multinational companies that need to transfer large amounts of data across units in different parts of the world. As employees increasingly rely on computer-mediated communication, directories can be created and updated both by human contact and human-machine interaction. Information technology also enables to link several transactive memory structures as actors participate to several groups, or as complementary information is exchanged between transactive memory systems (Anad, Manz & Glick, 1998). This increased connectivity through weak ties and radial networks provides actors an access to a larger base of potential expertise than by sole social interaction.

Electronic mail can be linked to directories through dyadic interaction (Moreland, 1999). Employees can simply engage into search activities through electronic mail by sending a message to everyone connected by similar interest or to a relevant distribution list. These broad requests for information to previously unknown people may sometimes lead to more permanent and intensive dyadic communication linkages (Steinfield, 1983). This way, the repeated contacts and clarifications may become slowly more interpersonal enabling processual development of directories and transactive memory structures. Research provides evidence that emergent groups have been developed through the use of electronic mail and electronic bulletin boards (Eveland & Bikson, 1987; Finholt & Sproull, 1990). These groups were indicated to transcend the existing organization structure, forming a new, overarching layer based on information need. The basic idea here is that through exchanged messages, employees are gradually able to assess and identify each other’s competencies and use them as external memory systems.

Electronic communication can also be used to maintain existing directories by periodical interaction. This way computer-mediated communication is frequently used to compliment face-to-face meetings in various work relationships. The need for this kind of interaction could be needed, for example, among colleagues working for a project in the same company in different geographical locations. In such collaborations, nonverbal communication may not be as important for effective
information retrieval as colleagues learn how to adjust their communication to the medium over continuing experience (Hollingshead, McGrath & O’Connor, 1993). Taking further into account the benefits of the speed and the cost, electronic communication may enable employees to be part of several transactive memories.

The other forms of information technology linked to directory formation are databases, group ware, and electronic yellow-page technology (Moreland, 1999). Since knowledge is difficult to transfer (Nonaka & Takeuchi, 1996), the goal of most of these systems is to connect experts with knowledge seekers. These systems allow employees to learn the cues and location of collectively recognized organizational expertise and job responsibilities by specific keywords and/or categories. Due to this, employees do not need necessarily to rely on social ties to locate ‘who knows what’ because of the identified location of an item with a certain label. Research provides evidence that queries of the expert database leads to personal contacts with individuals that would not have occurred except through the information provided in the database (Finholt, 1993). Furthermore, the frequently used group ware, Lotus Notes, enables employees to review the thread of discussions that had emerged on particular issues and to record and review the views and experiences regardless of their disciplinary background. This allows employees to rely on their own judgement from who to retrieve information. In summary, knowledge codification in knowledge sharing systems gives a structured way to identify and assess organizational sources of expertise.

**Hypothesis 5 (H5):** Electronic communication positively related to directories.

**Directories**

The ability for people to utilize external knowledge is a foundation for knowledge holding systems that are larger and more complex than either of the individuals own memory systems. Although the transactive memory – performance linkage is well documented in groups/dyads (e.g., Hollingshead, 1998a, 1998b; Liang, Moreland & Argote, 1995; Wegner, 1987), little research links it with organizational performance. Parallel to the previous research, it is assumed in the present paper that information allocation, integrative retrieval processes, and specialization leads to increased information-processing capacity in organizations.
Transactive memory is claimed to reduce individual cognitive load due to specialization, allowing social entities to have a wide range of information from diverse domains (Anand, Manz & Glick, 1998; Dess & Shaw, 2001; Wegner, 1987). Basically, each member has a distinctive role in a well-functioning transactive system. The related expert recognition facilitates task allocation and organizational learning (Argote & Ingram, 2000; Kieser & Koch, forthcoming). The specialization in organizational learning literature is an important source of productivity because it helps to route incoming information to and retrieve it from the appropriate people (Argote, 1993). Another factor linked to organizational performance is integrative retrieval processes because combination of two ideas might add up to the third idea (Wegner, 1987). For example, organizational actors, who might be asked to give ideas, related to customer service, might each put forward different ideas due to responsibility of different knowledge domains. Taken one at the time, these suggestions may not be noteworthy, but taken together the result might be significant. Integration of various knowledge bases has been acknowledged as one of the fundamentals in knowledge creation process (Nonaka & Takeuchi, 1996).

Despite the long laundry list of possible benefits, only few studies have demonstrated linkages between directories and organizational performance (Rau, 2001; Thomas, Clark & Gioia, 1993). First, Rau (2001) found that transactive memory has a positive influence on ROI in banks. Further, Thomas, Clark and Gioia (1993) show that information gathering is positively linked with admissions and profit in hospitals. In this study, directories are proposed to enhance service capital (ability to respond customers requests accurately) in three interconnected ways. First, accurate directories help organizations to respond fast and accurately to external stimuli (e.g., customer inquiries, complaints, etc.). This is possible because of specialization through expert recognition, which enables work units to store and retrieve information from collectively acknowledged sources. Second, directories enhance task allocation. Basically, transactive directories and expert recognition enable organizations to place the right people in the right positions. Third, integrative retrieval processes enable organizations to provide products and services based on customer needs, as various perspectives are utilized in decision-making. In sum, the complex and dynamic net of transactive directories can be conceptualized as an information processing system characteristics of non-redundant knowledge that enable to combine complementary knowledge bases and to link the firm’s internal capabilities with environmental
Hypothesis 6 (H6): Directories are positively related to service capital.

Methodology

Subjects and Procedures

The population for the study consists of 111 employees in ten (average size of 13 employees) small Nordic sales subsidiaries in Japan. The selection was based on two criteria: (1) size (< 20 employees) to maximize the impact of social interaction and to reduce structural impact; (2) the primary activity in sales and sales support to decrease industry variance. The companies’ coordinates were sustained through the respective chambers of commerce. The company presidents were contacted for the interviews where the questionnaires were distributed. The purpose of the personal interviews was two-folded. First, to maximize response rate. Second, to get additional information about the social processes that may influence directories.

Reflecting business activities, most respondents are working in marketing and sales (55%), and supporting administrative (13.5%) positions. Similarly, male employees are dominant in sales-related subsidiaries with a 68 percent share. The subjects have worked in the subsidiaries less than two years (42.3%), or two to five years (33.9%). The majority of the respondents have obtained a four-year bachelor (50.5%), or Masters-level education (18%). Most respondents were Japanese with a 89 percent share. Nordic nationalities were distributed evenly in the sample holding mostly managerial positions. The average age of the respondents was 36 years (standard deviation 9.9258). Material for the study was collected in 2002.

Measures

All the scales were measured with a five-point Likert response format ranging from ‘1 = to no extent’ to ‘5 = to a great extent.’ The questionnaires were distributed in English and Japanese. Japanese questionnaires were translated and back translated from English to Japanese and double-checked by two bilingual Japanese.
Value congruence indicates the perceptual differences in work values. The perceptual assessment of values, simply by asking respondents to estimate the extent their values, are similar to those of others what has been suggested in work value literature due to its relative accuracy (Meglino & Ravlin, 1998). The used scale, measured by a four-item scale ($\alpha = .8156$), was taken from Jehn’s (1995) study. The original construct was labeled as value diversity, but as the mean indicated high similarity in values, the scale was relabeled as value congruence. A four-item scale ($\alpha = .7788$) from Edmonson (1999) was used to measure psychological safety. Four items for the organizational commitment scale ($\alpha = .7637$) were taken from O’Reilly and Chatman’s (1986) study.

Scale for interpersonal communication ($\alpha = .8294$) was created combining items from three scales. First, Hoegl and Gemuenden (2001) ‘there is frequent communication in my work unit. Second, Earley and Mosakowski (2000) ‘people talk openly and freely in my work unit.’ The last four items were taken from a knowledge survey used at Hitotsubashi University: ‘we raise new ideas through free discussion’; ‘there are frequently meetings where we can express our ideas and opinions’; ‘we really listen to one another and try to understand the feelings and points of view of each other’; and ‘we spend a lot of time outside the workplace socializing.’ These questions, designed to measure organizational knowledge creation process, are validated by Nonaka, Byosiere, Borucki, and Konno (1994).

The scale for electric communication ($\alpha = .8253$) contained the following items: ‘information is distributed mostly through electronical communication in my company’, ‘electronic communication is used frequently in my company,’ and ‘we can store and derive information using the company database.’ The scale measuring directories ($\alpha = .7343$) contain the following items: ‘when exposed to novel task/problem with no clear solution, I am able to identify a person with relevant knowledge in my company’, ‘I know who has what kind of specialized expertise in my company’, ‘I know who is assigned to what task in my company,’ and ‘people in my work unit know the right people and sources of information to perform efficiently’. Service capital ($\alpha = .61$) was measured by two items: ‘This company is effective at retaining customers’, and ‘This company is effective at putting itself in the position of customer to identify their problems and needs.’
Results

Summary descriptive statistics and the correlation matrix are presented in table one. The mean and standard deviation of each construct are reported in the first two columns. All correlation coefficients are significant at the .01 level (two-tailed test).

***Insert Table one about here***

The measures indicate positive relationship among the used variables. For hypothesis testing, multicollinearity is not considered problematic until correlations reach .75 (Kennedy, 1979). Thus, the correlation \( r = .766, p < .01 \) between electronic communication and psychological safety might be a sign of multicollinearity. However, there was no feasible reason to combine these scales based on previous research, used questions, and/or factor analysis. To facilitate interpretation and minimize the possible problems of multicollinearity, the following analyses were conducted with centered variables (Aiken & West, 1991).

Six linear regression models were formed for hypotheses testing. The mediating relationships were conducted following the three steps proposed by Baron and Kenny (1986). The first step for mediation is indicated if the initial variable correlates with the outcomes. The second step is indicated if the initial variable is related with the mediator. The third criterion holds that the effect of the independent and the dependent variable has to diminish (partial mediation), or disappear (complete mediation) after including the mediator in the regression equation.

The first regression in table two shows the direct effects of independent variables to the dependent variable. The following two regression analyses tests the mediating role of directories.

***Insert Table two about here***

The first regression indicates that there is a positive relationship between electronic communication \( \beta = .308, p < .01 \), organizational commitment \( \beta = .198, p < .05 \), value congruence \( \beta = .304, p < .01 \), and directories. Thus, hypotheses one, three, and five are given statistically significant support. Hypothesis two, the direct linkage
between psychological safety and directories, was not supported. The third regression model indicates a positive relationship between directories and service capital ($\beta = .282, p < .01$), giving support for hypothesis six. The regression analyses show that directories mediate the relationships between electronic communication, interpersonal communication, organizational commitment, and service capital. It should be noted that step one is not required, if the path from the initial variable to the mediator and diminishing impact is indicated (Judd & Kenny, 1981).

Regression models in table three test the mediating role of interpersonal communication.

***Insert Table three about here***

The regression models show that interpersonal communication partially mediates the relationship between value congruence, psychological safety, and directories. Thus, hypothesis three is supported.

**Discussion**

Researchers in the fields of knowledge management and social psychology suggest that a specialized division of cognitive labor and intensive social interaction enable collective entities to create a structured way to process knowledge (Anand, Manz & Glick, 1998; Nonaka & Takeuchi, 1996; Wegner, 1987). The transactive memory concept describes the collective of individuals, their memory systems, and the communication that occurs between them (Wegner, 1987). To date, much of the empirical work on transactive memory has been conducted using controlled experimental studies of small groups comprised on two- to three-person teams working on relatively simple collaborative tasks. In this paper, the original concept of transactive memory is extended to deepen our understanding of the antecedents and consequences of directories in small work units. In addition to the previously found contributing impact of interpersonal communication, the results show also that value congruence, commitment, and electronic communication have a profound impact on directories in organizations.
The results firstly indicate that value congruence is positively related to transactive directories, both directly and through interpersonal communication. The mediated relation is in line with the recent conceptualizations claiming that value congruence decreases ‘cognitive noise’ and facilitates interpersonal communication (e.g., Dose & Klimoski, 1998). In contrast, cognitive differences require a significant cognitive effort and it is likely to result in negative feelings about the interaction with dissimilar employees. This linkage should not be confused with social innovation/knowledge creation, as cognitive variety is frequently found to have a positive relation with cognitive outcomes (Milliken & Martins, 1996). What can be concluded, instead, is that value congruence facilitates collective understanding of ‘who knows what’ through the depth and frequency of interpersonal communication. Since value congruence reduces the cognitive costs in communicative interaction, employees are able to recognize experts in their transactive memory systems. These properties can be linked with pathway accuracy, allowing the work units to develop a larger cognitive capacity than combined amount of individual repositories. It can also be assumed that the hostility and anxiety decreases directory formation and may distract employees from providing the optimal service to customers.

Electronic communication was surprisingly found to have the strongest relationship ($\beta = .308, p < .01$) with transactive directories. This gives empirical proof to the conceptual division of directories into interpersonal and technical dimensions (Moreland, 1999). Building on Moreland’s conceptual paper, it can further be claimed that electronic communication has an important role in the maintenance of the directories. While part of the electronic communication is used to send reports to headquarters, it provides chances for actors to form and maintain flexible communication networks. These information networks are formed to transfer knowledge among people linked through integrative work processes and common interests within and without the organizational boundaries. Employees who do not find the needed knowledge through the current directories may also rely on electronic communication in search activities to a certain extent. In some cases, prolonged information exchange enhances directory accuracy and enables people to turn to right places when external information is needed. If people have are already formed directories, simple and unequivocal information can be retrieved effectively and efficiently by electronic communication (Daft & Lengel, 1986). However, it can be
asserted that information technology is limited to transfer tacit knowledge that can be acquired mostly through observation and face-to-face interaction (Nonaka & Takeuchi, 1996).

The nature of the examined work units also partly explains why information technology is utilized largely in search activities and directory maintenance. Most of the researched work units are knowledge-intensive, indicating that employees utilize various information technology applications to locate and retrieve knowledge. It can be further assumed that the employees need to contact their colleagues beyond the unit borders and to seek knowledge through information technology because adequate information sources might not be available in the work unit. Whereas communication technology plays an important part in information exchange, the interviews reveal that training sessions at headquarters as well as internal ties within a work unit may also play an important role in creating shared understanding where information is located in the organizational network. That is, employees may locate experts within their organizational network through face-to-face interaction and use information technology for information retrieval. Further, research indicates that since electronic mail is increasingly playing a primary mode of communication in some work relationships, people learn how to adjust their communication to the medium through continuing experience (Hollingshead, McGrath, & O'Connor, 1993).

The strong role of electronic communication does not rule out the importance of interpersonal communication. In contrary, taking into account the size of the unit and value congruence, it can be assumed that the directories in these units are well developed, and utilized actively to locate and retrieve knowledge. In other words, the internal network density allows actors to rely on each other in search process due to actors various memberships in overlapping transactive memory systems. For example, person A may help person B to create a directory with person C due to person A and B’s membership in the same transactive memory system. This way, B uses his/her strong ties with actor A in search process that may eventually lead to directory formation with actor C. The wide utilization of strong ties explains why transactive networks are sensitive to employee turnover. The utilization of strong ties in the search process might be especially important in Japan where social capital determines ones access to both internal and external information. Therefore, the network density within the unit and the nature of external linkages enables employees to search and utilize information from various domains. The search process may occur through
social ties or information technology. The chosen media determines what kind of knowledge can be retrieved. In principle, face-to-face communication can be used to transfer tacit and socially complex knowledge. Leaner forms of communication are likely to have inadequate ‘bandwidth’ or carrying capacity (Hansen, 1999; Nonaka & Takeuchi, 1996).

The above discussion gives room to suggest that electronic- and interpersonal communication have complementary roles. Basically, whereas the strong ties through interpersonal communication enable to transfer tacit knowledge, organizations need to have weak ties through electronic communication for scanning purposes. These forms of communication enable organizations to obtain complex knowledge networks that link several overlapping transactive memories within and beyond organizational boundaries (Anad, Manz & Glick, 1998). The managerial interviews provide a concrete example how this works in a multinational company. According to the interviews, the subsidiary managers are often acting as a part of several transactive memory systems. Some of these are created through the interaction with subordinates in the work unit. Other linkages, for example, could be created or maintained through computer-mediated and occasional interpersonal contacts with colleagues at the headquarters/other subsidiaries. As indicated in the interviews, the managers use directories used in social interaction with other subsidiary managers, especially in practical issues. Most of these managers have formed the directories with the other managers at headquarters before their expatriate assignments.

The final linkage with the directories is the organizational motivation. The finding can be related to research that links motivation to knowledge transfer and participation (Dawes, van de Kragt & Orbell, 1988; Frey & Bohnet, 1995). A natural part of the commitment is to take responsibility of certain knowledge domains and to find out who possess what kind of knowledge in the work unit. Further, motivated employees engage in to search activities and help to create directories linking two or several transactive memory systems. In short, the employee’s motivation facilitates search activities, information allocation, and retrieval processes. It can further be assumed that the commitment – employee turnover linkage increase pathway accuracy and the directory’s stability.

The results also indicate that directories have a positive impact on service capital (ability to respond customer requests accurately). The finding is parallel with previous research showing evidence that environmental scanning and knowing ‘who knows
what’ has a positive impact on performance (Rau, 2001; Thomas, Clark & Gioia, 1993). In this study, directories may increase the actors’ ability to locate and utilize information. That is, transactive directories have a time saving function because employees can turn to a colleague instead of engaging into lengthy search activity. Moreover, the directories decrease causal ambiguity (i.e., imperfect understanding of the relationship between inputs and outputs) helping employees to respond fast and accurately to external stimuli.

There are implications for practice that can be drawn from this study. It is logical to note that transactive directories play a central role linking organizational commitment and communicative behavior to service capital because motivated employees tend to take more responsibilities and to find out collective sources of expertise. The finding can be supported by research, which shows that employees are motivated to undertake actions based on collective reinforcement (Bandura, 1986), and that people are motivated to help others when they perceive it, will effectively improve another’s condition (Utne & Kidd, 1980). In short, the division of labor and the wide utilization of collective expertise is most likely to take place in organizations with close and frequent interaction, supportive organizational climates and motivated employees.

There are several ways to increase the formation and maintenance of transactive memory directories. First, managers may promote collaborative work practices and group training-sessions where people are able to engage into close social interaction, and thus develop negotiated entries, perceptions of the relative expertise, and have access to individualized knowledge. Second, loose job descriptions may facilitate a task allocation based on collectively recognized expertise. Hence, it is important for managers to support naturally occurring cognitive division of labor rather than seek to kill it by emphasizing formalized division of work. In short, effective transactive memory directories can be seen as collectively supported knowledge networks where all employees recognize relevant sources of expertise, take responsibility and act as a source and depository in an interlinked knowledge system.

**Limitations**

This study has several limitations. First, this study relies on self-reported scales, increasing the possibility for response-bias. This is most problematic with the
perceived the scale measuring the service capital. However, on the other hand, research indicates that individuals perceive themselves and their social environment accurately (Funder & Dobroth, 1987). This should make the results less distorted and less subject to the problems of common method variance.

Second, the scales are limited to measure all dimensions attributed to the directories. The focus in this study was deliberately paid on expert recognition because it helps employees to utilize external knowledge. This measurement problem is due to occur because organizational environment provides more complex environment than previous studies of dyads/groups in controlled environment. Despite these methodological weaknesses, this research can be seen as one of the first steps to examine directories in organizations.

Third, some variables in the research model are subject to reversed causality. This is most apparent with organizational commitment, which can be used as both an antecedent and consequence of directories. Research shows that organizational commitment is linked to both information sharing (Dawes, van de Kragt & Orbell, 1988; Frey & Bohnet, 1995), and that expert recognition and specialization increase commitment and job satisfaction (e.g., Yamarino & Naughton, 1988).

Conclusion

This paper investigates the antecedents and consequences of transactive directories in small work units. The results indicate that value congruence and psychological safety enhance interpersonal communication, which, combined with electronic communication and organizational commitment, increases accurate presentation of ‘who knows what’ and from where to retrieve the needed information. The transactive directories have a positive connection with the service capital (ability to respond customer requests accurately). Taken together, the results suggest that directories decrease causal ambiguity (i.e., imperfect understanding of the relationship between inputs and outputs) because various knowledge repositories can be combined and utilized dynamically.

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References


**Figure 1.** Research model
Table 1. Univariate statistics and Pearson Correlations among the Variables (N = 111)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Value congruence</td>
<td>3.114</td>
<td>.980</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Psychological safety</td>
<td>3.441</td>
<td>.887</td>
<td>.557*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Org. commitment</td>
<td>3.421</td>
<td>.804</td>
<td>.459**</td>
<td>.638**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Communication</td>
<td>3.453</td>
<td>.817</td>
<td>.282**</td>
<td>.311**</td>
<td>.424**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Electronical com.</td>
<td>4.054</td>
<td>1.033</td>
<td>.576**</td>
<td>.766**</td>
<td>.576**</td>
<td>.276**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Directories</td>
<td>3.599</td>
<td>.780</td>
<td>.553**</td>
<td>.457**</td>
<td>.531**</td>
<td>.507**</td>
<td>.522**</td>
<td></td>
</tr>
<tr>
<td>7. Service capital</td>
<td>3.414</td>
<td>.868</td>
<td>.339**</td>
<td>.362**</td>
<td>.506**</td>
<td>.496**</td>
<td>.376**</td>
<td>.544**</td>
</tr>
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</table>

** Correlation is significant at the 0.01 level (2 - tailed)
* Correlation is significant at the 0.05 level (2 - tailed)

Table 2. Regression models for main effects and moderating role for directories

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Directories</th>
<th>Service capital</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main effects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interpersonal communication</td>
<td>.239*</td>
<td>.117</td>
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<td>Electronic communication</td>
<td>.308**</td>
<td>.335**</td>
</tr>
<tr>
<td>Organizational commitment</td>
<td>.198*</td>
<td>.306**</td>
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<td>Psychological safety</td>
<td>-.118</td>
<td>-.068</td>
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<tr>
<td>Value congruence</td>
<td>-.304**</td>
<td>.075</td>
</tr>
<tr>
<td>R-square</td>
<td>.477</td>
<td>.335</td>
</tr>
<tr>
<td>F</td>
<td>21.034**</td>
<td>12.090**</td>
</tr>
<tr>
<td><strong>Mediator</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Directories</td>
<td>.282**</td>
<td></td>
</tr>
<tr>
<td>Interpersonal communication</td>
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<td>Electronic communication</td>
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<tr>
<td>Organizational commitment</td>
<td>.250*</td>
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</tr>
<tr>
<td>Psychological safety</td>
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<td></td>
</tr>
<tr>
<td>Value congruence</td>
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<td></td>
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<tr>
<td>ΔR-square</td>
<td>.036</td>
<td></td>
</tr>
<tr>
<td>R-square</td>
<td>.371</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>11.801**</td>
<td></td>
</tr>
</tbody>
</table>

*p < .05 **p < .01, one-tailed test

Table 3. Regression models for moderating role of interpersonal communication
<table>
<thead>
<tr>
<th>Predictor</th>
<th>Interpersonal communication</th>
<th>Directories</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main effects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychological safety</td>
<td>.646**</td>
<td>.215*</td>
</tr>
<tr>
<td>Value congruence</td>
<td>.215**</td>
<td>.434**</td>
</tr>
<tr>
<td>R-square</td>
<td>.612</td>
<td>.326</td>
</tr>
<tr>
<td>F</td>
<td>87.745**</td>
<td>27.608**</td>
</tr>
<tr>
<td><strong>Mediator</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interpersonal communication</td>
<td>.284*</td>
<td></td>
</tr>
<tr>
<td>Psychological safety</td>
<td>.031</td>
<td></td>
</tr>
<tr>
<td>Value congruence</td>
<td>.373**</td>
<td></td>
</tr>
<tr>
<td>ΔR-square</td>
<td>.025</td>
<td></td>
</tr>
<tr>
<td>R-square</td>
<td>.351</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>20.860**</td>
<td></td>
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</tbody>
</table>

*p < .05 **p < .01, one-tailed test