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Information Technology as a Jealous Mistress: Competition for Knowledge Between Individuals and Organizations

Terri Griffith
John E. Sawyer
Margaret A. Neale

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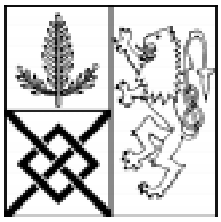

GRADUATE SCHOOL OF BUSINESS

STANFORD UNIVERSITY

Information Technology as a Jealous Mistress: Competition for Knowledge Between Individuals and Organizations

Terri Griffith
Olin Graduate School of Business
Washington University
St. Louis, MO 63130
griffith@olin.wustl.edu
314/935-6394

John E. Sawyer
Department of Business Administration
University of Delaware
319 MBNA America Hall
Newark, DE 19716
sawyerj@be.udel.edu
302/831-1787

Margaret A. Neale
Graduate School of Business
Stanford University
Stanford, CA 94305
maneale@pound.stanford.edu
650/723-8198

4/28/00

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Abstract

Information technology may play the role of a jealous mistress when it comes to the relationship between individual and organizational knowledge creation. Information technology can facilitate the dissemination of knowledge across the organization – even to the point of making virtual groups a viable alternative to face-to-face work. However, unless managed, the combination of information technology and virtual work may serve to change the distribution of tacit versus explicit knowledge within the organization. While greater access to explicit knowledge may be of short term benefit to the organization, the long term effect could be a marginalization of individually held knowledge, and perhaps, less overall knowledge creation in extreme cases. This paper advances theory and informs practice by illustrating the relationships between individual and organizational knowledge across the range of contexts enabled by information technologies.

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Outline

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Introduction

Knowledge is a crucial organizational resource (Conner and Prahalad, 1996; Grant, 1996). Effective organizational strategies include those where the organization possesses scarce knowledge which is not easily transferred or replicated (Grant, 1991). A corollary of this is that it is risky for this knowledge to dwell within an individual employee, or in a form which can easily leak across a firm's boundaries (see Liebeskind, 1997 for a review of the mechanisms for keeping knowledge secret.) Forty-nine percent of respondents to a KPMG (1998) survey said they had lost best practice knowledge as a result of an employee leaving the organization. On the other hand, an effective individual strategy is one where the individual maintains their value by having unique knowledge stores (Burt, 1992).

We propose that information technology may play the role of a jealous mistress. As individuals function in contexts enabled by information technology, more and more of their knowledge may become embodied in information systems or organizational systems more broadly (e.g., Zuboff, 1988). In the case of teams working across a range of traditional, hybrid, and more virtual settings (e.g., Griffith and Neale, 2000), we propose that the distribution and form of knowledge may vary. Specifically, over time more virtual settings may be associated with a greater focus on explicit knowledge (a possible benefit for the organization), while the relative amounts of unique, tacit knowledge held by individuals may decrease in more virtual settings.

Tacit versus Explicit Knowledge

The concepts of tacit and explicit knowledge stem from experimental psychological research on implicit learning dating back to the 1960's and 1970's. Tacit knowledge is defined as having three characteristic features: 1) it is procedural in structure, 2) it is practically useful in the attainment of goals, 3) it is acquired with little help from others (Horvath, Williams, Forsythe, Sweeney, Sternberg, McNally, and Wattendorf, 1994). Tacit knowledge is procedural in that it takes the form of "knowing-how" in contrast to "knowing-that." Procedural knowledge can be represented formally as condition-action (if-then) relationships. Tacit knowledge is practical in that it is instrumental toward achieving goals. Tacit knowledge is typically learned through experience and its acquisition is seldom has much support from other people or media. When people or media support knowledge acquisition they facilitate selective encoding, combination and comparison of information. These explicit processes have been found to interfere with the learning of patterns, if-then relations, and instrumental processes (Reber, 1993).

Hard distinctions between tacit and explicit knowledge are more often a convenience rather than theoretical requirement. Some knowledge will seem to be a particularly clear example of tacit, while other knowledge will seem to share some elements of tacit and some of explicit. In general, tacit knowledge is that which is uncodified (Polanyi, 1966), or perhaps, just not yet explicated or capable of being articulated (Spender, 1996); while explicit knowledge is codified and accessible to others (Leonard and Sensiper, 1998). Leonard and Sensiper (1998) suggest that instead of separate constructs, tacit and explicit may signify a continuum, noting that Polanyi's (1966) discussion allows that all knowledge has tacit dimensions. Nonaka (1994) builds on these ideas to describe his "spiral of knowledge" (p.18) which we will address in

greater detail below. We will discuss distinctions between tacit and explicit knowledge – but with a clear acknowledgment that knowledge can and does transition from one form to another over time.

Knowledge and Organizations

Attention to research on knowledge and the firm has increased dramatically. One example of this attention is the number of journal special issues that have been devoted to the topic (*Strategic Management Journal* (1996), *California Management Review* (1998), and *Organization Science* (in preparation)). While knowledge has always had value to organizations, current events such as liberalization of markets, increased focus on intellectual property rights, and advances in information technology are highlighting knowledge as the critical organizational resource (Teece, 1998). Our focus is on this latter component: Information technology.

If a major organizational task is to create value via the generation of knowledge (e.g., Nonaka, 1994), then information technology can play a key organizational role. Lado and Zhang (1998) present the case for expert systems, that is, that expert systems can lead to sustained competitive advantage. Our goal is both more focused and more broad.

We are interested in the role of information technology as it relates to individual and organizational knowledge acquisition, mediated by group process, and taking into account the full range of technologically enabled group settings. First, we present background on the foundations to our approach. We briefly discuss organizational knowledge, the related role of information technology, and transactive memory and synergistic group processes. These component parts then allow us to bound our discussion in terms of individual, group, and organizational level knowledge. We then focus on group level knowledge across a range of

settings enabled by information technology. The role of information technology as a possible jealous mistress is presented next, followed by implications that could be drawn from a more extensive coverage of this topic.

Background

Role of Knowledge

Liebeskind (1996; 1997) argues that organizations play a critical role of creating and sustaining competitive advantage by protecting valuable knowledge. Walsh and Ungson (1991) discuss the various repositories of organizational memory, including individuals and information technologies. Organizational knowledge is both more useful (for example Lado (1998) in the form of expert systems, and Liebeskind's (1997) description of General Electric's storage of records relating to every engine its AeroEngine Division has ever made) and less at risk of being forgotten (even when key individuals leave (Walsh and Ungson, 1991)), when it can be made explicit, and thus available broadly.

However, there is an agency problem when it comes to individuals' willingness to make their tacit or explicit knowledge available to the firm. Individuals hold power to the extent that they can fill a "structural hole" in a network (Burt, 1992), or maintain their own competitive advantage via holding information that is not replicated elsewhere in the organization (Grant, 1991).

Cinda Hollman (1999), CIO of DuPont put the problem in squarely in the jealous mistress perspective. She states that "knowledge equity is the heart and mind of a company." The company builds knowledge equity as learning is captured through experience so that it can be used in the service of future customers. However, "technology does not buy knowledge." "At the core of knowledge equity are people." Consider, for example, a chemist who was hired 20

years ago fresh out of graduate school. The chemist comes to DuPont with a small store of knowledge and a great capability to expand and create new knowledge. Over the 20 years the chemist works hard to create new knowledge. Some of that knowledge is explicitly shared with the company in the form of patents, reports, or entries into information systems, but a larger store of tacit knowledge is built up in the chemist's mind, and thus not available to the organization should the chemist no longer be employed by DuPont.

DuPont's wealth (as is the case in many organizations) is largely its knowledge equity. However knowledge equity is tied up in the minds of an organization's employees. An employee's source of attraction to the organization is largely a function of their knowledge and capability to create new knowledge. The value of their intellectual capital within the organization is dependent on the unique capabilities they bring to the organization. That value is diminished to the extent that it becomes less unique or is available apart from the individual. Thus the larger the relative portion of the employee's knowledge that remains tacit knowledge, the greater the value of the employee's intellectual capital within the organization. The larger the portion of the employee's knowledge that becomes explicit, the less their unique knowledge, and thus the less their intellectual capital is valued within the organization.

Role of Information Technology

Information technology is a jealous mistress to the extent that technologically-enabled settings create situations more likely to, intentionally or unintentionally, move individual level knowledge into organizationally-accessible repositories of organization memory. When this happens, the particular individual is no longer so unique a partner within the organization.

Intentionality is introduced to acknowledge that technology may play two roles in this developing drama. First, knowledge management systems such as LotusNotes are used

expressly to take explicit knowledge held by a subunit of the organization and make it available more broadly. This is an intentional process of taking individual level knowledge and making it available across the organization. (Note: in a broader presentation we would discuss alternative methods such as databases of individuals, rather than their knowledge, e.g., McDermott, 1999.) Second, use of technology as a method of work may capture tacit work methods, processes, or other knowledge in a way that can then be used to transform tacit into explicit knowledge at the organizational level. Individuals can be active participants in this process (e.g., Griffith, 1993; Stein and Zwass, 1995) or unintentional contributors.

A more detailed analysis of this process requires an examination of the social processes within the organization. Huber (1991), Nonaka (1994), and others suggest that organizations learn when their units learn. Within most modern organizations these units take two forms: individuals and work groups, with both being supported by organizational systems and technologies (e.g., Anand, Manz, and Glick, 1998).

The transition from tacit to explicit as well as the aggregation of explicit knowledge into new tacit knowledge relies on two process that have been identified in groups. Turning tacit and explicit individual knowledge into group-level knowledge is believed to be associated with the development of transactive memory (Wegner, 1995). The creation of synergy (combined or united action) is typically associated, at the group level, with both the creation of tacit knowledge within an individual as well as explicit knowledge at the group level. In the next section we will explore these two processes and their impact on knowledge development at the group and organizational level. We believe that the processes that exist in transforming (and transferring) knowledge at the group level also apply at the organizational level.

Transactive Memory

Group learning combines knowledge that individual members bring to the group with the knowledge developed by these individuals within the group. Levine & Moreland (1991) cited in Argote (1993) describe the kinds of knowledge that groups acquire: knowledge about the group (culture, structure, norms); knowledge of each other (who is good at which tasks); and knowledge about the work (what kinds of work the group does, how it should be done). The development of transactive memory (Wegner, 1987; Wegner, 1995) and its importance to group performance is an underlying theme in much of this work.

Broadly, transactive memory is a shared system for encoding, storing, and retrieving knowledge available to the group. More specifically, transactive memory is comprised of three components: directory updating -- the process whereby members of the group come to learn where knowledge is likely to be stored amongst group members (who knows what); information allocation -- the process of distributing knowledge to the member(s) whose expertise is best suited for its storage; and retrieval coordination -- the process of retrieving knowledge most effectively given knowledge of expertise distribution in the group (Wegner, 1995).

Synergy

Group learning can also be enhanced by knowledge created as a result of the group process. This is the knowledge behind the idea that groups are greater than the sum of their parts. Whereas transactive memory speaks to the efficient use of the information brought to the group (and eventually, that knowledge developed by the group), *synergistic knowledge* is that developed though the group's interaction. For example, two members each know one different way to solve a problem, yet together they are able to develop a new third solution.

Thus, individuals bring both tacit and explicit knowledge to the organization. Groups contain the knowledge brought to them by their members, the transactive memory developed for the efficient use of this individual knowledge, and synergistic knowledge (both tacit and explicit) developed as a result of the group's interaction. Some of this knowledge is viable outside its setting, while other knowledge is not (e.g., Liebeskind, 1997). The next step is to consider how individual and group knowledge fits within organizations.

The Transition from Individual to Group and Group to Organization-Level Knowledge

Anand, Manz, and Glick (1998) explicitly deal with the task of extrapolating from transactive memory at the workgroup level to an organizational level of analysis. Anand et al. (1998) note that Wegner's (1987) ideas of transactive memory can be applied effectively at the organizational level with some adjustment. These adjustments include the acknowledgement that besides the individual group members studied by Wegner and his colleagues, organizational-level transactive memory (what Anand et al., 1998 call systemic memory) includes multiple subgroups with varying amounts of overlap in membership, information technologies - some even designed expressly for the purpose of knowledge management - and a greater focus on "soft" or tacit knowledge, beliefs, judgments, etc.

Our purpose is more fine-grained than Anand et al.'s (1998). They develop a model of organizational memory for information management and suggest technological and organizational-level processes to overcome weak links in the acquisition, storage, and retrieval of information. In contrast, we assess [held out in the current draft] the expected outcomes of learning at the individual, group, and organizational level for traditional, hybrid, and virtual groups (Griffith and Neale, 2000). We draw on many of the ideas developed by Anand et al. (1998), but take both a broader view in the comparison of units of analysis, and a more detailed

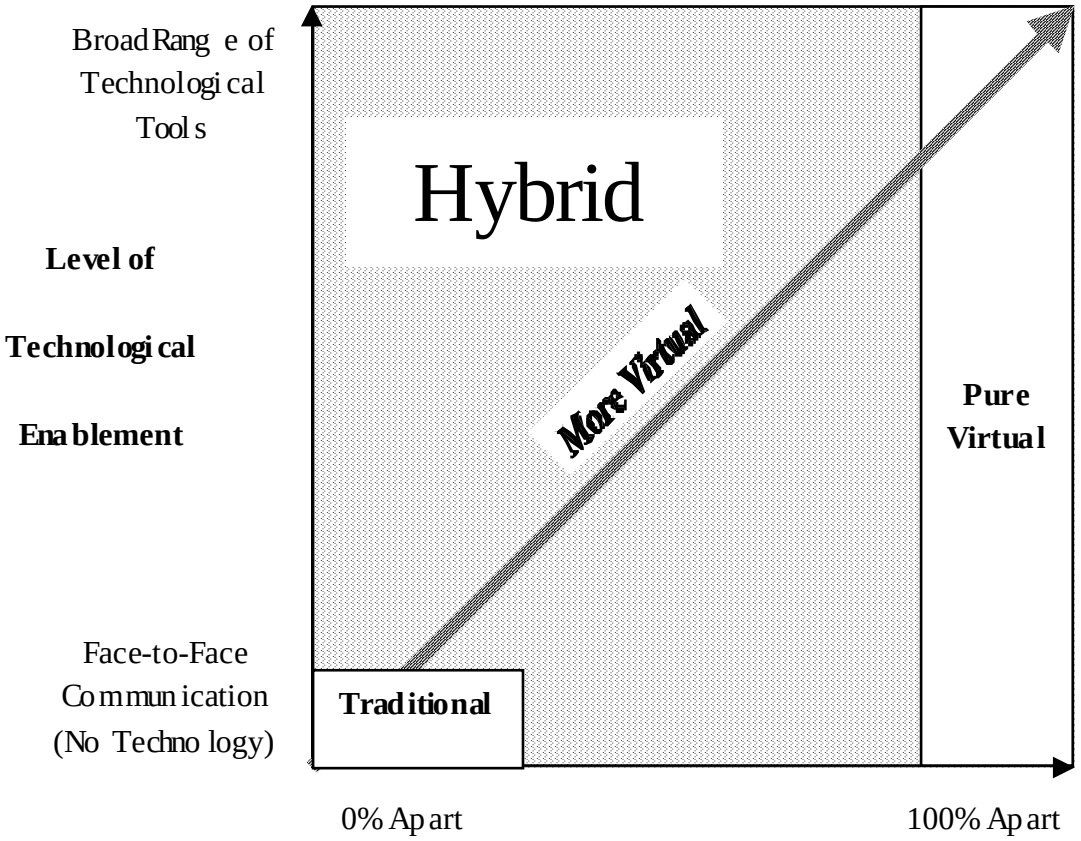
view in comparing learning at the individual, group, and organizational levels of analysis. Additionally, while Anand et al. (1998) acknowledge the role of technological support, it is generally outside their analysis. We believe that technology serves more than a simple supportive role. Rather, as suggested by Griffith and Neale (2000), technology has the potential to enhance as well as reduce the potential knowledge equity available to the organization.

Group Setting

Context is important to our analysis. Specifically, we address the outcomes for individual, group, and organizational learning given varying levels of time spent working apart, as well as varying levels of informational diversity available within the work group. Technology enables these variations in context in two ways. First, communication technology (such as email, voice mail etc.) makes it feasible for a broad range of work groups to be formed with members who do not necessarily work in close proximity. The reduction in physical and temporal boundaries subsequently diminishes the likelihood that homogenous groups are formed for convenience, or due to other factors that might co-locate members in either space or time (Griffith and Neale, 2000).

In addition, group support technology (such as Ventana Corporation's GroupSystems or IBM's LotusNotes) may provide additional functionality by structuring the group's tasks, enabling analysis of the group's process, and/or the storage of the group's information. Clearly the functionality of these technologies is mutable and socially constructed (Barley, 1986; DeSanctis and Poole, 1994; Griffith, 1999). Different configurations may provide communication and/or support (Griffith and Northcraft, 1994). As a result, we will speak in terms of "more" or "less" *virtual* rather than in technological, physical, or temporal structures. Figure 1 provides a graphic description showing the full range of work group possibilities.

Figure 1: Dimensions of Virtualness (Griffith and Neale, 2000)



Information Technology: The Jealous Mistress

Figure 1 provides our definitions of traditional, hybrid, and virtual organizations. Our prior descriptions of knowledge have focused on organizations that fall into the traditional category. Organizations that are less virtual (more traditional) have baseline knowledge formed from that embodied by the individual members and work groups. Knowledge availability and

transfer in these organizations is largely a function of: physically and temporally proximal human resources; synergy and transactive memory produced within face-to-face settings; and organizational/systemic knowledge made up of processes and methods of work.

Knowledge ability and transfer in more virtual organizations includes a greater technological component. Human resources are not necessarily constrained by geography or time; synergy and transactive memory may be influenced by the technologies associated the with group; and organizational/systemic knowledge can be stored in knowledge management systems of varying complexity.

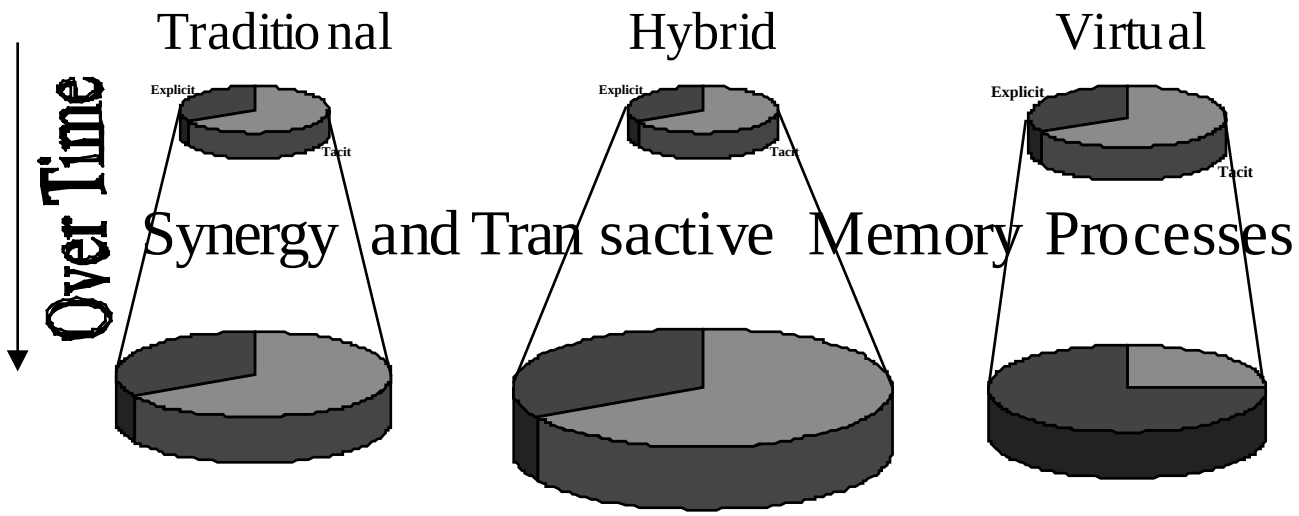
Through their use of technological systems, these organizations are expected to have access to a greater initial resource of knowledge, transition more knowledge from tacit to explicit, and to improve transactive memory at both the group and organizational level. Unfortunately, in pure virtual settings, we also expect that greater amounts of tacit knowledge will remain tacit, and thus, unavailable to other members of the organization. In addition, the virtual setting may affect the rate of development of new tacit knowledge. It is these distinctions and advantages (and potential disadvantages) that are discussed below.

The Love Triangle: Individuals, Technology, and Organizations[1]

Individuals in more virtual group settings are expected to embody a greater pool of knowledge over all, but also individually to gain less unique knowledge over time. More virtual settings are expected to contain more diverse members (Griffith and Neale, 2000). The ability to draw from a population less constrained by time or geography is expected to provide a pool of individuals with greater informational, value, and social category diversity (Jehn, Chadwick, and Thatcher, 1997; Pelled, 1996; Schneider and Northcraft, 1999).

Figure 2 illustrates this relationship by the overall size of the initial "knowledge pie." Traditional and hybrid groups initially contain less overall knowledge (both tacit and explicit) as they are more likely to be made up of more homogenous pools of individuals (as compared to a pure Virtual setting). Additionally, we expect that in more traditional and hybrid settings, the initial proportion of tacit knowledge will exceed that of explicit knowledge. This result is based on extrapolation from research on individual knowledge. As individuals gain experience in organizations, greater portions of their usable knowledge becomes tacit as they learn by doing and develop expertise (Sternberg, Forsythe, Hedlund, Horvath, Tremble, Snook, Williams, Wagner, and Grigorenko, 1999).

Figure 2: Organizational Knowledge by Type of Setting



Over time, the organization and its members learn new knowledge via synergy and the construction of transactive memory. Though the pure virtual setting is expected to begin with greater knowledge (perhaps in a nascent form), the dynamic effects of synergy and transactive

memory construction may both have offsetting effects. Traditional (face-to-face) and Hybrid (some combination of face-to-face and technologically supported) settings may have better group dynamics (e.g., better conflict resolution strategies, more rapid development of social identity, etc. Griffith and Neale, 2000). An extrapolation from Nonaka's (1994) description of the modes of knowledge creation helps us examine the possible outcomes for knowledge across settings with varying levels of information technology support and face-to-face interaction.

Table 1: Modes of Knowledge Creation (Adapted from Nonaka, 1994)

To *From*	**Tacit Knowledge**	**Explicit Knowledge**
Tacit Knowledge	Shared Experience between Individuals *Difficult in more virtual settings – Requires development of perceptions of richness (e.g., Carlson and Zmud, 1999) relating to technologies in use*	Metaphor – Articulation of Perspectives *Emphasized in more virtual settings – The only way work can progress*
Explicit Knowledge	Action – Learning by Doing *Difficult in more virtual settings -- Requires development of perceptions of richness (e.g., Carlson and Zmud, 1999) relating to technologies in use*	Exchange and Combination of Individually Held Knowledge *More virtual settings contain tools that can be used to make this process more efficient*

Primarily, tacit knowledge is thought to be difficult to transmit via electronic communication as non-verbal (Hollingshead, 1998), personal (Nonaka, 1994), and/or intuition (Anand, et al., 1998) based information may be important components. Second, tacit knowledge may be tacit because the individual is not consciously aware of its existence. The employee may not know what he or she knows (Polanyi, 1966). Relatively speaking then, we expect that explicit knowledge will be more readily transmitted via computer mediated communication than will tacit knowledge.[2]

Tacit knowledge is difficult to transfer from one person to another – or to provide organizational supports. This is because when knowledge is articulated it is greatly simplified. "Complex knowledge structures that map sets of antecedent conditions onto consequent actions get summarized and abbreviated into simpler, less complexly-specified procedures." (Horvath, et al., 1994, p. 10). To achieve tacit knowledge, one has to experience the knowledge in action. Thus, the development of tacit knowledge may not be fully supported by people or media. Tacit knowledge development may be partially supported by communicating simple if-then relations, but to understand and have usable knowledge, one may only come to know tacit knowledge through experience.

Given that explicit knowledge is expected to be in the minority of any one individual's stores, the largest part of an individual's knowledge will not be available to either their group or their organization. Thus, over time organizational knowledge in more virtual settings could be limited to explicit knowledge and tacit knowledge that becomes explicit.

Such a transition may or may not mean less overall knowledge for the organization, but it certainly means relatively less unique knowledge gained and maintained by individuals – and less need for the organization to rely on the individuals that it has in its employ. In extreme

cases, individuals will gain relatively less unique knowledge as they only have access to that which can be made explicit – the minority of the overall pool of knowledge. Additionally, the knowledge that any individual gains (i.e., the transmission of explicit knowledge) is less valuable as it is knowledge that is more widely available.[3] The organization gains as it has increased its store of explicit knowledge.

Effective knowledge management systems would increase the availability and value of this explicit knowledge to the organization. Knowledge management systems built into the communication systems of more virtual organizations would provide a direct link from individual and group work processes to organizational memory stores. We expect that computer-mediated communication and knowledge management systems, in general, will promote a greater emphasis on the conversion of some forms of tacit knowledge to explicit knowledge. Over time, explicit knowledge, permanently held by the organization, would become the larger component of organizational knowledge. Unless managed, information technology may play a role in marginalizing the relationship between the individual and the organization.

Implications

Individual, group, and organizational outcomes related to the use of any technological system are based on complex sociotechnical relationships. These systems are socially constructed (e.g., Barley, 1986; Weick, 1990) around sets of features which may interact in complex ways (Griffith and Northcraft, 1994), and exhibit a dynamic duality between understanding, design, and use (Carlson and Zmud, 1999; DeSanctis and Poole, 1994; DeSanctis, et al., 2000; Griffith, 1999; Orlikowski, 1992). Unintended consequences appear to be common unless specific attention is paid to the management of these systems (Griffith, Fuller, and Northcraft, 1998; Watson, DeSanctis, and Poole, 1988; Weick, 1993).

We have an opportunity at this relatively early stage in our examination of knowledge management systems and the use of more virtual teams. Here we have identified a situation where a positive outcome for the organization may have negative implications for the organization in the long run, and individuals in the more near term. In the short-term, information technologies can enable the dissemination of knowledge across the organization. Without such support, dissemination of knowledge is unlikely, or at the least, slow (Szulanski, 1994). However, unless managed, such information technologies used in more virtual settings with less opportunity for face-to-face interaction, may serve to shift the distribution of knowledge. The organization may gain as a greater proportion of knowledge becomes explicit and thus permanently available to the organization. However, individuals may lose if they gain less tacit (and thus uniquely valuable) knowledge over time.

In the long-term, the organizations would appear to have two choices. In a Machiavellian world, organizations might develop systems where they quickly turnover employees after any unique knowledge has been stripped away (simulations in March, 1991 describe such a process). Alternatively, information technologies and the organizational systems within which they exist could be managed to improve the transmission of more tacit knowledge (e.g., Carlson and Zmud, 1999), or the individual development of tacit knowledge based on more broadly available explicit knowledge. These systems would be characterized by richer media facilitating the communication of intuition through personal, non-verbal and other rich communication forms. Additionally, these systems would support personal experimentation and learning-by-doing exemplified in processes that facilitate transfer of knowledge having characteristics similar to tacit knowledge (Sternberg and Frensch, 1993). Continued development of a theory relating technology to learning in more virtual settings should lead to more empirical

investigation of these concepts. Observations such as those presented here serve as a starting point for critical organizational design decisions.

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Footnotes

[1] While group process plays an important part in this drama, we will focus on the outcomes for individuals versus their organizations. Parallel arguments could be made for individuals, technology, and groups.

[2] These concerns must, however, be tempered by an understanding of both adaptive structuration theory (DeSanctis and Poole, 1994; DeSanctis, Poole, and Dickson, 2000) and channel expansion theory (Carlson and Zmud, 1999). Both adaptive structuration and channel expansion theories acknowledge the role of perception, social construction, and types of experience in understanding the amount and kind of knowledge that can be transmitted via electronic means. We will not get into specific details here, but rather acknowledge the importance of these boundaries to what can be said about any specific sociotechnical relationship.

[3] In contrast, individuals can gain in value to the extent that they take the explicit knowledge and aggregate it in unique ways, creating new tacit knowledge.