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FOSTERING INTRANET KNOWLEDGE-SHARING: AN INTEGRATION OF TRANSACTIVE MEMORY AND PUBLIC GOODS APPROACHES

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ANDREA HOLLINGSHEAD

University of Illinois at Urbana-Champaign

JANET FULK
PETER MONGE

University of Southern California

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Center for Effective Organizations - Marshall School of Business
University of Southern California - Los Angeles, CA 90089–0806
(213) 740-9814 FAX (213) 740-4354
http://www.marshall.usc.edu/ceo

Abstract

How do members of distributed work groups locate, store, and retrieve the knowledge that they need for their individual and collective work? Intranets, i.e., company websites designed for internal use, are an important technological innovation in many organizations that can aid in knowledge management, expertise recognition and communication. This chapter identifies the conditions under which members of work groups are more likely to contribute to the development of intranets and the conditions under which intranets are more likely to result in more efficient and effective knowledge acquisition and dissemination. To that end, two theories developed to examine non-technological systems are integrated and extended to intranets and computer-based knowledge systems: the Theory of Transactive Memory, and Public Goods Theory of collective action. Transactive memory theory is useful for predicting how organizational members use intranets to acquire, store and retrieve knowledge. Public Goods Theory is useful for predicting whom, how much, and when members will contribute and retrieve knowledge on intranets.

Fostering Intranet Knowledge-Sharing:

An Integration of Transactive Memory and Public Goods Approaches

A key issue for distributed work groups is knowledge management, how distributed group members and their organizational colleagues locate, store, and retrieve the data, information, and knowledge that they need for their individual and collective work (DeSanctis & Monge, 1999). Data is commonly defined as raw facts out of context, whereas information includes context—the people, technology and other organizational aspects to which the data relate. Knowledge is information combined with experience, insights, beliefs and lessons learned possessed by people (Nonaka & Takeuchi, 1995). For ease of presentation, we use "knowledge sharing" and "knowledge distribution," to refer inclusively to data, information, and knowledge.

Knowledge, compared to data and information, is particularly problematic to transfer across persons because it requires the active and motivated participation of the knowledge holder. Sharing data and information can also be a significant problem in work groups, however, as illustrated by Blau's (1955) classic study of information hoarding within groups of job placement counselors. Gatekeeping, distortion, distillation and withholding of information are classic organizational challenges that turn what otherwise might be simple information retrieval tasks into information-sharing roadblocks (see Stohl & Redding, 1987, for an extensive review.). These classic challenges have been met with a variety of non-technological solutions. In Blau's work, alteration of the reward system to group-level goals and incentives overcame some information hoarding. Ancona (1992) found that teams that interactively sought information and feedback from their environment were better performers than those that focused on sharing existing information within the team. Other non-technical solutions include institutionalized practices designed to correct at the group and organization level self-serving biases and other flaws in individual human reasoning (Heath, Larrick & Klayman, 1998). These"cognitive repairs" can be as simple as slogans such as, "Don't confuse brains and a bull market," or as complex as programs that involve communication and interaction with others such as cross-sectional groupings that observe processes in action to look for flaws.

Increasingly, organizations have expanded upon these basic fixes by providing technological support for knowledge sharing, most commonly via intranets, according to a recent survey (http://www.knowledgebusiness.com/kmrlframe.htm). Depending on configuration, intranets can support (a) *individual activities* such as updating personnel records or changing benefit choices, (b) *formal information dissemination*, such as company news or policy manuals, (c) *pointers to knowledge and knowledge holders*, such as experts directories, search engines and hyperlinks, (d) individual and group *data*, *information and knowledge sharing* such as document exchange, or jointly maintained repositories such as project websites or so-called knowledge "vaults" maintained by groups, and (e) *group interaction* via synchronous or asynchronous methods, such as group discussions, forums, netmeetings, or joint creation and editing of documents (Fulk, Heino, Flanagin, Monge, Kim, Bar & Lin, 2001).

In 1996, two thirds of Fortune 500 companies had intranets in operation, but as problems arose in locating and determining the accuracy and timeliness of needed information, intranet usage began to plummet (Head, 2000). Outside of the practitioner literature (e.g., www.brint.com), little published theory or research exists about the success or failure of intranets. To begin to address this need in this chapter, we extend two theories developed to examine work groups and decentralized collectives in non-technological contexts to intranets. The Theory of Transactive Memory (TM; Hollingshead, 1998a; Moreland, 1999; Wegner, 1987) focuses on the optimal level of knowledge distribution within a group, and the conditions under which the group may be expected to achieve this state. Public Goods Theory of collective action (PG; Fulk et al., 1996; Marwell & Oliver, 1993; Olson, 1965; Samuelson, 1954) focuses on the processes by which individuals can be induced to engage in knowledge sharing in order to achieve a collective outcome, in this case a transactive memory system. Thus, the two theories provide important complements to each other. The next sections review these theories and offer six integrative propositions. Because we are building toward abstract theory, the propositions are "domain-general"(Heath et al., 1998) in that they apply across situations rather than to specific contexts or groups. The final section offers suggestions for theory, research and practice.

The Theory of Transactive Memory

TM theory details how people delegate responsibility for managing knowledge in relationships (Hollingshead, 1998a, 1998b; Wegner, 1987), groups (Moreland, 1999), and organizations (Anand et al, 1998). A TM system is a specialized division of labor that develops with respect to the encoding, storage, and retrieval of knowledge from different domains (Wegner, 1987, 1995). This division of cognitive labor reduces the amount of information for which each individual is responsible, yet provides all members access to a larger pool of information across knowledge domains. When one person needs information in another's area of expertise, they can ask the expert instead of spending time and energy learning it on their own. Research has demonstrated that groups that have TM systems perform their tasks and make decisions more effectively than those that do not, because members are better able to identify experts and make better use of expert knowledge (e.g., Hollingshead, 1998a, 1998b, 1998c; 2000b; Liang, Moreland, & Argote, 1995; Moreland, Argote, & Krishnan, 1996; Wegner, et al, 1991).

People specialize in different knowledge domains based on their relative expertise, skills or experiences, formal assignment (by a manager or based on a job description), or negotiated agreements with other people. Members can learn informally who is the relative expert across knowledge domains through shared experiences and conversations with one another (Hollingshead, 1998b; Wegner, 1987). For example, the person who knows most about computers in a work group may become the recognized computer expert. Communication often provides the basis for learning about others' expertise, and it is important for coordinating who will learn what (Hollingshead, 1998a, 1998b; Moreland & Myaskovsky, 2000).

Individuals can also learn what others know or what others should know through more formal means such as instruction from other people, documents, manuals, or other codified reference materials (Hollingshead, 2000b), or by expertise directories. Over time, as individuals learn about one another's relative expertise, they begin to specialize more in their own areas of relative expertise and expect others to do the same (Hollingshead, 1998b, 2000b; Wegner, Erber, & Raymond, 1991), and thus, knowledge becomes more distributed and less redundant among individuals in the system.

TM systems are more likely to develop when individuals perceive themselves to be interdependent, and when the incentive structure rewards specialization (Hollingshead, 2001). Research has shown that when people are interdependent, as they are in distributed work groups, they may be more motivated to learn about what others know and what they can contribute to the task (Rusbult & Van Lange, 1996). These arguments lead to the following propositions.

<u>Proposition 1</u>*. *Given interdependence, individuals who have more interaction with one another have (a) more unique knowledge and less redundancy across individuals, and (b)

more shared agreement about one another's relative expertise.

<u>Proposition 2</u>. Given interdependence, individuals who have accurate perceptions about their coworkers' expertise will perform their tasks more efficiently and effectively than those who do not.

<u>Application to Intranets and Distributed Work Groups</u>

A major prerequisite for an effectively functioning transactive memory system is the willingness of people who hold the particular knowledge to make it accessible to others. However, if someone makes the information available, network effects can quickly make it accessible to many (Shapiro & Varian, 1999). Data and information can sometimes be acquired or inferred without the participation of information holders. Consider the wealth of information collected on the Internet by examining patterns of website use, often without the knowledge of the user. Specialist information brokers capture and sell information regarding, for example, individual users' interests, political inclinations, and occupation (inferred from the type of websites the user visits), economic circumstances (based on patterns of spending and credit card information offered to a single site by unwitting users), and mobility (from travel sales sites). Increasingly companies are using such strategies to track activities by their employees.

Knowledge, however, as C. West Churchman asserted (1971, p. 10, cited in Molhatra, 1997), "resides in the user… It is how the user reacts to a collection of information…" Without the willing participation of the knowledge holder, knowledge is not accessible. A knowledge holder may choose to translate it into more explicit form through blueprints, manuals, etc., a process that Nonaka and Takeuchi (1995) label externalization. Absent such translation, others are dependent on the knowledge holder for the information. Indeed, a major source of power for such persons is an unwillingness to translate such knowledge into formal language, as in Pettigrew's (1973) classic study of the power of technical specialists who refused to codify their knowledge in any manual.

Knowledge that has not been externalized will be difficult to exchange directly over intranets. Whether individuals locate that knowledge will depend not only on their ability to learn about the expertise of coworkers, but also on whether they have informal or formal links to those "in the know." Intranets can help individuals to learn about the expertise and knowledge of others in their organization and identify communication links to them through such mechanisms as expert directories, postings of formal job descriptions and/or responsibilities, search engines for information and expertise, expertise inference systems (capture and analysis of activities such as who got reimbursed for travel to meetings on a particular topic, who participated in which forum, etc.), or "community-ware," tools to generate visual representations of knowledge and communication networks based on information voluntarily shared by individuals (e.g., I-KNOW; Contractor, Zink, & Chan, 1998). We refer to such capabilities as *expertise location mechanisms*, and individual access to intranets having such mechanisms as *expertise location access*.

As a result of the availability of expertise location mechanisms, intranets may allow people to locate experts outside their departments and outside their usual communication networks faster and more easily. This may lead to more decentralized communication networks in the organization, which, in turn, can lead to more effective knowledge sharing in situations when knowledge is distributed across individuals (Rulke & Galaskiewicz, 2000). Intranets should also increase network density, that is, individuals will have more direct communication with others in the network. This should result because of individuals' increased knowledge about where information resides. These arguments lead to the following propositions.

<u>Proposition 3:</u> ***Compared to individuals without expertise location access, individuals with expertise location access will (a) know more about the knowledge of their coworkers, (b) have more shared agreement about relative expertise, and (c) have more knowledge about expertise outside the division or department.***

<u>Proposition 4:</u> ***Compared to organizations in which individuals do not have expertise location access, organizations in which individuals do have expertise location access will have (a) more decentralized communication networks, (b) denser communication networks, (c) more effective knowledge sharing, (d) more efficient task performance, and (e) more effective task performance.***

A key consideration in whether these benefits accrue is whether people contribute their knowledge and whether people use intranets to access it, as well as the quality of the expert inference system. People who possess unique knowledge or know uniquely where to find it must have the motivation and the time to make their expertise available. In addition, individuals must be motivated to use an intranet for retrieving information about expertise. Public Goods Theory can be used to predict whom, how much, and when members will contribute and retrieve knowledge on intranets in ways that can result in these benefits.

<u>Knowledge, Intranets and Public Goods Theory</u>

The Public Goods Theory of collective action (Hardin, 1982; Marwell & Oliver, 1993; Olson, 1965; Samuelson, 1954) considers how best to induce members of a collective to contribute their resources to the creation and/or maintenance of a collective resource accessible to all members of the "public." The public can be a group, organization, neighborhood, political action group, interorganizational network, community, nation, the globalizing world, or other collective grouping. Two features define a resource as collectively accessible (Barry & Hardin, 1982; Head, 1972). First, the resource must be *nonexcludable*, in that all members of the collective have the opportunity to benefit from the resource, without exception. Second, the resource must be *nonrival*, such that one member's use of the good does not reduce the amount available to others.

A key public goods problem is "free-riding" (Hardin, 1968; Olson, 1965; Sweeney, 1973), where people enjoy the benefits of a collective resource without contributing to its establishment and/or maintenance. In essence, the nonexcludability feature creates a set of payoffs to each member that discourages contribution; the net effect is to make it "virtually impossible" for decentralized collectives to create such goods spontaneously in the absence of supplemental incentives and organizing forces (Samuelson, 1954). Examples of collective resources in the information realm are libraries, databases, bulletin boards, forums, websites and other information repositories, as well as communication networks by which people share data, information and knowledge (Fulk, et al., 1996).

TM systems are collectively produced information and knowledge resources designed to be nonexcludable and nonrival to the relevant public. Intranets offer a capability for identifying and linking people and knowledge in ways that can help to develop and sustain TM systems as collectively shared resources. This capability will be particularly important for distributed work groups, who lack the traditional "affordances" which proximity provides in support of collaboration. As Kraut et al. elaborate in chapter xx, these affordances include mobility in a common physical environment, audibility within the environment, visibility of other persons, visibility of the environment, and co-temporality. Finholt et al., in chapter xx, argue from research on expert databases that when communication systems offer information about who knows what, expertise exchange can occur effectively at a distance. Intranets and related communication and information technologies can serve this role if, and only if, members of the collective can be induced to contribute their unique valuable knowledge and participate materially in collective information sharing and communication processes (Connolly & Thorn, 1990).

Intranets can support the nonrival and nonexcludable aspects of a TM system. First, every person in the TM system can use an intranet to retrieve knowledge irrespective of whether they have contributed to its creation or maintenance. Second, if one person uses an intranet to publish or retrieve information, then it does not diminish the ability of others to do so as well. For transactive memory systems supported by intranets, the classic free rider problem appears as what has been labeled a "communication dilemma" (Bonacich & Schneider, 1992). A communication dilemma exists when a *group's or organization's interests* demand that people *share* their unique information, but individuals' own *personal interests* motivate them to *withhold* it (Kalman, Monge, Fulk & Heino, 2001). The interesting issue to explore here is how intranet TM systems can resolve this dilemma and induce members to contribute to the collective.

Monge et al. (1998) applied Marwell and Oliver's (1993) articulation of PG theory to knowledge management. In both instances, individual contribution decisions are based on the *value* people believe they will receive from the knowledge system minus their perceived *costs* of participating in it[1]. Value is a function of the current level of collective knowledge available through it: the more collective knowledge available, the more individuals value the system. The current level of collective knowledge available is itself a function of the contributions of knowledge by all of the members of the collective. Costs include the time and energy spent to contribute and retrieve information, assess it veracity, and combat any mistrust of other members with regard to how collectively owned information is used (Fulk et al. 2001).

An illustration of the dynamics of information contribution decisions is the knowledge sharing among members of a distributed design team for a new consumer electronics device. Teams members in New York, Amsterdam, and Tokyo have access to an intranet with a project website that allows them to post data, information, knowledge and expertise location information that could be of benefit to other team members. Postings might include technical breakthroughs, roadblocks, information obtained from university contacts made by any of them, information on who outside the team has useful information or would be a valuable consultant, and the like. This distributed design team has the potential for an effective transactive memory system because different team members have different specialties, levels of experience, external contacts and types of knowledge. Each team member decides what, if any, of his/her specific knowledge to make available to the rest of the team on the communal website.

The *value* to individuals depends on just how communal that website is—how much really useful knowledge other members have made and are continuing to make available through it. The *cost* to individuals of contributing knowledge is in proportion to the amount the individuals contribute, and also depends on how much time and effort it takes to compile it and post it to the website. Less tangible costs might include, for example, when a person provides a colleague access to a university contact, and in doing so incurs personal debt. The latter illustrates that a person might choose to withhold information because it incurs personal costs but provides no direct personal benefits.

<u>Costs and participation</u>. From the point of view of individuals, the most rational choice to maximize benefit is to *minimize costs*, since the *value* component depends on the contributions of others and thus is less readily changeable by any individual. Cost minimization

is accomplished by minimizing knowledge contributions, which incur costs. There can be many costs of participating in a communal knowledge system. Physical and social costs associated with the accumulation, transfer and storage of information include learning how to use the system; compiling information for the system; making the effort required to integrate the knowledge within the knowledge domain; and being available to others (Fulk et al., 1996). Costs for retrieving include the length of time it takes to find the relevant knowledge, the difficulty of using the system, and the potential consequences of retrieving dated or inaccurate information.

Publishing information on an intranet so that it becomes a communal rather than a private possession may also incur political costs. Sharing information that provides a competitive advantage may decrease its utility to the individual who once held it exclusively (Barry & Hardin, 1982). Uniquely held knowledge can form the basis of important personal capital to individuals in organizations. Connolly and Thorn (1990) suggest that higher payoffs are associated with withholding rather than contributing information, i.e., free riding. Each contribution to shared knowledge benefits everyone except for the supplier who already has that information. Thus, people may withhold information that would otherwise enhance the repository on an intranet.

Combating nonparticipation. Drawing on Kerr (1992), Kalman, Fulk and Monge (2001) suggest that there are two ways to solve this nonparticipation problem. A cooperation contingent transformation involves the relevant collective (organization, group, etc.) applying selective incentives for cooperative behavior. The incentive scheme rewards cooperation and/or penalizes noncooperation. One type of incentive might be designed to *reduce individual costs*, such as the provision of support staff for collection, compilation, inputting and updating knowledge for collective repositories. Systems may also be set up in a tit-for-tat fashion. People provide information such as personal opinions based on expertise and in return are given access to others' opinions on the same issue. The MovieLens movie rating system follows this model.

A second type of incentive assigns penalties for nonparticipation. For example, police organizations typically require their officers to report certain types of planned events to shared databases thereby permitting different agencies to coordinate law enforcement actions (e.g., planned drug busts), with the imposition of heavy penalties for noncompliance. This type of incentive also works on the *cost* component, in that lower contributions lead to higher costs. A third type of incentive provides direct individual benefits for participation that outweigh the costs involved. Organizations develop rewards for the best and most useful information contributions. This incentive decreases net *costs* by offering offsetting rewards.

The cooperation contingent transformation places burdens for monitoring and enforcement at the collective level. Since high quality information sharing behavior is not necessarily easy to monitor and identify, this transformation is an imperfect solution. It is particularly problematic for knowledge, which is less visible and separable from the knower than is information.

A second method is the so-called public goods transformation, in which individuals come to place increasing value on the collective resource itself. Increasing individuals' identification with the collective and/or to increasing commitment to an effectively functioning transactive memory system can motivate individuals to contribute their information and knowledge (Kalman, Fulk & Monge, 2001; Staw, 1984). Moon and Sproull's (chapter xx) study of contributors to the Linux project appears to fit this category. A variant occurs when achievement of a collective goal leads to a follow-on benefit for individuals. Employees may increase commitment to knowledge sharing on critical projects in order to get to market first, avoid losing out to competitors, and potentially finding themselves jobless.

With public goods transformations responsibility for monitoring and regulating performance rests with the individuals, who now have internalized the goals of the collective. In essence, individuals' fates are vested in those of the collective. External monitoring of participation is not required, except perhaps to assist people in coordinating their activities.

Synthesis of Theoretical Perspectives: Integrative Propositions

PG and TM theories can be integrated to pose additional propositions about knowledge sharing and distribution. TM theory predicts that knowledge in a work community will become more specialized and less redundant across people over time. When knowledge is specialized across people, more coordination and communication is required to accomplish complex tasks. Intranets can serve as a mechanism to achieve such coordination and communication, as well as knowledge dissemination. In these cases, individuals should *value* intranets more. Of course, intranets must also be efficient—the increases in value must be obtained without substantial increases in the *costs* of locating and securing knowledge in order for the net *benefit* to increase. In short, when unique knowledge is evenly distributed across members and intranets effectively and efficiently link knowledge holders, then the likelihood of people publishing and retrieving knowledge on intranets increases.

We posit a dynamic, recursive relationship between knowledge specialization and collective knowledge sharing in distributed work groups. As more individuals use knowledge repositories on intranets for publishing and retrieving knowledge, individuals will learn more about the expertise and unique knowledge of other people at distant locations, and they will not need to pay the costs of learning that information on their own. This will lead individuals to develop more specialized and unique areas of relative expertise over time. Kalman, Fulk and Monge (2000) suggested that the possession of unique knowledge or expertise increases an individual's "information self-efficacy," the belief that one can make a contribution that others will value. Information self-efficacy thus increases the likelihood that individuals will share knowledge via collective stores such as intranets.

This research and theory suggests a recursive cycle. Individuals in work communities that have transactive memory systems and effective intranets will be more likely to publish their knowledge on intranets. In turn, increased publishing will lead individuals to specialize more in areas of relative expertise. Finally, this specialization will contribute to increasing value for the collective knowledge sharing and, at the individual level, reduced costs and higher benefits from participation in the intranet-based collective. Thus, we offer the following propositions.

Proposition 5. ***Participation in knowledge sharing via intranets is positively related to the degree to which (a) knowledge is distributed across individuals in the work community, (b) individuals perceive their knowledge to be unique, (c) others perceive a person's knowledge to be unique, (d) others retrieve knowledge located on intranets, and (e) other people contribute knowledge to intranets.***

Proposition 6. ***The more members of a collective share knowledge via intranets, the more individuals will specialize in their areas of relative expertise.***

Private Benefits, Incentives, and Unexpected Effects

The context in which the above processes are embedded can impact knowledge sharing to the degree to which it offers potential contributors other incentives and disincentives. Several of these contextual factors have been investigated in research on group processes and on public goods production. We review several key findings and issues below.

Supplemental incentives. Equally divided group incentives have been shown to lead to high productivity and employee satisfaction (Honeywell-Johnson & Dickinson, 1999). This incentive structure may also reinforce individuals' perceptions of their interdependence with their work community, which is likely to be particularly important for distributed work groups (Weisband & Iacono, chapter xx). In many organizational situations, however, it is not possible or desirable to offer equal incentives. Research has shown that in situations of unequal incentives, fostering identification with the group can help to even out contributions to some extent by effecting a public goods transformation (Bonacich & Schneider, 1992).

Incentives, if not properly designed, can also have unintended effects. Connolly and Thorn (1990) point out that incentives can work against the viability of a database when they reward quantity at the expense of the quality, producing an oversupply of information that may not be useful. As noted earlier, this problem may be a function of the difficulty of developing performance criteria and of monitoring compliance in the absence of individual commitment.

Group size, monitoring, and efficacy of contributions. Olson (1965) made the theoretical claim that as group size increases, free riding should increase because the visibility of each contribution decreases. This principle suggests that the number of free riders who use but do not contribute to databases should increase with increases in intranet size (Kraut et al., chapter xx). However, subsequent investigations dispute Olson's group size principle, claiming that visibility need not be related to group size. Interventions to increase visibility of contributions even in large groups can spur participation. In the case of the very large Linux community, visibility came in part from identifying who contributed which pieces of code. For intranets, size may actually be positively related to the visibility of contributions. The larger intranet communities become, the more persons there are who could potentially view individuals' contributions. Since communal databases allow contributions to be distributed beyond people's immediate communication networks to persons the contributors may not know ahead of time, the potential audience can be quite large. Two features of intranets, if implemented, could help to support such visibility. The first is a mechanism for users to identify who contributed what knowledge. The second is a mechanism to feed back to contributors information on how much their contributions have been used by others. In Kalman et al.'s (2000) terms, contributors' information self-efficacy will rise, which will lead to greater overall motivation to participate in the collective.

Maintenance. Using intranets may lead to negative consequences for everyone when knowledge quality is poor. Inaccurate or dated contributions may affect individuals' perceived costs for retrieving knowledge on intranets, thus diminishing participation. A centralized authority may be needed to provide organization and quality control of intranet knowledge repositories (cf. Samuelson, 1954). A prime example is the creation of Knowledge Domain Teams at Ford Motor Company. Each intranet team was responsible for ensuring the usefulness of information in its domain (Austin & Cotteleer, 1997).

Discussion

With the trend toward distributed organizational processes has come an increasing awareness of the need to find new ways to identify, deploy, and effectively transfer organizational knowledge throughout the new organizational forms. Recent research by Nextera Enterprises (http://www.kknowledgebusiness.com/kmrlframe.htm) shows that among the most common forms of knowledge management systems are groupware and intranets. To the extent that intranets are used to seek knowledge from others whom individuals did not know ahead of time, and to build distributed knowledge resource pools, they can be seen as an ideal complement to network forms of organizing. Can intranets support effective knowledge sharing among specialists working in a distributed environment? One key is to facilitate individual creation and use of the collective resources occasioned by intranets. A second is to develop organizational mechanisms to institute cognitive repairs to naturally flawed human reasoning. The theoretical integration described in this chapter indicates some of the conditions under which intranets and transactive memory systems can recursively influence each other in the service of knowledge sharing. In the paragraphs below we suggest some further directions for theoretical development and implications for research design. We conclude with practical implications derivable from the theoretical analysis.

Future Directions

Research on collaboration tends to show that people collaborate better with experience, and that a successful history of collaboration predicts future success (Schunn, Crowley & Okada, chapter xx). Research on communication technologies in the workplace suggests that with experience people are better able to communicate and share information via technology (Fulk & Dutton, 1984). Clearly, one key consideration in studies of distributed workers is the extent to which these workers have experience working with each other and with the supporting technology.

With time, even unacquainted workers will develop experience, but how do they initially develop the underlying trust to initiate processes of knowledge specialization and coordination toward building effective transactive memory systems? Mannix, Griffth & Neale (chapter xx, p. xx) argue that in distributed work groups with limited history and future prospects of working together, it is difficult to develop trust from "scratch." They suggest that one possibility is to rely on "swift trust" (Meyerson, Weick, & Kramer, 1996), developed by drawing on expectations inherent in roles, specialties and other forms of category-based information processing. Research reported by Jarvenpaa & Leidner (1999) provides empirical support. In a study of short-term student project groups whose members were globally distributed, culturally diverse, and institutionally separated, the more successful groups were those who developed swift trust. When swift trust leads to success experiences that serve as a basis for more enduring trust, the cycle of successful collaboration may be effectively initiated.

Clearly, temporal issues play a significant role in understanding how knowledge sharing is fostered via intranets in transactive memory systems. Events and interactions unfold over time and change direction with experience. The interactions of transactive memory systems and intranet knowledge sharing described in this chapter take the form of dynamic, nonlinear, recursive processes in which time and experience are key concerns. The outcomes of a process, once initiated, are not deterministic even if they could be shielded from external influences. Indeed, a central premise is that internal patterns of knowledge sharing and distribution affect the continuing viability of a true public good. Such processes must be studied over time and in relation to themselves. Additional dynamic concerns include how sensitive the systems are to initial conditions, such as whether and when swift trust develops, what types of experiences groups have, and level of provision of the collective knowledge resource via intranets at the formation of distributed groups. Also, research on use of computer-mediated communication systems shows that over time mediated groups change their pattern of interaction sufficiently that temporal effects become more important than any effects otherwise assignable to the mediated condition per se (Walther, chapter xx).

There may appear to be an underlying assumption in this chapter that the ultimate goal is to get all individuals in groups to continually publish their unique knowledge, and to continually retrieve information pertaining to others' knowledge using intranets. This is not the case. Previous research seems to indicate that there needs to be a critical mass of users before shared databases provide benefits to users. However, it may be possible that there is an optimal size and breadth of knowledge for intranets. For example, when intranets contain too much information, searching and tracking down relevant information may become too time-consuming. If the expertise and job categories of too many people are listed, then finding the expert on an intranet may become more cumbersome than simply calling a colleague who may know the answer. And, the "experts" may be so overloaded with requests for information from hitherto unknown persons that they elect to reduce their availability. Electronic mail has been shown to link more otherwise unacquainted people (Constant, Sproull & Kiesler, 1996; Feldman, 1987), and also to increase information load concomitantly. Perhaps information accuracy and timeliness are sacrificed when intranets get too large. Monitoring information and quality control can become much more difficult, request queues can expand substantially, and response times can lengthen (cf. Finholt, chapter xx).

Today's network organizations are often described as supported by flexible, emergent ties that wax and wane as needed, rather than an all-channel network where everyone shares all their information with everyone else (Monge & Contractor, 2000). Indeed, it is the selectively and flexibility of the ties that is critical to the effective functioning of these organizations (Fulk, 2001). Care must be paid *not* to migrate intranets from this more flexible system where individuals can share information as necessary to one in which sharing is fixed, less selective and nonemergent. The challenge is to create and maintain transactive memory systems and collective knowledge resources that support differential sharing as task needs require.

This chapter focused on the cognitive aspects related to usage of intranets to support transactive memory systems in distributed work situations. Future research should address affective considerations, such as interpersonal trust in groups linked by transactive memory systems and intranets, confidence in system security and feelings of threat to privacy linked to technology-based knowledge sharing. We are beginning to learn a great deal about knowledge networks in new organizational forms, but less attention has been paid to non-cognitive aspects. For example, does retrieving knowledge from intranets rather than other people affect the nature and quality of interpersonal relationships in groups and in the organization as a whole (see Walther, chapter xx)? How much do network organizations rely on effective affect management processes as well? How does trust of others in the organization affect the degree to which individuals contribute their unique information (See Iacono & Weisband, chapter xx.)? Does relying on intranets for communication and knowledge recursively affect motivation or organizational commitment? These issues are likely to increase in importance in the future, as intranets become more commonplace in organizations, and as network organizations become the more modal form of organizing.

Practical Implications

Public goods theory suggests some very straightforward steps that can foster intranet knowledge sharing. To reduce costs, organizations can provide training in system features and knowledge seeking strategies. Further, they can offer subsidization of otherwise costly contributions by providing assistance in gathering, compiling and uploading information to data repositories and in keeping such information up-to-date. Organizations can also provide assistance and training in ways to externalize tacit knowledge, as suggested by Nonaka and Takeuchi (1995). To reduce costs associated with sharing sensitive information via communal repositories, organizations can design systems with options for selective dyadic knowledge exchange. For example, one law enforcement organization added a feature that informed knowledge-holders if other users had expressed interest in their knowledge, but did so without informing the knowledge-seekers. This feature allowed knowledge holders to identify who was seeking information and make an individual decision as to whether and how much information to release to that person, or to make personal contact to discuss issues with the person, or to do nothing at all (Monge, Fulk, Parnassa, Flanagin, Rumsey & Kalman, 2000).

Organizations can also develop mechanisms to increase commitment to successful transactive memory systems by providing follow-on rewards for project competition that depend on effective knowledge sharing. For example, a project group may receive a substantial group bonus for completing a project ahead of schedule. To accomplish this, group members must regularly share knowledge and develop an effective communal knowledge base. Rewards are better tied to effective knowledge sharing than to countable inputs devoid of a quality assessment. The key here would be to initiate a process by which individuals could, over time, achieve a public-goods transformation.

The theory proposes that people will contribute more when they value the collective resource and when there is useful knowledge within the system. Organizations can provide maps and statistics that provide on-line real-time views of where knowledge resides, who is contributing, and who is retrieving information on the intranet. This landscape view not only facilitates assessments of value, but also provides information on level and types of specialization and on the uniqueness of one's knowledge. Other feedback mechanisms would include notification to a knowledge contributor when another user accesses and uses the contribution, and when such information use has had important group- and organization level impacts. Identification of contributors would increase their visibility and provide recognition. Feedback on how many others are contributing would be useful to individuals in their assessments of value.

Because the early stages of intranet use are critical in gaining the critical mass necessary for the community to become self-sustaining, organizations should focus efforts in the above areas from the very inception of new distributed work groups. The ability to acquire an initial set of effective users in the absence of a real critical mass, at a time when users experience low intrinsic value relative to costs, is paramount. External incentives and motivational programs will be most effective in this initial period. If enough users can be attained beyond critical mass thresholds, the need for external incentives declines significantly.

Finally, given the role that a successful history of collaboration and knowledge sharing has on transactive memory systems, organizations may want to take steps that help positive histories develop quickly for new distributed groups. This might include offering shared training for new groups that involves intranet learning and exercises to build teamwork and develop conflict management skills. Organizations can also initiate teamwork with projects that have a high probability of generating successful collaboration and group-wide trust. Small initial investments in group success provide the potential for large long-term payoffs.

Endnote

[1] Formally, the theory states: $\mathbf{b_i = v_i[P(K)] - c_i(k)}$. At the individual level the benefit for publishing knowledge via intranets, $\mathbf{b_i}$, is equal to the value of the knowledge in the network's repositories at its current level of provision (i.e., the amount of valuable information available in the knowledge system), $\mathbf{v_i[P(K)]}$, minus the costs to the member of making their own knowledge available to others via the knowledge system, $\mathbf{c_i(k)}$. At the collective level the function **P(K**) shows the "provision level" of the knowledge repository, **P**, as a direct function of the total amount of useful knowledge resources available through it, **K**. **K** is defined to be the sum of the knowledge made available by each individual **(k)**.

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