

Uses of information sources in an Internet-era firm: Online and offline

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Abstract. Most research on the role of information and communication technologies (ICT) in the workplace has focused on companies that adopted ICT after many years of working without it. However, companies that have been “always connected” may offer different lessons. In this study, we look at how workers at an Internet-era company obtain information they need to do their jobs. We look at both human and documentary sources of information; whether those sources are accessed online or offline; and the impact of type of information source and access on individual performance. Results parallel past research with two significant differences: 1) workers accessed human sources via online channels more frequently than via offline channels, and 2) higher individual performance was associated with online access to human sources rather than offline access to human sources. The findings have implications for theories of knowledge management and uses and effects of technology in organizations.

Introduction

The challenges of implementing information and communication technologies (ICT) in organizations have been well documented in case studies across many industries (e.g., Leonard-Barton, 1988; Markus & Keil, 1994; Orlikowski, 1996). However, comparatively little research has been done on companies formed after widespread adoption of the Internet. For those companies, ICT has been part of the way they work from the very beginning.

Looking at Internet-era companies is important, because that category includes every company founded today and in the future. It is also important because of the opportunity it presents to examine the integration of ICT into the everyday lives of workers without also contending with the question of technological determinism, which assumes that technology drives change rather than existing in dialogue with social and institutional forces (Kling, 1996; Kling, Rosenbaum, & Hert, 1998; Orlikowski, 1992; Orlikowski, 1996). While some work has been done on Internet-era companies, more research is needed across other industries and types of workers (Teigland, 2000).

In this research, we examined the role of technology in supporting information access in a software and services company in the high-technology industry. Survey data collected via a web-based questionnaire from 27 employees are enriched with in-depth interviews and observations with a sub-sample of 10 employees. While the research also encompassed social interactions and organizational culture, our focus in this paper is on how workers obtain information they need to perform their jobs. Specifically, our goals are:

- (1) To better understand the information sources used by workers, and the ways they access those sources.
- (2) To examine whether type of information source and access have an influence on individual performance.

Theoretical Background

Information sources and access

Many studies have documented that, when seeking information, people prefer *human* to *documentary* information sources. Human sources include coworkers, managers, and other colleagues outside the organization. Documentary sources include such items as reports, databases, memoranda, and web sites.

This preference for human sources existed before ICT became prevalent in business organizations. More than twenty years ago, a study found that engineers were roughly five times more likely to turn to a coworker or other colleague for information than to use a documentary source (Allen, 1977). But the preference also appears in more recent work on other populations, such as executives in the telecommunications industry (Choo & Auster, 1993; Choo & Auster, 1994)

The telecommunications executives considered human sources most valuable because they “filter and summarize information, highlight the most salient elements, interpret ambiguous aspects, and in general provide richer, more satisfying communications about an issue” (Choo, 1998a, p. 31). Workers in other roles report “learning much more by studying on their own and discussing with co-workers than from formal sources or other external sources of expertise” (Clement, 1990 p. 226; see also Wenger, 1998). In some circumstance, human sources may also be uniquely valuable because of the nature of the work being performed or the nature of the information sought .

Further evidence supporting the importance of human sources of information comes from research into communities of practice. A community of practice is a group of people who come together informally to support and learn from one another in accomplishing a given task (Lave & Wenger, 1991; Wenger, 1998, 2000). Among the workers who have been studied as communities of practice are service technicians (Orr, 1996), fishermen (Miller & Van Maanen, 1979), and architects (Salaman, 1974). Theories of communities of practice see organizations as sense-making systems (Weick, 1995); that is, as social systems in which people interpret and give meaning to information about their work. Communities of practice allow workers to create shared understandings of situations and problems, as in the case of the Xerox technicians studied by Orr (1996).

By revealing how social relationships influence the flow of information (Allen, 1977), social network analysis has shed light on how communities of practice operate. For problem-solving, the exchange of information outside of formal meetings and hierarchical boundaries is essential for getting work done (Hinds & Kiesler, 1995; Nardi, Whittaker, & Schwarz, 2000). These informal social networks provide new information, answer requests rapidly, and help solve problems (Cross, Borgatti, & Parker, 2001; Cross, Rice, & Parker, 2002; Haythornthwaite & Wellman, 1998). A common language and frame of reference facilitate this exchange. Therefore, our first proposition is as follows:

Proposition 1: Human information sources will be accessed more frequently than documentary sources.

A reliance on human sources has its limitations. First, when a person leaves the organization, this person’s knowledge is also lost. Second, in large organizations

human sources are often distributed across the country or across the world, and it can be difficult to determine who knows what, and/or to obtain information from an unfamiliar or geographically distant source. Finally, reliance on human sources, particularly human sources accessed through traditional, non-ICT means, can be costly in terms of labor and time, and even reduce the potential for innovation by limiting the flow of ideas across boundaries (Teigland & Wasko, 2002).

In fact, it is to overcome these limitations that large investments in ICT have been made (Alavi & Leidner, 1999; Davenport & Prusak, 2000; Fulk & DeSanctis, 1995). Initially, investments focused on capturing information in documentary sources (Hansen, Nohria, & Tierney, 1999). More recently, ICT strategies have shifted to include greater focus on enabling access to, and interaction with, human sources (Hansen et al., 1999; Teigland & Wasko, 2003).

The result of these ICT investments is that workers have a wide gamut of information sources available, both human and documentary. Given our concern in this study with the role of technology in information gathering, we divide those sources into two categories: online and offline. For the purposes of this study, we use these terms as equivalent with “computer-mediated” and “non-computer mediated,” since the distinction is not significant for Internet-era firms.

How do workers choose a given source and access mode for acquiring information? Research has shown that the factor that most influences the selection of an information source is accessibility (Leckie, Pettigrew, & Sylvain, 1996; Pinelli, 1991; Pinelli, Bishop, Barclay & Kennedy, 1993). Fidel & Green (in press) have shown that definitions of accessibility vary widely. Their research with engineers found accessibility comprising as many as a dozen different factors, including format, level of detail, familiarity, searchability, timeliness, and physical proximity.

Though many of the factors of accessibility seem to favor online access, access to human sources still seems most effective when conducted offline. People often need to meet face-to-face to exchange experiences and especially what has been referred to as tacit knowledge or deep insights (Brown & Duguid, 2000). Online systems for enabling human sources to share their knowledge are often not as successful as predicted (Markus & Keil, 1994; Orlikowski, 1996). Although video and telephone conferencing is available, people still travel across the globe for business meetings (Cohen & Prusak, 2001). Therefore, our proposition with regard to human sources is:

Proposition 2a: Human information sources will be accessed more frequently offline than online.

For documentary sources of information, online access appears to satisfy many of the factors that make up accessibility. Sources available online are typically known (or easily locatable), combine many different types of information in one place, are searchable, are available at any time, and are interactive (searches can be refined).

For that reason, our proposition with regard to documentary sources is:

Proposition 2b: Documentary information sources will be accessed more frequently online than offline.

Individual performance

Access to information is central to the performance of any organization (Choo, 1998a, 1998b; Galbraith, 1973). This is because employees are limited in their abilities to solve problems and make decisions, a condition referred to as bounded rationality (Simon, 1988, 1996). In order to overcome bounded rationality, employees need to acquire the right information to solve problems and make the right decisions (Allen, 1977; Jarvenpaa & Ives, 1994). Indeed, research has shown that effective use of information does lead to better performance (Constant, Sproull, & Kiesler, 1997).

Research has also shown that the key factor influencing the use of information in organizations is access (Allen, 1977; Fidel & Green, in press; Gertsberger & Allen, 1968). The findings show that if an information source is difficult to access – either because it is physically distant or it is otherwise difficult to use – workers will be less likely to seek information from this source. Hence, the ways information sources are accessed can be expected to have a major impact on performance.

Few studies have been conducted into how modes of accessing information affect individual performance. However, it is obvious that information captured in databases, knowledge repositories, and other digital formats is more accessible than that same information would be in paper form, if only because ICT provides access across the boundaries of space and time. With information sources a “click” away, employees can use these resources to better solve problems. Therefore, we should expect to find in our case that electronic searching and retrieval of documentary sources would result in improved performance for workers who access those sources online:

Proposition 3a: Online access to documentary sources will have a higher association with individual performance than offline access.

ICT also provides new means to access human sources. Such tools as email, instant messaging, and bulletin boards facilitate the sending and receiving of messages and other digital information, and create dense social networks of information exchange (Haythornthwaite & Wellman, 1998; Sproull & Kiesler, 1991). Employees can communicate across the organization from the comfort of their desktops, which should also yield increases in productivity (Hinds & Kiesler, 1995).

Nevertheless, there are concerns that the use of ICT for accessing human sources may not have a positive impact on performance. These concerns are twofold. First, many types of information from human sources are not easily transferable via ICT. A

series of studies showed that computer-mediated communication lacks social cues that are important to facilitate the transfer of complex and uncertain messages (Daft & Lengel, 1986; Kiesler & Sproull, 1992; Lengel & Daft, 1988; Trevino, Lengel, & Daft, 1990). Further, theories in the field of knowledge management suggest that tacit knowledge – defined as insights, values, and experience-based knowledge – is transmitted primarily through face-to-face interactions (Cohen & Prusak, 2001; Nonaka & Takeuchi, 1995). Therefore, we would expect that, where human sources are concerned, offline access would be associated with higher performance:

Proposition 3b: Offline access to human sources will have a higher association with individual performance than online access.

Research method and design

Setting

To examine the above propositions, we undertook research at a software and services company in the high-technology industry. This company, located in a large North American city, will be referred to by the pseudonym KME.

Three criteria were important for selecting KME as the site for the study. First, KME is an organization that was founded in 1997 when Internet technologies were widely available in the United States, and has incorporated ICT into its operations from its founding. Hence, KME is not an organization that first operated in the time before the Internet and then adapted to ICT. Second, KME is an organization in the service sector and employs knowledge workers who extensively use a wide variety of information sources in their daily work activities. The company's products and services enable its customers to implement successful collaboration projects among customers, employees, or partners. Third, KME operates in a fast developing area and thus needs to be constantly developing new products and services and fine-tuning existing ones in order to meet customer needs and to remain competitive. Particularly in the services area of the business, processes and practices are not well established in the industry, and are therefore being created, tested, and evolved as part of everyday work.

KME has 80 employees. We selected for our sample 28 employees in total from the product development and management services groups, representing 35 percent of the total employee population. These two groups were selected because they have existed as functional groups for at least one year and the tasks accomplished within each group are interrelated and fairly homogeneous. Hence, we expected to find stable patterns of use of information sources and technology. Of the 28 employees

selected, 27 completed the questionnaire yielding a 96 percent response rate¹. Before administering the questionnaire, a pilot test was conducted with six respondents.² The numerical data were supplemented by in-depth interviews and observations with a sub-sample of 10 employees. There were four women in the sub-sample; this ratio is approximately representative of the gender distribution in the complete sample. Five respondents from each group were chosen. Participation in the interviews and observations was voluntary.

Survey

The main source of data collection was a web-administered survey. Each respondent was provided with a username and password to access the site. All responses were collected on a secure server. The key variables were information sources and access, individual performance, social interactions, and organizational culture as it pertains to knowledge sharing.³ The variables relevant to this paper are discussed below.

Information sources and access. To measure employees' use of various information sources, we draw from previous research into how information and knowledge is stored and used in organizations. Because ICT presence in organizations has only reached today's levels over a period of many years, past research has not always made a clear distinction between online and offline sources. Useful distinctions made in past research include personal versus impersonal (Choo & Auster, 1993; Choo & Auster, 1994) and human versus documentary (Fidel & Green, in press). Related distinctions arising from theory include tacit versus explicit (Nonaka & Takeuchi, 1995), and codified versus personalized (Hansen et al., 1999).

We have followed Fidel and Green in distinguishing between human and documentary sources, and make an additional distinction between online and offline methods for accessing those sources. Our use of these terms, and the list of items we include under each category of sources, are modified to conform to an Internet-era company and the specific technologies available at KME. The list of items is presented in Table 1. For each item, we asked respondents to indicate their frequency of use on a 7-point Likert scale [1=never; 2=a few times a year; 3=1/month; 4=1/week; 5=several times a week; 6=1/day; 7=several times a day]. Based on factor analysis of these items, new scales were computed. The items "Internal Memoranda, Circulars" and "Company Library" were excluded from the scale measuring use of

¹ We do not expect a non-response bias in the sample because the one employee who did not participate was on holidays at the time the survey was administered.

² Three respondents were not employed by KME, and three were employed by KME, but were not members of either target group. The pilot tests served to provide feedback about the length of the questionnaire and the appropriateness of the wording of items.

³ As noted earlier, social interactions and organizational culture will be addressed in future papers.

offline documentary sources because they did not show sufficient variance, with most employees responding “never.”⁴

Individual Performance. The most commonly accepted measures for employee performance are productivity and efficiency (Hall, 1997; Heneman, 1974). However, these measures are not generally maintained for all categories of workers. Even when they are maintained, it is often unclear what they reflect, because there are different ways in which they can be operationalized (Teigland, 2000). In the present study, self-reported ratings of individual performance are used because the company does not maintain quantitative metrics that are consistent across individuals in the sample.

We measured individual performance using four items in the questionnaire. Participants were asked to rate, on a 5-point Likert scale ranging from “strongly disagree” to “strongly agree,” their perceived ability to solve problems effectively. The first and second items are modifications of the items employed by Teigland and Wasko to measure individual performance (2002). These two items ask participants to rate their effectiveness in solving problems and the creativity of their solutions. The third and last items measure a person’s perceived contribution to finding a solution.

The four items were collapsed into a single measure of individual performance. Although self-reported measures may seem to be biased in favor of the respondents, some evidence suggests that they are not upwardly biased (Churchill, Ford, Hartley, & Walker, 1985). In the present study, we find that the items have no deviation from the normal distribution. See Table 2 for scale properties.

Interviews and observations

As noted, the study does not rely solely on self-reported data, but also includes rich, contextual data obtained through interviews and observations. The interviews asked group members about how they obtain information for work-related purposes. It also includes a critical incident technique to learn about how they use various information sources to solve ill-defined problems.

This research differs from other studies by using an ego-centered observation approach. That is, instead of observing an entire group or division, we observed single employees. These one-day long in-depth observations provide rich data about all the ways in which a group member obtains information. The triangulation of quantitative and qualitative data serves the purposes of explaining the patterns of interaction and communication that result from the study.

⁴ Similar results were found for the regression analysis that when the scale measuring offline documentary sources was used that includes “Internal Memoranda, Circulars” and “Company Library.”

Documentary Sources	
<i>Offline</i> (<i>Non-Computer-Mediated/Printed</i>)	<i>Online</i> (<i>Computer-Mediated</i>)
Newspapers	Newspapers
Periodicals	Periodicals
Internal Memoranda, Circulars	Internal Memoranda, Circulars
Company Library (Books, Tapes, etc.)	File Directories, Databases, Repositories
Newsletters	Newsletters
<i>Human Sources</i>	
<i>Offline</i> (<i>FTF Meetings, Phone Calls, Lunches</i>)	<i>Computer-Mediated</i> (<i>Email, Instant Messaging, Bulletin Boards</i>)
Colleagues Outside the Work Group but Within the Organization	Colleagues Outside the Work Group but Within the Organization
Colleagues Within the Work Group	Colleagues Within the Work Group
Superiors, Other Executives	Superiors, Other Executives
Customers	Customers
Competitors	Competitors
Business Partners, Vendors	Business Partners, Vendors
Conferences, Trips	Conferences, Discussions
Personal Friends Outside the Organization	Personal Friends Outside the Organization
Colleagues Outside the Organization	Colleagues Outside the Organization
Non-electronic Bulletin Boards	Online Bulletin Boards
<i>Individual Performance</i>	
I can quickly recognize the complexities in a situation and find a way of solving problems.	
My work tasks demand creative and totally new ideas and solutions.	
I feel that the solutions I provide are not very helpful.	
I feel confident that my work has contributed to the success of the organization.	

Table 1. List of Items

<i>Scales</i>	Range	Mean	S.D.	Cronbach's α^a	# Items
Documentary Offline	1-7	2.63	1.02	.61	3
Documentary Online	1-7	4.31	1.24	.69	5
Human Offline	1-7	3.02	0.62	.60	10
Human Online	1-7	3.90	0.94	.74	10
Performance	1-5	4.14	0.57	.73	4

^a Measure of reliability.

Table 2. Scale Properties

Results

Profiles of respondents

The web-based questionnaire was administered to 27 participants in two groups; 11 (3 females) participants in the product development group and 16 (5 females) in the management services group. Respondents had worked for KME for an average of 28 months (range 5-48 months). Employees in the product development and management services groups had worked an average of 15 months and 37 months, respectively, reflecting the fact that the company had started its product development efforts only in 2001. Twenty-two percent of respondents had a high school diploma or less, 44 percent had completed an undergraduate degree, and thirty percent had a graduate degree. The sample included 3 upper managers, 5 middle managers, and 19 group members.

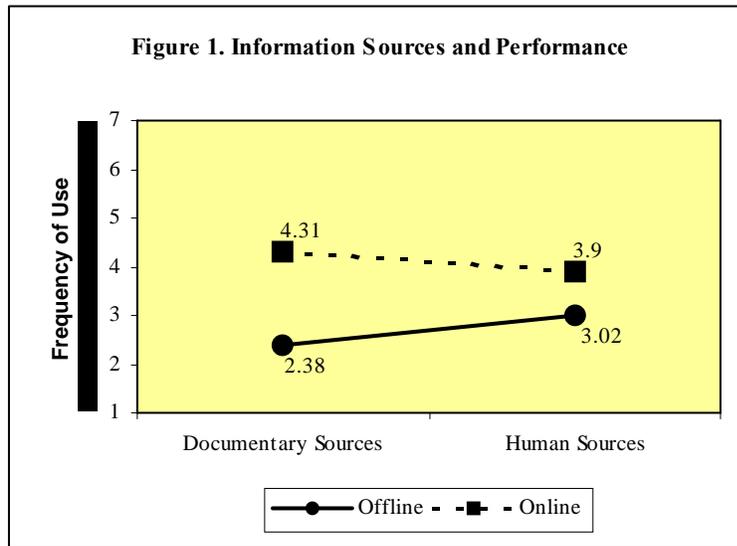
Interviews and observations were conducted with a sub-sample that included 10 employees, 5 respondents from each group. Participation was voluntary. The sub-sample consists of 40 percent females⁵. Interviews lasted about 45 minutes and the observations lasted for an entire workday (approximately 9 a.m. to 5 p.m.). To ensure anonymity, respondents are referred to by pseudonyms and gender, hierarchical position, and other identifying characteristics are omitted.

Information sources and access

Figure 1 shows the frequency of use of human and documentary sources. We predicted that employees would use human sources more frequently than documentary sources for work-related purposes. We also predicted that documentary sources would be more frequently accessed online than offline, whereas human sources would be more frequently accessed offline than online. We tested these predictions by conducting a 2x2 repeated-measures analysis of variance (ANOVA) with type of information source and type of access as within-subjects factors.

Results of this analysis revealed no effect of type of source, $F(1,26) = 0.70$, $p = \text{n.s.}$; an effect of type of access, $F(1,26) = 103.78$, $p < .001$), as well as an interaction between type of source and type of access $F(1, 26) = 32.11$; $p < .001$. Simple comparisons were conducted to test the source of the interaction. We find that documentary sources are more likely to be accessed online than offline $t(26) = 9.72$, $p < .001$. Similarly, human sources are more likely to be accessed online than offline $t(26) = 6.96$, $p < .001$.

⁵ This female to male ratio is approximately representative of the gender distribution in the two groups.



Contrary to Proposition 1, we found that documentary sources ($M = 3.34$) were used as frequently as human sources ($M = 3.45$). We also found that, contrary to Proposition 2a, human sources were accessed more frequently online than offline. Our finding for Proposition 2b supported the proposition: documentary sources were accessed more frequently online than offline.

Individual performance

Table 3 reports results of a hierarchical regression analysis that tested whether or not types of information sources and access predicted performance. The aim was to test if online access to information sources predicted variance in performance beyond that already predicted by offline access. We predicted that with regard to documentary sources, online access would explain variance in performance beyond that associated with offline access. To test this we entered each variable to the regression equation in a separate step. In the first step, we entered several control variables (including time with organization, education, and hierarchical position) that may influence performance, but are not the focus of the study. None of these variables were associated with performance. In the next steps (2 and 3), we entered offline access and online access to documentary sources sequentially. The models did not reach statistical significance, indicating that neither online nor offline access to documentary sources was associated with performance. Hence, there was also no significant increase in the explained variance between steps 2 and 3 for documentary sources.

With regard to human sources, we predicted that online access would explain variance in performance beyond that explained by offline access. Again, to test this we entered each variable into the regression equation in a separate step. The control

variables, which were entered in the first step, again revealed no association with performance. In the next step we entered offline access into the model. We found that this model reached statistical significance explaining 26 percent of the variance in performance. Offline access to human sources was found to be associated with performance. In the next step, we entered online access to human sources into the model. This model was also significant and explained 53 percent of the variance in performance. Thus, online access to human sources was also found to be associated with performance. To test if online access explained variance in performance beyond that explained by offline access, we examined the change in variance explained between the two steps (2 and 3). We found that, contrary to our expectations, there was a significant increase in the variance explained between steps 2 and 3, $F(1,18) = 18.46$, $p < .001$, indicating that after controlling for offline access, online access amounted for a significant proportion of variance in performance.

In sum, we found no support for Proposition 3a; documentary sources were not related to performance; neither access via online nor offline. With regard to human sources, we found that, contrary to Proposition 3b, after controlling for offline access, online access amounted for a significant proportion of variance in performance.

	<i>Performance</i>				
	Step 1 ^a	Step 2 ^a	Step 3 ^a	Step 2 ^a	Step 3 ^a
Time working	0.09	0.08	-0.02	0.04	-0.08
Education (reference=bachelor)					
High school or less	0.04	0.07	-0.02	-0.02	-0.14
Graduate degree	-0.29	-0.27	-0.38	-0.14	-0.18
Hierarchical position (reference=management)					
Group member	0.29	0.32	0.32	0.38	0.47*
Upper management	0.33	0.33	0.37	0.19	0.35
Documentary					
Offline	–	0.15	0	–	–
Online	–	–	0.35	–	–
Human					
Offline	–	–	–	0.59**	0.05
Online	–	–	–	–	0.77**
Adjusted R²	-0.06	-0.09	0.03	0.26*	0.53**

* $p < .05$, ** $p < .01$, *** $p < .001$.

^a Standardized (beta) coefficients.

Table 3. Information Sources and Performance

Interviews and observations

When individuals seek information, they make choices. These choices are to some extent personal: they are based on the individual's view of what sources and access methods would be easier, faster, or more effective. However, they are not made in a vacuum; they are greatly influenced by organizational factors. Interviews and observations at KME revealed that organizational factors were a very strong influence on the information seeking habits of most employees. In the paragraphs below, we discuss three organizational factors that were most salient: pace of work, workspace configuration, and norms for interaction and information management. Although we discuss each factor separately, we recognize that they are interconnected.

Pace of Work. The advantage of computer-mediated communication in bridging space and time constraints, thereby speeding up communication, is one reason for its dominance at KME. Like other companies in the high-technology industry, KME operated at an unusually rapid pace. Day-long observations revealed that KME employees were often performing three or four operations at the same time, including multiple separate conversations happening in instant messaging and email, and that deadlines for work in process were typically within the day rather than the week or month.⁶ In such an environment, it is essential that employees can access the documents they need quickly, from the convenience of their desktops.

For accessing human sources, the advantages of online access go beyond bridging time and space. Employees at KME often needed to solve problems that consist of interdependent tasks. Employees chose to use online means for information exchange because it allowed them to quickly send and receive messages with a large number of employees – either simultaneously or sequentially. In order to coordinate sub-components of work tasks, connectivity in real time is pivotal to avoid delays. While the phone and face-to-face communication would offer similar capabilities, neither was flexible enough for the type of high-frequency communication required at KME. Further, they did not support multi-tasking in the same way as email and instant messaging did. Employees could be working and simultaneously receiving email and instant messages without being interrupted. They could note the arrival of an instant message or email without abandoning their work, and reply later at a time that was more convenient.

Workspace Configuration. In this organization, the physical properties of the office influenced information habits. For example, the absence of a central paper file system for reports or other documents may help account for the great predominance

⁶ The product development group typically has longer timeframes than the management services group, but the complexity of their work means that the level of intensity is similar between groups.

of online versus offline access of documents. We found that documents were accessed online once a week on average, versus a few times a year for documents accessed offline. Limited storage space for individuals may also help account for this difference.

Workspace configuration also impacted how human sources are accessed. KME had limited office space and employees were sited in small cubicles in very close proximity. Employees reported that they often opt to use email and instant messaging because it was less disruptive to those sitting around them than would be holding a conversation (either face-to-face or via phone) at their desk. Perhaps ironically, technology here is not used to bridge distance, but to overcome the disadvantages of proximity.

Norms for Interaction and Information Management. Consistent with our quantitative findings, norms concerning documentary sources favor online access. Typical documentary formats include MICROSOFT WORD documents and MICROSOFT POWERPOINT presentations. Documents created for outside parties such as customers or partners were, with few exceptions, delivered in electronic form as attachments to email, not as hard copy shipped through the mail or overnight service. This norm was reinforced by the fact that most interactions with outside parties were conducted via phone rather than in face-to-face meetings where it would be customary to hand out copies of the documents to be discussed. Documents created for internal use were always exchanged and stored in electronic form, although they were printed out when under discussion in face-to-face meetings. Paper documents received from outside parties were typically stored in paper form by a KME employee involved with the relevant customer or project. Not surprisingly, the location, access, and retention of these documents were less convenient and reliable than for electronic documents.⁷

Norms for human sources favored online access as well. It was not uncommon for a KME employee to ask a coworker to “send me an email” rather than continue a face-to-face conversation where complex or highly detailed matters were being discussed. It was understood that using email would create a convenient record or reminder of the items being agreed to or discussed. Observations showed that employees exercised considerable care in crafting emails when they knew the emails were likely to be retained and referred to in the future. Even where face-to-face or phone interaction was required, most KME employees adopted the convention of contacting the source first via instant messaging or email to confirm whether they are available to talk.

It is worth noting that face-to-face interactions were nevertheless a large part of how KME operated. As our quantitative results show, human sources were accessed

⁷ Contracts and other financial and legal documents are stored separately in customer files maintained by the finance department, which was not one of the groups included in this study.

offline on average once a month, versus once a week online – that is, more online than offline, but not nearly the predominance that existed for documentary sources.

Conclusions

The goal of this study was to obtain a better understanding of how workers at an Internet-era company use information sources and access those sources. The study found that, based on the data from one company, Internet-era companies may exhibit different patterns in information seeking than do traditional companies. Specifically, workers at Internet-era companies reverse the traditional preference for offline versus online access to human sources. A further finding shows that online access for human sources may be preferred because it is more effective – that is, that such access is associated with higher individual performance, as performance is subjectively perceived by the individual.

Several other insights emerged in the course of this study that may have implications for future research. First, it is clear that ICT has significantly complicated the distinction between human and documentary sources. Most people would agree that a conversation with a coworker involves a human source, and that a document from a filing cabinet involves a documentary source. But when ICT is involved, the difference may be less a matter of kind than of degree. For example, when an employee obtains information from an email sent by a coworker, the source is obviously human. But what if the email is two years old, and the employee retrieves it not from the source, but from storage on his or her own computer? Or if the employee retrieves it from a repository, where another employee has placed it as something that might benefit others? Our research indicates that employees are consciously aware that the information they share with, or receive from, coworkers may have a “second life” as a documentary source, and are adapting their behavior accordingly. An area for future research is to focus on how these conversion processes occur, and how they can be optimized.

Another learning relates to the use of ICT to overcome the problems of a densely crowded workplace. In a study of a high performance team, the fact that everyone could hear what everyone else was saying was perceived as an advantage (Mark, 2002). The difference is that employees in the present study are not working on the same problem. While the tasks are interdependent, there is little overlap. Thus, the pattern of access to sources shows a complex relationship between computer-mediated communication and productivity. In general, the advantage of computer-mediated communication is seen in its capacity to bridge space and time constraints thereby speeding up communication (Sproull & Kiesler, 1991). By contrast, in the present study, we found that computer-mediated communication supports local

communication. The advantage does not lie in its ability to bridge spatial barriers, but in overcoming local physical constraints. By relying on computer-mediated communication employees can communicate without interrupting each other's work.

The high reliance on online ways of accessing human sources is particularly interesting in light of the fact that employees in this organization are co-located. We introduce the term *virtual localities* to describe bounded physical places where people communicate via computer-mediated means, creating dense networks of exchange. The fact that people are not interacting visibly in public spaces does not mean that they are in isolation. They are going online to send and receive emails, to chat with colleagues via instant messaging, or to post questions to a bulletin board. This finding is contrary to theories of network and virtual organizations, which argue that computer-mediated communication creates sparsely-knit, boundary spanning structures (Monge & Contractor, 1988, 1997; Monge & Contractor, 2003; Monge & Eisenberg, 1987). We found that computer-mediated communication also creates dense, local networks of information exchange. Thus, the Internet is contributing to new and unexpected forms of interaction and community in organizations, which blend computer-mediated communication for both local and distant interactions.

While the purpose of this study was to examine how Internet-era companies use and access information sources, there are many areas of research that remain unexplored. First of all, we only examined frequency of use and did not collect data on the time employees spent using an information source. Thus, the next step would be to conduct a more detailed analysis looking at the time employees spent on each source. Second, although we related use of information sources and access to performance, we do not have data mapping the usefulness and quality of single sources. It would be interesting to see how employees evaluate specific sources in the context of their work. Third, we measured individual performance using employee's self-rating. To strengthen the validity of performance, it would be useful to employ a third-party measure of performance. Fourth, this study is based on a single organization reducing the generalizability of the results to other companies. We believe however that the findings can serve as a baseline for future research on Internet-era companies.

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