The Utility of Information and Communication Technologies in Organizational Knowledge Management

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By virtue of their tremendous capacity to capture, store, transmit, and process information, electronic technologies have become critical information management tools in the last several decades. A wide range of information and communication technologies (ICTs) – ranging from simple tools like calendar systems and e-mail to more complex group support and data-mining technologies – has ushered in substantial organizational efficiency gains. Yet, in many instances, the advantages conferred by ICTs are primarily first- or second-order improvements of "substitution" or "enlargement" (see Malone & Rockart, 1991), whereby existing tasks are performed more efficiently, though often by several orders of magnitude. These efficiency gains are for the most part firmly rooted in the *processing of information*, rather than in the generation, support, and transmission of organization *knowledge*. Thus, and depending on the definition of knowledge adopted, one view is that though they are immensely important for information processing, ICTs often fail to alter organizational knowledge creation and management today in any fundamental way.

Yet, contemporary ICTs can also go well beyond substitution and enlargement of existing practices, and are in many cases being used to "reconfigure" (Malone & Rockart, 1991) social, economic, and political structures. The Internet, for example, by positioning discrimination and processing functions primarily in the hands of individuals, privileges interactivity among users through a dynamic system where people play roles of both information consumer and information provider. One consequence of this structure is wide-scale, sustained collaboration among individuals, which can support instances of collective problem-solving that reconfigure existing social relations. Indeed, this capacity to promote, support, and sustain collective endeavors among dispersed individuals is a core feature of contemporary technologies that can readily contribute to organizational knowledge creation and sharing. Nonetheless, this capacity remains largely unexamined as a form of organizational knowledge management today, particularly in its most prevalent web-based and "non-organizational" instantiations.

Thus, the utility of ICTs in organizational knowledge management to date has been both exaggerated and understated. The role of ICTs is

exaggerated when their information processing features are viewed as equivalent to knowledge creation, transfer, and learning. The role of ICTs is understated when their remarkable potential for supporting situated practice – which we argue is the core feature of organizational knowledge – is not recognized, appreciated, or exploited for organizational knowledge management.

In this chapter we address these issues by first discussing the nature of knowledge (as distinct from information), and the implied requirements for organizational knowledge management (as distinct from information processing). In the process, we distinguish between "content" and "relational" perspectives on knowledge management and advocate for a view of knowledge that accommodates its communicative nature. We next discuss the circumstances under which ICTs are and are not well-suited to support knowledge management, and identify current instances of technology use that (1) are said to be used for knowledge management but are not; (2) are being used for knowledge management but are not identified as such; or (3) have potential to be used more fully for organizational knowledge processes. To this discussion we bring a focus on contemporary web-based tools that have traditionally been viewed as outside the purview of organizational knowledge and knowledge management. We then identify the kinds of social and organizational issues that arise with the use of ICTs for knowledge management processes, and suggest theoretical and practical directions for future inquiry based on these observations.

Communication and Organizational Knowledge

During the mid-1990s there emerged a growing sentiment that an organization's stock of knowledge and how it is sustained, managed, and grown is a critical part of a wider movement toward a knowledge society (Drucker, 1994; Nonaka & Takeuchi, 1995; Spender, 1996). The concept of a knowledge society stands in contrast to industrial society, where workers need neither an education nor specialized skill in order to obtain work in most industrial firms. Industrial workers could be taught their craft on the job. A knowledge society, however, requires workers with formal education, and the ability and drive to seek out continuous opportunities for learning (Drucker, 1994). Knowledge workers make use of reflective practices in order to accomplish their work, such as actively managing a network of contacts and resources that enables the worker to accomplish his or her job. This emphasis on knowledge generally, and organizational knowledge specifically, is attributed to the emergence of globalized economies, highly competitive business environments, and the advancement of information and communication technologies (Alavi, 2000; David & Foray, 2002; Zorn & May, 2002).

Organizational knowledge is enabled by the interrelation of organizational members who each possess individual stocks of knowledge, but who

interact within the shared context of the firm (Nonaka, 2005). Formal organizations serve to integrate the disparate knowledge of individuals in order to accomplish larger goals, such as achieving competitive advantage (Chakravarthy, McEvily, Doz, & Rau, 2003), and knowledge takes on its organizational status when individuals "draw distinctions in the courses of their work by taking into account the contextuality of their actions" (Tsoukas & Vladimirou, 2001, p. 979). Although it is most often assumed that knowledge resides in the individual, other perspectives emphasize knowledge as socially embedded (Lundvall & Johnson, 1994), as a collective resource that is greater than individual inputs (Wegner, 1995), as a network phenomenon (Contractor & Monge, 2002), or as a social property of communities of practice (Brown & Duguid, 1998; see also Iverson & McPhee, 2002).

Boundaries demarcating where knowledge resides are not always clear in a knowledge society where free markets allow greater flows of materials and information, information and communication technologies contribute to a dramatic increase in and improved accessibility of knowledge, and competitive business environments force organizations to innovate in order to establish or maintain competitive advantage. In addition, how knowledge differs from information is sometimes ambiguous when electronic communication tools enable immediate access to a wealth of resources, both within and between organizations. Issues of where knowledge resides and how it differs from information are particularly salient to firms that seek to understand and manage the public knowledge generated by consumers, professional groups, advocates, and others that affect a business's operations on a daily basis. In this fashion, organizational knowledge is critical, yet sometimes ill-defined and indistinct, in the context of a knowledge society.

Knowledge and its Communicative Nature

There is disagreement about the nature of information and knowledge, and the distinction between the two. Traditional information processing perspectives, for example, distinguish between data (raw numbers and facts), information (processed or analyzed data that takes on relevance), and knowledge (applied information endowed by experience). A further distinction is often made between "explicit" and "tacit" knowledge (see, for example, Nonaka, 1994): explicit knowledge can be codified and communicated in the form of symbols, such as operation manuals and written procedures, whereas tacit knowledge is gained only through experience in a specific context, and is therefore obtained through mechanisms such as apprenticeship training. Thus, although explicit knowledge is "transmittable in formal, systematic language," tacit knowledge "has a personal quality, which makes it hard to formalize and communicate" (Nonaka, 1994, p. 16). The distinction between explicit and tacit knowledge is sometimes supplemented by a consideration of "cultural" knowledge, or the

shared beliefs and assumptions about an organization's goals, identity, capabilities, and the like (Choo, 2006).

Yet some argue that tacit knowledge is required to make sense of explicit knowledge, since a particular personal understanding is necessary to interpret and process explicit information (Polanyi, 1966, 1969). Absent this indispensable personal component, explicit information cannot be understood, and cannot contribute to the formation of new tacit knowledge. Knowledge thus has an "irreducibly social, value-laden, and personal character" (Tsoukas & Mylonopoulos, 2004, p. 7; see also Brown & Duguid, 2000) that distinguishes it from information, which some accordingly define as knowing *about* something, as distinct from knowledge, or knowing *of* something (Tsoukas & Mylonopoulos, 2004). Seen this way, knowledge is "socially embedded and inseparable from practice" (Hayes & Walsham, 2003, p. 73), whereas information serves as an input that is contextualized and understood through complex and situated processes of knowledge creation.

Consistent with this perspective, Hayes and Walsham (2003) note two fundamentally different epistemological views underlying knowledge and knowledge management. "Content" perspectives argue that knowledge is codifiable, and can be readily and accurately stored and retrieved. This content view emphasizes knowledge as an economic asset that can be obtained, held, and exchanged among individuals. Knowledge itself is thus seen as capable of being stored in databases and other repositories, which enables it to endure beyond the tenure of any single organizational member. By contrast, "relational" perspectives argue that knowledge is relative, specific to a particular context, and reflects esoteric viewpoints that may or may not be understood beyond the specific locations in which they are embedded. From the relational perspective, the focus is on the processes by which knowledge is gained and shared. In this context, the use of ICTs as knowledge transfer tools can be problematic, unless they can accommodate the rich processes required to support sensemaking activities (Walsham, 2002).

Taken together, this suggests a definition of knowledge as *situated practice, problem-solving, and thinking*. Knowledge involves judgments within a domain that are guided by the particular context in question (Tsoukas & Vladimirou, 2001). According to Tsoukas and Mylonopoulos (2004, p. 7):

Viewing organizations as knowledge systems makes us realize that the locus of individual understanding is not so much in the head as in *situated practice*: the individual understands and acts in the world through drawing on sets of socially defined values, beliefs, and cognitive categories within particular material and social circumstances.

Kuhn and Jackson (2008) similarly argue that knowledge is fundamentally social, and extends beyond cognition to include emergent social practices within specific contexts. They thus view knowing as "situated problem solving" (p. 457), and propose that researchers consider the "knowledge-accomplishing activities" that occur in organizational practice.

Defining knowledge as situated practice, problem-solving, and thinking suggests its fundamentally *communicative* nature. Because it is necessarily situated in practice and a specific context, knowledge requires communication among individuals in order to make sense of it, to exchange it, and therefore to derive benefit from it. These processes are all rooted in human communication, and require an understanding of communicative processes. That said, knowledge is not a commodity that can be transferred simply and unproblematically from person to person. Rather, it requires situated understanding achieved in context. As Walsham (2002, p. 272) argues, this requires a shift in current thinking about knowledge processes:

I would like to see a change of language from the use of terms such as "knowledge repositories," "knowledge transfer," and "knowledge sharing" to more human communication-oriented terms such as "supporting sense-reading and sense-giving processes," "facilitating knowledgeable action," and "enabling effective interaction."

This change is not trivial, suggesting as it does a shift from a transmission model of communication to a more deeply relational view. Moreover, this perspective on information, knowledge, and their differences suggests particular features, roles, and capabilities of ICTs in the support of organizational knowledge, as discussed next.

The Use of ICTs for Knowledge Management

Several, often incompatible, perspectives exist regarding the applicability of ICTs to organizational knowledge management processes. Some among these are more true to the view of knowledge as a situated communicative process (as articulated above), while others rely on a more traditional information processing view. In addition, important socio-technical developments, such as the rise of social computing processes on the web, suggest compelling new directions in contemporary organizational knowledge management.

ICTs, Information Processing, and Knowledge Management

The advent of networked computing and the ability to store large amounts of information has prompted many attempts to capture organizational knowledge, using tools like information databases, expert yellow pages, or best practice directories (McDermott, 1999; Tsoukas & Vladimirou, 2001; Walsham, 2001). It is not uncommon, for example, for organizations to take a stockpile approach toward knowledge management, using ICT tools

as information repositories (Huysman & de Wit, 2004) rather than as tools that foster knowledge generation and facilitate its transfer. Such efforts, however, have met with mixed success, and have spawned a number of debates regarding the use of ICTs in knowledge management.

As noted earlier, "content" perspectives on knowledge management (see Hayes & Walsham, 2003) argue that knowledge is codifiable, can be readily and accurately stored and retrieved, and therefore lends itself naturally to support from ICTs. Consistent with this view, ICTs have been heralded as critical in the development, sustenance, and creation of organizational knowledge by virtue of their capacity to capture, store, transmit, and process information. Indeed, a wide range of ICTs, ranging from e-mail to calendaring systems to group support technologies, has ushered in critical efficiencies in organizational information capture, processing, and transfer. This approach, however, has often resulted in "information junkyards" (McDermott, 1999, p. 104) or "data warehouses that nobody visits" (Walsham, 2001, p. 601), due to a misperception that knowledge can be readily and simply commoditized. For the most part, affordances of ICTs in this context either augment current capabilities or merely facilitate existing ones. Put another way, the application of ICTs in this domain appears to largely facilitate changes in scale, not kind.

Moreover, the use of ICTs for organizational knowledge management appears in many instances to be the province of information processing (i.e., the capture, storage, transmission, and processing of analyzed data) rather than organizational knowledge management. To some degree this is reflective of the predominant information technology emphasis of many organizational knowledge management initiatives, which are often seen as "technical projects" (Hayes & Walsham, 2003, p. 73) rather than social endeavors. This is further reflected in the fact that information technology specialists comprise 70 percent of the authorship for knowledge-management related publications (Easterby-Smith, Crossan, & Nicolini, 2000). As a consequence, there appears to be a propensity to "artificially reduce knowledge complexity with the use of technologies for knowledge management. In essence, the trend in knowledge management has been to condense knowledge to less than it is, in order to increase the capacity to process it efficiently" (Flanagin, 2002, p. 244). Indeed, there is considerable controversy about the appropriate use of ICTs to capture and share knowledge, which requires high levels of shared understanding (Flanagin, 2002; Walsham, 2002). As Tsoukas and Mylonopoulos (2004, p. 3) note:

The electronic storage, processing, and retrieval, and the instant communication of information, manifested most impressively in the Internet, have made it so tempting … to view *all* knowledge in terms of information. This leads to *information reductionism*: we believe we get to know the world through layers of abstract representations about the world.

Yet, to bring meaningful technological support to organizational knowledge processes requires acknowledgment of the core features of knowledge, as distinct from information, and a means to accommodate these features with ICTs. To truly take advantage of ICTs to support knowledge processes requires consideration of its "processual, provisional, and highly context dependent" nature (Hayes & Walsham, 2003, p. 54). Consistent with the relational perspective noted earlier, to foster organizational knowledge ICTs must accommodate the rich processes required to support shared understanding, sensemaking activities, contextual judgments, and situated practice. To date, this appears to be the exceptional application of ICTs, rather than the rule.

To effectively support organizational knowledge ICTs must not only (1) provide effective means of communication; (2) support information sharing; and (3) coordinate individual contributions among participants when collaboration is required, but also provide effective means to form and maintain rich, unambiguous communication across diverse participants, to sustain viable communities of practice, and to fortify the social context that is critical for the situated practice, problem-solving, and thinking that define organizational knowledge. Accordingly, Walsham (2002) proposes several "opportunities" for ICTs to support knowledge management. For example, he notes their capacity to provide a structure to data that can support thinking. Google, for instance, via its algorithms that impose order on otherwise unwieldy data sources, serves to organize data in a manner that renders them manageable. Next, he argues that ICTs provide a means of information sharing and interpretation, via communication. Ideally, they provide a means of "sense-reading and sense-giving activities" that aid in the transfer and sharing of knowledge. Finally, he argues that ICTs can serve as guides to action by providing order and social arrangements that can augment decision-making and activity. Zuboff (1988) makes a similar distinction between the capacity of new technologies to "automate" and "informate." When a technology automates, it replaces human tasks with machine technology; taking over continuity and control. The same machinery, however, can informate as well, which supersedes automating by generating new processes and abilities for human knowledge.

In spite of this potential, the success of ICTs in these pursuits has been mixed. As already noted, in many instances ICTs are actually used to process information rather than to support knowledge management. Additionally, ICTs have the potential to be used more fully for organizational knowledge processes than they currently are, and cases can be identified where ICTs are indeed being used for knowledge management but are not identified as such. To explore these possibilities, we next advocate a relatively novel focus on lessons learned from contemporary web-based tools that are typically viewed as outside the purview of organizational knowledge and knowledge management.

The Application of Emergent, Web-based Technologies to Knowledge Management Practices

Until recently, the enormous cost and complexity involved in producing and disseminating information on a large scale limited the number of information providers, who generally had substantial investment either in the information itself or in the apparatus required to deliver it. In recent years, however, web-based technologies have blossomed in their capacity to support sustained collaborative efforts among individuals working toward shared goals, across myriad domains. Digital network technologies associated with the Internet and the web have lowered the cost of information production and dissemination, thus increasing the sheer amount of information and the number of information sources available. Potential contributions from a wide variety of users can be sustained over long periods of time and across geographic, cultural, and even interest domains. The proliferation of user-generated content – ranging from the coordination of political protests to aggregations of movie ratings to the creation of complex software – and the rise of far-reaching collaborative efforts that require coordination among large numbers of people are by-products of this environment.

This fundamental shift in connective capacity represents significant new benefits to organizations, given the enormous knowledge assets that reside in collectives and which until recently remained largely untapped due to insurmountable communication and coordination costs. The essential premise of this new environment is that, given efficient means of information sharing and participation, knowledge assets can more readily be fostered, shared, and maintained.

The open-source movement serves as an example. For more than a decade now, software development efforts among independent computer programmers, often numbering in the hundreds or thousands, have thrived, based on the simple principle that the collective efforts of a diversity of software developers produce superior products (see Raymond, 2001; Weber, 2004). It is notable that prior to the open-source movement, software development was a largely isolated, proprietary activity that took place among relatively small groups of workers, who typically enjoyed high levels of personal contact with one another. Yet the open-source movement has shown that widescale, complex collaboration among disaggregated individuals can take place successfully online, and can produce freely distributed, collectively authored, viable software. Indeed, a recent survey indicates that more than half of IT professionals supplement their use of proprietary software with open-source applications in their organizations (a figure that climbs to two-thirds if those who report they plan to use it soon are included) (Schindler, 2008).

From a knowledge management perspective, the open-source movement illustrates that sustained, situated problem-solving and practice – precisely

the kinds of activities achieved through the relational interaction that is required to produce software, and the heart of organizational knowledge – can be successfully supported almost exclusively through the use of ICTs. Open-source community members are guided by standards and rules, adhere to particular procedures for decision-making, and are subject to specific sanctioning mechanisms as they share and produce knowledge. Open-source collaborators epitomize the mutual engagement, shared repertoire, and joint enterprise critical for communities of practice in the pursuit of organizational knowledge (Wenger, 1998). Moreover, such communities of practice can be viewed as constitutive not only of organizational practices, but also of organizations themselves (Iverson & McPhee, 2002).

These same types of knowledge-based activities can be supported by ICTs within more traditional organizational frameworks as well. For instance, electronic procurement (e-procurement) technologies provide a rich web-based interface that connects corporations to their system of suppliers. E-procurement systems allow purchasers "to (1) formulate supplier selection criteria (2) rank potential suppliers (3) choose a subset of ranked suppliers and (4) monitor supplier performances" (Massa & Testa, 2007, p. 29). Through the system, requests for bids may be made, new searches for competitive suppliers may be initiated, and bid histories are archived. The e-procurement tool facilitates knowledge management that crosses organizational boundaries by offering interactive features through which multiple purchasers from different parts of an organization can aggregate their individual perceptions of suppliers and information regarding previous transactions, alongside information provided by suppliers. Although the e-procurement system requires tremendous codification of organizational knowledge before it can be considered a suitable substitution for manual purchasing routines (Massa & Testa, 2007), this codification exercise itself can stimulate substantial knowledge production because it requires employees to reflect upon the processes used during a purchasing activity (Tsoukas & Vladimirou, 2001). Moreover, this knowledge creation continues after the system is implemented, because the dynamic, interactive nature of the system keeps it highly relevant and historically accurate.

The e-procurement system may be a typical organizational response to the use of ICTs in organizational knowledge management inasmuch as it allows an organization to continue to manage knowledge processes, while allowing employees wider access to the resources needed to make better decisions. Yet, there are additional lessons to be learned from the power afforded to individuals in an interactive online environment. For example, Cho, Lee, Stefanone, and Gay (2005) describe the research and development process of a distributed community where people worked together for a year in an effort to design a portion of an aerospace system. Distributed teams with different skill sets participated in this highly

interdependent task, which required the ability to communicate verbally and visually in order to collaborate. Using a web-based ICT, team members were able to create simulations, share their applications, communicate with each other in a variety of ways (i.e., via audio/video conferencing, chat, instant messaging, e-mail, and discussion boards), network, retrieve information within the system, create custom information storage, and participate in conference calls with NASA scientists. These ICTs produced a knowledge management environment through their storage, retrieval, and creation mechanisms that supported the development of relationships based on expertise. In this instance, ICTs provided users the ability to customize and manage their information sharing and communication, and gave them the ability to provide structure to shared data and information. This decentralized approach gave users the means to access, interrogate, and collaboratively create new knowledge and organizational products.

Considering knowledge-sharing and knowledge-creation processes from this user-oriented point of view exposes a control bias inherent in most top-down knowledge management efforts (Huysman & de Wit, 2004), which appears to privilege ICTs as tools for information processing over knowledge management. Upper management control of centralized data repositories can result in content deemed unhelpful by those who attempt to use these static tools, which often lack context that allows integration with employees' unique knowledge sets (Newell, Bresnen, Edelman, Scarbrough, & Swan, 2006). Moreover, the pressure that upper management can put on employees to document their processes and record their insight into a static directory inhibits effective knowledge integration (Grant, 1999). However, shifting the locus of control by offering employees tools that allow them to learn and build upon others' input (similar to the open source movement, for example) may enable knowledge workers to participate more fully in knowledge creation and management, which may generate new opportunities for innovation. This more fully relational strategy acknowledges the communicative nature of organizational knowledge. Accordingly, social media tools such as RSS, social ranking, and wikis can offer users the ability to manage information, build relationships, and provide opportunities for feedback, which are key knowledge creation and sharing processes. These tools offer promise as the newest instantiation of ICTs supporting knowledge management.

The use of social media for organizational knowledge management even extends beyond an organization's boundaries. Many companies now realize that individual technology users external to an organization create public knowledge about an organization by sharing information and comments about products and services, through product ratings, social networking groups and connections, and RSS feeds, to name only a few possibilities. In response to individuals' new role in the information environment, some companies are working to actively manage external knowledge channels. For example, Dell has created a "communities and

conversation team," where employees reach out to customers on Twitter and blogs in order to provide proactive customer service and actively seek out customer-driven innovation. Southwest Airlines has a similar team, ready to respond to anything related to Southwest that appears in cyberspace (Johnson, 2008). Monitoring tweets, understanding what is being talked about in the blogosphere, and seeing which news stories are rising to the top of consumer rated news (e.g., digg.com) allows organizations to partially control, or at least be aware of and potentially manage, what circulates about topics of concern. In this manner, knowledge is shared and created by cutting across organizational boundaries.

Embracing this user-oriented perspective for employees can also have profound knowledge creation effects. Pfizer, for example, advocates the use of blogs, wikis, and RSS for all of its employees. Blogs enable a more informal and personal way to share what employees are currently working on or are interested in. RSS helps employees organize the different streams of information that are important to them, while wikis encourage the production of active stocks of knowledge. Pfizerpedia currently boasts over 10,000 wiki entries, including "how to" videos created by employees (McDougall, 2008). Similarly, in order to create a wider dialogue around product innovation, Dell launched a social ranking website, Dell Idea Storm, to its employees in order to encourage them to offer product suggestions and to comment on and rank suggestions offered by others. Extending this functionality beyond its organizational boundaries, Dellideastorm.com now exists as a public site where anyone can participate in this innovation tool. Finally, IBM is migrating from information management to knowledge sharing by offering and using ICT tools that facilitate knowledge-sharing processes. On any given day, for example, over 22,000 IBM employees are logged into Facebook, allowing employees to actively maintain their social networks and stay up to date regarding what their peers are working on (Lewis, 2008).

Such tools provide the situated, context-dependent interface crucial to knowledge processes while offering a means for others to build upon such experiences through feedback mechanisms. When these tools are combined, the knowledge management terrain of an organization can become much richer. For example, wiki tools can facilitate the knowledge-sharing processes of communities of practice by making a space available where the members can impart their knowledge and build upon that of their peers. Blogs offer employees a more personal space to log their organizational activity and interact around specific topics. Social ranking can be employed on any set of organizational information deemed worthy of organizational, or even wider, debate. Existing social networking tools such as Facebook enable the formation and maintenance of organizational relationships, recognizing that such relationships can extend beyond the boundaries of a company. In order to stay on top of the newest conversations emanating from these tools, employees customize RSS feeds that stay

active on their desktop. To tie it all together, aggregating applications such as semantic web tools have the ability to search through the various channels and compile specific relationships that exist between the channels, such as the 10 people commenting on or involved in a particular product launch (Drucker, 1994; Feigenbaum, Herman, Hongsermeier, Neumann, & Stephens, 2007). Going one step further, IBM offers Atlas, a tool that unveils employees' social networks by analyzing the various ties (e.g., e-mails received/sent, friends on Facebook, links on blog, feedback on social ranking posts) employees accumulate through their social media tools in relation to the rest of the company (Ehrlich & Lin, nd). The most intriguing aspect of Atlas is its ability to reveal people to whom one is connected by two degrees, creating a more permeable knowledge-sharing system through a more open organizational network.

ICTs, however, are not always well-suited for knowledge management efforts. Because they are user-centered, a hierarchically managed knowledge management system can impede participation and use of these decentralized tools. In fact, the open-source movement suggests that traditional conceptions of knowledge management that utilize ICTs in a hierarchical manner can actually *detract* from knowledge sharing and production capabilities. Downing (2004), for example, describes a failed attempt at the implementation of knowledge management tools for call-center employees. This knowledge management initiative introduced a data repository designed to lead the call-center staff through a series of questions in order to prompt each caller to adequately explain his or her technical problem. This system, however, lacked any sort of interactive feature, and ultimately failed to reduce overall call times and improper diagnoses, even though the repository was fully searchable and filled with a major cross-section of known issues. Without an interactive feature, the repository actually impeded the knowledge creation process by reducing the amount of informal interaction on the call-center floor and turning the call-center employees' jobs into a keyword guessing game in order to access the required information. Those who used the knowledge management tool increased, rather than decreased, their average call length, because searching the database was a slower process than simply asking their neighbor. In this case, codifying technical problems appears to have changed a knowledge creation process into an information processing task.

Implications of ICT-supported Organizational Knowledge Management

Our discussion of the use of ICTs for organizational knowledge management suggests several organizational directions, issues, and concerns. For instance, one implication is that organizational boundaries are, or should be, more permeable and fluid. Taking advantage of knowledge that lies beyond the organization's border, for example, requires sharing ideas and

collaborating with others, about whom little is sometimes known. Indeed, a feature of the contemporary media environment is the relative anonymity of information and individuals, suggesting problems of source and information credibility, potential conflicts of interest, and the complex dynamics of securing and maintaining competitive advantage. In extreme cases, information sharing and the co-production of knowledge can even take place unwittingly or unknowingly, for instance when information and knowledge artifacts are stored and subsequently accessed in publicly available forums, such as discussion boards, web sites, blog entries, and other repositories that endure long after their "contribution," which can itself be unintended, since in many instances it has become more effortful to secure information than to share it (see Bimber, Flanagin, & Stohl, 2005).

Indeed, the Internet's open-access information environment fosters the notion of information as a "public good," readily available to all regardless of organizational affiliation or individual contribution. The public nature of web pages, tweets, blogs, discussion groups, and wikis, and the endurance of these information artifacts over time, raise questions regarding the extent to which an organization should support the public posting of organizational work and the costs and benefits of knowledge creation processes in an open, inter-organizational environment. In this environment, organizations must confront a new type of knowledge production that cannot always be supervised by the organization.

An implication of this potential boundary permeability is that it is necessary in many instances to look beyond "the organization" toward *processes of organizing* as a more appropriate frame for organizational knowledge management. The very notion of knowledge as communicative and relational, for example, emphasizes the processes of knowledge creation, sharing, and maintenance. These processes are often not linear, nor can they be easily codified (e.g., as a business practice) or represented (e.g., on an organizational chart). Instead, these processes more closely resemble patterns of organizing, which enact the organization through "the actions and conversations that occur on behalf of the presumed organization and in the texts of the activities that are preserved in social structures" (Weick, Sutcliffe, & Obstfeld, 2005, p. 413). From this perspective, organizations should not be concentrating their efforts on managing knowledge, but rather on managing knowledge processes. ICTs are critical in this endeavor, and should be viewed not as static tools to capture, store, or process information (i.e., an information processing view), but as dynamic tools capable of supporting the rich and situated practice of co-creation required to generate knowledge and manage it within and across organizations. Toward this end, we have chosen to emphasize current web-based applications of ICTs that tend to highlight the capacity of technologies to support organizational knowledge management processes.

However, social media tools likely require a different kind of management than past knowledge management efforts. Organizations that lack a

collaborative, knowledge-sharing spirit are unlikely to realize the full potential of these tools. For instance, organizational practices such as knowledge hoarding can seriously detract from organizational knowledge management efforts that reward individual achievements over collaborative activities (Walsham, 2001). Therefore, an organization's culture figures strongly in the success or failure of a knowledge management initiative. Larger cultural issues, such as the communicative style of a particular group (e.g., high context versus low context cultures), also play a part in the acceptance of ICTs as suitable tools for knowledge creation, storage, and sharing actions. Hence, the tools introduced here must be considered in light of these and other organizational constraints.

The notion of more fluid and flexible organizational boundaries also suggests a reconsideration of interrelated features such as organizational definition, commitment, ownership, and identity. The relational perspective on organizational knowledge evokes a more fluid definition of the organization that can encompass processes, and therefore assets and resources, outside of an organization's traditional boundaries. Similar to the mutual technological dependence that occurs among firms who search beyond their boundaries for sources of innovation (see, for example, Jaffe, Fogarty, & Banks, 1998), many knowledge workers engage in boundary-spanning activities to stay up to date in their field, complete their everyday tasks, and/or find new opportunities for innovation that create a kind of knowledge dependence. The effects of this dependence on organizational commitment should not be overlooked. When knowledge processes occur at a community or professional level instead of at the organizational level, this may impact knowledge workers' organizational commitment. In turn, concerns over knowledge ownership could potentially lead an organization to attempt to control employee movement within an industry for fear of losing competitive advantage through employee turnover. Yet, such manipulation of employees' portability within an industry can also negatively affect an industry's knowledge growth.

Our focus on organizing processes and the management of knowledge processes, instead of organizational knowledge management, also brings to light theoretical and practical directions for future inquiry. Research will need to consider literature on organizational forms and new forms of organizing to better understand the structural impediments organizations must overcome as they shift to a relational view of knowledge management through ICTs. For example, research should consider (1) how the decentralized nature of ICTs may affect workflows, worker relations, and worker commitment, as organizational knowledge is produced; (2) the role of management in shaping employee use of ICTs, and whether such use might simply reify existing structures or facilitate truly new forms of organizing; and (3) the implications of and for privacy policies in organizational implementations of ICTs that facilitate knowledge processes and make many organizational conversations public.

In addition, evolving notions of organizational definition, commitment, and knowledge ownership implicate a new understanding of organizational identity. The concept of identity is both relational and comparative (Tajfel & Turner, 1985). Therefore, the provision of tools that increase relationally-driven knowledge processes is sure to affect multiple levels of identity. Open issues include questions of what kinds of identity (e.g., individual, group, organizational, industry level) are fostered through knowledge and organizing processes that cross organizational borders, and whether these new identities are empowering and beneficial to an organization, or detract from an organization's cohesiveness and constrain its ability to bring incongruent identities together through an overarching goal.

Finally, when the interactive features of knowledge creation are privileged, the informational component of knowledge is not what distinguishes organizations. Rather, as they become more comfortable with a facilitative role in the management and development of organizational knowledge, the successful use of ICTs for knowledge management is what provides organizations with competitive advantages. In this case, a communicative understanding of organizing processes and knowledge will provide greater insight into the characteristics of competitive advantage in a knowledge economy where trust, reputation, and credibility are assessed and assigned through a complex mix of sources and media.

Conclusion

The use of ICTs has increased organizational efficiency and scope by exploiting the scalability that technology affords. The focus, however, has traditionally been on the informational use of ICTs, rather than their capacity for rich communication and the situated practice, problem-solving, and thinking they support. This focus has in turn bled over into knowledge management efforts that have largely created static tools for organizational knowledge. However, current, often web-based, applications make the most of the communicative ends of ICTs by drawing attention to knowledge management processes. These communicative features give organizations the tools to facilitate knowledge creation, sharing, and maintenance by supporting the relational nature of knowledge. As ICTs continue to evolve, their ability to contextualize interactions has the potential to enhance their appropriateness and desirability for inclusion in efforts to manage organizational knowledge processes.

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