Success Factors in the Implementation of a Collaborative Technology and Resulting Productivity Improvements in a Small Business: An Exploratory Study

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ABSTRACT

Practitioners and academics often assume that investments in technology will lead to productivity improvements. While the literature provides many examples of performance improvements resulting from adoption of different technologies, there is little evidence demonstrating specific, generalizable factors that contribute to these improvements. Furthermore, investment in technology does not guarantee effective implementation. This qualitative study examined the relationship between four classes of potential success factors on the adoption of a collaborative technology and whether they were related to performance improvements in a small service company. Users of a newly adopted collaborative technology were interviewed to explore which factors contributed to their initial adoption and subsequent effective use of this technology. The results show that several factors were strongly related to adoption and effective implementation. The impact on performance improvements was further explored. Results showed a qualitative link to several performance improvements including timesavings and improved decision-making. These results are discussed in terms of generalizability as well as suggestions for future research.

Keywords: knowledge sharing; collaborative technologies; performance/ productivity improvement; success factors

INTRODUCTION

The importance of knowledge sharing and the ability to tap into an organization's vast reservoir of creative intellect have been acknowledged as possibly the greatest strategic competency an organization can achieve (Davenport 1999; Pan et al. 1999). By enabling associates to share their ideas, expertise and wisdom, problems can be more easily solved, processes improved, and productivity increased. As business environments become more turbulent and technologies become increasingly dynamic, the pace of change and competitive pressures spiral more steeply upward. As this paces continues, organizations require technologies, capabilities and a culture that enables them to keep up with these changes (Senge 1997; Rumizen, 1998).

Furthermore, in an era that is becoming predominantly digital, the ability to share knowledge is becoming easier, cheaper and more widely accepted. Many organizations recognize that collaborative technologies, supported by distributed electronic networks, can reduce barriers to communication and facilitate knowledge sharing within the organization (Ciborra et al., 1996). Collaborative technologies can enable people in distributed environments to work together seamlessly irrespective of location, time or functional area. By sharing a common goal in a networked environment, virtual teams can create synergistic relationships and quality output via collaborative knowledge sharing. In addition, the communication patterns that develop in electronic collaborative environments are equally applicable to people sharing knowledge in the same building or even the same room as those who are divided by continents (Barbar et al., 1998).

While causal relationships between knowledge sharing and specific quantifiable performance improvements to achieve competitive advantages have been scarce, researchers have qualitatively documented some organizational performance improvements. For example, the adoption of one particular collaborative technology (*Lotus Notes*) to facilitate knowledge sharing increased productivity and efficiency in a software company by "creating a knowledge repository which prevented duplication of research efforts" (Orlikowski, 1996). The research literature acknowledges this relationship while seeking to validate it with additional empirical studies. While most research in knowledge management and collaborative technologies has focused on large organizations, few studies have examined its impact on small businesses. In addition, few studies have explored the specific success factors that contribute to the adoption and diffusion of technologies that facilitate knowledge sharing and resulting performance improvements.

This article describes the experiences of a scientific contract research organization that works in the pharmaceutical industry, in their attempt to improve organizational performance by adopting a collaborative technology to facilitate knowledge sharing within the organization. It explores four classes of potential success factors to facilitate this process. The literature on knowledge sharing and collaborative technologies suggests a number of factors considered to be instrumental in achieving successful knowledge information among people in organizations.

In addition, researchers in the field of performance measurement and collaborative technologies have found tentative relationships between performance improvement and knowledge sharing using different collaborative technologies in different contexts. However, organizations often introduce new technologies using a forced adoption approach without fully understanding the specific factors required for their continued and effective use. This represents a prerequisite requirement if the technology is to be used to fulfill the goals for which it was intended.

Therefore, this study explored how and why certain variables contribute or fail to contribute to the effective use of a CSCW (computer-supported collaborative work) system, as well their influence on knowledge sharing using a CSCW system. The relationship between knowledge sharing, facilitated by a collaborative technology, and resulting performance improvements in this small business was also examined. Finally, the article reflects on the lessons learned from this experience and whether the findings may be generalizable to other organizations.

REVIEW OF THE LITERATURE

Adoption of Technology Innovations and Success Factors

Pan and Scarbrough (1998, 1999) studied specific factors relating to the successful implementation of a knowledge sharing system. The model outlined below serves as the framework for the initial study model (Figure 1). They introduced a theory that said knowledge management should contain three components to be successful:

1. *Infrastructure:* "The hardware/software that enables the physical/communicational contact between network members; provides the means to share knowledge", e.g., the technology. H. Saint-Onge, a senior vice president at a Canadian financial company, described the necessity of infrastructure as "connectivity-building, a seamless railroad that can carry the knowledge freight around the organization" (*Informationweek*, 1999).
2. *Infostructure:* "The formal rules which govern the exchange between the participants in the network, providing a set of cognitive resources (metaphors, common language) whereby people make sense of events on the network."
3. *Infoculture:* "The stock of background knowledge which actors take for granted and which is embedded in the social relations surrounding work group processes; core values and attitudes, reflected in employees and managers' willingness to exchange knowledge to solve company problems." This would also be known as the organizational culture. A common theory among researchers was that organizational culture played a crucial role in the effective adoption and use of both collaborative technologies and knowledge sharing.

The importance of culture in the adoption and implementation was exemplified by the CEO of Buckman Laboratories, "The core values and attitudes of Buckman employees are reflected in their willingness to exchange knowledge simply to solve company problems, without the usual political baggage and ulterior motives." He further asserted, "What happened at Buckman was 90% cultural change. At the heart of knowledge-sharing activities at Buckman is a climate of continuity and trust" (Pan and Scarbrough, 1999). Saint-Onge also stated "you need a culture that fosters interdependence–that has a sense that everyone is creating the future of the firm through everything they're doing." (*Informationweek*, 1999).

Scheraga (1998) contended, "Putting knowledge management solutions in place can prove useless unless a company encourages its workforce to contribute its knowledge to the cycle. This is one of management's greatest challenges, as workers are often reluctant to share information. The modern business climate inherently rewards people for what they know, which discourages people from sharing their knowledge." However, he suggests that the answer to this is to reward employees for sharing information and knowledge.

Pan and Scarbrough also emphasized the importance of top management involvement. As mentioned above, the CEO of Buckman Laboratories acted as the visionary and the champion in the effort to create a knowledge-sharing environment within the company. Not only did he invest heavily in the infrastructure (the technology to provide the vehicle for sharing knowledge), but

he created unique reward and recognition systems to actively promote knowledge sharing, stating "the most valuable employee is one who becomes a source of knowledge and actively shares that knowledge with other people." In addition, he modeled the culture by sharing knowledge and empowering associates to also share theirs. Thus, creating a successful knowledge sharing culture is a blend of technology and sociology, creating both the mechanisms to facilitate knowledge sharing and the culture to encourage it in practice.

Collaborative Technologies, Knowledge Sharing, and Performance Improvements

What lessons can be learned from the literature on knowledge sharing and collaborative technologies that can help a small business? By creating the capability to capture, organize and disseminate knowledge, a small business can potentially improve decision-making, processes, quality, customer satisfaction and reduce costs. This premise is based on capturing and sharing the experience and knowledge of employees to facilitate creativity and innovation.

This assertion is based on the research found in the knowledge management literature. Karl Wigg (1999) described the benefits of a knowledge management system as reducing costs due to benchmarking and sharing best practices between different groups inside and outside the organization, decreasing time-in-process, reducing rework, and increasing customer satisfaction and quality by increasing people's knowledge of and improvement of processes. Other benefits include an increase in innovation in products, services and processes due to sharing of knowledge among different functional areas, and increased knowledge of customers resulting in the ability to better satisfy their needs, resulting in increased market penetration and increased profit margins.

Reisenberger (1999) further asserts "the rate of employee turnover and the speed of change requires us to place greater emphasis on capturing, disseminating and rescuing our precious intellectual capital." He takes this one step further in his contention that "Today's fast-paced business environment is characterized by chaotic markets with constantly evolving global customers, competitors and suppliers. Tomorrow's winners will be determined by these few firms that create the ability to develop constant and continuous innovation and transformation. This ability will be successfully manifested by those enterprises that understand, properly harness, and exploit global learning and the use of the organization's intellectual capital." Even Peter Drucker mirrors this view, asserting that in a 'knowledge society', the basic economic resource is no longer capital or natural resources or labor, but is and will be knowledge, and where knowledge workers will play a central role" (Drucker, 1995).

In terms of the relationship between knowledge sharing and performance improvement, most researchers admit that while there are many conceptual articles supporting the relationship, there is little empirical evidence to validate it. Davenport (1999) stated, "If knowledge and strategy have only been weakly linked, connections between knowledge management and organizational performance are even more difficult to establish." However, in an empirical study on large pharmaceutical firms that compete on the speed and effectiveness of the drug development process, it was found that those firms using knowledge management developed drugs more quickly. Furthermore, they found that "firms

with more aggressive and innovative knowledge creation approaches were found to be more profitable over time than those with more prosaic knowledge strategies."

Davenport also contended "despite considerable discussion of the ties between knowledge and indicators of performance, few if any companies have been able to establish a causal link." He suggested that one way to establish credibility in relating knowledge management to improved performance is to use intermediate measures. For example, he suggested measuring the number of hits to a knowledge repository or the satisfaction measures of employees using a knowledge management system. He also contended that "if both knowledge management and process measures are rising at the same time, we can credibly argue that knowledge management helped to cause the improvement in process performance, building a chain of credibility tying knowledge management to better financial performance."

Orlikowski (1996) studied the users of a digital collaboration software system in a technical customer support division of a software company. Her observations demonstrated a non-quantified increase in productivity. The creation of a knowledge repository allowed associates to share processes and document problem-solving methods. This collective knowledge contributed to better solutions to customer problems, and improved efficiency and productivity since associates did not have to start from "ground zero" to research customer problems. It also increased accountability and decision-making because information entered into a repository was signed by the author and users were aware of the credibility of the sources. As the knowledge base grew, it shifted from being simply a knowledge repository to a training mechanism as well. She attributed the success of the groupware in this situation to a departmental culture, which was open to change, and to using new technologies, as well as adequate training and expectations. The collaboration software was also user-centered, emphasized a specific functionality, and was phased in gradually.

Failla (1996) similarly found that a team-oriented collaborative culture was necessary for the successful adoption of collaboration technology tools as well as commitment by top management and the users. He also identified interesting criteria for the success of a collaborative database as a useful information filtering system.[1] He found that if no one took ownership of the system and filtered data for relevance and usefulness, then it was not deemed to be valid by the users. Consistent with this was his observation that users needed to take personal satisfaction in the input they made into the system, inputting valuable knowledge that would make a significant contribution to the organizational knowledge.

In a consumer products manufacturer, Ciborra and Patriotta (1996) found that the effectiveness[2] of the new technology depended on the perceived benefits of the new system (relative advantage) as well as the willingness of the users to act collectively. They also found that resistance to the tool by new users depended on how closely it matched pre-existing work practices, as well as the presence of alternative communication tools that users were already familiar and comfortable with. Adoption depended on organizational rewards and incentives to use and actively contribute to the system. This particular organization needed to change its culture to a more collaborative one and to implement a reward scheme to encourage contributions to the system. These findings are consistent with the adoption and diffusion literature

(Rogers, 1995) regarding the importance of relative advantage and compatibility in the continued and effective use of a new technology.

In terms of knowledge sharing and contract research organizations, Mancini (1998) suggested that using document sharing technologies like CSCW tools are becoming more important, as "time to market" in the pharmaceutical industry is more critical than ever. In 1998, it took about $500 million and 15 years to bring one new drug to market. "At the heart of this cost and a lot of this time is paper–mountains and mountains of it." Thus, the reasons for using a document-sharing technology "have never been as compelling as they are right now." This article contended, "a month's delay in approval can mean millions of dollars in lost revenue." Therefore, if a CSCW technology can allow people within this industry to share information (documents and otherwise) and knowledge more effectively, thereby reducing review, editing and process time, it can give both the Contract Research Organizations and their clients, pharmaceutical and chemical companies, a competitive advantage by reducing time to market.

THE STUDY

Purpose

The overarching purpose of this research was primarily to identify and understand success factors that influence the continued and effective use of a CSCW system, enabling knowledge sharing. Secondarily, the purpose was to examine the resulting consequences of its use in several dimensions including performance improvements in time, productivity, and quality.

RESEARCH QUESTIONS

The literature suggests that factors associated with infrastructure, infostructure and infoculture are related to the successful adoption and implementation of a knowledge sharing system, facilitated by a collaborative technology. The literature also suggests a relationship between knowledge sharing and performance improvements in the organization. Based on this analysis of the literature, the following research questions were posed:

1. Which of the variables involved with a) infrastructure, b) infostructure, c) Infoculture, and d) individual concerns exert an influence (positive or negative) on the effective use of a CSCW technology and knowledge sharing, and in what ways do they exert their influence?
2. How does the use of a CSCW technology to facilitate knowledge sharing influence the performance dimensions of time, productivity and quality assurance?

A study model (Figure 1) was developed to explore the influence different potential success factors associated with the four major categories might exert on the adoption and diffusion of a knowledge sharing system, enabled by a collaborative technology.

The model attempts to incorporate the success factors from the literature into a comprehensive array of potential contributors to adoption and diffusion of a knowledge sharing system. Specifically, the work of Pan and Scarbrough (1998, 1999) discussed in the literature review serves as the major framework for this study model, incorporating their socio-technical view of the firm with their infrastructure, infostructure, and infoculture variables. This study model added a fourth major variable

called individual concerns.

In this model, the infrastructure components incorporate the factors of:

- Relative advantage: user-friendly technologies that users perceive as superior to existing technologies, providing more or better benefits.
- Training and time to learn and use the system effectively.
- Compatibility with existing work routines and norms.

The infostructure components dealt with rules governing the use of the system including:

- Recency and relevancy of information: how the knowledge was managed to ensure that contributions were both recent and relevant, thus motivating its continued use.
- Rules governing the system: did users perceive that the system was managed well with clear and consistent rules for usage?

The infoculture component integrated many variables from the literature including:

- Influence of leadership on initial and continued use of the system.
- Influence of reward and compensation structures.
- Influence of peers and social networks.
- Influence of trust and communication for effective knowledge sharing.

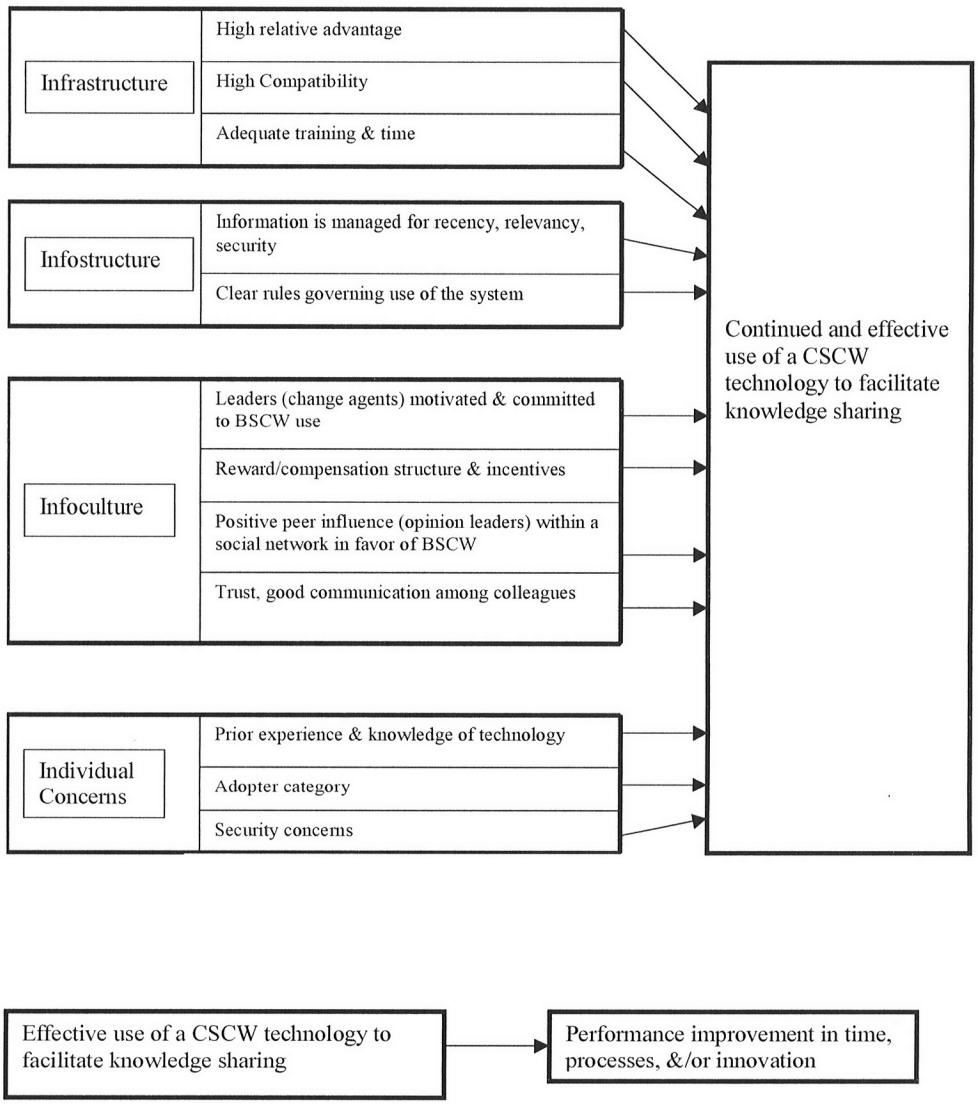
Finally, the last component, called, individual concerns, explored potential success factors related to an individual's personal "agenda" including:

- Prior experience with technologies.
- Personality variables, identified as adopter categories.
- Security concerns with using a collaborative technology and sharing knowledge.

Methodology

In January 2000, a contract service business made the decision to adopt a Web-based collaborative technology for the purposes of enabling knowledge sharing within the firm. The business was composed of three divisions with about 250 employees. The population of interest for this study consisted of the entire population of users of a CSCW system within a contract research organization. When the study was initiated in April 2000, there were approximately 10-15 users. By completion of the study in December 2000, there were approximately 47 users. Special emphasis was made to interview the leadership team (top executives), who represented the heaviest users of the system. These individuals included the president/CEO, three of the four vice presidents, and the chief financial officer. In addition, five of the six business development (marketing) managers, who represented low-moderate users, were interviewed, as well as the director of information systems. Finally, from the remaining pool of approximately 37 occasional-moderate users, 20 were selected by using a quota system[3] to represent the remaining functional areas. Eight managers, four quality-assurance/compliance, and eight data-entry people agreed to be interviewed. During the interview, questions were asked using a survey instrument designing to elicit their perceptions and attitudes towards this collaborative technology and knowledge sharing in terms of the factors described in the study model. Respondents were encouraged to answer freely and openly and were prompted only to keep responses focused

Figure 1: Study Model



on the variables of interest if the conversation began to stray from the topic under discussion.

In this organization, the collaborative system used was a Web-based document sharing technology called BSCW (Basic Support for Shared Work (*http://bscw.gmd.de/*). Its primary application was to enable top management and mid-level managers to collaborate on reports, share information about sales and budgets, and share information about customer problems and complaints with the quality assurance personnel for quality improvement purposes. This Internet-based software is platform independent, requiring only an Internet connection, a login/password sequence and a current version of a Web browser such as Netscape Navigator or Internet Explorer. BSCW may be considered a groupware

product similar to Lotus Notes in that it allows multiple users to work on documents from a central repository, version the documents and demonstrate accountability in terms of who created changes and when they were made. The system is organized within shared folders, such as "Sales Forecast: Division A" folder. The owner of that folder then invites those people he/she wishes to share information with, thus controlling access. Each invited member can then retrieve documents, edit them, version them, and resubmit them. The versioning capability allows the members to see what changes each member made and keep track of different versions. Its greatest benefit may be that employees can access needed information anywhere in the world at any time as long as they have web access.

Metrics: In this qualitative study, metrics represented indicators of employee perceptions and attitudes regarding the collaborative technology. The number of times that respondents discussed each factor was counted from the interview transcripts and analyzed using SPSS for frequency distributions and correlations with actual usage. For example, if respondent #12 discussed relative advantage 4 times, this was documented. In contrast, this respondent might not have discussed compatibility at all as a factor in his/her usage of the collaborative technology. Usage was documented on a daily basis from a log file that recorded the number of hits to the system per user per day. All data were analyzed qualitatively from the recorded transcripts, as well as quantitatively using frequency distributions and correlation analyses on the SPSS software program.

RESULTS

Influence of Major Variables

Figure 2 shows the total number of responses for each major variable in the study. It may be inferred that the number of responses correlates with how strongly people felt about each topic, as they would tend to elaborate more on topics of interest to them. Because the responses focused on infrastructure and infoculture variables, those factors are discussed in this paper. In this case study, the users did not express indications that the factors associated with infostructure or individual concerns influenced their usage of this collaborative technology or their willingness to share knowledge and information.

A correlation analysis (Table 1) between the four major variables of interest and average BSCW use per day per per-

Figure 2: Total responses for major variables (n=30)

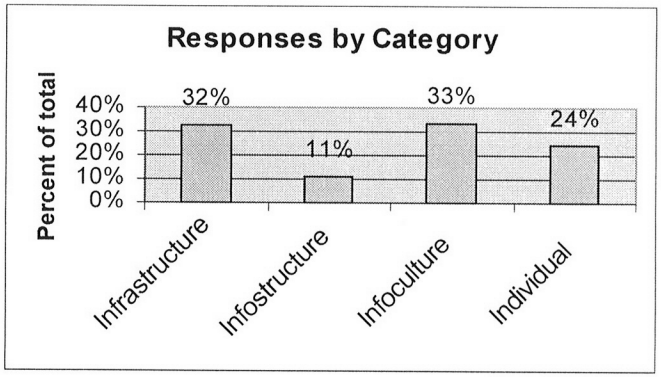


Table 1: Correlation Analyses: Major Independent Variables (n=30)

Independent Variables	Avg. Usage per day per person*
Infrastructure	.527**
Infostructure	-.202
Infoculture	.299
Individual Concerns	-.088

* Average usage per day was measured in terms of the number of hits to the system per person.
** Correlation is significant at the 0.01 level (1-tailed).

son was run. Infrastructure showed a significant correlation with usage at the 0.01 level. While not statistically significant, infoculture did show a higher correlation than the other variables.

Based on these results, the individual components associated with infrastructure and infoculture were examined. In terms of the subcomponents components within "infrastructure," results showed that relative advantage emerged as the major factor of influence (Table 2).

For the infoculture sub-components, the rich interview responses suggested that leadership exerted the greatest influence on use of the collaborative technology to support knowledge sharing. A reward/compensation structure to support knowledge sharing was also seen as important. The following quotes exemplify this.

"Basically, (President/CEO) told us to use this system, so we are. He can look to see who uses it to update the forecast and other information."

"Well, I guess to be real honest, (President/CEO) did. He said "you are going to use it!" End of discussion."

"Oh yeah-(President/CEO)! He goes in there and looks who's been reading it, who's been revising it, yeah. It was the greatest motivation to begin with."

Figure 3 shows the major perceptions of performance improvements from knowledge sharing, enabled by a collaborative technology.

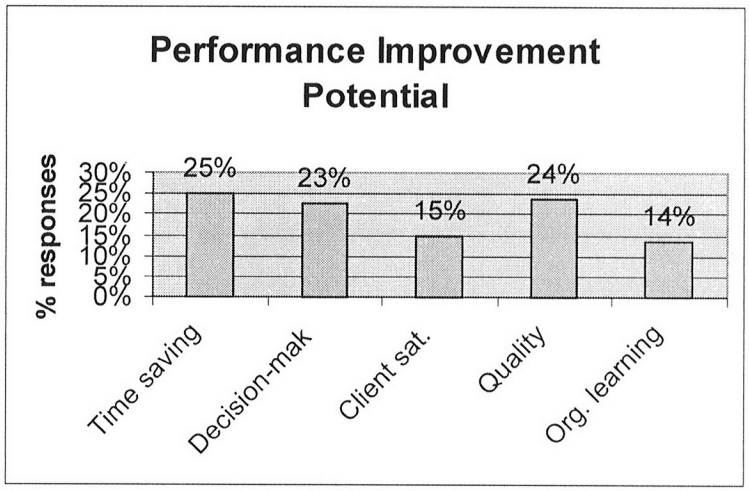
The following sections demonstrate the qualitative link between knowledge sharing, enabled by a collaborative technology and performance improvements.

Table 2: Correlation Analysis -Sub-Elements of Infrastructure (n=30)

Independent Variables	Avg. Usage per day per person
Relative Advantage	.515**
Compatibility and Training	.279

** Correlation is significant at the 0.01 level (1-tailed).

Figure 3: Total Responses relating to performance improvements (n=30)



RELATIVE ADVANTAGE

Time and Efficiency

Time is one of the most valuable and scarce resources in a scientific contract research organization due to the time-to-market pressures for its clients. Thus, time-to-market and the lifespan of patents in the highly competitive pharmaceutical and agro-chemical industries presented the driving force in achieving rapid turn-around time. In addition, many companies enjoy significant profits from achieving a "first mover" advantage if they can be the first to get their products to the marketplace.

As stated by one of the associates: "It cuts down on the number of meetings that we need to have because we can take care of a lot of business just over the network." Another associate documented time savings in this statement: "You have everybody who's doing invoicing sitting in a room for two hours projecting what you're going to make for next month and that was a waste of time. I can be in and out of BSCW in 10 minutes."

By sharing information via BSCW, valuable knowledge could be entered quickly and people could make decisions, initiate studies and make corrections much more quickly. In addition, simply by eliminating manual processes, such as copying and distributing information manually, saved time in the research process. As stated by an associate: "Unless you want to print up separate documents and hand it to each person, and then integrate all those documents at once, this is a better alternative because you have a single document. People at their leisure can make changes and there's no integration of the document left and there's nothing to transcribe error-wise."

In this company, the leadership team traveled extensively, primarily to attend conferences or visit clients. In addition, some executives were located at the European site. Thus, the ability to share information in a distributed environment on a timely basis was greatly facilitated by this collaborative technology. Executives could simply input their current information about strategic plans, budgets, forecasts, industry developments or competitive actions any time and from any place in the world. This

allowed the president to save time in face-to-face meetings and make better decisions based on the most current information available from within his organization.

Decision Support

This collaborative technology enabled managers throughout the company to input needed information such as sales forecasts, budgets, client and competitor information on a real time basis, which was accessible to the leadership team. This allowed executives and managers to make decisions based on the most recent, relevant information and knowledge. This was exemplified by the following response, "It allows managers and top executives to make better decisions by having access to more timely information."

Quality Assurance and Compliance

In terms of better client service, the president concluded: "This offered us a better solution at prioritizing. We can identify if there's going to be a conflict with resources ahead of time, resolve it, communicate to the clients, adjust their expectation, and meet them." In addition, the ability to identify trends to improve quality in processes as well as client satisfaction was demonstrated by this associate's statement: "The biggest advantage to this is being able to use that as a tool to teach ourselves what we need to do." By sharing client comments and concerns, the quality assurance and compliance people could identify recurring problems or trends and take corrective actions to improve quality or client satisfaction.

Leadership Influence

In the interviews, the importance of leadership appeared to support the literature. From the emphatic responses in the interviews, it became clear that probably the most important influence on the initial adoption and use of the technology was the President/CEO of the company. A typical response to "who influenced your use of the system" was: "Oh–absolutely–our CEO!! He initiated that BSCW is what we would use." In this particular organization, the forced adoption of a new technology appeared to have a great influence on adoption and continued, effective use of the CSCW technology to facilitate knowledge sharing. The results from the quantitative study appeared to support this view where approximately 70% of the respondents indicated that leadership or managers exerted an influence on their use of BSCW to facilitate knowledge sharing. Interestingly, 72% of the respondents also indicated that a perceived need (relative advantage) in sharing knowledge also influenced their use of this technology to facilitate knowledge sharing. Thus, this finding appears to further support the importance of the "relative advantage" variable.

Potential Performance Improvements

In addition to the performance improvements in time, efficiency, decision support and client satisfaction, several other potential improvements surfaced. This research was conducted while this technology was relatively new to the company, and it was revealing to see how people were beginning to find new uses for it that could result in additional performance improvements. For example, one associate referenced its potential use in benchmarking best practices: "A lot of times somebody will have a problem with the analysis or they're trying to develop a method and something's

not working. If there's a way to encourage people, especially the sharper minds in the company, to look at these and offer solutions, then I think that that could be extremely beneficial to the company."

Similarly, performance improvement potential was recognized in the ability to share other information, such as those found in this statement by a manager: "A good use for it would be to input agency guidelines. It took about 45 minutes to search for an EPA guideline, but it would be great to have the EPA guidelines available when they needed them and not have to search for them–that would save a lot of time."

Finally, some managers recognized the potential for better and more efficient communication with clients by providing a Web-accessible place to share information on study status, reports or other valuable information. As one manager stated: "The real benefit of using BSCW is that it allows the client to have access to it 24 hours a day. We work with clients that are spread out all over the United States and even in Europe. If they log on, and get on the web, they can access that document, download it themselves, make changes in the document. " Table 3 summarizes these performance improvements.

DISCUSSION AND CONCLUSIONS

Corporate practitioners and academic researchers recognize the increasing rate of change in virtually all industries, often driven by dynamic technological changes. Technologies that provide ways to reduce time, costs, or improve quality, efficiency or customer satisfaction are readily embraced.

What have we learned that may be generalized from this one small case study that may prove beneficial to the managers and researchers considering technology in support of distributed knowledge management?

First, we learned that there was a clear need, a pressing business reason for investing in this collaborative technology as well as for initiating the knowledge sharing process: relative advantage. The president had recognized the need for a mechanism to share information across the organization. This need arose from identified redundancies in processes and the need for more up-to-date sales and operational information accessible in a distributable format.

The perceived relative advantage of the system was the driving force behind the subsequent diffusion and effective use of this collaborative technology at this company. This is consistent with the work of several researchers including Beckman (1999) and Pan and Scarbrough (1999) who asserted that the perceived relative advantage of knowledge sharing; e.g. time-savings, increased customer satisfaction, improved decision making among others, would provide a motivating influence on employee behavior to share knowledge.

In this study, relative advantage emerged as the primary determinant influencing use of the CSCW technology to facilitate knowledge sharing as discussed above, but relative advantage also emerged as being context specific. For example, the leadership in this case study perceived relative advantage in the ability to acquire the most recent information and knowledge to make the best decisions, monitor the financial status and health of the company, and use it as a control mechanism to monitor employee productivity. Leadership also clearly perceived relative advantage in using this type of technology to facilitate organizational learning for continuous improvement. They recognized potential im-

Table 3: Summary of Performance Improvements Attributed to BSCW and Knowledge Sharing at a Contract Research Organization

Stakeholder	Performance Improvements
Leadership Team	• Time savings due to fewer meetings, less tracking of reports and data • Better decision making due to availability of the most recent information available • Improved quality and performance due to monitoring of projects on real-time basis
Marketing	• Improved efficiency on client monitoring and prospect identification • Improved responsiveness to managements needs for current sales forecasts • Availability of marketing information on and off site to improve marketing efforts and responsiveness to clients
Quality Assurance/ Compliance	• More responsive to client needs by trending patterns in shared information • Improved efficiency with fewer meetings and ability to prioritize projects • Improved quality and problem solving by centralizing master schedules and detecting common problems
Other Performance Improvements	• Sharing of best practices within functional areas and among divisions • Sharing information throughout company such as new government regulations • Improved responsiveness to client needs by sharing information on study status and reports on a real-time basis with 24/7 availability • Improving organizational learning by sharing knowledge throughout the company • Increased innovativeness by sharing ideas • Improved responsiveness to stakeholders including employees and shareholders by sharing reports and other information on a timely basis

provements in client satisfaction by increasing turnaround time and solving client concerns.

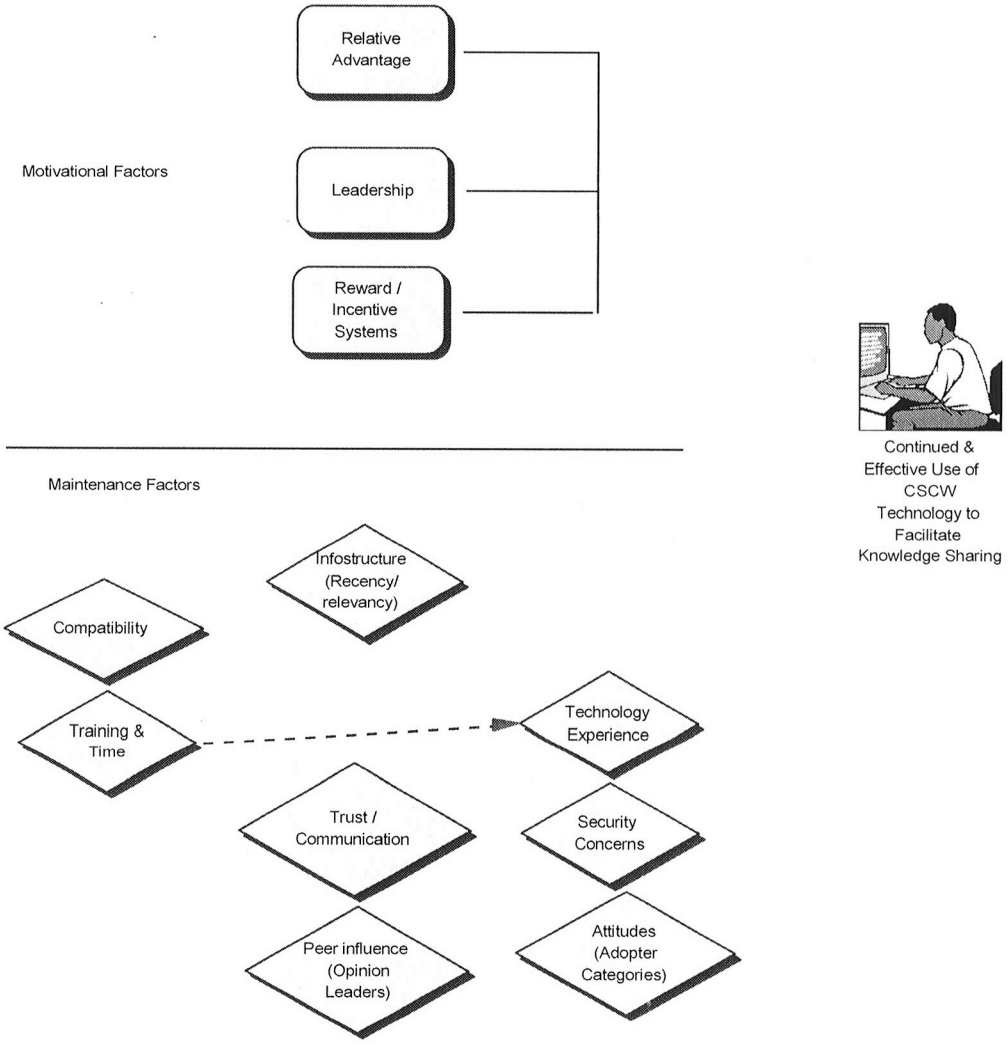
Second, we learned leadership influence was a powerful factor in the initial adoption and subsequent effective use of a collaborative technology and knowledge sharing. In this situation, the initial forced adoption of the collaborative technology to facilitate knowledge sharing by the president was a very effective means of jump-starting the system. The issue of accountability proved to be a very powerful motivator in employee behavior in adopting and implementing the systems. When employees, from clerks to top management, understood that their behaviors and actions were being monitored and that they were being held accountable for using the collaborative technology to input valuable and needed information and knowledge, they responded quickly and positively.

Based on the emerging themes from the results of this study, a new model, which

we call the "Motivation-Maintenance Technology Implementation Model," is proposed (Figure 4). The foundation for this model lies in respondent perceptions. Most respondents indicated that only certain factors (independent variables) truly motivated them to effectively and continually use this CSCW technology to share information and knowledge. The major factors included the relative advantage of the system and the influence of leadership. Secondarily, the reward/compensation structures associated with using the technology and sharing knowledge were also mentioned as somewhat important. In contrast, the other factors from the original study model were expected or assumed to be available for them.

These results were analogous to a classic management theory called "Herzberg's two-factor model" (Hellriegel & Slocum, 1996). In this theory, Herzberg suggests that there are two separate and distinct factors that influence satisfaction or dissatisfaction. The factors associated with positive factors are called motivational

Figure 4: Maintenance-Motivation Technology Implementation Model



influences. In contrast, factors that were associated with dissatisfaction were called hygiene factors. Herzberg contends that these hygiene factors are necessary to maintain satisfaction, but are expected by associates. In and of themselves, they do not contribute to increased satisfaction. On the other hand, the factors called motivation factors do motivate employees.

The major finding was that perceived relative advantage appeared to be the major influence on BSCW usage to facilitate knowledge sharing as well as the perceived performance improvements resulting from knowledge sharing. However, the results from the interviews also support findings that a strong leadership that supports knowledge sharing, enabled by a collaborative technology, was also a very important influence on these users. Since leadership support also included some form of reward/incentive structures to motivate individuals to share their knowledge and use this system to do so, this was also considered a motivating factor. Therefore, using Herzberg's theory as a framework, these factors would be considered the motivational factors.

In contrast, the factors considered to be maintenance (hygiene) factors include: compatibility and time/training (sub-components of infrastructure), infostructure (including rules for managing the system for recency and relevancy), trust/communication and peer influence (sub-components of infoculture), and all of the sub-components of individual concerns (prior technology experience, security concerns, and adopter category/attitudes towards technology and change). The results from this study demonstrated that while each of these factors was considered important by the respondents, they did not appear to motivate users to continually and effective use BSCW for the purpose of sharing their information or knowledge. Rather, they were expected to be at a certain level. If not, they were considered to be dissatisfiers, or a hindrance, but did not truly influence use or the sharing of knowledge. For example, the computer hardware and software systems were expected to be compatible. If they were not, users assumed that the IT (information technology) department would correct the problem. They similarly assumed that they could get the training and time they needed from the IT department or their managers. In terms of infostructure, they normally assumed that the rules for management of the information (recency and relevancy) were controlled either by management or by project or department needs and requirements.

Trust and communication were deemed to be adequate to use this system as well as the level of perceived security to share information within the organization. However, in the future evolution of the system, when dealing with stakeholders outside the firm (clients, suppliers), most respondents felt there should be additional training and communication about BSCW, its level of security and management of the information on the system. However, again, this was expected rather than motivational. In terms of prior technology experience and user attitudes, those respondents who had more positive attitudes towards technology and change, as well as those who had used different technologies, did appear to be more confident and comfortable using the technology. However, these factors did not seem to motivate them to use the system. On the other hand, the issue of incentives, a motivational factor, may become relevant when dealing with those people who are resistant to using technologies or sharing information for different reasons.

Implications for Organizations

In this study, relative advantage emerged as the primary determinant influencing use of the CSCW technology to facilitate knowledge sharing, but it also emerged as being context specific. For example, the leadership in this case study perceived relative advantage as the ability to acquire the most recent information and knowledge to make the best decisions, monitor the financial status and health of the company, and use it as a control mechanism to monitor employee productivity. In contrast to the leadership group, relative advantage was perceived by the marketing/business development associates as improving their efficiency by creating a repository of shared client information. However, these associates as well as data entry and quality assurance associates perceived a unique attribute of relative advantage quite differently than the leaders. Specifically, they perceived personal relative advantage in terms of potential rewards or punishments for their effective use (or lack of) in providing information and knowledge required by their bosses.

We would theorize that leaders have the power and authority to shape the organization and to develop reward/compensation structures needed to support the implementation of new technologies. This idea may be supported by the classic management theory that people tend to do what they are rewarded for or to avoid punishment. In this case study, using this CSCW technology and sharing knowledge represented a forced adoption. This may be true in many other organizations. However, once introduced, this research suggests that developing rewards, incentives or ties to performance appraisals may overcome initial resistance. This may lead to more effective implementation of the new technology and knowledge sharing. It may also facilitate the routinization of use. Again, the specific rewards, incentive, or ties to performance appraisals would depend on the priorities of the leaders, the specific needs of the associates and the organizational culture.

Inherent in the above factors is the associated issue of accountability. Results from this study indicate that accountability played a large role in influencing effective use of a CSCW system and knowledge sharing. Most associates acknowledged that accountability was a driving motivation in their effective use of the technology and sharing valuable information on a timely basis, especially when perceived to be tied to their performance appraisals.

Thus, despite the complexity of different organizations in different industries and cultures, using specific definitions of relative advantage, along with supportive leadership who introduce effective reward/compensation structures and accountability in the process, may significantly improve the successful implementation of a CSCW technology to facilitate knowledge sharing in any organization.

Suggestions for Future Research

In terms of the correlation between knowledge management, enabled by a CSCW technology, and resulting organizational performance improvements, it would be helpful to establish quantitative measures to validate and confirm our results and recommendations. If researchers were granted access to study time-in-processes within an organization for specific tasks before and after, or with and without the use of a knowledge sharing collaborative technology, this would also help establish a more quantifiable relationship. Similarly, if researchers measured the level of innova-

tion in terms of new products or new processes before and after implementation, or with verses without a CSCW technology, this would also help to strengthen and validate the relationship. Quality could similarly be measured by factors such as errors in reports or data. Customer satisfaction could be measured by documented customer complaints with verses without a CSCW system or before and after implementation, or by conducting customer satisfaction surveys. The different success factors studied may be context specific. Therefore, similar research in different types of organizations, industries and situations would be interesting.

While this case study focused on a small business, the potential for performance improvement extends to many other businesses including large, small or non-profit organizations. Given the potential improvements in time/efficiency, customer satisfaction, and innovation enabled by Internet and e-commerce technologies, there exists an array of potential research explorations involving collaborative technologies and their ability to support corporate knowledge sharing. Some of the key questions that we might need to ask include:

- Is the context of relative advantage determined by role, industry or other factors?
- Is knowledge sharing heavily influenced by corporate culture, industry norms or other factors?
- Is the willingness to share knowledge via a collaborative technology influenced by prior technology experience, leadership influences or other factors?
- Are there other factors that significantly contribute to knowledge sharing and the use of collaborative technologies (such as personal agendas, reward/compensation systems) that should be considered in management decisions to adopt knowledge sharing technologies?

ENDNOTES

[1] These criteria included a great organizational emphasis on teamwork, a need for experts who can filter and select contributions to the repository based upon on their usefulness, and forums where contributions represent a source of personal satisfaction. The organizational culture should also embrace and reward the use of groupware and teamwork.

[2] Effectiveness in this study was measured by the actual usage of the technology and the meaningful contributions to the system.

[3] The quota system used in this study represented an attempt to interview a proportionate number of users from each of the major functional groups using this collaborative technology. This included middle management, data entry and quality assurance/compliance.

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