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THE DIFFUSION OF A COLLABORATIVE CSCW TECHNOLOGY TO FACILITATE KNOWLEDGE SHARING AND PERFORMANCE IMPROVEMENT

A Dissertation
presented to
the Faculty of the Graduate School
University of Missouri-Columbia

In Partial Fulfillment
of the Requirements for the Degree

Doctor of Philosophy

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by
NORY BETH JONES

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MAY 2001

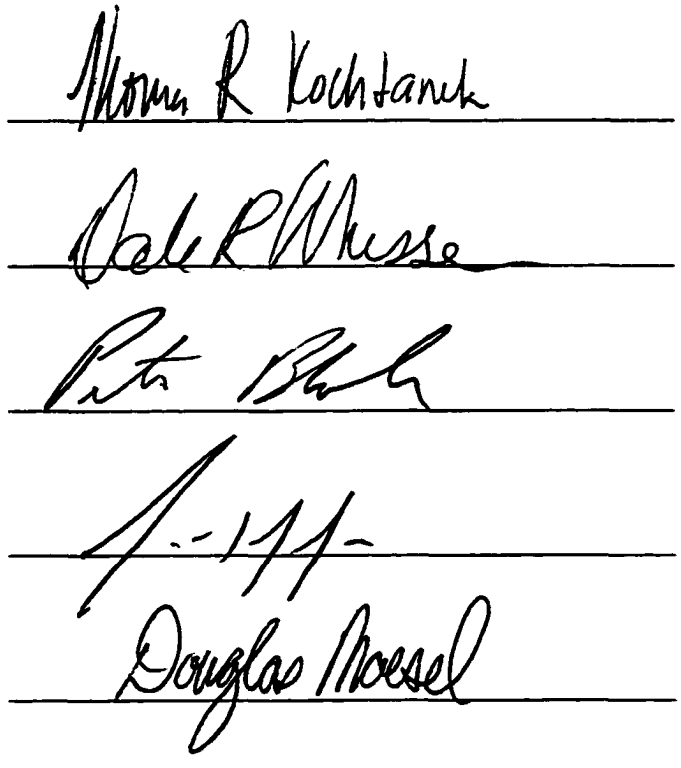
The undersigned, appointed by the Dean of the Graduate School, have examined the dissertation entitled

THE DIFFUSION OF A COLLABORATIVE CSCW TECHNOLOGY TO FACILITATE KNOWLEDGE SHARING AND PERFORMANCE IMPROVEMENT

Presented by Nory B. Jones

A candidate for the degree of Doctor of Philosophy

and hereby certify that in their opinion it is worthy of acceptance.



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ABSTRACT

Knowledge sharing is the ability to share ideas, perspectives, information, or knowledge among people within or outside an organization. By tapping into the vast reservoir of creative intellect and expertise, anyone in the organization, enabled by a collaborative technology, can share their knowledge. People within or outside of an organization can similarly search for knowledge held by others, creating the potential for continual performance improvements. In an era that is becoming predominantly digital, the ability to share knowledge is becoming easier, cheaper and more prevalent through the use of collaborative technologies.

This research explored factors potentially contributing to the diffusion and effective use of a collaborative technology, known as BSCW (Basic Support for Shared Work), within a scientific contract research organization. The impact of using BSCW to facilitate knowledge sharing and specific performance improvement factors was also examined. A case study employed a qualitative research approach (in-depth interviews) followed by a quantitative approach (a web-based Likert-scale survey) to assess which factors exerted an influence on BSCW use and knowledge sharing as well as performance improvements resulting from the use of this collaborative technology.

Results show that while initial use represented a forced adoption situation, the factor "relative advantage" exerted the greatest influence on the continued and effective use of the technology. Results from the qualitative study suggest that leadership exerted a great influence on adoption as well as a reward/compensation system to motivate use of the technology and sharing knowledge. Based on user perceptions, the greatest performance improvement benefits included significant time savings in work processes, improved quality and improved decision making, as well as the potential for improved client satisfaction from using this collaborative technology to facilitate knowledge sharing. The quantitative study supported these findings. The findings from this study may help organizations more effectively implement new innovations for potential performance improvements.

Keywords: CSCW, collaborative technologies, knowledge sharing, performance improvements.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Overview

No one knows what everyone knows. "Knowledge has often been described as the only real sustainable competitive advantage." (Davenport, 1999) The ability to share knowledge, ideas, perspectives, or solutions among collaborators, known as knowledge management, represents possibly the greatest strategic advantage any organization can achieve. (Pan & Scarbrough, 1999) By tapping into the vast reservoir of creative intellect and expertise within any type of organization, be it public, private, for-profit, not-for-profit, large or small, anyone in the organization can easily input and share their knowledge. People within or outside of an organization can similarly search for the knowledge of others, creating the potential for perpetual innovation and continual performance improvement. For a for-profit organization, this can represent a strategy to achieve a sustainable competitive advantage. For non-profit organizations, knowledge sharing represents the means for continuous performance improvements, resulting in increased customer and employee satisfaction. (Pan& Scarbrough, 1998, 1999, Senge, 1997, Rumizen, 1998).

In an era that is becoming predominantly digital, the ability to share knowledge is becoming easier, cheaper and more prevalent by using collaborative technologies. Given the importance of this new arena, much research and discussion of the impact of knowledge sharing using collaborative technologies has emerged. (Ciborra et al, 1996).

Ciborra and Patriotta (1996) assert that "electronic collaboration can make work more transparent. Therefore, electronic networks open up new possibilities for reducing barriers to communication and sharing organizational knowledge." Many researchers have demonstrated the value of electronic collaboration among multi-national teams in distributed, often global environments (Ciborra, 1996, Failla, 1996, Orlikowski, 1996, Soloman, 1998). However, Barbar and Camerata (1998) also demonstrated that the same communication patterns and concepts are equally applicable to people sharing information in the same building or even in the same room as those separated by continents.

In terms of performance improvements resulting from collaborative technologies and knowledge sharing, Orlikowski (1996) found that the adoption of a collaborative technology (Lotus Notes) increased efficiency and productivity in a department of a software development company by "creating a knowledge repository which prevented duplication of research efforts." It also created documentation of customer support situations, which helped others with similar problems in the department. "While no formal measures of productivity were kept, both managers and specialists reported the use of the collaborative technology led to improved personal and departmental effectiveness." This research was representative of most in this area. While descriptive studies infer productivity improvements, quantitative measurements of the impact of knowledge sharing via collaborative technologies on organizational performance are limited. Few studies have quantitatively validated the relationship between the use of

collaborative technologies, the ability to share knowledge, and resulting improvements in individual or organizational performance. (Orlikowski, 1996, Wynn, 1996)

The ability to use different types of collaborative technologies in useful ways to facilitate knowledge sharing and achieve performance improvements is not as easy as simply installing the technology and telling employees to "go at it." While classic theories of adoption and diffusion (Rogers, 1995) have defined the variables that influence the adoption and diffusion of innovations, there has been little research applying these theories in the specific context of knowledge sharing and use of a CSCW (computer-supported collaborative work) technology. It therefore becomes interesting to speculate on the benefits of knowledge sharing, enabled by different collaborative technologies. However, it also be comes necessary to understand how they are successfully or effectively used, or the preceding points become moot. Classic diffusion of innovation theories focus on the behaviors of ultimate consumers. Newer research is exploring adoption and usage behaviors in for-profit organizations. There is little evidence supporting the impact of the continued and effective use of an innovation such as a CSCW technology to improve turn-around time, process improvement, or innovation in information-intensive processes. Some researchers have found certain preconditions that influence the successful adoption, diffusion and use of collaborative technologies as well as successful knowledge sharing (Greengard, 1998, Coutu, 1996, Solomon, 1998, Riesenberger, 1999). The literature suggests that the predominant requirements included effective leadership and a culture that actively supports knowledge sharing and collaboration as well as trust among the participants. In addition, users must perceive a

clear need for a new innovation that provides additional benefits (relative advantage) over existing tools to facilitate the adoption and continued use of the innovation . There are many other potential variables that could influence the effective use of a CSCW technology and knowledge sharing including variables relating to the technology itself, compatibility issues, or individual user issues, to name just a few.

In terms of performance measurement, the literature has shown an evolution in thought in the field of performance indicators. Traditionally, performance was measured strictly in financial terms, using profitability and performance indicators such as ROI (Return on Investment), ROE (Return on Equity) and net profitability measures, among others. Manufacturers have used specification-based indicators such as defect rates or conformance to mechanical standards. However, researchers and executives alike began to realize that these performance indicators did not capture crucial measures of organizational performance such as customer, supplier, or employee satisfaction, quality of processes, or innovation. And, in a predominantly service-based economy, these new dimensions are vital to true performance measurement. Traditional accounting practices have been shown to be inadequate to truly capture and properly assess the value of knowledge assets. One recent approach, called the "balanced scorecard" has attempted to quantify the benefits of knowledge management by monitoring customer needs, innovation and learning, internal processes, and financial performance. (Kaplan & Norton, 1992) They contend that traditional financial measures tell the past results of actions already taken while operational measures on customer satisfaction, internal

processes, and the organization's innovation and improvement activities are drivers of future financial performance.

Because this doctoral research only examined departments within organizations and because financial data were not available, financial performance indicators were not considered. In addition, because the theory behind this research took a future-oriented approach, the operational measures of time, process improvement and innovation were explored in primarily qualitative ways.

Statement of the Problem

The literature on knowledge sharing emphasizes the importance of sharing information and ideas among people in organizations. 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 mechanisms required for their continued and effective use, which represents a prerequisite requirement if the technology is to be used to fulfill the goals for which it was intended. This represents an area open for exploration into how and why certain variables contribute or fail to contribute to the effective and efficient use of a CSCW (Computer-supported collaborative work) system as well their influence on knowledge sharing using a CSCW system.

Purpose of the Study

The overarching purpose of this research was primarily to understand which variables influence the continued, effective, and efficient use of a CSCW (computer-supported collaborative work) system, enabling knowledge sharing, and secondarily to examine the resulting consequences of its use in several dimensions including time, process improvement, and innovation. The major goals included:

(1) To examine which variables contribute to the willingness or ability to effectively use a CSCW (computer-supportive collaborative work) technology as well as knowledge sharing, and to understand the degree to which and how these variables exert their influence.

(2) Secondarily, to understand in what ways the ability to share knowledge using a CSCW technology may contribute to improvement in productivity via the elements of time and process improvement.

This study employed a combination of quantitative and qualitative data collection techniques including:

- unobtrusive monitoring of the use of a CSCW technology
- qualitative and quantitative data collection in a case study involving user perceptions on the effective use of a CSCW technology and its ability to facilitate knowledge sharing
- consequences of its use in specified performance criteria in a contract research organization.

Significance of the Study

As discussed in Chapter Two, the literature demonstrates the great strategic importance of knowledge sharing. "Our competitive advantage is what the organization knows, not what one person knows anymore." (Arthur Andersen & Co., Solomon, 1998) While the literature primarily supports the conceptual value of knowledge sharing, most researchers agree that more quantitative and qualitative research is needed to understand the variables that influence user willingness to share knowledge, and to validate the relationships between knowledge sharing and the resulting impact on performance dimensions within and outside the organization.

The literature also supports the contention that digital collaborative technologies, including organizational Intranets, Extranets, and the Internet/World Wide Web represent crucial tools that support knowledge sharing and performance improvement. The ability to share information was shown to facilitate communication among people across continents or across the room, increasing efficiency and productivity, and reducing the time to complete studies (Ciborra et al, 1996). Orlikowski (1996) similarly demonstrated qualitatively the increase in efficiency and productivity via knowledge management enabled by a digital collaborative technology.

However, there is little research on the variables that influence the effective use of collaborative technologies enabling knowledge sharing after the initial adoption. Therefore, this study attempted to contribute new knowledge to the literature base by

offering some tangible evidence of which factors influenced the effective use of a CSCW-type technology, how and why they influenced them, and the impact of those factors on knowledge sharing. Secondarily, the research examined the consequences of its use on specific performance dimensions. Thus, this study contributes to an understanding of how organizations can successfully enable the effective use of new innovations such as a CSCW technology, as well as encourage knowledge sharing. The way people communicate in a distributed environment using a CSCW technology presents interesting questions for continuing research. Finally, this study drew upon the theories and applications of previous research and extends the knowledge of the relationship between collaborative technologies in the specific context of using a CSCW type collaborative technology, knowledge sharing, and which factors influence their effective use and some consequences of use. The study illustrates through specific examples what variables may influence different stakeholders to share knowledge and use a CSCW technology, why they use or resist using it, and suggests factors contributing to its effective use.

Statement of the Research Questions

Primary Research Question:

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?

Secondary Research Question:

2.) How does the use of a CSCW technology to facilitate knowledge sharing influence the performance dimensions of time, process improvement, and innovation?

Definition of Constructs

- Knowledge Sharing: While the term "knowledge management" is often used in the literature to mean the sharing of ideas, knowledge and experience, the term "Knowledge Sharing" is used in this study to mean the ability to easily store, access, and share both information and knowledge. Information is defined here as fact-based, explicit information such as reports or raw data. In contrast, knowledge is defined here as individual constructs, ideas, or expertise that can be shared with others to create synergy in solving problems, creating new ideas, innovations, or processes.

- CSCW Technologies: A CSCW (Computer-Supported Collaborative Work) system is one that allows people to share knowledge in a digital space. It represents one type of collaborative technology that actively facilitates collaboration among users and enables people to share knowledge. Collaborative technologies can take many forms including electronic mail (e-mail), video or tele-conferencing, or document-sharing archival systems among others and are usually enabled through the use of intranets, extranets, the Internet and the World Wide Web to support the exchange of information. In this study, we examined the

use of a collaborative technology called BSCW (Basic Support for Cooperative Work) created by OrbiTeam Software GmbH: GMD – Forschungszentrum Informationstechnik GmbH. (http://www.orbiteam.de). BSCW supports asynchronous or synchronous collaboration among people over the Internet, in an internal Intranet, or over an external Intranet. In the system studied, BSCW was housed on the server of the host company, but functioned on the Internet so that both internal and external stakeholders could access the system from any computer connected to the Internet using a browser such as Netscape Navigator or Internet Explorer. The advantage of using a CSCW system such as BSCW was that users had virtual access to the information needed in shared workspaces where they could store, manage, share and edit documents using a version control feature.

Chapter Summary

This chapter established the purpose and foundation for this study. The strategic importance of knowledge sharing and the use of collaborative technologies to facilitate its use were explained. The need for understanding which factors contributed to the effective use of a CSCW technology on knowledge sharing as well the consequences of its use was also established.

Chapter II reviews the literature in the areas of diffusion of innovations, knowledge sharing, collaborative technologies, and contract research organizations. Chapter III presents the theoretical foundation behind the hypotheses. Chapter IV presents the

methodology for the study including the research questions, population and sample, data collection methods, and instrumentation as well as the statistical analysis techniques. Chapter V presents the results of the research. Chapter VI presents a discussion of the results, conclusions, and recommendations for additional research in this area.

CHAPTER II

REVIEW OF THE LITERATURE

The purpose of this study was to explore the variables that contribute to the continued and effective use of a CSCW (Computer supported collaborative work) technology after adoption, and its influence on knowledge sharing within and outside of organizations as well as the consequences of its use within the organization.

To understand the foundation for this study and what other researchers have discovered on these topics, this chapter reviews the professional literature in the areas of (1) adoption, diffusion, use, and consequences of innovations, (2) knowledge sharing, (3) collaborative technologies, and (4) contract research organizations.

Adoption, Diffusion, Use, and Consequences of Innovations

Both the classic theories and new thoughts on how new technologies are adopted initially and then diffuse or are used throughout target populations were researched.

Classic Theories

Based on many years of adoption and diffusion of innovations research, Rogers (1995) developed a model often considered the foundation for the adoption and diffusion of innovations. This model proposes that there are four main elements influencing the adoption and diffusion of innovations including: (1) the innovation, (2) communication channels, (3) time, and (4) the social systems. While the entire model contains a great

number of postulates, the major theories within the four main elements listed above are as follows:

1. The innovation: According to Rogers, there are five main attributes of innovations that can predict an innovation's rate of adoption. (a) The relative advantage of an innovation (the degree to which the innovation is perceived as better than the idea it supercedes) is positively related to its rate of adoption and continued and effective use. (b) The perceived compatibility (the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters) of an innovation is positively related to its rate of adoption and continued and effective use. (c) The perceived complexity (the degree to which an innovation is perceived as relatively difficult to understand and to use) of an innovation is negatively related to its rate of adoption. (d) The perceived triability (the degree to which an innovation may be experimented with on a limited basis) is positively related to its rate of adoption. (e) The perceived observability (the degree to which the results of an innovation are visible to others) is positively related to its rate of adoption.

In terms of compatibility, there have been some additional theories that build upon Roger's construct. Relating compatibility to the "infostructure" variable (defined in Chapter III) in this doctoral research, a theory in this area is called the "Adaptive Structuration Theory" (AST) (Desantis & Poole, 1994). AST suggests that when a technology is applied to a group, that group already has existing rules, resources, and structures to which it adheres. Therefore, the adoption and subsequent use of a technology will be adapted by each group in such as way that fits that groups needs and

purpose. This structuration will result in usage and results configurations that are unique to each group. Similarly, contingency models suggest that technology fits well with specific environmental contexts, highlighting the importance of the environment in the effective adoption and use of new technologies. They concluded that Woodward's (1980) original work in this area concurred with theirs, asserting that "technologies whose forms most adequately fit the function of the organization were most likely to be successful" in the adoption and use of a technology. Thus, this appears to be consistent with Roger's theory of compatibility. McGrath et al (1993) support the contingency (compatibility) model saying "the effects of technology on task performance depend on the degree of fit between the technology and the group, its tasks, and the context within the action taking place." Thus, the rules and norms governing a particular group will strongly influence the adoption and use of a technology.

Another perspective relating to the issue of compatibility deals with change and re-adaptation in use of a technology. Tyre and Orlikowski (1994) suggest through their research that "the process of technological adaptation is not gradual and continuous, but instead highly discontinuous." They found that there appears to be a brief window of opportunity within which to modify new process technology after initial adoption. However, once users begin to routinize the technology, the technology and its use "tend to congeal, often embedding unresolved problems into organizational practice." Behavioral research has found that individuals tend to use active problem-solving soon after the introduction of a new technology, but that these activities appear to drop dramatically after the tasks and the technology become familiar and manageable. These

authors contend that adaptations of a technology heavily influence the operating efficiency by users. Prior researchers have found that through experience, users tend to discover the ramifications of using a technology and then adapt it to better suit their unique needs. However, the authors also point out that interruptions can also serve an important role by triggering the adaptation process. They suggest that when a change occurs such as new management or employees or perhaps a change in goals or processes, this provides an opportunity for further adaptation of the technology in terms of capabilities and processes. They link this with behavioral patterns in that people, individually or in groups, "in the aftermath of a major change or disruption, are often able and willing to revise, adapt and critically evaluate the new situation", opening a door for modifications. This is consistent with Hord et al's (1998) research, which suggests that change agents need to monitor compatibility in terms of each individual's levels of use and concern, providing needed support and training at different stages to ensure effective use of the technology.

2. Communication Channels: The "two-step flow model" suggests that communication messages flow from a source, via mass media channels, to opinion leaders, who pass them on to followers. From this original model, Rogers developed an alternate model proposing that mass media channels are primarily knowledge creators, which are most effective during the "knowledge of an innovation" stage of the innovation decision process. In contrast, interpersonal channels are more effective in the adoption decision and use stages among homophilous (individuals who have similar attributes such as common beliefs, education, social status and values) individuals because they "enjoy the

comfort of interacting with others who are similar". However, heterophilous (the degree to which pairs of individuals who interact are different in certain attributes; the opposite of homophily) interactions are important to carry information about innovations through the "theory of weak ties". This theory suggests that "homophilous communication may be frequent and easy, but not as crucial as the less frequent heterophilous communication in diffusing innovations. Homophily accelerates the diffusion process, but limits the spread of an innovation to individuals in the same network." Thus, people who are different from others are needed to expose the other people to different ideas and innovations. The relevance of these theories to this doctoral research is that homophilous social networks and the opinion leaders within them can exert a profound influence on the continued and effective use of a new innovation / technology.

3. Time: Rogers theory of the adoption process proposes that there are five steps in the innovation decision process: (1) knowledge: when someone learns about the innovation, (2) persuasion: when an individual forms an attitude about the innovation, (3) decision: on whether to adopt the innovation or not, (4) implementation: when an individual puts the innovation to use, and (5) confirmation: when an individual seeks reinforcement of the innovation decision and may either continue to use it or reject its use. He proposes that the innovation-decision process either leads to a decision to adopt or reject an innovation and the innovation-decision period is the length of time required to pass through the process. As mentioned in a preceding section, the rate of adoption is also influenced by several of the other variables discussed. However, the message from this theory is that if organizations understand the innovation-decision process, they can

reduce the time required to introduce a new technology as well as to reduce time for users to achieve efficient and effective use of the technology.

4. The Social System: Rogers states that adoption and diffusion occur within social systems, "which constitute the boundary within which the innovation diffuses." The effect of norms, opinion leaders, and change agents can exert a profound influence on the adoption and diffusion of an innovation throughout a social system. Norms (culture) can exert a powerful influence in people's willingness to accept or reject a new innovation depending whether it is compatible with their existing values and norms. Opinion leaders often serve as social models whose behaviors are imitated by other members of the social system. Thus, they can also have a huge impact on the adoption or rejection of an innovation as well as its rate of diffusion throughout the social system and its continued and effective use. In addition, a change agent often acts as the champion for the adoption and diffusion of an innovation, often using opinion leaders to facilitate the process through the social system. Finally, in an organizational social system, authority innovation decisions are often made by a powerful individual within the organization who can exert an influence on the adoption and diffusion process within that organizational social system. Therefore, many adoption decisions within organizations are forced ones, changing the nature of the adoption-decision process by the users. In the next section, newer theories build upon Roger's original work.

More Recent Diffusion Theories

Some recent research on adoption and diffusion of innovations has focused on issues associated with organizational users rather than ultimate consumers. However, Alange et al. (1998) contends that much of this recent research is mostly theoretical because "it still appears as if there is little systematic knowledge about the determinants of the diffusion of organizational innovations and indeed, about their effects" on performance dimensions, or consequences of the diffusion of innovations." However, they propose that technological change within organizations represents a cumulative learning process where firms will seek to improve and diversify their technology in areas that enable them to build upon their current strategies in technology. Thus, this once again suggests that compatibility plays an important role in the adoption and diffusion of an innovation if organizations seek to build upon an existing technological foundation. However, they also suggest that technological knowledge is tacit (person embodied) and cannot be diffused easily, where "technological accumulation is based more on experiences and communication, and technology is increasingly transferred in a verbal fashion and through interpersonal contacts", emphasizing the importance of diffusion networks in organizations. Relating this concept of organizational diffusion networks to Rogers' original theories, is the idea that change agents within an organization may promote change, but that the opinion leaders within a somewhat homophilous social system would still be the facilitators of the adoption, diffusion, and use process for new technologies that build upon a compatible technological foundation .

Alange et al. define a social system as one with a common cultural background. They also emphasize the importance of top management in facilitating the adoption, diffusion, or use of innovations, emphasizing that top management involvement and visible support is often crucial for successful adoption, diffusion or use to occur. This sentiment is echoed in the collaborative technology literature, where Pan and Scarbrough (1998) found top management support and involvement in encouraging and promoting the adoption and use process to be a prerequisite to success. Alange et al. further add that subordinates will read the behavior of their managers to find out what is really important, emphasizing the need for involvement by managers and top executives in this process.

Since some later adopters tend to be influenced by opinion leaders, who are often early adopters, these authors contend that these early adopters (opinion leaders) will also strongly influence the way innovations become used and standardized within the organization. Both managers and opinion leaders often need to help workers to "unlearn" or abandon earlier, often deeply entrenched practices in order to break the status quo inertia before a new technology will be fully adopted and used. They further contend that if the technology can be standardized in its use, the rate of adoption and diffusion will increase.

Iacobucci (1996), previewing Valente's book, "Network Models of the Diffusion of Innovations", supports Alange's emphasis on the importance of networks in the adoption and diffusion process, saying that network models help to explain patterns of influence and exchange among individuals and groups that are interconnected in various ways with

varying degrees of cohesion. She emphasizes that these network models are relevant at both the firm and consumer level of analysis in explaining how innovations diffuse throughout a social system, identifying the group members most likely to be influential in the process and network structures. This further supports both Rogers and Alange et al's contention that opinion leaders strongly influence the initial adoption and later diffusion and continued use of an innovation throughout social networks within an organization.

Dong and Saha (1998) propose that because technologies are changing so rapidly, organizational consumers have found that it is useful to wait for more information before adopting. Another dimension discovered by Aggarwal & Cha (1997) involved the issue of a surrogate buyer rather than the end user in an organization, who may purchase the new technology. This surrogate buyer tends to be an expert buyer with greater access to information and greater professional expertise in the analysis and decision-making process. Thus, this may tie in to the previous theories by suggesting that expert surrogate buyers may act as change agents in the adoption process. However, it does not address the issues of what will motivate potential users to adopt and then to continue using this new technology once it has been purchased.

Karahanna et al (1999) brought up the interesting issue that most research on the adoption, diffusion and use of innovations have focused on the initial sequence of activities that lead up to the adoption decision. However, they contend that "few empirical studies have made a distinction between individuals' pre-adoption and post-adoption (continued use) beliefs and attitudes", asking whether the "antecedents of user

adoption change over time as individuals start using the innovation?" Therefore, these authors examined the differences in the determinants of attitude or behavior prior to and after adoption, emphasizing that this research enables organizations to enhance the efficiency of implementation at different stages in the adoption and diffusion process. They argue that beliefs after the use of a product may not be the same as beliefs that led to the initial adoption decision, focusing on the dimensions of norms and beliefs. Specifically, they postulate that an individual's intention to adopt is determined by personal interests and social influence. This mirrors the theories discussed above as emphasizing the importance of change agents and social networks in terms of social pressure to adopt or resist adopting. The attitude component reflects Roger's theory about relative advantage. However, these authors state that individual's attitudes towards adopting are generated by their salient beliefs about the consequence of adopting as well as continuing to use the adoption while prior research demonstrated that compatibility, perceived usefulness (relative advantage) and ease of use were most influential for continued use decisions. However, in terms of attitudes and beliefs that would influence pre-adoption decisions, these authors propose that direct prior experiences exert the greatest influence. They postulate that attitudes and behaviors for existing users of an IT (information technology) will be stronger than for potential adopters. Therefore, the inference is that individuals who have prior experience with different technologies may have stronger attitudes and beliefs (positive or negative) about adopting new technologies because of their prior experience. Prior experience will also contribute to the continued and effective use of a technology. In terms of norms, these authors agree with Rogers that a homophilous social network will exert a great influence on potential user's attitudes and

beliefs regarding the adoption process. However, they add that normative pressure from supervisors to adopt will increase the legitimacy and appropriateness of the adoption decision for potential adopters. Peer and supervisor influence are suggested to be much greater for potential adopters than for users due to the lack of direct experience for the potential adopters. However, peer influence still exerts a great influence on continued and effective use. A final variable associated with potential adopters attitudes and beliefs towards adoption was the degree of voluntariness associated with the adoption decision. They cite former research findings that the more voluntary the decision to adopt a technology, the greater the degree of continued usage. The results of this study suggest that "social pressures from an organizational environment may be an effective mechanism to overcome adopter initial inertia in adopting a new technology." In addition, these authors found that while norms, triability, observability, ease of use, and perceived usefulness were relevant for pre-adopters, only perceived usefulness (relative advantage) was the most important criteria to continuing users. However, in both pre-adopters and continuing users, work networks, including peers, top management and supervisors were shown to be important, influential reference groups. For potential adopters, the significant reference groups in order of importance were top management, friends, supervisors, peers, and the MIS department. In contrast, for continuing users, the significant reference groups in order of importance were peers, local computer specialists, top management and supervisors.

Another study by Hu and Chau (1999) further investigated the Technology Acceptance Model (TAM), used as a foundation for the prior study. While the prior study examined

participants in a financial institution in the United States, this study examined physicians in Hong Kong as potential users and their attitudes towards adoption. Interestingly, these authors found that perceived usefulness was the primary determinant of intention to adopt a new technology whereas ease of use was not significant. However, consistent with the prior study, they found that the physician's attitudes played an important role in their decision to adopt or not adopt the new technology.

Thong et al. (1999) contends that there are several major variables that will act as predictors of innovation adoption: "(1) characteristics of the organizational leaders, (2) characteristics of the technological innovation, (3) characteristics of organization, and (4) characteristics of environment in which the organization operates." The results of their study of IS adoption in small businesses showed similarities to the previous studies discussed. First, they found that businesses with a positive attitude toward technology were more likely to adopt, emphasizing the importance of relative advantage, compatibility, and complexity. The CEO's innovativeness and IS knowledge were also found to contribute positively to the adoption decision. In addition, the greater the employee knowledge and experience with technology, the more likely was the adoption decision as well as continued use of the technology. Larger businesses were also more likely to adopt new technologies, probably due to greater availability of resources (Thong, 1999, Daugherty et al, 1995). Interestingly, in a study of technology uptake in small businesses in New Zealand (McGregor and Gomes, 1999), their major finding relating to adoption decision was that small businesses required extensive external

sources of information to facilitate first the awareness of need for the adoption of new technologies.

In terms of adoption or resistance to a web-based CSCW type technology, Nambison and Wang (1999) have identified several knowledge barriers to inhibiting the adoption of this type of technology. The first, categorized as a "technology-related knowledge barrier, relates to the lack of knowledge regarding the appropriate hardware and software infrastructure, technology features, security and standards" relative to an organization's unique business context. The second, categorized as a "project-related knowledge barrier, includes lack of knowledge regarding resource requirements (both financial and human) for web-based application development, development process/duration, project leadership, functional participation and so forth." This category is consistent with the dimension categorized as "infostructure" by Pan and Scarbrough, discussed in the knowledge-sharing literature, described as the formal rules governing use of the system. Nambisan and Wang give similar examples such as who should be responsible for the web site, the data published on it, how should changes be made to it, etc. The final barrier, categorized as an "application-related knowledge barrier, relates to the lack of knowledge regarding the specific business objectives that will be served by the web-based application, the value of the various technology features for the adopting unit, the key business assumptions required to be made for deploying the technology, the potential for integrating the application within existing IT applications, and the impact of the web application on the current organizational structure and systems." They assert that while the "key impact of web technology is likely to be easy and transparent information flow

within the organization, most adopting units have yet to devise organization-wide policies on data ownership and information sharing", relating back to the variable, infostructure.

Daugherty et al (1995) examined the impact of structure on the adoption of EDI (electronic data interchange) technology. They defined structure as including the following components: (1) formalization (the degree to which decisions and working relationships are governed by formal rules and standard policies), (2) specialization (the division of tasks and activities across positions within the organization), (3) decentralization (the delegation of decision-making authority within the organization), and (4) integration (the use of committees and other coordinative mechanisms. They cite organizational researchers as asserting that an organization's structural characteristics significantly influence its adoption behavior. Specifically, they suggest an inverse relationship between innovation and an organization's degree of formalization, where strictly enforced rules discourage the adoption of innovations by limiting the discretion of employees. In contrast, they state that specialization encourages innovation as "the greater the number of specialists, the more easily new ideas can be understood and procedures developed for implementing them". Similarly, they postulate a positive correlation between decentralization and successful adoption of innovations "where employees are likely to feel a sense of ownership that increases the likelihood that they suggest, identify, and attempt to implement innovations". Consistent with this theory, McGee (1999) studied Proctor and Gamble's initiative in introducing knowledge sharing into the organization with the goal of reshaping the company and its culture, from a "conservative, slow-moving bureaucratic behemoth to a modern, fast-moving Internet-

savvy organization." One of the moves to accomplish this involved decentralizing the organization. "The new structure is intended to make us a multiple-disciplined organization to create more cross-sharing of information. That's a cultural change."

Irwin et al. (1998) explored the relationship between technology adoption and organizational performance within the hospital industry. They assert that little if any empirical research has been conducted on this relationship, probably because of what Rogers (1995) calls "pro-innovation bias", where there is an assumption that the adoption of a given innovation will produce only beneficial results for the adopters. Thus, most research has concentrated on the adoption of the innovation rather than the consequences of the adoptions. However, they also contend that the conceptual literature contains abundant support for the validity of this relationship. The basic theory is that technological innovations are adopted to achieve competitive advantage. They cite Barney's theory (1991), the firm resource-based theory of competitive advantage. This holds that "a firm's resources are key determinants of its competitive advantage and financial performance. Specifically, there are four empirical indicators of the potential of firm resources to generate competitive advantage: value, rareness, imitability, and substitutability. This competitive advantage offers the possibility of increased prices allowed through the adoption of technological innovations and thus, better financial performance." Therefore, Irwin et al. argue that there appears to be "reasonable conceptual support for the existence of a relationship between the adoption of technological innovations and performance." In the hospital industry, they postulate that the adoption of technological innovations will provide a means for differentiation,

increased occupancy rates, and increased financial performance. In their study on hospitals, they measured performance using each hospital's return on assets (ROA) as well as capital outlays for technical equipment and net revenues. They found that in large hospitals, adoption of technological innovations was negatively correlated with improved financial performance while in small hospitals, adoption of technological innovations was positively correlated with improved financial performance. They postulated that in large hospitals, they may have over-adopted, investing too much in technological innovations which could not be recuperated by any degree of differentiation and increased occupancy, thus the technologies may have been underutilized. However, for small hospitals in poorer environments, the adoption of new technological innovations did differentiate them from their competitors, increasing their occupancy rates and resulting financial performance. They suggest that adoption decisions in larger hospitals should be based on the resource-based theory, only adopting new technologies that would be considered rare, valuable, not easy to imitate, or those that do not have close substitutes. Another interesting point brought up by Deborah Jude-York (1998) is that "if the speed of introducing new technologies exceeds the ability of people to adapt and exploit it, then the technical systems may in fact inhibit productivity. The flood of information has insidiously added an entire layer of work on top of jobs that are typically requiring people to do more with less." Thus, a consideration for management when introducing a supposed productivity-enhancing tool such as a CSCW system is whether employees are overwhelmed by too much work, too much technology, and not enough time to get their jobs done, let alone learn yet another technology.

Therefore, the major themes that emerge from the adoption, diffusion, use and consequences of innovations literature appears to be the importance of perception of relative advantage in both the adoption and continued use decision. Compatibility was also shown to be important in both of these stages. Similarly, infostructure, the rules governing use of the system as well as standardization of use appear to have important ramifications in the adoption and continued use of technological innovations. The literature also supports the importance of social networks, relationships, peer pressure, opinion leaders, change agents, strong leadership and a culture that supports innovation for the successful initial adoption and continued effective use of new innovations. Consistent with these contentions is the theory that a decentralized organizational structure that empowers associates to adopt and use new innovations will similarly contribute to continued and effective use of the technology. Finally, there is conceptual and some empirical support for the link between the adoption and continued, effective use of new innovations and an improvement in organizational performance. Thus, while the literature does not contain many studies on the consequences of adopting technological innovations, there is preliminary support for some positive relationships between adoption, use, and improved performance.

Knowledge Sharing

The original term, "Knowledge Management" (KM), was coined by Karl Wigg at a 1986 Swiss Conference sponsored by the United Nations International Labor Organization. He defined KM as "the systematic, explicit, and deliberate building, renewal, and application of knowledge to maximize an enterprise's knowledge-related effectiveness and returns

from its knowledge assets." Thus, KM represents the ability of an organization to capture, organize, and disseminate knowledge to create and maintain competitive advantage. As Beckman (1999) states, "Knowledge management is considered a key part of the strategy to use expertise to create a sustainable competitive advantage in today's business environment." Another clarifying definition of KM by Pan and Scarbrough (1999) asserts that "Knowledge management is the way organizations build, supplement, and organize knowledge and routines around their activities and within their cultures and develop organizational efficiency by improving the use of employee skills. It is the capacity within the organization to maintain or improve organizational performance based on experience and knowledge. Organizational knowledge is knowledge that is available to organizational decision-makers and which is relevant to organizational activities." Thus, it becomes apparent that knowledge management encompasses many areas relating to gathering, archiving, organizing, and disseminating both information and knowledge to create competitive advantage for the firm. In the context of this research, the dimension of information sharing was focused upon. Thus, while the literature reviews different aspects within the knowledge management arena, this dissertation only considered those aspects within knowledge management dealing with the ability and willingness of users to share their data, information, knowledge, and perhaps even their wisdom.

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.

Dr. Ikujiro Nonaka, credited with defining a unified framework for knowledge creation, asserts that there are two types of knowledge; tacit and explicit. Tacit knowledge is "subjective and experience-based knowledge that cannot be expressed in words, sentences, or numbers because it is context-specific. It also includes cognitive skills such as images, beliefs, and mental models as well as technical skills such as craft and 'know-how'" Explicit knowledge is "objective and rational knowledge that can be expressed in words, numbers, formulas," etc. It includes theoretical approaches, problem-solving manuals and databases (Rumizen, 1998). Thus, explicit knowledge is more easily shared than tacit knowledge, particularly within the framework of a CSCW (Computer-support collaborative work) technology that allows users to input explicit information such as reports or data.

In other words, if an organization can collect and store the knowledge (both tacit and explicit) of its employees within an easily accessible and searchable "organizational memory mechanism", then if an employee leaves the organization, their knowledge, skills, and expertise do not necessarily leave with them. With an effective knowledge management system, the firm may not have knowledge gaps when they lose their employees, who represent valuable sources of knowledge. Rather, that expertise and

knowledge can be retained in the organizational memory. Pan and Scarbrough (1999) further define this as an "organizational knowledge repository", which is "used as a network through which associates share knowledge electronically among colleagues or with customers." Reisenberger (1999) further asserts that "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, saying that "We are entering the 'knowledge society', in which the basic economic resource is no longer capital or natural resources or labor, but is and will be knowledge, and where knowledge workers will pay a central role."

In Riesenberger's research to assess the value of knowledge sharing, he surveyed 563 senior executives from Fortune 1000 companies. The results indicated that knowledge about customers, best practices, internal competencies & products, emerging market trends, and competitive intelligence were cited as the reasons for using knowledge sharing. The executives also listed the benefits of knowledge sharing as increased responsiveness to customers, increased innovation in new products and processes, increased efficiency & productivity of knowledge workers, improved decision-making,

and increased flexibility / ability to adapt to change. He contends that by properly harnessing and exploiting global learning and the use of an organization's intellectual capital, it will increase the organization's ability to reduce product life cycles, increase consistency in service and quality at globally competitive prices, and increase the ability to develop constant and continuous innovation and transformation. He also studied several cases to examine the impact of knowledge sharing on consequent performance in several dimensions. In one case involving a Fortune 500 global food manufacturer, by using a CSCW type collaborative technology (Louts Notes), this company was able to electronically share the "best practices" vendor approval process with everyone world wide. The net result was that vendor approval time was reduced on the average from 8 days to 41 minutes. In another case, a sales manager in the United Kingdom discovered that his equivalent in Austria had double the market share he did. By sharing the "best practices" responsible for his success, the Austrian manager revealed that advertising in specific trade journals and personal selling was the reason. The result was that the UK manager was able to significantly increase his market share by using this knowledge. Finally, a major global pharmaceutical firm was able to reduce product development time from 866 days to 379 days by sharing knowledge around the globe, resulting in improved processes, eliminating and reducing certain steps to reduce time-to-market.

In terms of the cultural implications of knowledge sharing, he discusses the resistance to sharing knowledge in a society where most people have gotten ahead by keeping knowledge to themselves. The answer is for top management to develop new cultural and reward systems; to recognize and reward learning behaviors in front of the entire

organization as well as to endorse, participate, and lead in knowledge sharing. He stresses that top leaders must lead the effort, becoming change agents within the organization who model knowledge sharing, obsessed with a passion to give away all their knowledge in the never-ending pursuit of continuous learning and improvement. He also gives suggestions for implementing a knowledge sharing cultural change within the organization:

- Identify a project champion (change agent) and obtain endorsement and support from senior management.
- Optimize the flow of information that meets user's need. Consistent with the adoption and diffusion theories in the prior section, this would mean making the information flow compatible with user needs and routines.
- Provide training designed for the least knowledgeable associates.
- Senior management must be comfortable with a team-based approach that requires knowledge sharing across organizational boundaries.
- Establish databases in which high performers are encouraged and rewarded for sharing the best practices that are responsible for their success.
- Establish a knowledge-exchange network with chat capabilities that enable associates to share ideas.

Therefore, he summarizes his research findings by stressing that the following success factors are crucial in knowledge sharing systems: a corporate culture focused on learning and knowledge sharing, senior management endorsement and participation, a direct link to a key strategic business imperative, IT partnership to adapt to worker requirements and competencies, financial and non-financial measures that identify value by the knowledge-

sharing system, emphasis on a team-based organizational structure, and a recognition and reward system to support knowledge sharing.

Pan and Scarbrough (1998, 1999) supported Reisenberger's theory, stating that "the ability to access, develop, and deliver in the shortest amount of time a quality solution, derived from the broadest possible knowledge base, will increase customer satisfaction and confidence in a supplier." They also introduced a supporting 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.
2. Infostructure: "The formal rules which govern the exchange between the actors in the network, providing a set of cognitive resources (metaphors, common language) whereby people make sense of events on the network." An example of this is given by American Management Systems, Inc., an IT consulting firm. They have created "knowledge centers", each one a "worldwide virtual community of AMS people connected by interest and expertise in a specific discipline. They share knowledge using Lotus Notes and AMS expert practitioners are selected as Knowledge Center Associates for their expertise in one or more AMS disciplines.
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. Scheraga (1998) states that "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.

From their research, Pan and Scarbrough found that within the context of organizational culture, "trust must be one of the company's core values. For knowledge sharing to become a reality, you have to create a climate of trust in your organization. You cannot empower associates you do not trust and who do not trust you." In addition, the CEO of Buckman Laboratories contends that "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." Buckman further asserts that "what happened at Buckman was 90% cultural change. At the heart of knowledge-sharing activities at Buckman is a climate of continuity and trust." Saint-Onge also stated that "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." T. Brailsford, manager of knowledge leadership at Hallmark Cards, stated "Knowledge has no value until it moves. The interesting thing about knowledge is if I share what I know with you, I still own it. But now you own it and it has grown in value." Thus, these executives in knowledge sharing stress the importance of creating a culture that changes the paradigms of all employees and managers regarding the role of and sharing of knowledge.

Barker (1998) assert that the preconditions necessary for a learning organization that shares knowledge includes the elements of trust, commitment, and perceived organizational support, all consistent with the theories of the previous authors cited. In their review of the research literature, they found that using positive reinforcement techniques rather than punishment proved to be an effective technique in a change effort to a knowledge-sharing learning organization. When employees felt trusted, empowered, and free from the fear of negative consequences associated with sharing their knowledge, the attitudes and cultures within those organizations slowly changed. In McGee's (1999) research on Proctor and Gamble, she found that their cultural change included not only internal, but external changes as well. For example, "Proctor and Gamble is addressing cultural change through aggressive use of technology in its supply chain. The company is looking to change its relationships with its suppliers and with its customers, from one of passive market acceptance to one of proactive sharing of knowledge and data." Puccinelli (1998) addressed the cultural concerns associated with resistance to change when introducing a new technology or the concept of knowledge sharing. He also emphasized

the importance of top executive involvement as well as using basic change management techniques. These include communicating with potential users about the need for a change to sharing knowledge using a new technology as well as the strategic imperative behind it. Consistent with the diffusion of innovations literature, this author contends that identifying key opinion leaders as catalysts for the change process is also important to champion the process. He also supports several of the other authors cited in providing adequate motivation for potential users to change their processes to embrace the concept of sharing knowledge and using a new technology to do so. In addition to incentives, he recommends goal setting and training programs, changes in job descriptions and incorporating the new activities into performance appraisals. Finally, he suggests measurement and adaptation within the system using surveys on accomplishment of the goals of the change effort.

Consistent with Reisenberger's research, 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 that "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. Elliott and O'Dell (1999) cited APQC's (American Productivity and Quality Center) research on the impact of culture in adopting a knowledge-sharing strategy throughout the firm, stating that "knowledge sharing can thrive in a variety of cultures. The key is to fit the knowledge management approach to the culture and tie it strongly to the organization's core values, rather than expecting knowledge-sharing initiatives and activities to change the culture." For example, in an engineering firm, the core value was to design the most elegant, reusable designs in the industry. Thus, management focused knowledge-sharing initiatives on this core value and the employees were driven to share knowledge because they saw the value of it within the context of their core value.

Much of the qualitative research, including Pan and Scarbrough's, demonstrated improved customer satisfaction, reduced turn-around time in processes, and increased ideas and innovation among employees, such as the case study of Buckman Laboratories after that company instituted a knowledge sharing system.

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) states "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."

Again, this author contends that "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 suggests that one way to establish credibility in relating knowledge management to improved performance is to use intermediate measures. For example, he suggests measuring the number of hits to a knowledge repository or the satisfaction measures of employees using a knowledge management system. He also contends 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."

In terms of attempting to measure the consequences of knowledge sharing, an interesting article by Kaplan and Norton (1992) presents a new theory on which measures should truly reflect the performance of a firm. While traditional measures have been strictly financial and focused on historical performance, these authors argue that non-financial performance measures are needed to assess a firm's future potential performance. They contend that managers should look at a business from four perspectives: (1) a customer perspective, (2) an internal perspective, (3) an innovation and learning perspective and (4) a financial perspective to get a well-rounded and realistic view of the firm. They call

this model the "Balanced Scorecard". Within a firm, they suggest surveying managers and employees first by assessing perceptions of how important each of the criteria are. They then suggest a second survey to assess how well the firm is doing in each of those rated areas as well as how much improvement is needed in each area. Thus, in examining the relationship of continued use of a CSCW technology and the consequences of its use, it would be interesting to examine employee and manager perceptions of at least several of the four criteria mentioned in relation to the use of this technology.

Pelton (1999) suggests several ways to measure ROI resulting from knowledge sharing. Measure the creation of faster business solutions, improved customer service, and the spreading of best practices. Elliott and O'Dell (1999) expand this to using knowledge sharing systems to provide greater "customer intimacy; capturing and using company-wide knowledge about how to market, sell and service customers more efficiently and effectively" as well as "product-to-market excellence", and "organizational excellence"; both using best practices, internally and externally. McGee (1999) cited Proctor and Gamble's efforts to use technology and knowledge sharing as resulting in better communication with both customers and retailers, offering 24/7 communication with their retailers as well as customers, improving satisfaction levels with both groups.

Collaborative Technologies

As organizations have begun to implement collaborative technologies, researchers have also begun to explore its potential for performance improvement due to knowledge sharing. As Ciborra & Patriotta (1996) state: "Electronic networks open up new possibilities for reducing barriers to communication and sharing organizational

knowledge." Similarly, Solomon (1998) quotes Arthur Anderson and Co.: "Our competitive advantage is what the organization knows, not what one person knows anymore, especially because our clients are so sophisticated now. This requires technology that facilitates information sharing. Technology offers solutions that can maximize the efficiency of people. Eliminate redundant costs by centralizing data." Townsend (1998) further asserts that electronic collaboration tools can tap into expert knowledge and resources throughout an organization "where productivity, flexibility, and collaboration will reach new, unprecedented levels." He suggests that success in increasingly competitive marketplaces will depend on effective communications and knowledge sharing among members.

The message from these researchers is clear. Using digital collaboration tools can help to improve productivity and organizational performance while reducing costs by allowing people to share resources, reduce redundant processes, and create synergies by sharing knowledge and ideas. In one successful example, 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 an interesting criteria for the success of a collaborative database as a useful information filtering system. 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.

Ciborra (1996) confirmed this finding when studying a large collaborative database system in a pharmaceutical company, which was rarely used because it was not updated and the information in it was not trusted. However, a collaboration software system used for knowledge exchange was successfully implemented and used because it represented a focused application with a homogeneous population of users. A videoconferencing system was successfully implemented only after extensive training and adaptation time.

This system became effective as users learned that it saved time and money in decision making and meeting by reducing travel costs and time. In a consumer product manufacturer, Ciborra and Patriotta (1996) found that the effectiveness of the new technology depended on the perceived benefits of the new system 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 which users were already familiar and comfortable with. If there was a high comfort level with pre-existing tools such as e-mail, the new collaboration system was seen as a "redundant hindrance." 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 regarding the importance of relative advantage and compatibility in the continued and effective use of a new technology.

Interestingly, in a study by Satzinger et al (1999), they found that when study participants had creative ideas available to them on a collaborative technology, they produced significantly more creative ideas than those participants that did not have that knowledge available to them. They suggest that this research is consistent with both the social interaction stream of research and the cognitive processing stream of research since "individuals conformed to the type of feedback provided and ideas they generated were similar to the ideas provided to them. Thus, this demonstrates the impact of group

memory and how its use could actively influence individual or group brainstorming and idea generation. They further suggest that if an organization were interested in particular problem-solving activities, they would be able to seed the organizational memory to start the process and further use the CSCW technology to allow participants to share their ideas and create greater synergy. Ross-Flanagan (1998) similarly found that "when groups used computer-mediated communication in brainstorming tasks, they outperform face-to-face groups in the number of ideas generated and according to some studies, the quality of ideas." She speculates that seeing ideas on the screen makes them more real to people. In addition, they can reflect on them longer and tend to reply with longer, more complex and more carefully developed responses. She also suggests that the electronic medium may reduce apprehension in contributing by more reticent members. However, as mentioned by other researchers, virtual collaboration does not appear to produce the trust, cooperation and long-term relationships that person-to-person communication does.

Bikson (1996) studied the implementation of a collaborative video-conferencing system to facilitate global meetings. The successful implementation of this system was due to the perceived benefits (relative advantage) of using this system (e.g.; significantly reduced time needed, ability to discuss sensitive issues, encourage active participation by reticent members, and rapid meeting feedback). Other factors which contributed to its success included a user-oriented, well prepared facilitator, a well prepared technographer to run the equipment, a high-level champion of the system as well as committed, motivated participants, the involvement and relationships of the participants, good training, and pilot studies (period of experimentation) to learn the system. Results were

"vastly more efficient meetings" and perceptions that "participants attributed much greater value to experienced improvements in knowledge exchange across disciplines and hierarchical levels, with improved meetings as a result."

Ciborra and Suetens (1996) explored the question of how to successfully introduce collaboration technology into a large, centralized, bureaucratic utility company. A large database was not successfully implemented because it was not designed to meet user needs and as previously mentioned, no one took ownership of the system. In contrast, an interactive newsletter forum was readily accepted and heavily used because it was managed by an active, involved group, and its benefits (relevant news) was perceived as valuable by all of the users. They also noted the importance of training and leadership for successful implementation and acceptance of the technology as well as a need for a cooperative culture rather than an autonomous one.

Wynn (1996) examined a digital collaboration system in a health insurer. She attributed the success of its introduction and adoption to several factors. First, the users perceived a need for the new system and the benefits it would provide (relative advantage). The collaboration technology was easy to learn; user friendly, and easily adaptable to their specific work requirements (compatibility). The organizational culture was supportive of innovation and experimentation with new technologies and encouraged users to take the time and risks needed to play with and learn the system. The developer used a participatory design in meeting the needs of the users, top management and users "bought

into" the system, were motivated, and supported each other. There was an appropriate size, scope and strategic scale for the project and the software.

Several authors explored the related issues of relationships and teams when working with digital collaboration tools. Several of the authors (Schultz, 1996, Solomon, 1998, Coutu, 1998, McCune, 1998) emphasized the importance of establishing relationships, usually recommending face to face meetings to establish these relationships as a precursor to effective collaboration. They stressed the issue of trust and effective communication and interpersonal skills when working in a collaborative environment, particularly, a digital one. Other criteria including motivation and active participation were also seen as important to the successful use of digital collaboration. Greengard (1998) also stressed the importance of top management commitment, a collaborative culture, and a strong reward and incentive program to reinforce the importance of the digital collaboration systems. He suggested rewarding, recognizing, and compensating those who effectively used the system and contributed valuable information. Solomon (1996) further advocated training in interpersonal, cultural, and problem-solving skills as well as interdependency, a clear goal and measurable outcomes for any collaborative project. Coutu (1998) expanded these criteria to include clear roles for team members as well as assigning specific tasks in collaborative projects. McDermott (1999) argues, however, that cultural change does not happen by decree, by top management initiatives, by rewards, policies, or organizational structure. Rather, he contends that culture changes "more by contagion than decree." Consistent with the Diffusion of Innovations research emphasizing the importance of social networks and opinion leaders on diffusion, this author states that

"people ask trusted peers for advice, teach newcomers, listen to discussions between experts, and form judgments in conversations." In addition, McLagan and Nel (1995) argue that change is a social process in which everyone must be involved, requiring communication and collaboration for it to happen. Consistent with this assertion, Liff (1998) contends that "groupware (CSCW) is not just another technology; it is also social. It impacts the way people communicate with each other; impacting the way people work." In his doctoral dissertation, D'Souza (1996) also suggests that a CSCW system can prevent bottlenecks in information distribution, contending that "bottlenecks tend to occur when personnel who generate or process key product information in the context of product development, are unavailable, when information is not disseminated to all those affected, and when multiple, uncontrolled, or informally controlled versions of information co-exist." Thus, his theory is consistent with the previous authors cited as well as providing some additional thoughts on the relative advantage of using a document-sharing CSCW technology. Also consistent with other authors cited, he contends that the reasons for ineffective use or discontinuance of this type of technology may be due to an inability to harness a critical mass of users, making the system relevant, threats to existing power structures, violations of social taboos, and the perception that the new system causes additional work with little additional benefits. However, in his research, he was able to document a significant savings in time to perform several tasks in the product development process and found that the major factor influencing effective use of the system was the perception that it could provide greater individual and organizational benefits (relative advantage) than the existing technologies. Consistent with Hordet al's (1998) Stages of Concern model, he found that the greatest use occurred

during his final evaluation stage, when users became well trained and comfortable using it. Also consistent with several other researchers, he found that prior experience with technology and the availability of PC's as well as support by managers and the corporate culture of the organization exerted a great influence on the initial adoption and subsequent use of this CSCW technology.

In an interesting study by Mark and Wulf (1999), these authors studied the impact of using a CSCW technology within a government agency in Germany. They found that the change from physical to electronic exchange of documents reduced the number of meetings and saved time in that regard, but it also reduced the richness of the face-to-face communication process, thereby potentially reducing the quality of communication among associates. Time was also saved in that people now tended to work more independently. While this may represent a process improvement, the authors found that "occasionally information important for a task was not communicated anymore" as it would have been with face-to-face communication, causing long-term negative impacts on the social networks within the organization. They suggest that organizations that rely heavily on electronic systems such as CSCW should develop planned channels of communication to compensate for the loss in the interpersonal process within the organization. These authors appear to suggest that organizations need to find the right balance between electronic networks and personal communication. In contrast to this study, Ciborra and Patriotta (1998) found that implementation of a video-conferencing technology at a large global pharmaceutical firm increased the number of meetings and participants reported that they found the meetings to be more enjoyable, leading to

improved teamwork. However, in terms of other technologies, top management and the IT (Information Technology) department did not take the time to understand user needs and work practices. Thus, other potentially useful collaborative technologies such as CSCW document sharing were either not effectively installed or users did not receive adequate training or motivation to use it. They attribute a lack of diffusion or effective use of technologies to a "combination of corporate inertia, entrenched organizational and cultural feuds and limits in learning from innovation."

Finally, Coleman (1999) contends that the following requirements are necessary to effective knowledge sharing using a CSCW technology: Trust, trust and trust, the ability to communicate clearly and with enough bandwidth to transfer meaning, a common context or language, the space to think and reflect, the autonomy to share, awareness that knowledge is local, sticky and does not transfer easily, a flexible organizational structure to support knowledge sharing, and the infrastructure to support knowledge and information sharing.

From this rich literature base, the following common themes emerge for the successful adoption, and continued, effective use of CSCW technology:

- Need for a strong collaborative/cooperative organizational culture
- Clearly perceived value and benefits of new system, especially over pre-existing substitute tools
- Adequate training on the new system
- Reasonable expectations of the new system

- The digital collaboration system should be user-centered/user-friendly
- The new system should match / be compatible with pre-existing work processes
- There must be ownership and filtering of the collaboration system, particularly in a database type knowledge repository
- Involvement, motivation, and commitment by users and top managers
- Need time for experimentation with and adaptation to new system
- Organizational rewards/incentives to effectively use system
- Good leadership; championship of the new system
- Need for good working relationships: trust and communication.

Contract Research Organizations

Contract research organizations (CRO's) represent a variety of business models. They encompass organizations that can handle the outsourcing needs of pharmaceutical or chemical companies in their research and development (R&D) needs as well as providing services in environmental testing, analytical services, field research services, toxicological services, and many others in different scientific research disciplines. Naude (1999) contends that the demand for outsourcing in the pharmaceutical industry is steadily increasing. She attributes this to the fact that drug discovery companies are continuing to narrow their core capabilities and thus, relying more heavily on outsourcing of many of their former processes. Thus, CRO's now account for about 20% of a pharmaceutical company's traditional development process. According to this author, there are about 1300 CRO's worldwide with a global market of approximately $8.5 billion. Of this, about $5 billion goes to clinical work, research accounts for about $1.5

billion, clinical manufacturing controls another $1.5 billion, and regulatory services, pharmacology, and toxicology represent about $800 million. A 1998 article in Supply Management contended that there was an annual global contract research market of more than $40 billion. Most CRO's focus on analysis and data management, representing a very knowledge-intensive industry as a whole. Thus, the issue of knowledge sharing becomes particularly crucial as a potential means for achieving a sustainable competitive advantage. Mancini (1998) further supports this, suggesting that using document sharing technologies like CSCW are becoming more important as time to market in the pharmaceutical industry, and thus by extension in Contract Research Organizations, 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 (like BSCW) "have never been as compelling as they are right now." This article contends that "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 CRO's and their client, pharmaceutical (as well as chemical) companies a competitive advantage by reducing time to market. Even the FDA (Food and Drug Administration) is more receptive to electronic submissions. A 1997 Information Week article further states that CSCW type technologies can help improve the relationships between pharmaceutical companies and CRO's. When pharmaceutical companies network with a lot of different CRO's, there is a great deal of data and different organizations working with each other. "Such arrangements amplify

the need to share information." In addition, Howells and Howells (1999) demonstrate that in a competitive environment, many firms within the research sector are developing networks and collaborative agreements as well as formal and informal technical agreements to enhance the innovative process and create synergy among firms with different core competencies. This further enhances the need for effective means of sharing data, information and knowledge among multiple, distributed partners in the research industry, and particularly among contract research organizations.

Lewis (1998) examined the role of technology in sharing information and its impact on research managers. Within the context of a research community, he defined the sharing of information and knowledge as challenging because of the complexity of the different research processes, relating to issues of uncertainty (transmission of the correct information or whether any important information may be missing) and equivocality (information may be interpreted in different ways, need to develop shared meaning and frames of reference.) For example, when planning a research project within a particular research community, he found that the issue of reducing equivocality became important in the sharing of information and knowledge so that the research questions and plan could be clearly developed. In his research, he found that the richness of face-to-face meetings was necessary to reduce this equivocality. In contrast, when using a CSCW technology, the equivocality could not be reduced to a sufficient degree such that all research team members truly had a shared understanding of the project and the research plan. In interviewing members of this research community, he discovered that their motivation in using a CSCW technology, rather than face-to-face communications, included the ability

to access different areas and levels of expertise than was available locally, obtaining up-to-date information and scientific results, widening contacts, status and future opportunities. Thus, while he found that many scientific researchers were enthusiastic about the benefits of using a CSCW technology, it was not proven that they actually used it and engaged in more collaborative work and projects. Thus, consistent with the adoption and diffusion literature, even within the framework of a specific research or CRO community, there appears to be a distinct difference between pre-adoption attitudes and beliefs and post adoption attitudes and actual use patterns. If this author is correct, the level of complexity is higher and thus, the obstacles to adopting and then effectively using a new technology like CSCW becomes even greater. However, his conclusions were also consistent with the adoption and diffusion literature that within a research or CRO community, social interaction (networks, relationships), sharing tacit information, building trust, support by top management, and individual autonomy (empowerment) all contributed positively to more effective use of collaborative technologies.

Chapter Summary

A review of the literature revealed trends throughout the diffusion of innovations, knowledge sharing, collaborative technologies, and contract research organization literature bases. Throughout all of the literature reviewed, a recurring theme was the importance of an organizational culture that actively promoted teamwork and collaboration as well as strong, involved leaders committed to knowledge sharing or the new technology. In addition, social networks, opinion leaders, trust and building relationships were common in terms of effectively using a new technology as well as for

knowledge sharing in most organizations studied. In addition, the concepts of relative advantage and compatibility appeared frequently as important elements in the effective use of a CSCW technology and somewhat in the knowledge sharing process. In addition, many of the researchers acknowledged the conceptual relationship between the use of CSCW type technologies to enable knowledge sharing as well as the importance of knowledge sharing itself. However, most researchers also stated that there is little empirical research demonstrating the causal relationships between collaborative technologies, knowledge sharing and resulting performance improvement within the organization.

Chapter III presents the theoretical foundation for the research as well as the hypotheses while Chapter IV presents the methodology.

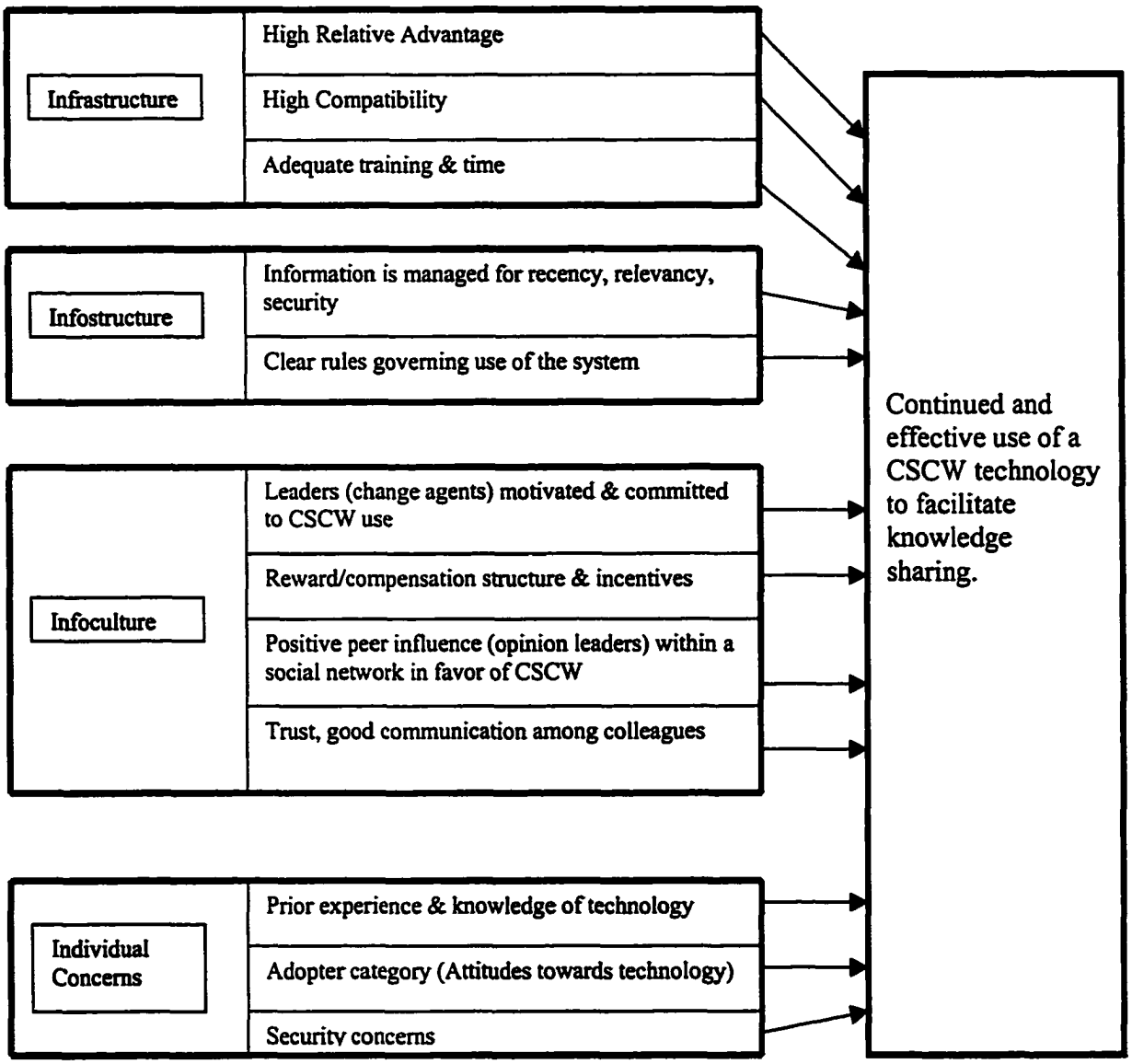
CHAPTER III

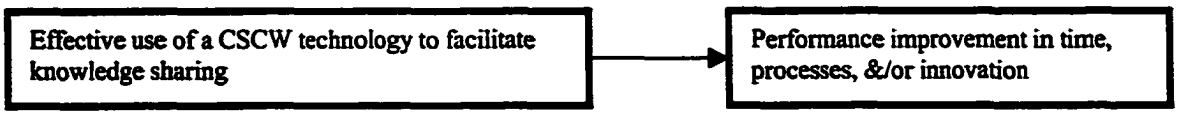
THEORETICAL FOUNDATIONS & HYPOTHESES

By understanding the variables that contribute to the continued and effective use of a CSCW (Computer-supported collaborative work) technology that can enable knowledge-sharing after initial adoption, we can make this knowledge available to organizations to help improve their ability to facilitate the use of new innovations like a CSCW system and perhaps knowledge sharing as well. The initial assumption is that each of the independent variables will exert an equal influence on the dependent variable.

A model illustrating the proposed theory follows along with explanations of each independent variable and the hypotheses associated with each.

Study Model





Theoretical Foundations:

The adoption, diffusion, and/or use of an innovation are influenced by multiple factors, representing a complex mix of variables that can enter into the equation. In the context of this study, an assumption was made that within many organizational settings, most adoption decisions are made by top managers and the adoption by subordinate users throughout the organization would represent a forced adoption. Rogers (1995) describes this as an "authority innovation decision" in which "choices to adopt or reject the innovation are made by a relatively few individuals in a system who possess power, status, or technical expertise." Therefore, the initial adoption decision was not considered in the context of this research. Rather, the primary focus was on the continued and effective use of the technology implementation after the initial adoption; a specific focus on how and why people might be willing and motivated to use, or to resist using a particular technology effectively. Specifically, a CSCW (computer-supported collaborative work) technology that enables users to share information and knowledge, called BSCW (Basic support for cooperative work), was studied. The research questions and hypotheses seek to understand the relationships between a number of possible variables and their impact on users willingness or resistance to continue using this particular technology as well as to share information or knowledge using it. In addition, the influence of knowledge sharing, enabled by a CSCW technology on performance improvement in certain areas of time, processes, and innovation were explored qualitatively. The terms used in the study model, "infrastructure, infostructure, and infoculture" were coined by Pan and Scarbrough (1998) in the knowledge management literature, and defined originally as follows:

Infrastructure: hardware and software that enables the physical communicational contact between network members.

Infostructure: the formal rules which govern the exchange between people on the network.

Infoculture: the cultural knowledge which defines the constraints on knowledge and information sharing.

However, while these terms were used as variables in this research, their meanings have been altered for the specific purpose of this project and will be discussed and redefined in each of the following sections. In addition, in Chapter II the professional literature was reviewed in these areas and some of the elements within were found by different researchers to carry different weights on their influence on the dependent variable. However, for the purpose of this specific study in this unique context, each sub-element was initially assumed to influence the dependent variable equally. The reason behind this assumption is that there is not enough empirical research in the literature to support an initial weighting system of the variables. In addition, within the unique context of this case study, weighting the variables would represent a speculation.

Infrastructure

Infrastructure in this study is defined as the elements that make up the BSCW technology itself as well as the variables that are associated with this technology. The basic theory is that there will be specific elements associated with a given technology that can contribute positively or negatively to its continued and effective use after its initial adoption. The first element, called "relative advantage", is defined as the perceived additional benefits provided with a new technology compared with existing technologies. Rogers (1995)

states that "diffusion scholars have found relative advantage to be one of the best predictors of an innovation's rate of adoption." Subsequent research has confirmed the importance of this sub-element in its continued use after adoption. Therefore, a major component of this theory is that if users perceive a relative advantage inherent in this particular CSCW (Computer- supported collaborative work) technology (BSCW), this dimension will positively contribute to its continued and effective use. Similarly, if BSCW is perceived as providing the users relative advantage, it will contribute positively to positive consequences of its use including elements such as time-savings and increased innovative activity. Another dimension, included within this context as an important element, and associated with the technology itself (infrastructure), is the variable of compatibility, the degree to which an innovation is perceived as consistent with the existing work routines and patterns of users. Do users or potential users of this CSCW technology (BSCW) perceive it as compatible enough with their established work routines that they will be willing to adopt and then continue to use it or is it seen as so foreign and uncomfortable that they will either refuse to adopt it or discontinue use after adoption? In theory, BSCW represents a technology cluster. Because it relies on use of the Internet as part of the cluster, the assumption would be that most users would find this part of the cluster compatible with their normal technology usage patterns since so many people have already incorporated the Internet as a normal technology tool. However, the actual software enabling the information and knowledge-sharing component of BSCW would most likely not be a tool that most people have used. Thus, this part of the technology cluster would most likely represent the incompatible portion, leading to some potential degree of resistance to both adoption and continued use after adoption. Again,

consistent with Roger's emphasis on the importance of compatibility in the diffusion and use of an innovation, researchers found in several independent studies that compatibility consistently played an important role in the continued use of a given technology. In addition, the compatibility of the hardware and software will influence use of the system. If a user has a software application which is older and thus, not compatible with the new technology, they may be unable to use a system like BSCW. Finally, researchers have found that adequate training and providing users with the time to learn a system effectively with the necessary support also contributed to its continued use. Increasing demands on worker's time, increasing workloads, and rapidly changing work environments due to competitive pressures, are becoming more and more common in the American workplace. After the initial forced adoption, did the users receive the training and time they perceived as adequate to learn this new technology and to be able to use it effectively? In a time-stressed work environment, users simply may not have the time to tackle the perceived laborious learning curve to master a new technology adequately unless they are provided with the time and training by the organization.

According to Hord et al (1998), in their Stages of Concern model, they assert that users have different levels of concerns in terms of using a new technology, that, if not addressed, will negatively impact their continued and effective use of it. Their major premise is that change agents must constantly be aware of the level of concern for each user and address this concern with appropriate training and support to overcome the resistance to continued and effective use. Therefore, the last sub-element within the "Infrastructure" variable is time and training.

In theory, then, if current users receive adequate training and time to learn and use BSCW and if they perceive that a technology such as BSCW continues to provide them with relative advantage (benefits) that are superior to existing technology tools and it becomes more and more compatible with their normal work routines (routinized or standardized), then they will continue to use BSCW effectively.

H1: Elements involved with Infrastructure will positively contribute to the continued and effective use of a CSCW technology and knowledge-sharing.

1. $H_{1.1}$: Technology that fulfills a need for the user and is perceived as providing clear benefits (high relative advantage) and value over existing substitute tools (such as e-mail, telephone, fax, etc) will positively contribute to the continued and effective use of a CSCW technology and knowledge sharing.
2. $H_{1.2}$: Technology that is compatible and matches pre-existing work processes; e.g. possesses high compatibility (the technology must be perceived as compatible with existing work routines and easy to use as well as compatible with technological requirements of the system) will positively contribute to the continued and effective use of a CSCW technology and knowledge sharing.
3. $H_{1.3}$: When users perceive there is adequate training and time to learn the system, this will positively contribute to the continued and effective use of a CSCW technology and knowledge sharing.

Infostructure

Infostructure was defined by Pan and Scarbrough (1998) as the formal rules which govern the exchange between people on the network. For example, at Buckman Laboratories, a problem that could not be answered by a given associate would be fed into their CSCW type system and picked up by people with expertise in that area. The rules established for their system mandated that teams of volunteer experts check the system within specified time parameters to take care of those sorts of customer problems. In addition, their CSCW technology contained a database of archival material that associates could access to look for knowledge from others which would help them in solving problems or finding information relevant to their needs. Inherent in the preceding example is the assumption that the information in a central repository will be relevant for its population of users. In addition, in dynamic, turbulent environments, the recency of information can also be a very important criteria as old information can quickly become obsolete. Thus, in theory, an important element within the infostructure variable is not only that rules and procedures clearly guide its use, but also that these rules and procedures maintain the recency and relevancy of the information and knowledge contained within a system like BSCW. If there are rules and mechanisms that enable people to use the BSCW technology and these rules are communicated to everyone, this will most likely facilitate its continued and effective use.

Another issue relating to rules and procedures is whether there are clear rules for interacting on a CSCW type system. Potential users may feel hesitant to freely enter information or knowledge if they do not know how well access to information is

regulated, relating to the level of security. For example, users within a particular CSCW system in a large, global corporation were freely entering information as well as their knowledge and ideas. However, upon discovering that the CEO and top executives had access to their input, they became concerned about the consequences of freely entering information and usage of the system dropped dramatically. Thus, clear rules governing the use of a technology such as BSCW helps to allay potential concerns and may help to facilitate use of the technology. Similarly, if mechanisms to filter information and ensure its validity and recency are in place, users may also feel more secure and confident in using it and contributing their information and knowledge.

H2: Elements involved with Infostructure will positively contribute to the continued and effective use of a CSCW technology and knowledge-sharing.

1. $H_{2.1}$: When there is clear ownership of the CSCW system where the information is managed for recency, relevancy, and security as perceived by the users, this will positively contribute to the continued and effective use of a CSCW technology and knowledge sharing.
2. $H_{2.2}$: When there are clear rules governing the use of the CSCW system as well as the knowledge and information to be shared as perceived by the users, this will positively contribute to the continued and effective use of a CSCW technology and knowledge sharing.

Infoculture

Infoculture: The influence of organizational culture on information sharing, performance, risk-taking, and innovativeness has been well researched. It becomes clear from the

literature that organizational cultures whose norms and values encourage trust in their associates, collaboration, communication, innovation and risk-taking appear to be successful in creating perpetual innovation, often providing mechanisms for sustained competitive advantages. Similarly, the literature shows that leaders who create these collaborative, empowering, nurturing cultures tend to be more supportive of knowledge sharing and using a CSCW technology to facilitate knowledge sharing.

Similarly, leaders and change agents who support and model the use of a CSCW system to share knowledge also tend to create reward, compensation, and/or incentive systems to motivate its use by associates. For example, at Buckman Laboratories, associates are not only expected to collaborate with each other, but are rewarded with monetary, non-monetary, and intrinsic rewards for effectively sharing their knowledge with others using their CSCW-type knowledge sharing technology. Motivation theories have long acknowledged that people will do what they are rewarded for. Similarly, classic motivation theories contend that everyone has different intrinsic and extrinsic needs. Thus, motivating associates to continue using a new innovation/technology effectively requires management to understand and then offer the rewards and incentives that are important to each individual.

In addition, researchers have found that peer influence and social networks can have a profound effect on the continuing and effective use of an innovation. For example, Rogers (1995) has demonstrated the effectiveness of opinion leaders with homophilous networks on influencing user behavior in both the adoption and continued use of

innovations. Thus, peer influence, particularly opinion leaders, who are well respected by their peers, within social networks are proposed to exert a positive influence on the continued and effective use of a CSCW technology.

Correspondingly, in an environment where associates do not trust one another, where they fear that their ideas will be used by others for personal gain or that their contributions will not be valued or rewarded, they would probably be reluctant to share information or even to use a technology that enabled them to do so. Strong, effective leadership is needed to develop and nurture an empowering, collaborative, trusting culture as well as to establish the appropriate reward and incentive systems to encourage associates to use a CSCW-type technology effectively and be willing and motivated to share their ideas, information, and knowledge Since management theories acknowledge the strong influence top management has on the organizational culture within a firm as well as their ability to create the reward and incentive systems necessary to promote desired behaviors, leadership and reward and compensations systems are also considered important elements within the variable of infoculture. Therefore, the sub-elements considered as part of the "Infoculture" variable include user perceptions of leadership that models and supports CSCW and knowledge sharing, reward, compensation, incentives to motivate its use, peer (opinion leader) influence within social networks, and good trust and communication among colleagues.

H3: Elements involved with Infoculture will positively contribute to the continued and effective use of a CSCW technology and knowledge-sharing.

1. $H_{3.1}$: Proactive participatory leadership who are actively involved, committed to and supportive of BSCW and knowledge sharing including their pro-active change agents will positively contribute to the continued and effective use of a CSCW technology and knowledge sharing.
2. $H_{3.2}$: Reward and compensation structures (motivations to share knowledge and use BSCW, what will it do for me?) as well as incentives to use BSCW and share knowledge will positively contribute to the continued and effective use of a CSCW technology and knowledge sharing.
3. $H_{3.3}$: Peer influence (opinion leaders) within social networks that support the use of BSCW and knowledge sharing will positively contribute to the continued and effective use of a CSCW technology and knowledge sharing.
4. $H_{3.4}$: Good working relationships: trust and good communication among associates, departments and functional areas will positively contribute to the continued and effective use of a CSCW technology and knowledge sharing.

Individual Concerns

Individual Concerns: Yet, even within an organizational culture that promotes and supports collaboration and trust among colleagues, each person comes to the job with their own attitudes, values, norms, and personal agenda. Therefore, it becomes important to recognize the unique characteristics of each user and what individual variables or concerns might uniquely influence their willingness or resistance to continue using a CSCW technology like BSCW. As mentioned in the first section, Hord et al. (1998) addressed this issue with their Stages of Concern theory. While it is considered a sub-element of the "Infrastructure" variable, it also is relevant in this "Individual Concerns"

section. Each person has evolving concerns regarding the use of the technology depending upon their level of familiarity and usage with the system. Thus, these unique concerns should be addressed to continue to motivate people to effectively use the system.

Technology itself can play a role in someone's attitudes towards change and the adoption-decision process. Techno phobia, possibly due to prior use or experiences, or lack thereof, might contribute to continuing to use a new technology. Similarly, someone who has used a similar CSCW type system would be more likely to adopt and then to continue to effectively use a new CSCW system due to their experience and comfort level with the technology. Hord et al (1998) suggest in the Stages of Concern model, that by understanding an individuals unique concerns and attitudes about the technology, they can take the appropriate actions to facilitate successful implementation and effective use of it. In this model, a slightly different approach is taken to the Stages of Concern model. The proposal here is that there is a direct correlation with an individual's prior experience, particularly with similar technologies, to their implementation and continued effective use of the new technology.

Different people also have different attitudes toward change based on their prior experiences and personalities. Some people, who embrace new changes willingly and enthusiastically, often characterized as "innovators" or perhaps "early adopters, would be more likely to continue using an innovation and finding more effective ways to use it. In contrast, people who resist change and prefer the comfort of the status quo, would be less

likely to put forth effort in looking for effective ways to use it. Rogers (1995) proposes a classification of individuals based on the cumulative work of many researchers. He proposes that there are 5 major categories of adopters with distinct characteristics. Innovators are characterized as venturesome and obsessed with innovations. They take more risks and venture outside their homophilous networks to seek out new innovations. Early adopters are categorized as more integrated into their social system and are most likely to be the opinion leaders within their social network. They evaluate and use new innovations discretely. Early majority adopters deliberate before adopting a new innovation. Late majority adopters are skeptical about new innovations and usually only adopt due to necessity, and laggards tend to be very suspicious of new innovations and change agents. The relatively early adopters tend to have more formal education, are higher in socio-economic class, has greater empathy, rationality, more favorable attitudes towards change, less dogmatism, are more cosmopolite, have greater knowledge of innovations, and are more information seeking.

Adapting Rogers theory on adopter categories, this model proposes that innovators and early adopters, due to their unique characteristics listed above, are more likely to effectively use a new innovation, such as BSCW, after the initial forced adoption.

Finally, in many industries, including the environment of a Contract Research Laboratory (CRO), studied here, security appears to be a primary concern among most individuals. Due to confidentiality issues with clients as well as competitive rivalry, the security of sharing information become a major concern to many people. Trust again plays a role in

this issue. Relating back to the individual need for power or achievement as well as the reward and incentive systems within an organization, many people may not trust the technology or even the organization in terms of the consequences of sharing their information and knowledge freely. As mentioned earlier, they may fear that others will use their knowledge, take credit and be unjustly rewarded for their work. They may fear the lack of security and control of sharing information on a CSCW technology where knowledge seems to go into the "black hole" of cyberspace, fearing that individuals who are not authorized may gain access to their information. Therefore the elements of trust and security are also incorporated into the variable "Individual Concerns".

H4: Elements involved with Individual Concerns will contribute (positively or negatively) to the continued and effective use of a CSCW technology and knowledge-sharing.

1. $H_{4.1}$: Pre-existing positive knowledge, experiences and attitudes towards technologies, particularly a technology that is similar to a CSCW system, will positively contribute to the continued and effective use of a CSCW technology and knowledge sharing.
2. $H_{4.2}$: Individuals with the basic characteristics consistent with innovators and early adopters will be more likely to continue to effectively use BSCW.
3. $H_{4.3}$: Security concerns over sharing knowledge or using a CSCW technology will negatively contribute to the continued and effective use of a CSCW technology and knowledge sharing.

Performance Improvement

Researchers in almost every area of the literature reviewed appeared to agree that little empirical research has been conducted to validate causal relationships between either the use of a CSCW technology or knowledge sharing on performance improvement indicators. However, most of the researchers also agree that the reason for this lack of research is attributed to the great difficulties in measuring performance dimensions quantitatively other than financial measures. However, there appears to be such a large conceptual consensus about the probability of the validity of these relationships as well as the importance of them, that it has become irresistible to explore these concepts, if only qualitatively. However, based on primarily conceptual and qualitative research findings, with a few quantitative results, it appears that using a CSCW technology to facilitate knowledge sharing positively contributes to performance improvement in the areas of time, processes, and innovation.

Pan and Scarbrough (1999) demonstrated quantitative and significant reductions in the time required to process customer orders in Buckman Laboratories while qualitatively demonstrating perceived increases in customer satisfaction, innovation and process improvements. Similarly, Reisenberger (1999) cited research that demonstrated a reduction in vendor approval time within a global food manufacturer for 8 days to 41 minutes as well as a reduction in product development time in a pharmaceutical firm from 866 days to 379 days.

Bikson (1996) reported on user's qualitative perceptions of improved efficiency in meetings using videoconferencing technology. D'Souza (1999) found a quantitative reduction in process time required for several activities within a product development cycle while Orlikowski (1996) demonstrated a non-quantifiable increase in productivity as expressed by user's perceptions of satisfaction and time saved in processes. Reisenberger (1999) further contended that knowledge sharing is an essential element to perpetual innovation in today's fast paced, rapidly changing business environment.

Davenport (1999) suggests that measuring intermediate measures is a good way to establish a link and increase the credibility in relating knowledge management, enabled by a CSCW technology to improved performance. Specifically, he suggests measuring the number of hits to a knowledge repository, as well as satisfaction measures of the users. Pelton (1999) also suggests examining improvements in customer service and the spreading of best practices. While CSCW technology, enabling knowledge sharing, could result in performance improvements in many areas, the issues of time improvement in processes and increased innovation were explored as a consequence of use in the context of this research.

H5: Knowledge sharing, enabled by a CSCW technology will positively contribute to reduced time to complete processes and improved innovation within an organization.

Finally, while these major variables and their sub-variables are initially assumed to be weighted equally in their influence on the variance associated with the dependent variable, the results of the actual study may demonstrate that one or more of the major variables as well as the sub-elements contained within them contribute more or less, positively or negatively to the continued and effective use of this BSCW technology, knowledge sharing, and the consequences from its use.

In terms of the case studies, a Contract Research Organization was selected for study because it is a knowledge-intensive organization that works with different stakeholders in a distributed environment. Thus, the need to share information in a timely manner is significant. A CRO is representative of an information-intensive organization in which "time to market" represents critical competitive pressures. Delays in government agency approvals can mean millions in lost revenues or give their competitors a crucial first mover advantage. (Inform, 1998) Thus, the ability to share information effectively via a collaborative technology primarily by reducing time in process for various activities represents an important strategic consideration within this organization as well as similar knowledge-intensive organizations in many industries and contributes to the significance of this research. This concept may be generalizable to many other industries as the same competitive "time to market" pressures are becoming more prevalent as competitive pressures increase and product life cycles become increasingly shorter.

Chapter Summary

This chapter established the study model and hypotheses. It also discussed the significance of prior research and theories as the foundation for this study. Chapter IV discusses the methodology including study design, sample selection, data collection, instrumentation, and proposed statistical analyses.

CHAPTER IV

METHODS

Statement of the Research Questions

Primary Research Question:

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?

Secondary Research Question:

2. How does the use of a CSCW technology to facilitate knowledge sharing influence performance dimensions such as time, process improvement, and innovation?

Research Design

The research consisted of an internal organizational case study. A secondary external distributed organizational case study was initiated but stopped by the request of the external client involved.

Internal Organizational Case Study:

Introduction: This study examined the adoption, diffusion, continued, and effective use of a CSCW (Computer supported collaborative work) system within a Contract Research Organization (CRO) over a period of approximately eight months. The factors that were proposed in the study model (Chapter III) were examined within the context of the use of

this CSCW technology, called BSCW (Basic support for cooperative work). In April, 2000, a meeting with the President of the contract research organization took place in which permission was granted to study the use of the newly adopted CSCW technology, BSCW. This represented a window of opportunity into the attitudes and perceptions of users associated with a newly adopted innovation.

Population and sample: The population of interest for this study consisted of the entire population of users of BSCW within this contract research organization. When the study was initiated in April, 2000, there were approximately 10-15 users. By the completion of the study in December, 2000, there were approximately 47 users. A convenience sample was used due to the limited size and specific characteristics of the population. An attempt was made to include the entire executive team as well as the entire product development team in the sample. The remaining users were selected using a quota system as described below.

Methods

Phase I: Unobtrusive Monitoring of BSCW

From May 12 – December 31, 2000 root statistics were monitored and summarized on a daily basis. Each day, the Director of Information Systems submitted a detailed report via e-mail of the total organization-wide use of BSCW by person. This included how many times each person accessed the system each day. This data was then summarized using an excel spreadsheet to look for trends and patterns in overall usage as well as by users and functional area. Data were also summarized by total use per day and

the number of users per day. In addition, permission to about 13 shared workspaces was granted by the President of the company, allowing access to entries by invited members of those particular workspaces including creation, revisions, and reading of the different files contained within each workspace. Of those thirteen shared workspaces, about four were actively used by top management, middle managers and associates working in different divisions of this organization throughout the term of this study. The data in these shared workspaces were similarly monitored and summarized on excel worksheets. However, one particular shared workspace, the Sales Forecast, represented the file that was most actively used and was therefore studied and monitored most intensively.

Phase II: Qualitative Research

a.) Depth Interviews

From September through December, 2000, approximately 30 users of the BSCW system out of a total of approximately 50 total users, were contacted via e-mail (Appendix A) to request an interview. The purpose was stated as assessing their perceptions of use of the BSCW system and knowledge sharing in order to better understand what factors most influenced the continued use of the technology and willingness to share knowledge among colleagues, and potential resulting performance improvement within the organization. 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 to represent the remaining functional areas. Eight managers, four quality-assurance/compliance, and eight data entry people agreed to be interviewed.

An e-mail (Appendix A) was sent to each person requesting approximately a half hour of their time for the interview. If the respondent agreed, a date and time was scheduled at their convenience at the organization. During the interview, questions were asked using a survey instrument (Appendix B). Respondents were encouraged to answer freely and openly and were prompted only to keep responses focused on the variables of interest in the conversation began to stray on tangents. All interviews were recorded on a tape recorder with the permission of the respondent, and the transcripts were later typed into a qualitative analysis program.

b.) Focus Group

To see whether any synergy would be generated or different ideas or responses from the in-depth interviews, a group of five users were invited via e-mail to participate in a focus group over lunch at the organization. This focus group took place on October 4, 2000. The same questions were used as in the depth interviews. However, the researcher acted as a moderator and facilitator to keep the group focused on the relevant variables. The focus group was limited to 45 minutes to accommodate the lunch schedule of the participants and was recorded using a tape recorder with the permission of the

respondents. The transcripts were later typed into a qualitative analysis program for future analysis.

The focus group consisted of a committee within the contract research organization, known as IACUC (International Animal Care and Use Committee). The participants included two employees of the contract research organization and three volunteer members from the local community. One volunteer was a farmer in the area, another, a local veterinarian, and the third, a professor at the state university.

Phase III: Quantitative Research

Web Surveys

After the data from the in-depth interviews and focus group were coded and analyzed, the major findings were used to develop a series of Likert-scale questions (Appendix C) to further quantify the qualitative results. For the major constructs (independent variables discussed in chapter III), approximately 2-3 different questions were posed to increase the reliability of the instrument. The questions were developed after examining the responses from the qualitative interview results. The major themes that emerged from that study were then developed into Likert questions that attempted to quantify the results. This web survey was sent via e-mail (Appendix A) to the entire population of 47 users. Users responded to the survey by clicking on the link embedded in the e-mail and then clicking on their selected responses on the screen. When finished, they clicked on the submit button and the data was returned to the researcher via e-mail.

Instrumentation:

The survey instruments were all developed and pilot-tested with representative users before administering it to the study subjects. The representative users were part of the original study population. However, they were part of a reorganization within the company, and thus, not used in the final survey. Items requiring modifications based on feedback were made before final distribution. For example, feedback from a study manager resulted in the re-wording of several questions as well as improving the formatting and clarity of the form. The in-depth interviews were constructed to encourage open-ended responses. "The Long Interview" (McCracken, 1988) book was used as a guide in developing the in-depth interviews.

Likert-scale questions were used to collect quantitative interval data for subsequent statistical analysis. Several dichotomous questions were used to collect demographic data. This was administered with a form designed for web access using Dreamweaver® web page development software.

II. External Distributed Organizational Case Study:

This case was initially set up as a paired comparison time-series study, examining the flow of information (knowledge sharing) using a CSCW collaborative technology in a distributed setting with a group of diverse stakeholders from different types of for-profit organizations as well as a university. However, due to confidentiality and security concerns by the director of the study (an external client), the use of BSCW was

terminated shortly after it was initiated. Therefore, this study was not accessible to the researcher.

Measurement Issues

Internal Validity

"Establishing the validity of the dependent variable (performance improvement) involves evidence to support the hypothesis that the dependent variable actually measures the construct we want it to measure." (Chrisensen, 1991) Given the sampling constraint, the sample size was small, thus reducing the validity of the results. In addition, given the complexity of studying human subjects and the many intervening variables, we cannot assume homogeneity of variance and must also assume multiple sources of error. Therefore, the internal validity will not be as controlled as in a laboratory experiment. However, by using a sample size of 30 and examining perspectives from different functional areas within this organization, an attempt was made to decrease the variability due to the small sample size. The validity would have been increased if the sample size was significantly larger. However, in this case study context, with an entire user population of 47, this was not possible. In a further effort to increase the internal validity for this case study, several data collection methods were used including unobtrusive monitoring of usage, depth interviews, a focus group, and a web-based survey to compare and validate user responses and actual use characteristics.

External Validity

To what extent are the findings from this study generalizable to other settings? While the subjects used and the context are from real world situations, the findings may be

generalizable to similar settings, perhaps extending to other types of contract research organizations, the chemical industry, or other service organizations. Caution must be used however in generalizing these findings because the context for the specific performance indicators used may be situation specific. Thus, they may not be applicable/relevant outside of the context in which they were studied. On the other hand, researchers and organizations may be able to use the general concepts. For example, "leadership" may be applicable to facilitate knowledge sharing and use of a CSCW technology in almost any organization. Similarly, the concept of "relative advantage" can be applied to almost any organization and any context.

Reliability

Reliability is defined as the extent to which the same results are obtained when responses are measured at different times. (Christensen, 1991) In order to establish reliability within the measurement procedures, the following approaches were used.

(1.) Internal comparison reliability: For each construct in the web-based survey, often several different questions were used to assess the response to it. In addition, there should have been a fairly high correlation between responses to specific criteria among similar respondents.

(2.) Alternate form reliability was used by applying several equivalent forms of the measurement to the same subjects. In this case, using interval scale questions and open-ended questions represented an attempt to examine similarity of responses.

Statistical Analysis Techniques

Qualitative Research: In-Depth Interviews:

After collecting the data via semi-structured depth interviews for the individual respondents as well as the focus group, the transcripts were typed into a qualitative analysis program called "EZ-Text" http://www.cdc.gov/hiv/software/ez-text/readme.htm, developed by the CDC (Center for Disease Control, Atlanta, GA). This program was developed specifically for the purpose of analyzing qualitative data from semi-structured interview questions such as the ones used in this study. This program provided the first step in the qualitative analysis process: text segmentation. The text segmentation step involved division of the text into manageable segments of text. EZ Text organized these segments into series of templates corresponding to each question asked in the interview. Therefore, the data were pre-segmented by question in this program, resulting in approximately 300 text segments (10 questions x 30 respondents). After typing in the transcript text into these segments, codes were developed that corresponded to the distinct themes that emerged from the interviews. This was primarily an inductive task. Initially, codes were developed by section after reading through all the transcripts for each section. After these first codes were developed, an iterative process of reflection on the themes and responses resulted in a narrowing of the codes to capture the major themes into categories that were broad enough to capture meaningful information while remaining mutually exclusive. This process was repeated several times until a list of codes met the criteria mentioned above. The final list of codes developed per section is shown in Appendix D.

After completion of the code list, the codes were assigned to specific responses within each section and for each respondent within the EZ-Text program. After all codes were assigned and checked for accuracy, spreadsheets in excel and SPSS were developed to enter the coding data for quantitative analysis. Because most respondents had multiple responses for each question, the data were entered into the spreadsheets by code as dichotomous data. EZ-Text also allowed demographic information to be recorded. This demographic data was also entered into SPSS for analysis. The coded responses were examined for emerging trends and theories. Interesting comments and passages were noted to lend support or to refute proposed hypotheses or to develop new understandings of the factors involved with the adoption, diffusion and use of this technology to facilitate knowledge management as well as its apparent effect on performance improvement within this organization.

Qualitative and Quantitative Research: SPSS Analyses

The data were first analyzed with descriptive statistics. Each major category relating to a question and set of codes was examined using frequency data and charts to look for trends. BSCW usage was similarly examined with descriptive data and different bar and line charts to look for trends in the usage patterns.

Regression and correlation analysis was used to look for statistical significance between the dependent variables with the independent variables proposed in the study model and hypotheses. Chi square analysis was used to examine relationships among several demographic variables such as role, gender or age with the dependent and independent variables to look for significant differences. Analysis of variance (ANOVA) was used to

examine the variance in the dependent variables attributed to each of the independent variables. An alpha coefficient analysis was conducted for inter-item reliability on the questions pertaining to each major category associated with a dependent variable.

Chapter Summary

This chapter described the research model, research questions, population and sample used in this study. It also described the data collection methods, instrumentation, and data analysis techniques. Chapter Five presents the results of the research.

CHAPTER V

RESULTS

The purpose of this study was to examine specific variables in order to understand which ones influence the continued and effective use of a CSCW (computer-supported collaborative work) technology, for the ultimate purpose of enabling the sharing of knowledge. The secondary purpose was to examine the consequences of knowledge sharing. The performance improvement consequences that were examined included time-savings, process and quality improvements, improved decision making, problem solving and client responsiveness.

To accomplish this, an internal organizational study was conducted in three major phases. Phase I involved the unobtrusive monitoring of usage of the new collaborative technology, called BSCW (Basic Support for Cooperative Work), at the Contract Research Organization being studied. Phase II involved qualitative data collection, interviewing 30 BSCW users with semi-structured interviews and one focus group. Phase III built upon the qualitative phase by developing a quantitative survey based on the results from the interviews to quantify user perceptions along the dimensions of interest.

PHASE I: BSCW MONITORING

As previously described, daily root statistics were collected on total usage per person per day over an eight-month period (May – December, 2000). The data were entered into an

excel spreadsheet and analyzed using SPSS. The results of this monitoring are shown in Figures 1- 4.

Figure 1a: Total Daily BSCW Use

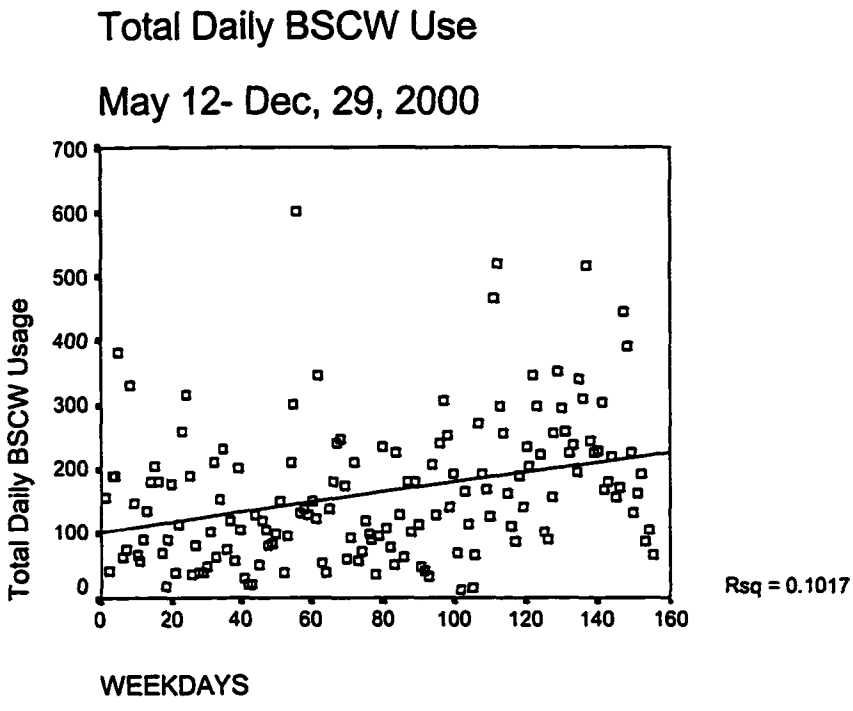


Figure 1b: Average Daily BSCW Use

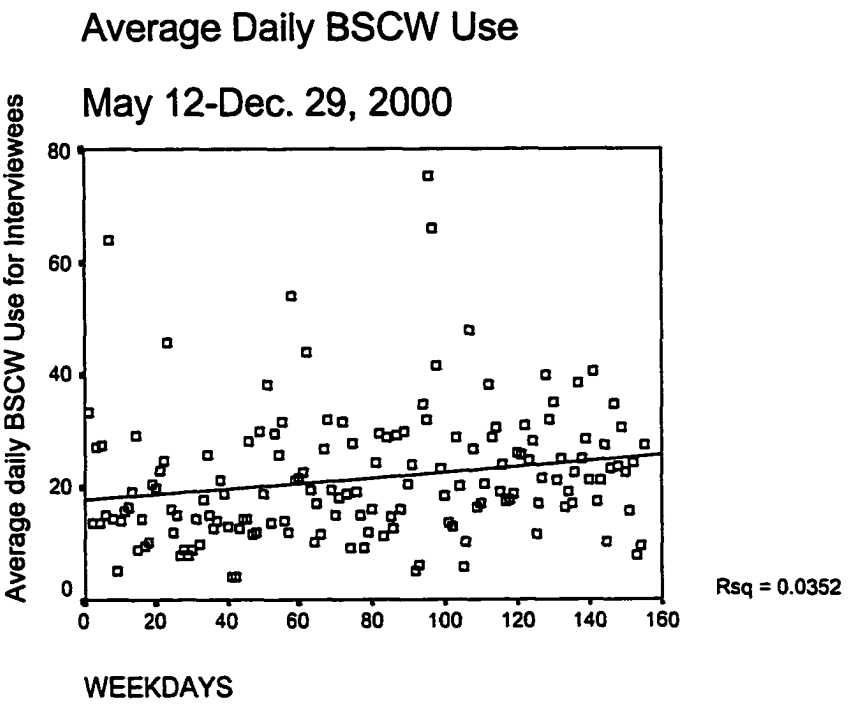


Figure 2a: Total Weekly BSCW Use: May-Dec, 2000

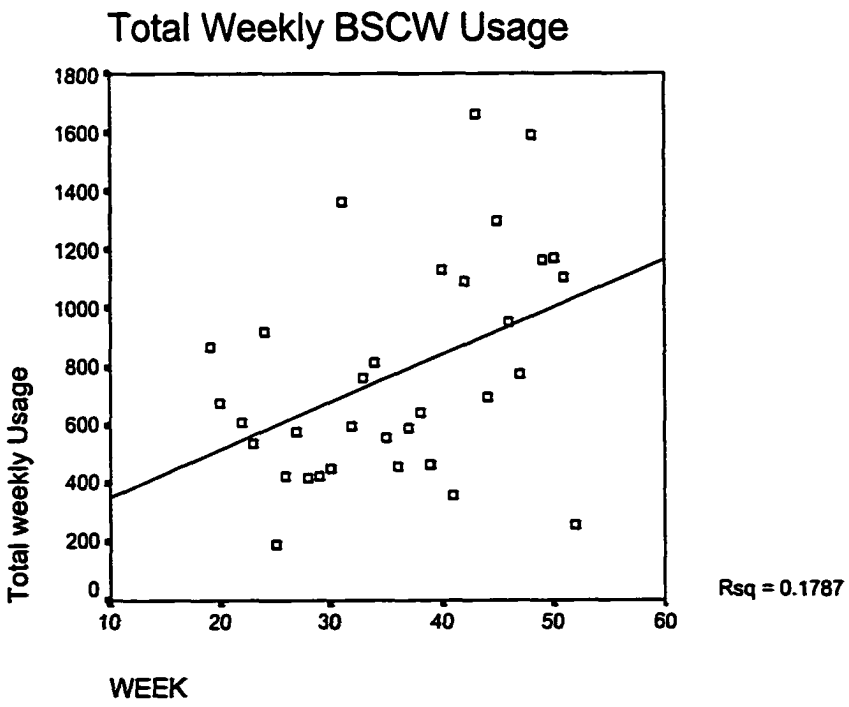


Figure 2b: Average Weekly BSCW Use, May- December, 2000

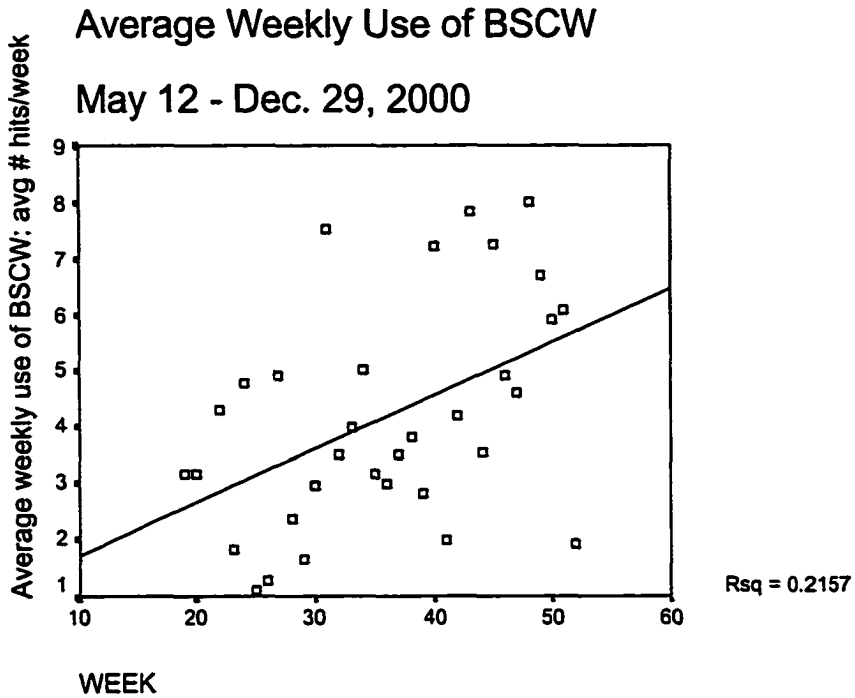


Figure 3a: Total Monthly BSCW Use, May-December,

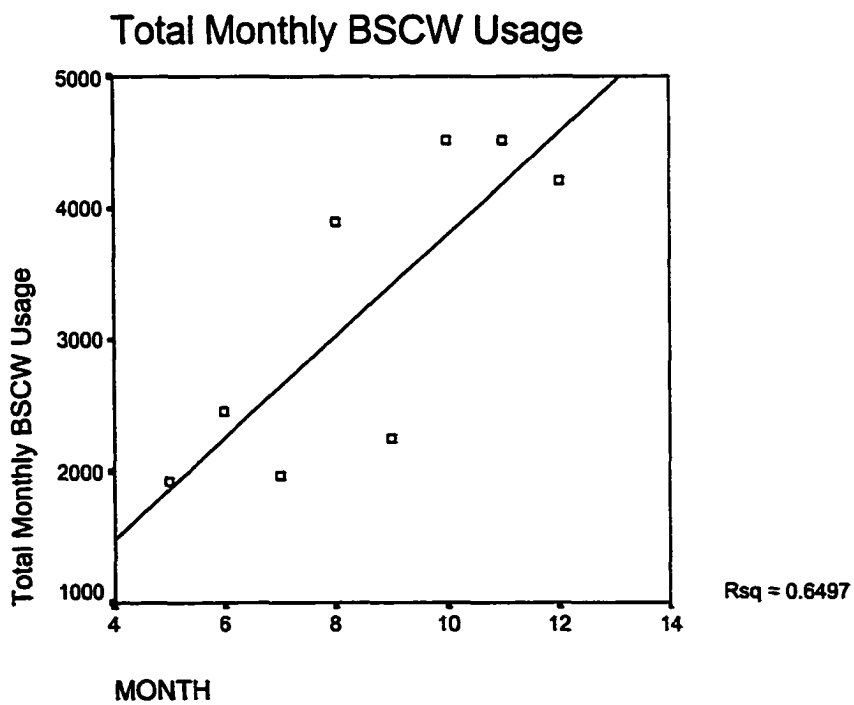


Figure 3b: Average Monthly BSCW Use

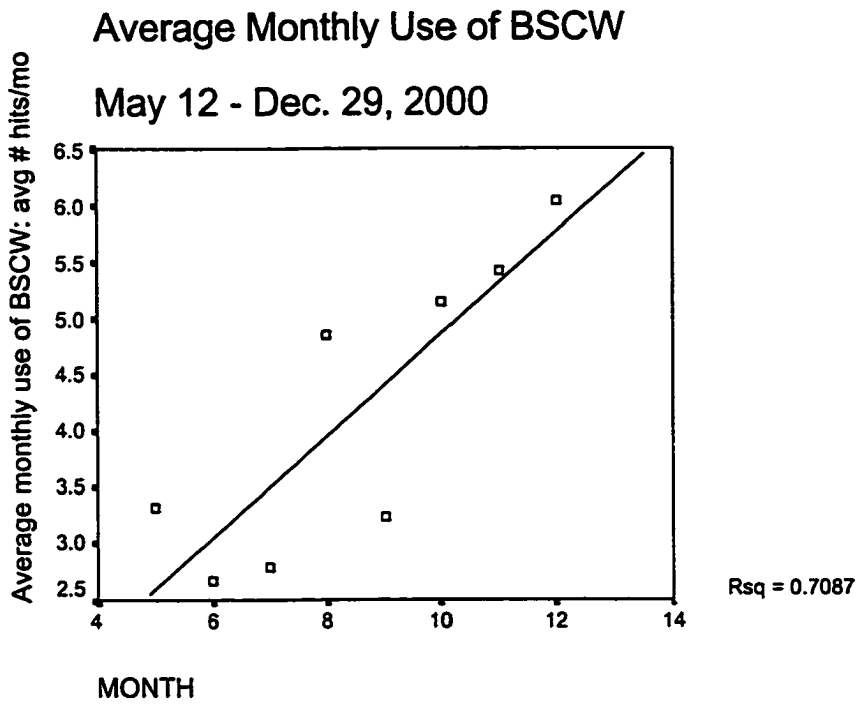


Table 1: Regression Analysis: Total Daily BSCW Usage

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.319(a)	.102	.096	102.8317

a Predictors: (Constant), WEEKDAYS

ANOVA (b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	183072.709	1	183072.709	17.313	.000(a)
	Residual	1617877.975	153	10574.366		
	Total	1800950.684	154			

a Predictors: (Constant), WEEKDAYS

b Dependent Variable: Total Daily BSCW Usage

Table 2: Regression Analysis: Average Monthly BSCW Usage

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.842(a)	.709	.660	.7681
a Predictors: (Constant), MONTH				

ANOVA(b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.613	1	8.613	14.599	.009(a)
	Residual	3.540	6	.590		
	Total	12.153	7			
a Predictors: (Constant), MONTH						
b Dependent Variable: Average monthly use of BSCW, May-Dec, 2000						

BSCW Usage: Figure 1a represents a scatter plot with a total fit regression line of the total hits per day. This represents the total number of times all users enacted any types of transactions on the BSCW system. This could include opening files, reading documents, locking a file and making changes to a document, making comments within a file, among other possible transactions. Figure 1b shows the average hits per day per person for the users interviewed. While the data were monitored on a daily basis, these results reflect weekday usage to reduce the large variability between weekday usage and the low to non-existent usage of the system on weekends and holidays. A total of 156 weekdays shows the number of total transactions for all users of those days between May 12, 2000 – December 29, 2000 as well as average use for the 30 users who were interviewed. Despite the high variability shown in the scatter plot, figures 1a and 1b clearly show a constant increase in usage over time. The high variability in usage of BSCW may be attributed to a number of factors. Because this system was introduced into the company in January, 2000, stable, routine usage patterns have yet to develop. Rather, more erratic

usage can be explained by the continual entry of new users who may experiment with the system and use it heavily initially during the experimentation stage, take a break from it, and gradually learn how to incorporate it into their normal work routines. Figures 2a and 2b show the data consolidated into total and average weekly usage and figures 3a and 3b show total and average monthly usage over the same time period. It is interesting to note the increasing slope of the regression line and the increasing r^2 value from daily to weekly to monthly use. This can be attributed to reducing variation in usage as the data is collapsed into weekly and monthly time frames. Tables 1 and 2 show that for both daily and monthly usage over time, there was statistical significance at the .01 level. Figure 4 shows the total number of users per day over the same period. Therefore, it can be shown that there was a steady increase in the adoption and diffusion of this technology over the eight-month study period.

Figure 4: Total Number of BSCW Users per Day: May 12 – December 29, 2000

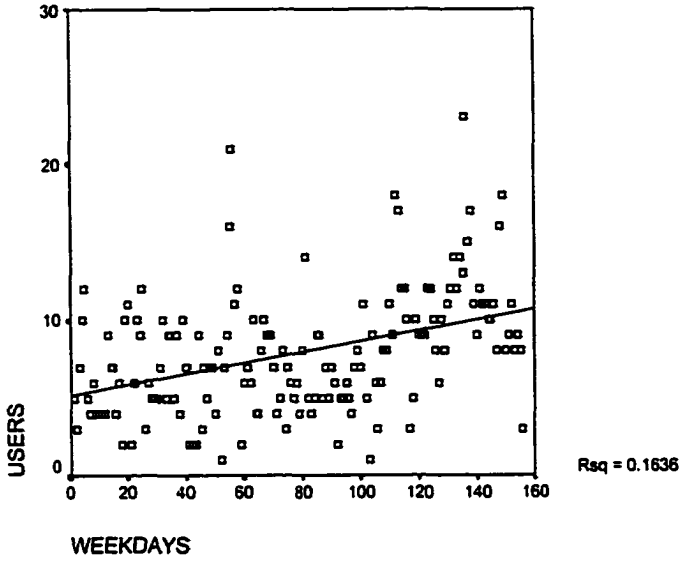
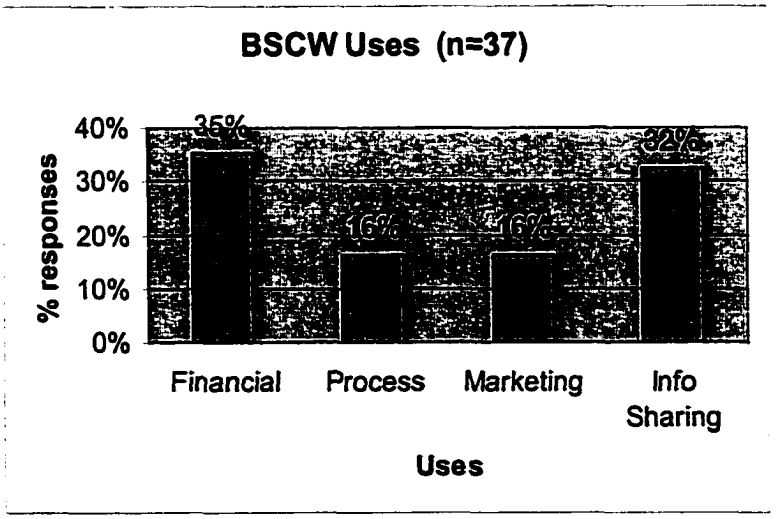


Figure 5 shows the primary uses for BSCW for the respondents in the qualitative study.

Figure 5: Primary Uses of BSCW (Qualitative Study, n=30)



It should be noted that the leadership team (top company executives) were the first to use the system during the first quarter of the year. The next group introduced to BSCW were the business development managers, probably in the second quarter. However, from the

approximately May through September, 2000, other individuals, representing middle mangers, quality assurance and technical and support staff were also gradually introduced to the system. During the fourth quarter, select individuals from all areas of the company were invited to use the system. Figure 6a shows the composition of respondents in terms of their roles in the company in the qualitative survey and the quantitative survey (Figure 6b). Figure 7 shows the combined usage of BSCW for each of these groups over time. However, it should be noted that there is great variability in this data also because different people were invited to use the system at different times throughout the year. Another reason for the great variability in usage can be explained by the reasons for using BSCW, which varied greatly among individuals. The top management team tended to use BSCW primarily for sales and budget purposes. Thus, they needed information on a consistent basis and their usage patterns were the greatest and most consistent. In contrast, quality assurance (QA) people used BSCW to input client comments from QA audits to develop trends and use this data for process improvement and client responsiveness. Thus, their use of BSCW was far more sporadic and project-driven. Middle managers tended to use BSCW to input sales and budget data as well as for QA tracking and other purposes. However, their usage was dependent on the individual manager and less consistent than with top management. The business development people used BSCW for both sales forecasting as well as for client contact information. Again, their usage was both project dependent and based on requirements from top management. Finally, different associates including secretaries, technical and support staff used BSCW primarily to input information at the request of their supervisors for use in reviewing information at different levels of the organization.

Figure 6a: Roles of Respondents (Qualitative Survey, n=30)

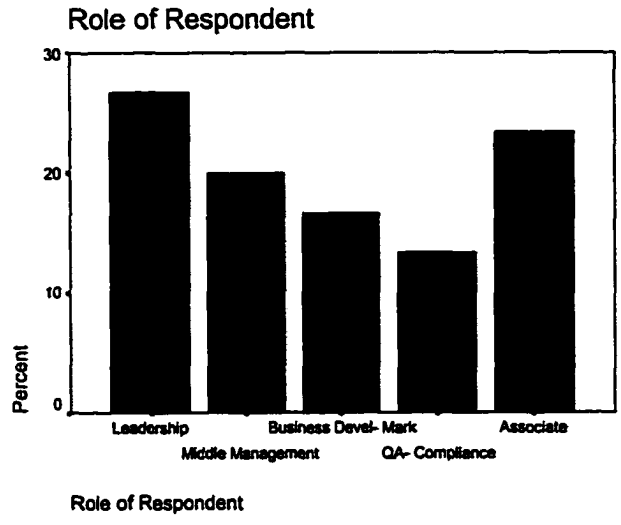


Figure 6b: Roles of Respondents (Quantitative Survey, n=34)

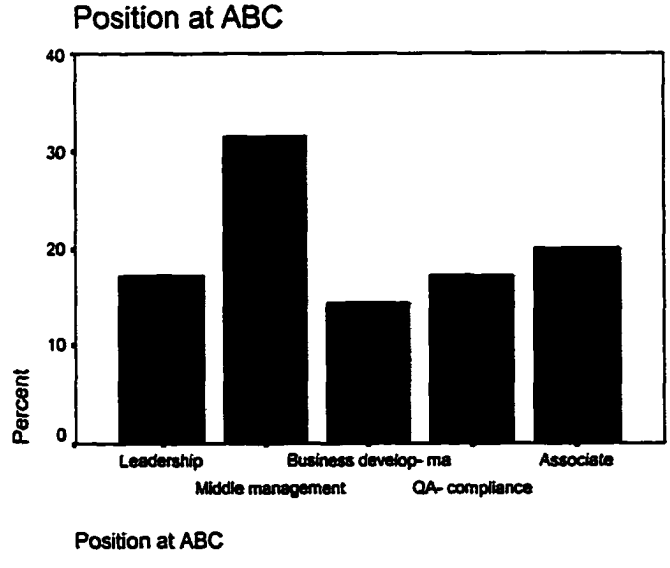


Figure 7: Total BSCW Usage by Position in Company (Qualitative study, n=30)

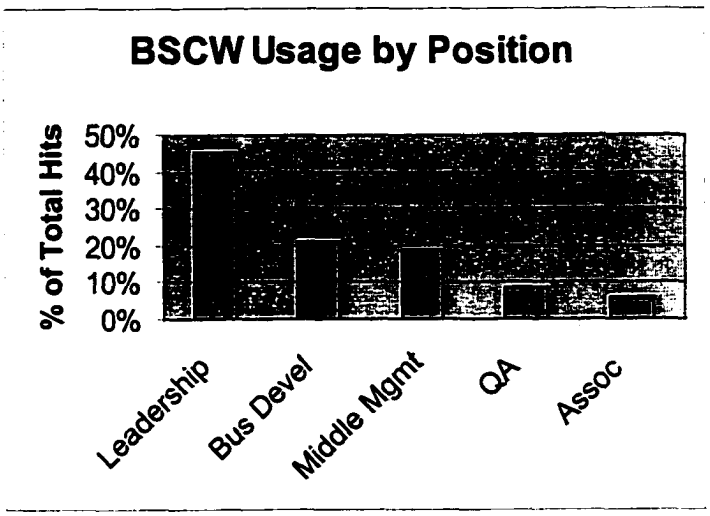


Figure 8 shows the current usage of BSCW while Figure 9 shows respondent's expected use of BSCW over the next year. Finally, Figure 10 shows the number of people respondents normally communicate with using BSCW on a weekly basis.

Figure 8: Current perceived use of BSCW (Quantitative study, n=34)

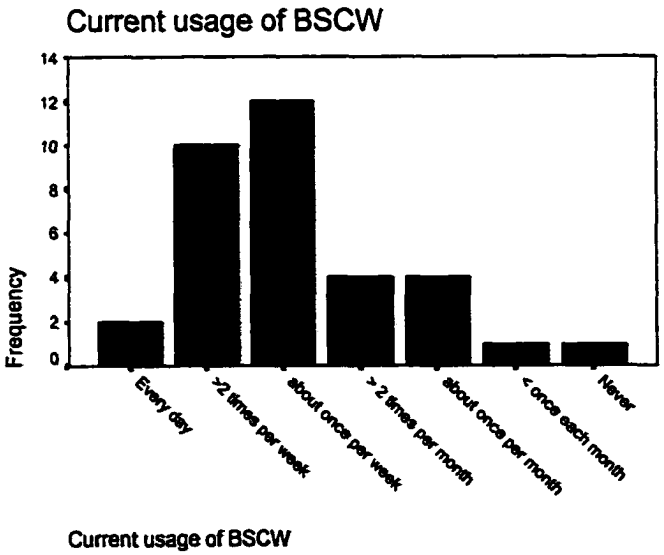


Figure 9: Expected use of BSCW over the next year (Quantitative study, n=34)

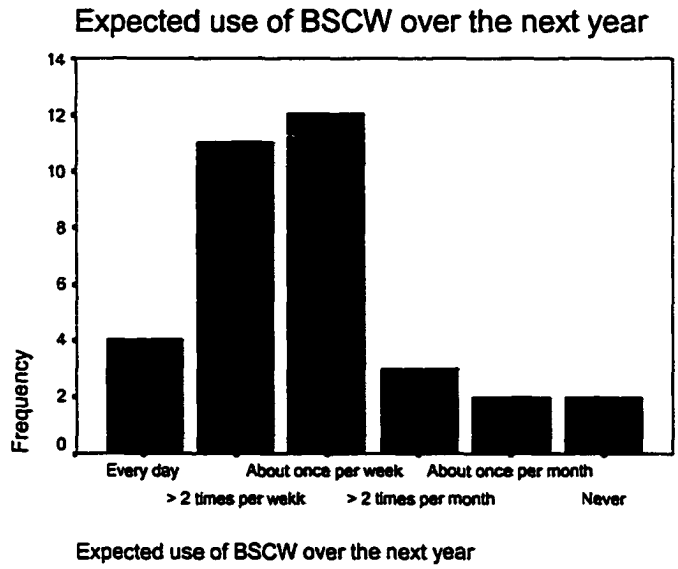


Figure 10: Number of people respondents communicate with using BSCW on a weekly basis (Quantitative study, n=34)

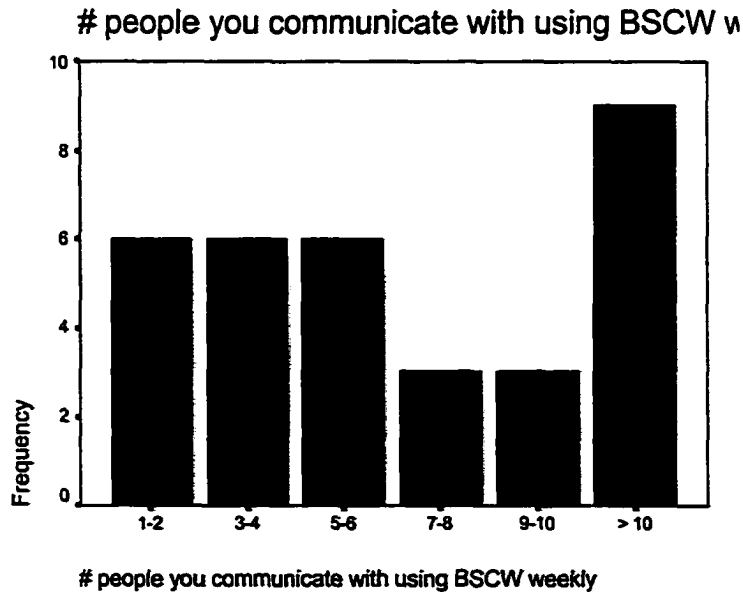
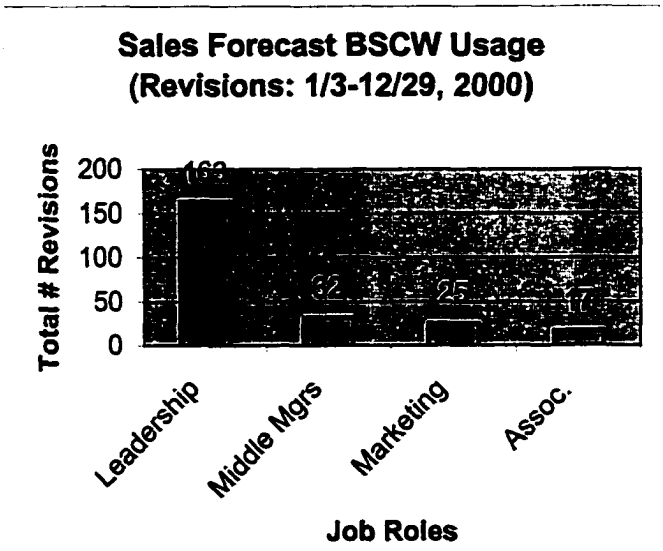


Figure 11 shows the usage of BSCW in terms of revisions to the "Sales Forecast" shared folder for each of the major groups of users.

Figure 11: BSCW Usage: Sales Forecast, January 3 – December 29, 2000



PHASE II: QUALITATIVE RESEARCH

A total of 30 BSCW users were interviewed at this company over a 3-month period (October – December, 2000). Each person was asked the same set of questions (Appendix B) relating to the study research questions and hypotheses. Everyone was encouraged to give their open and honest responses regarding their attitudes and opinions on each topic. It should be noted that this is referred to as a "qualitative" research approach because it involved an interpretive, naturalistic approach, As such, the users were interviewed in their natural work setting and drew upon their personal and professional experiences in the in-depth interviews. The data were coded by the researcher and the codes were checked by an objective participant to validate the coding

reliability. A total of 30 users were interviewed so that the data could be further manipulated using statistical methods. Therefore, while there are references to qualitative data results in SPSS, this simply refers to the analysis of the coded responses using the statistical software package SPSS. The heart of the qualitative responses lie in the rich in-depth interview quotes which follow each subsection in this chapter.

PHASE III: QUANTITATIVE RESEARCH

A total of 47 web-based surveys (Appendix C) were sent via e-mail to the entire population of BSCW users. The Likert-scale questions were based on the emergent themes from the results of the qualitative study.

Following the demographic data, the results presented below are organized by hypothesis for consistency with the study model. Thus, results from both the qualitative and quantitative studies are presented under each category.

Demographic Data.

Figures 12a and b indicate that there respondents were equally represented by gender. Respondent ages were somewhat normally distributed as shown in figures 13 a and b.

Figure 12 a: Gender (Qualitative Study, n=30)

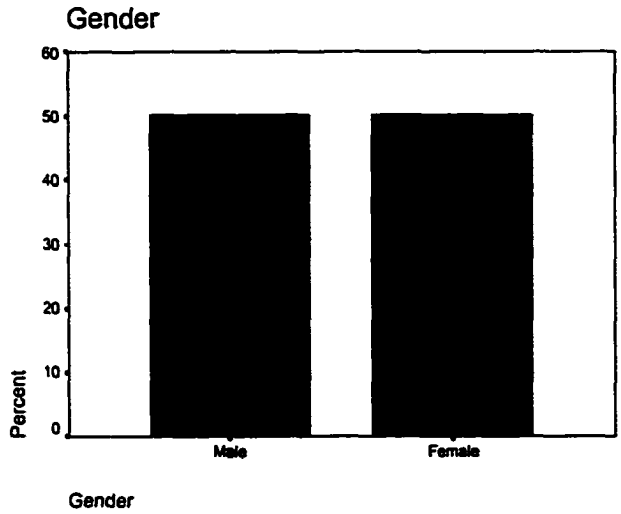


Figure 12b: Gender (Quantitative Study, n=34)

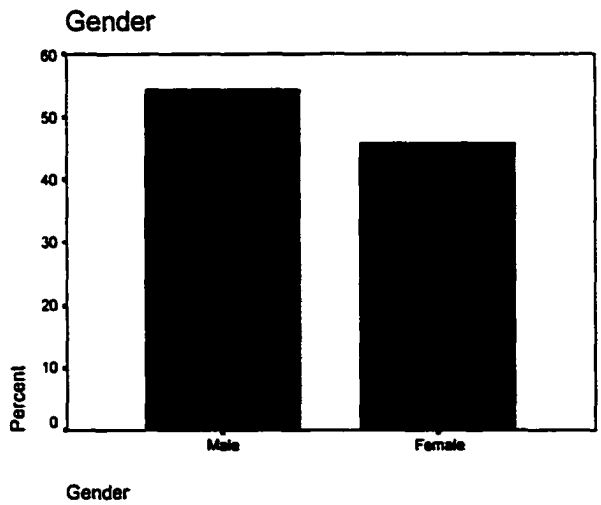


Figure 13a: Age Distribution: Qualitative Study (n=30)

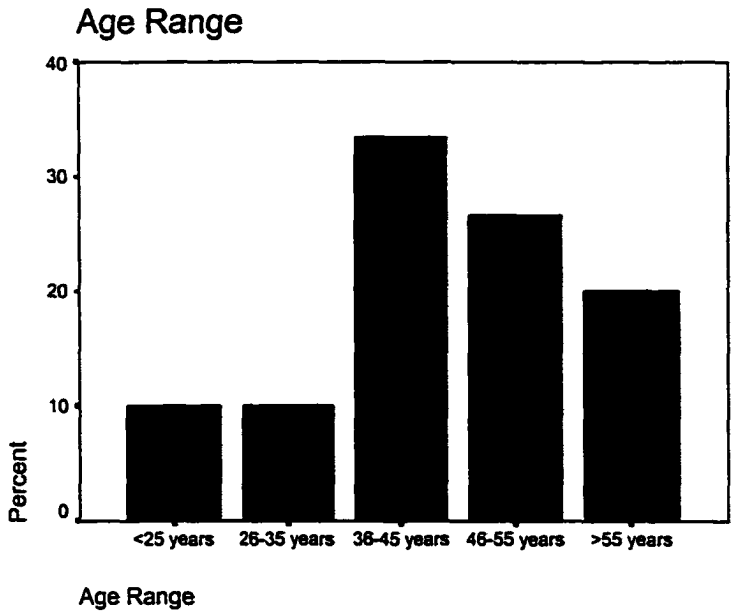
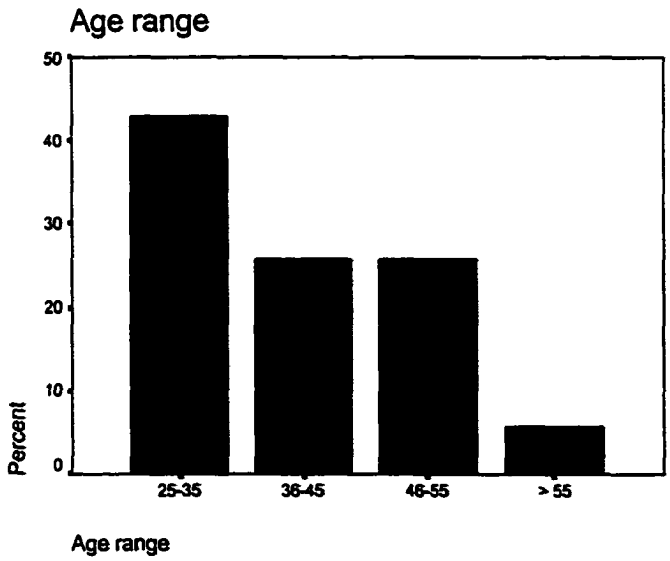


Figure 13b: Age Distribution: Quantitative Study (n=34)



Consolidated Results

The questions asked during the interviews attempted to elicit responses regarding attitudes towards the variables associated with the research questions and hypotheses. The following results show the four major variables together.

Primary Research Question:

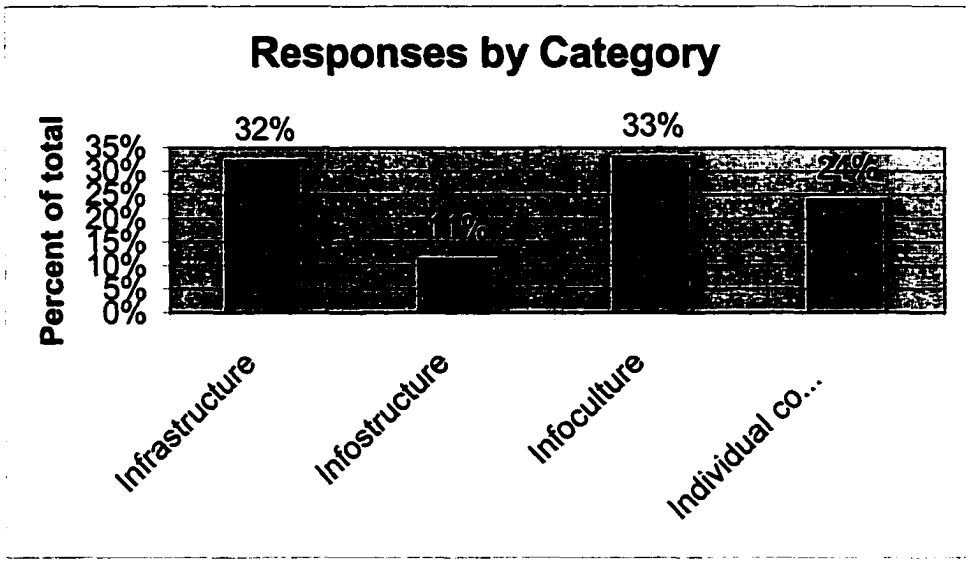
3. Which of the variables involved with a.) infrastructure, b.) infostructure, c.) infoculture, and d.) individual concerns exert an influence (positive or negative) on the effective use of a CSCW technology and knowledge sharing and in what ways do they exert their influence?

Secondary Research Question:

4. How does the use of a CSCW technology to facilitate knowledge sharing influence performance dimensions such as time, process improvement, and innovation?

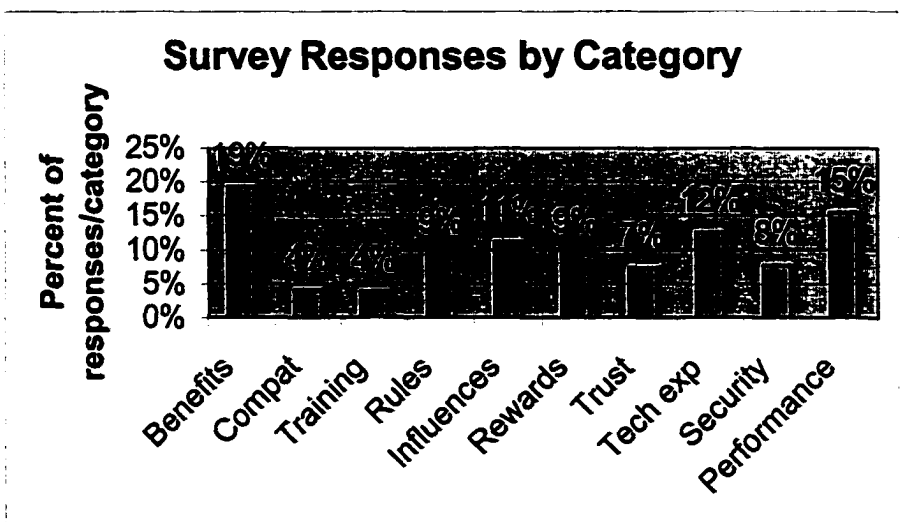
Figure 14 shows the total number of responses for each major variable in the qualitative study. It may be inferred that the number of responses correlates with how strongly people felt about each topic as they would tend to elaborate more on topics of interest to them.

Figure 14: Total responses for major variables (Qualitative Study, n=30)



Similarly, Figure15 shows a summary of total responses in the qualitative study for the sub-components of each of the major variables (a. Infrastructure: Benefits, Compatibility, Training, b. Infostructure: Rules, c. Infoculture: Influences, Rewards, Trust, d. Individual Concerns: Technology experience, Security concerns) as well as perceived performance improvement benefits.

Figure15: Total Responses for Sub-Variables (Qualitative Study, n=30)



A regression analysis of the four major independent variables in the qualitative study showed a statistically significant relationship as shown in Table 3. There were no statistically significant results in the comparable analysis for the quantitative study.

Table 3: Regression Analysis for BSCW Usage vs. Major Study Variables (Qualitative Study, n=30)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.652	.426	.334	3.7413

a Predictors: (Constant), Individual concerns: computer experience, attitudes, security, Infrastructure: Relative advantage, compatibility, & training, Infoculture: leadership, rewards/incentives, peer influence, & trust/communication, Total responses for rules- mgt of information

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	259.312	4	64.828	4.631	.006
	Residual	349.931	25	13.997		
	Total	609.243	29			

a Predictors: (Constant), Individual concerns: computer experience, attitudes, security, Infrastructure: Relative advantage, compatibility, & training, Infoculture: leadership, rewards/incentives, peer influence, & trust/communication, Total responses for rules- mgt of information

b Dependent Variable: Average usage per day per person

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	-2.184	3.023		-.722	.477			
	Infrastructure: Relative advantage, compatibility, & training	1.120	.357	.489	3.138	.004	.527	.532	.476
	Total responses for rules- mgt of information	-1.388	.905	-.256	-1.534	.138	-.202	-.293	-.232
	Infoculture: leadership, rewards/incentives, peer influence, & trust/communication	.924	.448	.339	2.061	.050	.299	.381	.312
	Individual concerns: computer experience, attitudes, security	-.505	.509	-.161	-.992	.330	-.088	-.195	-.150

a Dependent Variable: Average usage per day per person

The regression analysis shows that the Infrastructure variable showed the greatest correlation in the part and partial correlation analysis.

To verify this, a correlation analysis (Table 4) between the four major variables of interest and average BSCW use per day per person was run for the qualitative data. Again, Infrastructure showed a significant correlation with usage at the 0.01 level. There were no significant results for the corresponding correlation analysis for the quantitative study.

Table 4: Correlation Analyses: Major Independent Variables (Qualitative Study, n=30)

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

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

However, these results must be viewed with some caution. When examining the alpha reliability coefficients and the factor analyses for both the qualitative and the quantitative studies, several of the variables do not appear to correlate well together. Therefore, the results from the individual subcomponents may provide more meaningful results than from the consolidated variables (infrastructure, infostructure, infoculture and individual concerns. Tables 5-8 present these results. In addition, regression analyses were run to compare the dependent variable (BSCW usage) with the four major variables as well as job roles to assess whether the leadership group perceived these four factors differently than middle managers, marketing managers, Quality Assurance associates and data entry

associates. When adding the job role dimension to the regression analysis, no differences were found, suggesting that job role may not be a significant moderating variable in this study model.

Table 5: Alpha Reliability Analysis (Qualitative Study, N=30)

Variables & components	Alpha	Standardized Item Alpha
Infrastructure: relative advantage, training/time/compatibility	.3788	.4354
Infostructure: information management, recency/relevancy of information	-.7231	-.6967
Infoculture: influence on use, trust/communication, rewards/compensation.	.3572	.3911
Individual Concerns: security concerns, technology experience, attitudes	.2488	.2582

Table 6: Alpha Reliability Analysis (Quantitative Study, N=34)

Variables & components	Alpha	Standardized Item Alpha
Infrastructure: relative advantage, training/time/compatibility	.1057	.1568
Infostructure: information management, recency/relevancy of information	.4983	.4758
Infoculture: influence on use, trust/communication, rewards/compensation.	.5690	.5526
Individual Concerns: security concerns, technology experience, attitudes	.8238	.8556

Table 7: Factor Analysis (Qualitative Study, n=30)

a. Infrastructure: relative advantage, training/time/compatibility

Component Matrix

	Component
	1
Total responses for perceived benefits/ relative advantage	.799
Total responses for problems with BSCW	.799

Extraction Method: Principal Component Analysis.
a 1 components extracted.

b. Infostructure: information management, recency/relevancy of information

Communalities

	Initial	Extraction
Information input should be routine	1.000	.220
Self managed- controlled by invitation process	1.000	.774
Managed by IS department	1.000	.722
Training needed	1.000	.600
Driven by dept/project needs	1.000	.606
Requires managers to oversee information input	1.000	.560

Extraction Method: Principal Component Analysis.

c. Infoculture: influence on use, trust/communication, rewards/compensation

Communalities

	Initial	Extraction
Total responses for influences on use	1.000	.477
Total responses on rewards/incentives	1.000	.432
Total responses for trust, communication	1.000	.444

Extraction Method: Principal Component Analysis.

d. Individual Concerns: security concerns, technology experience, attitudes

Communalities

	Initial	Extraction
Total responses for prior technology experience	1.000	.574
Total responses for security concerns	1.000	.574

Extraction Method: Principal Component Analysis.

Table 8: Factor Analysis (Quantitative Study, n=34)

a. Infrastructure: relative advantage, training/time/compatibility

Communalities

	Initial	Extraction
Average Benefits- Relative Advantage	1.000	.843
Average Compatibility	1.000	.811
Average Training & Time	1.000	.763

Extraction Method: Principal Component Analysis.

b. Infostructure: information management, recency/relevancy of information

Communalities

	Initial	Extraction
Managers in charge of info mgmt	1.000	.167
IT dept should manage info	1.000	.652
Info input routinely	1.000	.779
Input info as needed	1.000	.934
Training needed on info mgmt	1.000	.678

Extraction Method: Principal Component Analysis.

c. Infoculture: influence on use, trust/communication, rewards/compensation

Communalities

	Initial	Extraction
Average Leadership Influence	1.000	.801
Average of Rewards, Incentives	1.000	.843
Average Trust/Communication only within the company	1.000	6.323E-02

Extraction Method: Principal Component Analysis.

d. Individual Concerns: security concerns, technology experience, attitudes

Communalities

	Initial	Extraction
Average Security Concerns	1.000	.578
Average negative attitudes towards technology	1.000	.642
Average positive attitudes towards technology & knowledge sharing	1.000	.785
Average Computer Experience	1.000	.788

Extraction Method: Principal Component Analysis.

Infrastructure

H1: Elements involved with Infrastructure will positively contribute to the continued and effective use of a CSCW technology and knowledge-sharing.

As shown in Table 4 above, there was a significant correlation between average BSCW usage per person per day and the Infrastructure variable. The following sub-variables explore the components of Infrastructure.

4. $H_{1.1}$: Technology that fulfills a need for the user and is perceived as providing clear benefits (high **relative advantage**) and value over existing substitute tools (such as e-mail, telephone, fax, etc) will positively contribute to the continued and effective use of a CSCW technology and knowledge sharing.

Table 9 shows the qualitative correlation analysis results for average BSCW usage per person per day with the major sub-elements of Infrastructure.

Table 9: Correlation Analysis -Sub-Elements of Infrastructure (Qualitative Study, n=30)

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

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

The correlation analysis from the quantitative survey did not show any statistically significant relationships between usage and infrastructure, but did show correlations with perceived performance improvement potential:

Table 10 shows the correlation of the specific benefits associated with relative advantage in the qualitative study while Table 11 shows the equivalent correlation analysis for the quantitative study.

Table 10: Correlation Analysis: BSCW Usage vs. Elements of Relative Advantage (Qualitative Study, n=30)

Independent Variables	Avg. BSCW Use/Person/Day	Performance Improvements
Accessibility	.05	.08
Sharability- Internal	.201	-.02
Sharability- External	-.152	.076
Saves Time	.242	.305
Improves Quality	.378*	.197
Improves Decision-Making	-.102	.007
Improves Customer Satisfaction	.595**	.010
Versions	.147	.241
Accountability	.273	-.099
Resource Management	.291	-.068

** Correlation is significant at the 0.01 level (1-tailed).
* Correlation is significant at the 0.05 level (1-tailed).

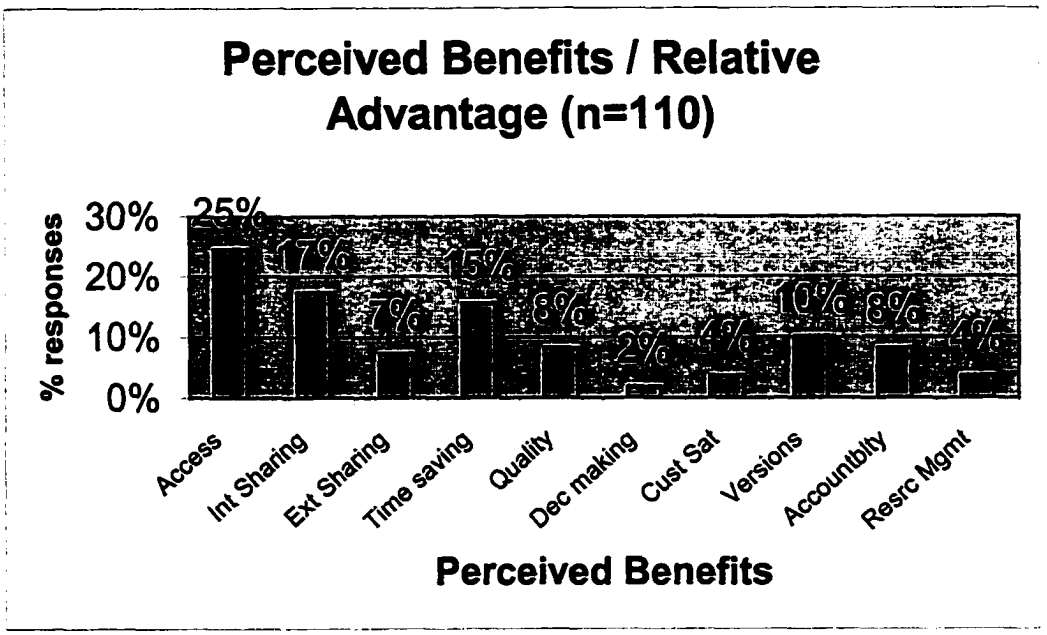
Table 11: Correlation Analysis: BSCW Usage vs. Elements of Relative Advantage (Quantitative Study, n=34)

Independent Variables	Avg. BSCW Use/Person/Day
Accessibility	-.121
Sharability- Internal	-.016
Sharability- External	-.096
Saves Time	-.149
Improves Quality	.037
Improves Decision-Making	-.071
Improves Customer Satisfaction	-.139
Versions	-.355*

** Correlation is significant at the 0.01 level (1-tailed).
* Correlation is significant at the 0.05 level (1-tailed).

Figure 16 (Perceived Benefits/Relative Advantage) shows the frequency distribution of perceived benefits from using BSCW.

Figure 16: Perceived Relative Advantage (Qualitative Study, n=30)



Because these represent interview responses, most people had multiple responses. Thus, for each variable, n is different, reflecting the total number of responses from the 30 respondents for each question. Accessibility was cited as the major benefit (25%) in using BSCW. Accessibility is defined as the ability to access information or knowledge at any time (24 hours per day, 7 days per week), from any location around the world as long as the user has access to an Internet connection. The importance of this can be seen in several representative quotes from respondents.

"I can be in any location, as long as you're on the net and it's loaded up, you can go out and deal with it on my terms, my time, rather than somebody else's."

"The real benefit of using BSCW is that it allows the client to have access to it 24 hours a day. It's important to us in some respects because we work with clients that are spread out all over the United States and even in Europe. So, if someone can access that without any special mechanisms, like having to dial long distance across the ocean or worry about a time zone difference. If they log on, and get on the web, they can access that document, download it themselves, make changes in the document when they're at work and you may not be and then upload it, when you come in the next day, the thing is freshly uploaded and you've got something where changes have been made."

"I mean, I can change something on the European side and somebody can change it here simultaneously and then when my data was reintegrated into the US, one of us would lose, depending on who had control of it last. And since I have to present weekly updates of budget and sales and staff turnover, staff mix, you know, all the general management data, we looked extensively for a way to share that data easily. It allows me to access data wherever I am in the world and to update it in real time and then give others here at the corporate headquarters access to that data. And it gives me access to stuff that I'm working on here at home as well as on the road. So when I'm on the road, it's not uncommon for me to work on a proposal in the US that's actually going to be delivered in Europe and when I come to the US, I can usually try and put in a visit as well as working here at the headquarters. I can take my laptop and take my data no matter what country I'm in and work on it and put it back up there for me for the next time that I'm someplace else without carrying a lot of fragile electronic data."

"I like the access. I like being able to pull it up here. I like being able to pull it up at home. I like that whenever a manager has a moment, they can put some information out there and whenever I have a moment, I can retrieve it, so we're not having to chase each other down, play phone tag. So, I like the access."

The ability to share information or knowledge, termed "Sharability" was examined as (a) "internal Sharability": the ability to share information with multiple inside the organization while "external sharability" was the ability to share information with multiple people both inside or outside the organization. Several quotes that demonstrate user perceptions include:

"When you've got multiple business units, multiple people contributing, trying to get it all into one document, it's a chore and that's where something like BSCW will allow people to contribute and it's all in a central place, so again, if it's all centralized in one place and contributed by the people who need to contribute to it, it saves time and energy in that respect. It's saved I'd say about a third of the time as before."

"We're actually starting to use that with quotations to clients because we can involve a quotation in certain comments and we can go back and forth on comments about what we think is correct or incorrect or where we have disagreements. We can exchange that pretty readily and we can access it from home or here. And a lot of managers now are doing a lot of work at home, so it helps out a lot."

Time-savings was another benefit that was quoted as very important as demonstrated by the following quotes:

"It cuts down on the number of meetings that we need to have a great deal because we can take care of a lot of business just over the network instead of having everyone come in and meet and go over stuff. It saves a lot of time."

"And it's the time saver again. It eliminates using the phone- hey Joe- what did you do? Are you going to respond to this? A lot of people are in and out and by making sure that everyone is cognizant- this has been put out, this is the audit, it's in BSCW, please take care of the items, etc., it does save and brings all the information together in one document and really all that needs to be done then is just dress it up to make it look nice."

Quality was inferred as improving processes; as demonstrated by the following quotes:

"Responses involve a team effort. And 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 and everybody- you can insert comments into a program like an excel or a word program that are not printed out."

"As an internal tool, as I said. if you see the same comment over and over and over again, that's helpful. Whereas if we didn't have it, all these different clients would come through with different reports. You'd see one, you'd address it, and go on and you'd never think about it again and this is a way to summarize as time goes on what clients are concerned about. Quality is the whole intent of it so we can see if the same thing is coming up."

Finally, versions and accountability were perceived as important benefits of the system as shown by the following quotes:

"I like the version piece that keeps track of a historical version because there's been times that I want to go back and look at something and compare month to month, quarter to quarter, year to year and I don't have to keep track of that. I can look at it by date."

"The version capability is quite helpful, You can essentially put the documents up there and then as you modify one, it leaves the version that was previous to it behind and shows that whatever version- however many times that document's been modified. Another good reason to have version control is that if something happens to the current version; if it's somehow corrupted or lost, or damaged, you have a previous version to fall back on."

"Well, it's time, accountability, because you can see when people have been there, if they haven't updated it, you can say it's been 2 weeks- why is that? Where you wouldn't be able to view that otherwise. So, time savings, accountability, and just good, solid communication as opposed to wondering what version is this and trying to communicate by interoffice mail... just having it all in one place- the time savings, the quality of the communication and the accountability are, in my opinion, the 3 biggest things. The accountability - don't underestimate that. Because having the ability to - if somebody knows they're responsible to visit that site and update it weekly, and they know that there's a way that we can see whether or not they've been there weekly, that's a big force. You can see exactly when they're there, how long and all that type of stuff."

In terms of the quantitative study, Table 12 shows respondent's perceptions of how each element of relative advantage influenced their use of BSCW.

Table 12: Components of Relative Advantage & It's Influence on BSCW Use (Quantitative Study, n=34)

Component of Relative Advantage	Cumulative Valid Percentage of "influenced or strongly influenced BSCW use"
Accessibility	87%
Sharing info inside company	83%
Sharing info outside company	50%
Versions	73%
Time-savings	36%
Improving performance, quality	63%
Better decision-making	77%
Improved client responsiveness	52%

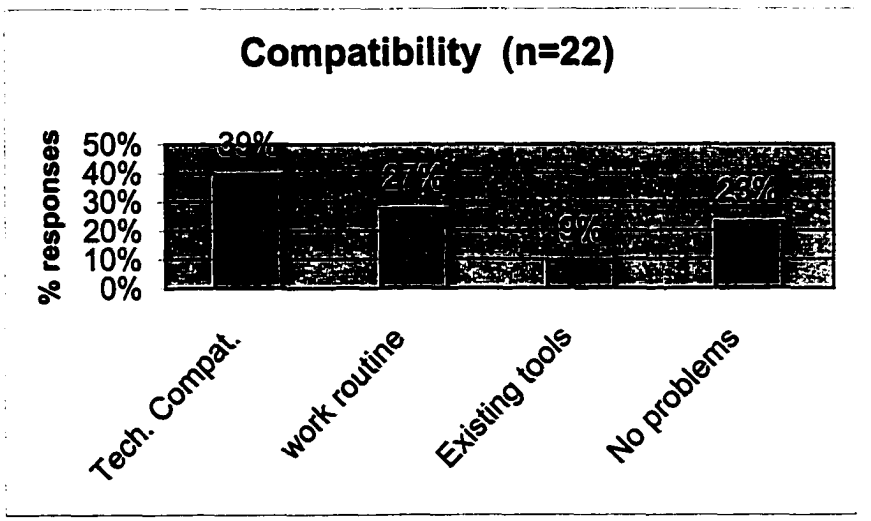
It was interesting to observe the differences in responses between the qualitative and quantitative studies. The major difference among them in relative advantage was the low percent attributed to the influence of time-savings in the quantitative study vs. the strong

emphasis on this element in the qualitative study. This may be attributed to the wording of the question in the quantitative study.

5. $H_{1.2}$: Technology that is user-friendly and matches pre-existing work processes; e.g. possesses high **compatibility** (the technology must be perceived as compatible with existing work routines and easy to use as well as compatible with technological requirements of the system) will positively contribute to the continued and effective use of a CSCW technology and knowledge sharing.

Figure 17 shows the frequency distribution of responses from the qualitative study.

Figure 17: Responses on issues of compatibility of BSCW with normal work routines (Qualitative Study, n=30)



The following quotes from the qualitative study serve to illustrate several issues that respondents found important regarding the issues of comp ability in terms of their use of BSCW.

"Because we're such as paper-driven environment that if it's not laying there in front of you, you kind of forget about it. I think the biggest drawback is that we're not used to it. We're not used to using it as an open communication. You're not used to having- you

know, if you're used to sending notes back and forth to someone, you have that physical presence to remind you that you're supposed to go talk to so and so."

"Some of our individuals actually review on paper the hard data; an original observation of what when on. That's their focus- is to make sure all that is correct. So, working in a computer media environment is not applicable to what they are associated with."

"Well, I'm in a mac environment and so we are problematic because we're Macintosh users. And that's really been a hard thing because we try to integrate different infrastructures. And we're still not perfect. Sometimes I go in there and I'm able to download a document so that it's not gobbldy-gook and sometimes it is gobbldy-gook. Pc and Mac platforms problems."

"There were technical problems. It was difficult to upload the files and it did not work with the computer at work. Technically, it did not appear to be compatible though it did work with my computer at home. Also, I don't think the committee members understood the system and thought the data was just out on the Internet for anyone to see."

"I think it's particularly challenging for some people who don't work particularly well with electronic documents. Some people need to have something tangible that they can see and write on. Other people around here really respond well to electronic documents because it's not another thing stacked on their desk. I don't even think that it's an age or generation issue. I just think that it's a personality type."

Results from the quantitative study showed the following frequency distributions

regarding the issues of compatibility.

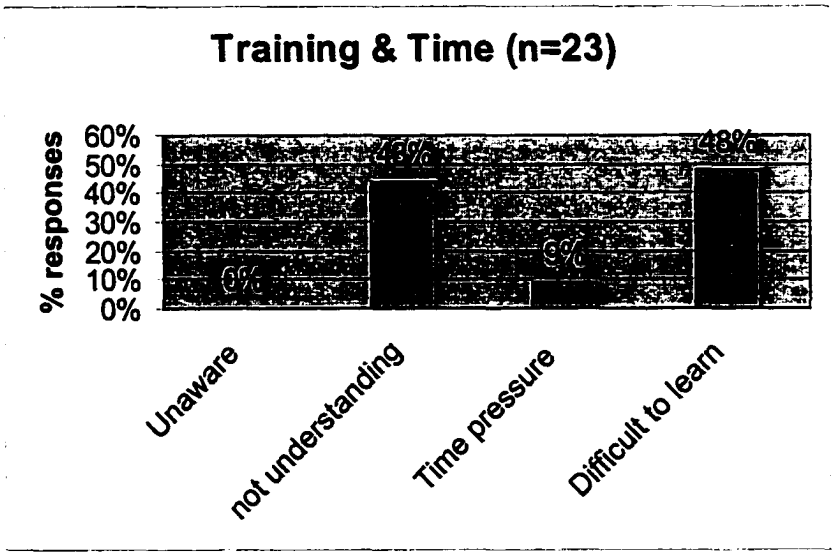
Table 13: Components of Compatibility: It's Influence on BSCW Use (Quantitative Study, n=34)

Component of Compatibility	Cumulative Valid Percentage
Technical hardware compatibility problems	80%: did NOT influence use
Software compatibility problems	53%: did NOT influence use 33%: did influence use
Compatibility with normal work routines	50%: did influence use
Preference for existing tools	37%: did NOT influence use 33%: did influence use

6. $H_{1.3}$: When users perceive there is adequate training and time to learn the system, this will positively contribute to the continued and effective use of a CSCW technology and knowledge sharing.

Figure 18 shows the frequency distribution relating to training/time responses in the qualitative study.

Figure 18: Responses on issues of training and time influencing BSCW use (Qualitative Study, n=30)



The following quotes from the qualitative study serve to illustrate several issues that respondents found important regarding the issues of training or time and their use of BSCW.

"You need to have a direct application, see some value. To anybody who is very busy in their workday, they got to see some immediate payback or else they're not going to mess with it. But, the learning curve seemed kind of steep at first."

"It's major quirks stem around making sure that you understand the metaphors of the icons. The other problems with the program are basically the ...explaining the philosophy of what it actually does to people who have never used it before."

"Well, initially, finding my way around it was somewhat difficult and sometimes- it's probably because it's a little bit hard to sometimes - it's not quite as user friendly as some programs are, so you have say - "oh yeah- I forgot- you have to do that first".

"That was my biggest opinion about it. It takes an awful lot of time. I know that it's meant to be usable over the Internet so we can use it at home if we want to or on the road and all that but there's got to be an easier way of keeping track of this thing because especially when you first start using it, it's really clumsy. Training would have helped."

In terms of correlation and regression analyses, there were no statistically significant findings related to either compatibility or training/time for either the qualitative or quantitative studies.

Results from the quantitative study showed the following frequency distributions regarding the issues of training and time.

Table 14: Components of Training/Time: It's Influence on BSCW Use (Quantitative Study, n=34)

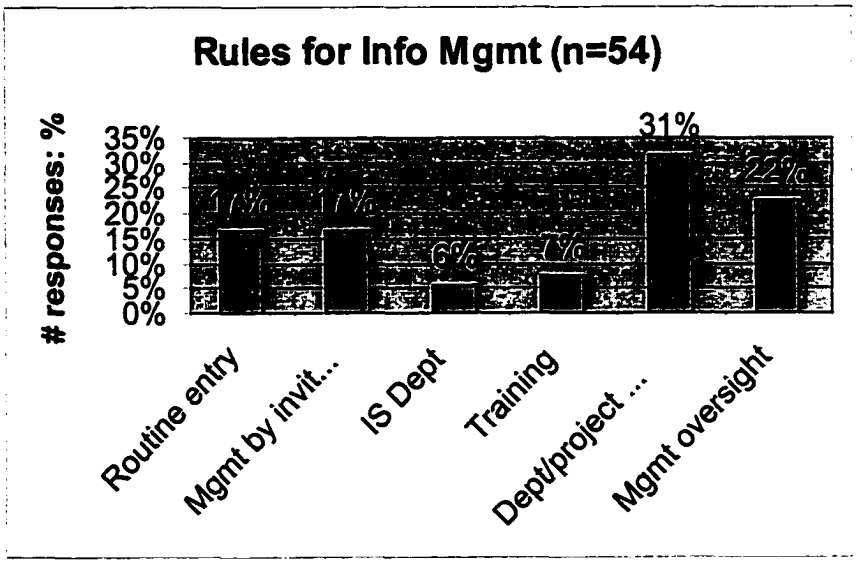
Component of Training/Time	Cumulative Valid Percentage
Difficult to learn BSCW	67%: did NOT influence use
Lack of time	70%: did NOT influence use
Easy to use inside company	60%: DID influence use
Difficult to use outside of company	46%: did NOT influence use 35%: did influence use

Infostructure

H2: Elements involved with Infostructure will positively contribute to the continued and effective use of a CSCW technology and knowledge-sharing.

In the qualitative study, respondents were asked whether and how a system like BSCW should be managed to ensure the recency and relevancy of the information/knowledge contained within it. Figure 19 shows a summary frequency distribution of the responses to this question.

Figure 19: Summary of responses regarding rules for information management (Qualitative Study, n=30)



The issues of information management to ensure recency and relevancy were explored in the "Management oversight" and "IS Dept" categories whereas the actual rules governing the use of the system were shown in the categories: "Routine entry", "Mgmt by invitation", "Training", and Dept/project needs".

3. $H_{2.1}$: When there is clear ownership of the CSCW system where the information is managed for recency, relevancy, and security as perceived by the users, this will positively contribute to the continued and effective use of a CSCW technology and knowledge sharing.

The issue of information management for recency and relevancy can be understood by some of the respondent comments as illustrated by the following quotes:

"I just go in, check and see if it's all updated and then if somebody is behind, and (President/CEO) needs the updates, I'll call and say have you been on BSCW lately or have you just forgot to update?"

"I think it's relevant in whether the information is recent. Generally, since it's the forecast, it's better than a budget number, even though that forecast number may have only been updated a month ago."

"I think it depends on the individual. It's like- oh- this is just another part in the step in this process- entering information. Other people- it seems like such a minor detail, but the sharing of the information is so needed, it's getting in the habit as training and making it a part of the procedure instead of supplemental- sometimes you do it and sometimes you don't."

"If you don't have real recent information, you're really nowhere because you look like you've been in some backwater out of the loop." (Marketing)

"The thing that BSCW does for the company is that it allows (President/CEO) to take fresh numbers to his meetings so he has up to date information and he doesn't have to track us down."

"In the long run, the CEO and the CFO are the ones that are really wanting the information and if you haven't been into the documents, they'll let you know!"

"It's really the managers and everything- it's their responsibility to keep the forecast updated and so, we have to get our information from the people who work for us directly and we usually have a good handle on what's going on."

In the quantitative study, Table 15 shows the frequency distributions regarding the issues of information management for recency and relevancy.

Table 15: Components of Information management: It's Influence on BSCW Use (Quantitative Study, n=34)

Component of Information Management	Cumulative Valid Percentage
Managers should be in charge of information management	60%: DID agree
IT dept should manage information	73%: did NOT agree

There were no statistically significant differences found in the correlation or regression analyses to support this hypothesis.

4. H_{22}: When there are clear rules governing the use of the CSCW system as well as the knowledge and information to be shared as perceived by the users, this will positively contribute to the continued and effective use of a CSCW technology and knowledge sharing.

The issue of rules governing the use of the system can be understood by some of the respondent comments as illustrated by the following quotes:

"We are expected to input information for (President/CEO) when he needs it."

"It's not a daily routine, but whenever I need it, I know how to do it and it's pretty quick recovery. You learn your path and you pretty much just follow that."

"It's not a good idea to just take a list of files you might have and put them out there for who you think you can see them because you have to clear them with the person who's in charge of those documents. You might think there's not a problem, but you should always check with the person that's ultimately responsible to make sure that you're fulfilling what they want to do."

"There are 2 sets of rules. There are rules that BSCW sets up in terms of who you invite to a particular document. And there are the unwritten rules, the etiquette rules, are how people would use it, when they would use it, for what information. Other rules as far as not deleting, when to lock out the box and so on, depends on understanding."

"In terms of who gets to see what.... I may be the only person who recognizes people's reluctance to put things on there because they're not comfortable with the CEO seeing it."

"That's part of the inviting process. Maybe I have access to 10 different things. The CEO might have 30 and people below me might have two. So, it depends on what information you want out of it."

In the quantitative study, Table 16 shows the frequency distributions regarding the issues of information management for recency and relevancy.

Table16: Components of Rules for Information Management: It's Influence on BSCW Use (Quantitative Study, n=34)

Component of Rules	Cumulative Valid Percentage
Information should be input routinely	40%: DID agree 33% did NOT agree
Information should be input as needed; per project or dept requirements	60%: DID agree
Training needed on information management; how & when to input information	83%: DID agree

There were no statistically significant differences found in the correlation or regression analyses to support this hypothesis.

Infoculture

H3: Elements involved with Infoculture will positively contribute to the continued and effective use of a CSCW technology and knowledge-sharing.

5. $H_{3.1:}$ Proactive participatory leadership who are actively involved, committed to and supportive of BSCW and knowledge sharing including their pro-active change agents will positively contribute to the continued and effective use of a CSCW technology and knowledge sharing.

The issue of leadership influencing the use of the system and knowledge sharing can be understood by some of the respondent comments as illustrated by the following quotes:

"(President/CEO). 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."

"I think everybody is doing a good job in putting their data forward, so, and it's requested by the CEO, so of course, you know, you do that."

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

"(President/CEO). It just takes a learning experience, but once you learn the benefits of it, it becomes pretty fast. The more you become familiar with it, it becomes easier and quicker to do things with it. It's an easier way for my boss to figure out that I'm working on these things and making recent updates to things so that if he wanted to, he could verify that I'm actually am productive for the company."

"Oh absolutely- our CEO. He initiated that that was what we would use. Based on his experience, he picked the product that we would use."

"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."

"Well, I think it started with (President/CEO) and then he passed it on to (Vice President), the VP, so he's disseminated all the information to the program managers and that's how it came down."

"(President/CEO) let it be known that he expected the numbers to be fresh and when they weren't fresh, he would be sure and point that out to you."

"(Manager) said "We're going to put this on- put your stuff in it!"

"(President/CEO) I pretty much had to hold people's feet to the fire to make them use it, where we had to help them because they naturally assumed that this was more difficult than it was, and with anything that's new, there are some impediments initially. But we've gone from helping people over those thresholds of resistance to where we're getting people complaining- "how come I'm not on BSCW?"

"(President/CEO) had indicated that in the future they wanted to go an electronic means and then myself and (Vice President) a couple of others put this together and it evolved to what it is now. But yeah, definitely, (President/CEO) for the most part."

"I would say (VP) and (President/CEO)."

There were no statistically significant differences found in the correlation or regression analyses to support this hypothesis.

6. $H_{3.3}$: Peer influence (opinion leaders) within social networks that support the use of BSCW and knowledge sharing will positively contribute to the continued and effective use of a CSCW technology and knowledge sharing.

The issue of peer influence on the use of the system and knowledge sharing can be understood by some of the respondent comments as illustrated by the following quotes:

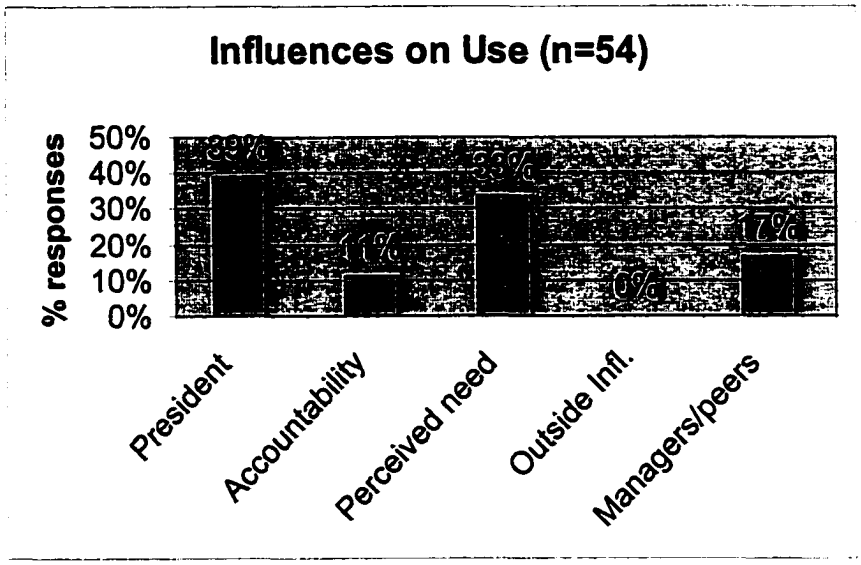
"Also, success breeds success. There wouldn't be too many people using it if they heard horror stories about it."

"It was group discussion- let's do it. This seems to be a good way of putting it together. I think we're the only group within the company that uses it because we get audited on a routine basis- more than some of the other groups."

There were no statistically significant differences found in the correlation or regression analyses to support this hypothesis.

In the qualitative study, respondents were asked who influenced their use of BSCW and their willingness to share information and knowledge. Figure 20 shows a summary frequency distribution of the responses to this question.

Figure 20: Summary of responses regarding who exerts an influence on use of BSCW (Qualitative Study, n=30)



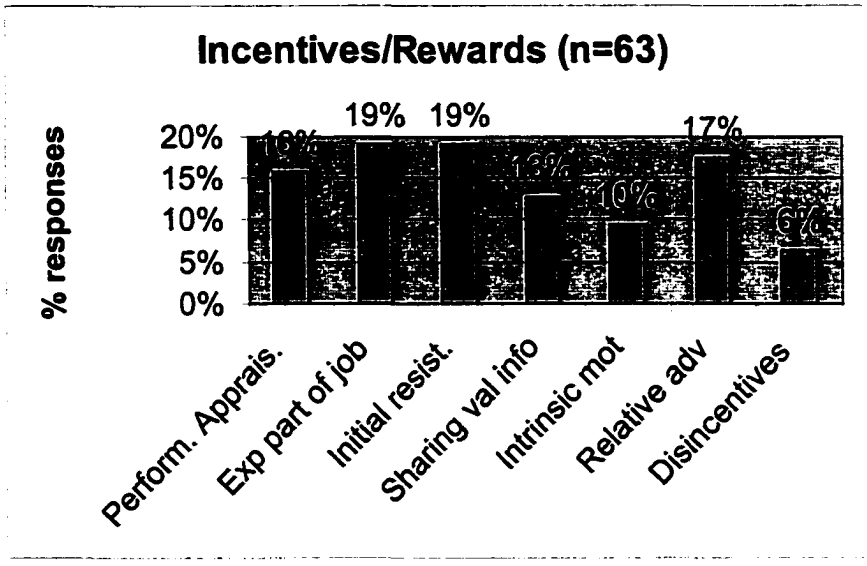
In the quantitative study, Table 17 shows the frequency distributions regarding the issues of who influenced respondent's use of BSCW.

Table17: Components of Influence on BSCW Use (Quantitative Study, n=34)

Component of Leadership	Cumulative Valid Percentage
President/CEO	70%: DID influence use
Managers	69%: DID influence use
Peers/Colleagues	40%: DID influence use 43% did NOT influence use
Self-motivated to share knowledge	73%: DID influence use
Perceived need/benefit in sharing	72%: DID influence use

7. $H_{3.2}$: Reward and compensation structures (motivations to share knowledge and use BSCW, what will it do for me?) as well as incentives to use BSCW and share knowledge will positively contribute to the continued and effective use of a CSCW technology and knowledge sharing.

Figure 21: Summary of responses regarding issues of reward structures or incentives on influencing BSCW use and sharing knowledge (Qualitative Study, n=30)



In a correlation analysis comparing the components of rewards and incentives with average BSCW usage, the intrinsic motivation to share knowledge had a significant correlation (.508**) with average BSCW use at the 0.01 level of significance (1-tailed).

The issue of rewards or incentive on the use of the system and knowledge sharing can be understood by some of the respondent comments as illustrated by the following quotes:

"It depends on how much the reward is. It's directly in proportion. Or how much the disincentive is. You know, a lot of things are driven by disincentive. So, if you don't go on the system, what's the disincentive associated with that? Probably more disincentive than incentives. In other words, (President/CEO)'s on there, (Vice President's) on there, and they expect you to be on there and be up to date."

"You know, incentives usually mean monetary or time when you're talking about a company and just about anybody is attracted, especially when its encourage you to do something that you already need to do or want to do. It's especially attractive- it allows you to find the time that you may not have had before."

"I think that an incentive system would help. I'm one for rewards or incentives and any time you say reward or incentive, dollar signs automatically pop up in the minds of many people. And I'm a big proponent to stopping and saying "you did a really good job by getting all that taken care of." Send them an e-mail, send a voice mail, see them in the hall and say "oh by the way, you did a really good job- thanks for doing that!" To me, that's an incentive; making you feel your self worth."

"Any time - anybody will take a bribe or a hint if there's money involved. I think that would help. You're always going to have people who are computer phobic. Or people say I don't have time for this and a lot of people resist change. That might be just the motivator for them to get in and actually play around with it and once they get over the uncomfortable and the unfamiliar, things that we all go through when we go through something new, that might be just the motivator to get them past that hump and realize hey- this is not so bad. I wouldn't see why rewards or incentives wouldn't get people motivated to use the system more effectively to share their knowledge. You can't watch everybody 100% of the time, so you've got to find ways to communicate that and hopefully reward them or give them incentives to make that effort."

"I think the performance evaluation would motivate people to use it. That's what motivated me to use it. I don't think cash or bonuses or incentives like that would be appropriate. I mean, that's - it should be part of their performance, part of their job. For the broad base of people using BSCW, I think the performance appraisal link would serve the same purpose."

"Some people do operate much better on a reward system- like a carrot dangling in front of us! It might give them the incentive to try it and then, maybe like a reward system for trying it and then they could decide whether it was something they wanted or not."

"The incentive would be if you don't want to be asked to update it, you get it done!"

"I don't think I would have any problem getting buy-in with my group here or the European group because it makes things easier."

"But most people are motivated by the almighty dollar. Maybe an extra day of vacation, some people may value their free time more than dollars, what ever it is. I think actually what they did was they had a list of things you could choose from; roughly the same dollar value. So the company didn't care which one you picked, but it depended on which one was more rewarding to you. And it was absolutely tied to their performance appraisal."

"I think if you push it at people, you've already lost that battle, so we don't advocate it in any way. They see it being used to great advantage by other people."

Therefore, based on the correlation analysis and many of the quotes, it appears that the perceived relative advantage gained from using the system and sharing knowledge exerts a significant influence on use. However, the quotes imply that rewards or incentives could be very effective in the initial willingness to try the system.

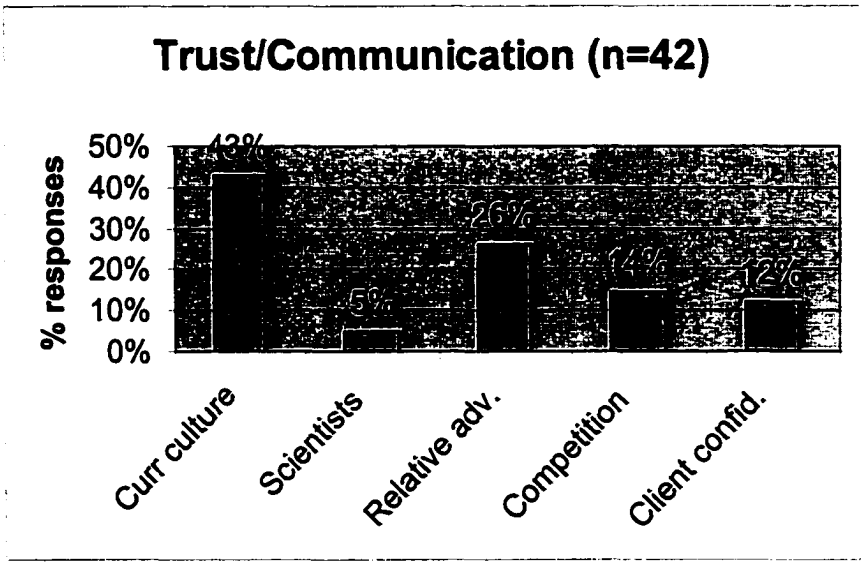
In the quantitative study, Table 18 shows the frequency distributions regarding the issues of rewards or incentive on the use of BSCW.

Table18: Components of Rewards/Incentive on BSCW Use (Quantitative Study, n=34)

Component of Rewards/Incentives	Cumulative Valid Percentage
Ties to performance appraisal	53%: DID influence use
Expected part of job	60%: DID influence use
Rewards/incentives for using system effectively and sharing knowledge	23%: DID influence use 63% did NOT influence use
Intrinsic motivation to help others by sharing knowledge	59%: DID influence use
Manager monitors use of system	40%: DID influence use 40%: did NOT influence use

8. $H_{3.4}$: Good working relationships: trust and good communication among associates, departments and functional areas will positively contribute to the continued and effective use of a CSCW technology and knowledge sharing.

Figure 22: Summary of responses for perceptions of trust and communication in the company and its influence on BSCW use and sharing knowledge (Qualitative Study, n=30)



In a correlation analysis comparing the components of trust and communication with average BSCW usage, perceived relative advantage in sharing information for the common good of the company had a significant correlation (.459**) with average BSCW use at the 0.01 level of significance (1-tailed).

The issue of trust and communication on the use of the system and knowledge sharing can be understood by some of the respondent comments as illustrated by the following quotes:

"Well, my attitude is different than a lot of people. Mine is to give it all away, make it available and useful to whoever can useful for whatever reason, but I don't feel that that's necessarily reciprocated. A lot of people feel that knowledge is power, so they're not going to give it away, but my feeling is why not? That's what it's there for."

"For the most part, trust is not a problem but in some divisions, there are concerns with trust because they overlap slightly in the type of work that they do. In those division, those people would be less likely to share information with their peers than in others. So, when you get into those types of instances, you're going to see a reluctance to share information. But where you see divisions collaborating with a client and each one has a

different section of the pie they're working on, then you see where collaboration can be very helpful and that's what I'm trying to foster and it seems to be working well. But any time you've got competition for the same resource between individuals or divisions, you're going to see a lack of trust in some respects. It's very hard to convince somebody whose performance is based on their sales that it's for the good of the whole company, but that's the way it is."

"At this point, we don't share information between divisions. Only that information that the CEO thinks that we need to see is available."

"I think we would share information. I mean, we do now. It could very well be a function of size as we're pretty small. . If someone has something to share, it's going to help the whole group. They'll share it - they're not going to keep it to themselves and be the guru because it only makes their job harder to be the guru. I mean, they're better off to train other people."

"My trust in the numbers are based on my experience with individuals."

"I think they do foster a good environment for thinkers if you're a personality type that's a thinker."

"We have been using the Internet increasingly every year to research, look up different current literature, so I think in that way, what we need to do is look more outside - on the Internet verse what we're internally putting on BSCW. I think what we're putting on BSCW we already know, and in order to increase efficiency and new service lines, and that sort of stuff, we probably need to look outside ourselves a little more. We can't put stuff on BSCW if we don't already know it unless we find something on the Internet and say - Oh _ I need to share this, so then you post it over here or usually, we just e-mail a link and say -look at this."

"I heard a story one time that said a chemist would rather share his toothbrush than his data!"

"I think that (President/CEO) definitely has that mission. He conveys many times that communication is very open and he wants it open and he wants everyone to put everything out on the table because it's a much easier and more efficient way to communicate and get things done. I think with BSCW, it gets everything out there, it identifies who said it, when they said it and you can attach priorities as well. So it's pretty clear and pretty open and I've never heard of someone not putting something on there because they didn't want somebody else to know about it."

In the quantitative study, Table 19 shows the frequency distributions regarding the issues of trust and communication on the use of BSCW while Table 20 shows the results of a

correlation analysis comparing the components of trust with BSCW usage and performance improvement.

Table 19: Components of Trust/Communication on BSCW Use (Quantitative Study, n=34)

Component of Trust/Communication	Cumulative Valid Percentage
Information should be shared within dept.	97%: DID agree
Information should be shared throughout co.	63%: DID agree
Information should be share outside company with clients, cooperators, etc.	50%: DID agree

Table 20: Correlation Analyses: Trust/Communication with BSCW Use and Performance Improvement (Quantitative Study, n=34)

IV's	Avg. Usage per day per person	Total responses: Performance Improvement
Self-motivated to share information	-.212	.480**
Perceived need/benefit in sharing information	.060	.414*

** Correlation is significant at the 0.01 level (1-tailed).
* Correlation is significant at the 0.05 level (1-tailed).

Individual Concerns

H4: Elements involved with Individual Concerns will contribute (positively or negatively) to the continued and effective use of a CSCW technology and knowledge-sharing.

4. $H_{4.1}$: Pre-existing positive knowledge, experiences and attitudes towards technologies, particularly a technology that is similar to a CSCW system, will positively contribute to the continued and effective use of a CSCW technology and knowledge sharing.

Figure 23: Summary of responses regarding prior technology experience and attitudes on influencing BSCW use and sharing knowledge (Qualitative Study, n=30)

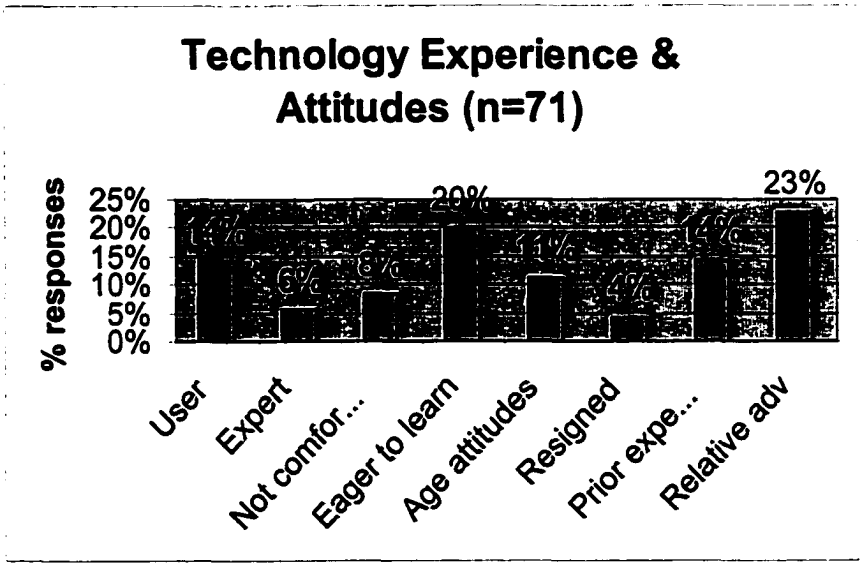


Figure 24: Summary of responses regarding prior experience with technology on BSCW use and knowledge sharing (Qualitative Study, n=30)

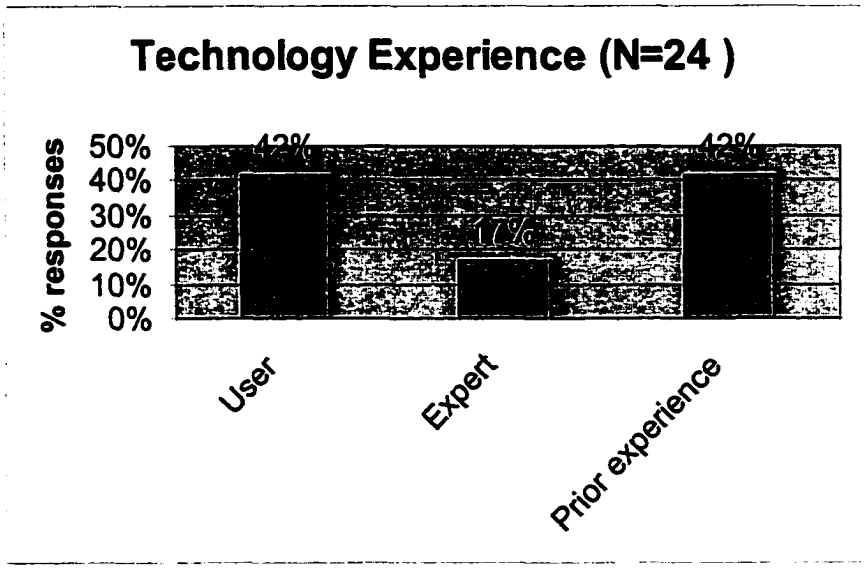


Table 21: Correlation Analyses: Computer Experience/Attitudes with BSCW Use and Performance Improvement (Qualitative study, n=30)

Independent Variables	Avg. Usage per day per person	Total responses: Performance Improvement
High level of expertise	.288	.481**
Resigned to changes, new technologies	-.104	-.435**
Perceived relative advantage of new technology	.424**	.028

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

It was interesting that a regression analysis of average daily BSCW usage vs. the positive components of technology experience and attitudes was statistically significant as shown in Table 22.

Table 22: Regression Analysis: Average Daily BSCW Usage vs. Positive Components of Technology Experience and Attitudes (Qualitative Study, n=30)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.593(a)	.352	.248	3.9754

a Predictors: (Constant), Prior experience helps adapt to new technologies, Just a user, High level of expertise, Perceived relative advantage of new technology

ANOVA(b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	214.152	4	53.538	3.388	.024(a)
	Residual	395.091	25	15.804		
	Total	609.243	29			

a Predictors: (Constant), Prior experience helps adapt to new technologies, Just a user, High level of expertise, Perceived relative advantage of new technology

b Dependent Variable: Average usage per day per person

Coefficients(a)									
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	-.175	1.674		-.105	.918			
	Just a user	2.949	1.656	.308	1.780	.087	.103	.335	.287
	High level of expertise	5.168	2.247	.390	2.300	.030	.288	.418	.370
	Prior experience helps adapt to new technologies	.396	1.656	.041	.239	.813	-.168	.048	.039
	Perceived relative advantage of new technology	4.571	1.591	.506	2.873	.008	.424	.498	.463
a Dependent Variable: Average usage per day per person									

The issues of technology experience on the use of the system and knowledge sharing can be understood by some of the respondent comments as illustrated by the following quotes:

"I'm not a computer expert, but I've used computers a lot and this system was easy to learn and easy to use, so it was not a problem learning and using it."

"I like to play with computers. If you had asked me this 25 years ago, I would have said "no way! I'll never use a computer- no way!" But then I started working here. I've grown with the company and with the computers and have tried to stay on top of what's new.

"I'm a computer-oriented person. I'm no genius with the computer, but things are a lot easier with the computer. There's a lot of other things that we do around here that I'd like to do by the same method. If I had my way, we will get to that point."

"I do not take a lot of time to explore the new technologies because I feel like my primary focus needs to be doing my job well. If I ever got to the point where I felt like I had a few hours, then maybe I'd try it."

"I don't think it hurts a person to be aware of what's going on because otherwise, your knowledge gets out of date so quickly. That's what happens to old-timer middle managers who become suddenly useless when some new kid comes along who has the up to date information that they were supposed to keep up with, but didn't. So, if you're going to

play the game, you ought to keep current. I would say it's our modern culture, not just our company. But if you haven't caught on to that, you're probably not going to last too long. I just think we ought to be adaptable as a cockroach!"

"I think the more you use it, the more you feel comfortable with it. I mean, success breeds success. Once you lose your fear, it's gone"

"The more computer skills you have, the more you'll be willing to try new technologies."

"I'm very much computer and Internet oriented even if I am 58! We sort of -we didn't grow up with them. They didn't exist when we started, but we've grown with them as they've developed."

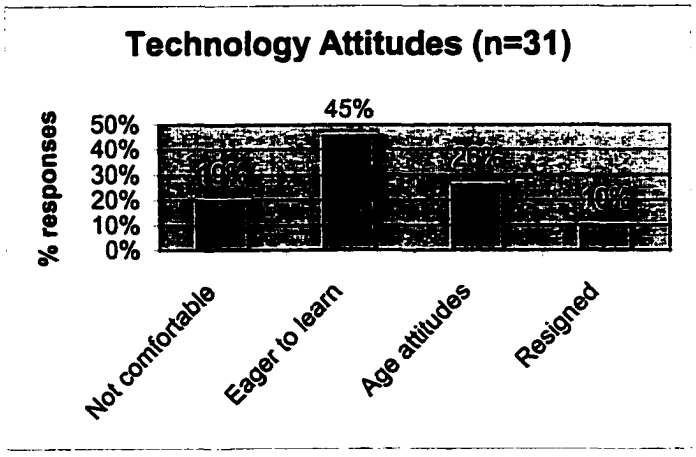
In the quantitative study, Table 23 shows the frequency distributions regarding the issues of prior technology experience on the use of BSCW.

Table 23: Components of Prior Technology Experience on BSCW Use (Quantitative Study, n=34)

Component of Prior Technology Experience	Cumulative Valid Percentage
Experience with computers	47%: DID influence use
Prior experience with technology	50%: Did NOT influence use 23%: DID influence use

5. $H_{4.2}$: Individuals with the basic characteristics consistent with innovators and early adopters will be more likely to continue to effectively use BSCW.

Figure 25: Summary of responses regarding attitudes towards technology on BSCW use and knowledge sharing (Qualitative Study, n=30)



The issue of attitudes towards technology and change on the use of the system and knowledge sharing can be understood by some of the respondent comments as illustrated by the following quotes:

"I'm at the frustration level. I'm always at the frustration level. There's always something new to learn, right?"

"I don't have a problem with changing technologies. But there are a lot of people who are not that way. They look at these things specifically as tools. They look at it only from the standpoint of what can it do to make my job run faster, which may be more objective than what I do, where I'm willing to try something. Other people say I don't have time to fool with that. Unless you can come in here and show me how to use it in 5 minutes, it's not worth my while to make changes in what I normally do. Sometimes you know it may be able to help them in a lot of ways, but they're not going to do it because they're a little bit resistant to the change."

"I'm kind of the guy who always wished he knew more. I'm always the guy asking all about how do you this, how do you do that because of my limited knowledge. I know the basics. I know how to get around. I know what I want to do. I either don't have the time or haven't taken the time to learn all the specifics that an intimate user would have. But to me, in the work that we do, computers are invaluable and things keep getting- becoming better communicated, easier, and there's good and bad."

"I love computers and I love what I can do with them, but I would definitely like to learn more with them because I do very limited work. Time and personally, I don't take the time from home to learn."

"There's one thing I like about it - I love computers. I get tired of changing. I do get tired of software changing so often, but in general, I really do like to manipulate it."

"I like getting new stuff. I love learning it. I'm not the most expert by no means. But I'm always willing and eager to learn new things."

In the quantitative study, Table 24 shows the frequency distributions regarding the issues of attitudes towards technology on the use of BSCW.

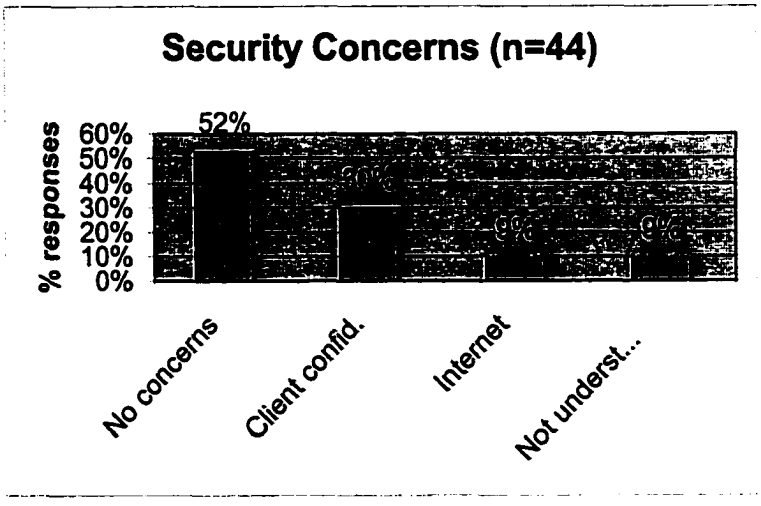
Table24: Components of Technology Attitudes on BSCW Use (Quantitative Study, n=34)

Component of Technology Attitudes	Cumulative Valid Percentage
Enjoyment of technology	47%: DID influence use
Uncomfortable with technology	83%: Did NOT influence use
Required part of job	50%: Did NOT influence use 23%: DID influence use
Not enough time to learn new systems	73%: Did NOT influence use

There were no statistically significant differences found in the correlation or regression analyses to support this hypothesis.

6. $H_{4.3}$: Security concerns over sharing knowledge or using a CSCW technology will negatively contribute to the continued and effective use of a CSCW technology and knowledge sharing.

Figure 26: Summary of responses regarding perceptions of security on BSCW use and knowledge sharing (Qualitative Study, n=30)



The issue of security concerns influencing the use of the system and knowledge sharing can be understood by some of the respondent comments as illustrated by the following quotes:

"It's got as much security on it as I need. You can make it as secure as you want. I mean, it's has the capability, so you choose whether you want to use it or not."

"The only way people can get to the documents is if you invite them and the only way you can invite them is for them to be invited by the IS people, so security is not an issue."

"As far as I know, there's not a bunch of industrial spies trying to get our information. But the information's there and we do want to keep it as confidential as possible. I think BSCW is designed more for internal closed systems, though I don't know its other capabilities. I think a lot of the clients would probably be uncomfortable using BSCW. We even have clients who don't want us e-mailing information to them because it's not secure."

"I had to comfort one of our clients who was very concerned that the information was being disseminated to people it wasn't supposed to be disseminated to. The problem is the lack of understanding. They see it as a black box sitting out there for everyone to access. They don't understand that it's not like other web pages. So, in general, there are lots of things about the Internet that are very enigmatic to people because they can't understand how things work. And there are things that I don't understand how they work, so it's a matter of educating people who use the system, what it's limitations are."

"You sure don't want to invite someone from another company into look at your other client names. There are confidentiality concerns, but as long as you have a competent person involved with the inviting list, you shouldn't have any trouble. It seems like it's a pretty secure piece of software because you really do control who sees it, even if they ever do accidentally find the web site, they're not going to see the folders unless they're invited because there's nothing to click on."

"It's internal. This information is not shared with clients until they gave the final report. They can't have access to this. I know that our CEO would at this point not want this to happen because there are comments in there that you might not want your clients to read. There may be some internal things to be worked out before you want your client to see it."

"(Client) It doesn't bother me personally. I'm not concerned about that. I think the so-called security on corporate security is highly exaggerated- or overemphasized because these reports and things- you know, somebody coming in to look at it or steal it wouldn't know what they were doing anyway. We have enough trouble figuring it out our self!"

In the quantitative study, Table 25 shows the frequency distributions regarding the issues of security concerns on the use of BSCW.

Table 25: Components of Security Concerns on BSCW Use (Quantitative Study, =34)

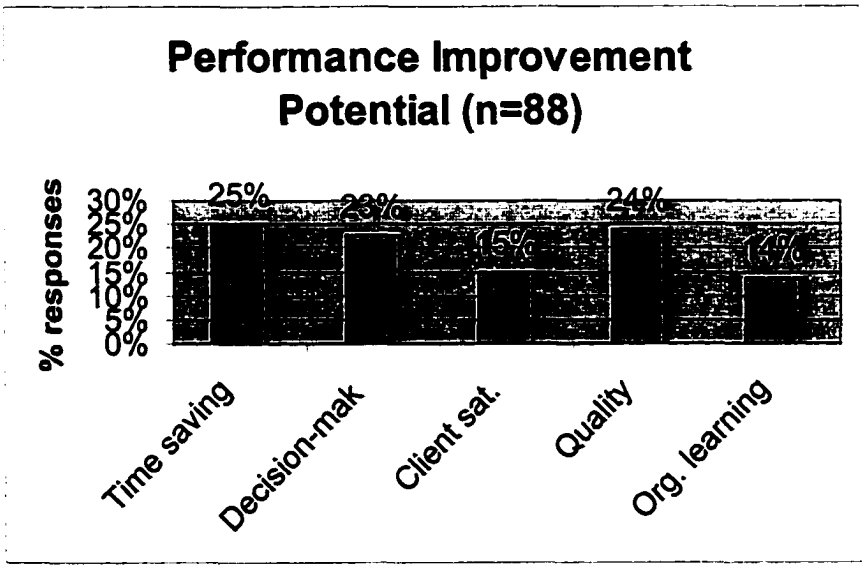
Component of Security Concerns	Cumulative Valid Percentage
No security problems inside company	63%: DID agree
No security problems outside company	53%: DID agree
Danger from Internet hackers	27%: Did NOT agree 67%: Neutral
Don't understand system; therefore reluctant to share information on it	76%: Did NOT agree

There were no statistically significant differences found in the correlation or regression analyses to support this hypothesis.

Performance Improvements

H5: Knowledge sharing, enabled by a CSCW technology will positively contribute to performance improvements within an organization.

Figure 27: Summary of responses regarding perceptions of performance improvements resulting from BSCW use and knowledge sharing (Qualitative Study, n=30)



The issues relating to performance improvement as a consequence of BSCW use and knowledge sharing can be understood by some of the respondent comments as illustrated by the following quotes:

"BSCW does save time right now in eliminating the need to have paper copies going to everyone. It also saves time in that I can update my files from home or from the road, so there are no bottlenecks as long as you have access to the Internet. In terms of potential uses, we might be able to share information within the department. We also might be able to post regulatory information on it that would be useful to many people."

"You could put the annual report, or quarterly reports- you could put all kinds of shareholder information out there too that isn't used out there now. Well, from a time-saving standpoint, you don't have to go ask anybody for anything. You know right where it is and you go get it yourself. So, that's a real advantage. And like I said earlier, it's on my time, rather than on somebody else's time. If somebody's not there, I don't have to wait for them to get back to their office to get the information. I go to BSCW and get it when I want it. It's always there and you know if its been updated or not because of the

version stuff, so you know everything about that file, so that's helpful. That's an efficiency gain."

"BSCW has the potential for problem solving, innovation, etc. Right now, BSCW is not being used to its full potential. I can see some more uses inter-divisionally than we actually use. One of the greatest uses it can have that it's not being used for at the present time is its use in dissemination of company-wide SOP's with a mechanism for people to pull-up, make changes and revise SOP's when they're needed and place them back on with different revisions and there can always be a revision of the SOP in place that can't be altered. It could save a lot of time."

"Something that I can see that could possibly be quite useful here anyway is – a lot of times somebody will have a problem with the analysis or with something and they're trying to develop a method and something's not working and if there's a way to encourage people to - if people could put this - and 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."

"I can envision some things. Trending is a key word in the industry. And we don't have a good grasp on it. It's something that we're working on is trending or trend analysis. If the same problem occurs on a regular basis and you can give a cause to that, then it's trending. You can trend it. You've determined what is the problem and the probability of occurrence again. Then you can begin to take preventative action. So, really that's probably the biggest payback or the biggest advantage to this is being able to use that as a tool to teach ourselves what we need to do or what we don't need to do."

"Also, it is a time saver. You don't have to see the person face to face or on the phone. With myself being an evening person or a night person, I might not think of something until 6:00 o'clock. Well, I'm kind of lost. I can send a voice mail, I can send an e-mail, or I might be able to prompt more action by putting it on BSCW. Make it an action item instead of bringing it up and tossing the questions around, just put it out there and there it is and it's not going to go away until something happens."

"And again, I can't stress the efficiency of: OK I've had a long day and I want to get on the Internet at 1 in the morning, then I can do my work then. Its' been great. I can do it then. It allows us to be considerably more flexible. Definitely the biggest advantage."

"Clients may eventually have access depending on all the rules and regulations that go along with that, but that's a wave of the future."

"Right off the bat, when you said time, you hit the nail right on the head right there, because before we had this, we had projection meetings and those took forever and you have everybody who's doing invoicing sitting in a room for 2 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, get my stuff done, everybody else does the same thing, and that right there, just pays for itself. So, we don't have to have a meeting. It's already there on

the invoice schedule. Everybody's putting their projections in and everybody's putting their billings in. That is a huge advantage. I despise meetings almost as much as paperwork. And the same thing on the audit schedule. You've got- we 'used to site down and go over every client audit with everybody involved in the room; hours. And now, we've got it on BSCW. We see what we're responsible for, we can put down our responses to the comments and there it is right there."

"Ultimately, what I would like to see is that when (accounting person) and I are doing the financial statements, that they are out there and available. And say like (Manager) could pull up his financial statement and drill down on the activity- that kind of shared system. I haven't explored that, but this is something I've come up with recently after reading an article in the Journal of Accountancy. Wow- that's where we need to go, so that those people when they're traveling, they're still getting the information they need to be making the latest decisions about current information- when there's time to make some changes. I think it's going to happen within the next 2 years."

"He gets Chemical News magazines and that's where he's getting a lot of the information and you see that it's blank, you can pick that particular company to work on. So, we needed to have some kind of a data base with our client contacts. 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."

"I'm thinking that it could be very helpful to a lot of different clients. We have some that we send out copies of the chain of custody to - the field manager person and the person who actually sent the samples and the person doing the analytical. We have 4 sets of copies that we send out, so we're making all these copies and then we have to find the addresses and then we have to either fax them or mail them. I can see where this would be very helpful- you just put it on there and you can skip all that part. It would save us a lot of time because then you have to make all the copies- you've got to stamp them, you've got to sign them, and then date them, especially on this study here that we're doing on BSCW because we still have to make the copies and send them but it's not like the only thing because it's also on computer."

"It saves a lot of time and allows managers and top executives to make better decisions by having access to more timely information. It make us more responsive to clients as a side effect. The program is directly primarily though for internal use to keep everyone updated as to where do we stand, what's production going to look like for the current month or quarter that's ahead of you. If you can go out to a year, which is pretty difficult, then it gives you some sort of idea as to what we're expecting down the way."

"It may make you give some real thought to what you're putting down rather than taking a shot-gun approach. Saying - oh well- we've got this out there and we may do a little bit of this and a little bit of that. Because you are accountable for what you're putting into the document, so it may make you be a little bit more realistic, at least on the initial entry for a given month."

"But I think the time savings and the availability of the information for everyone without having to go around and ask what's happening are by far the largest savings. And time is gold!!"

"we've already agglomerated the quality data because everybody has options to look at what other people have said about out facility even if it's not directly involved with them. That's where people have come in and audited us, made comments about our operation, everyone in leadership has access to that."

"(President and CEO) "We share the view that knowledge is the key to our competitiveness and to remaining sustainable over time and if you look at that, there are 2 dimensions to that. One is to have the processes by which you learn the knowledge, and having learned it, share it. We can't have 210 people spending all their time learning, so we have as a pretty stiff requirement on the leadership individuals here that they are the learning individuals and the individuals here that are highly successful here are learners. Particularly - even in a company that thinks it's not changing, and the world is changing around them and in our company, we know we had to change. So, we have learned our way in rather than believe that we would go out and buy people who know and bring them on, we have chosen to take people who know the contract research business and who, on our behalf, will learn our way into the various businesses. And what we've discovered through that not everybody can do that- from an efficiency standpoint. Therefore, the key staff becomes - yes, you've got to learn that and then you've got to disseminate what we've learned so that the organization can change, adjust and be successful. And the role that BSCW plays for us fundamentally is as a knowledge sharing, though it views itself as a document sharing, it's a knowledge sharing system. It's one of several things that we do to share information.

What we've discovered, we will be more and more competitive and more and more sustainable the better we learn and the better we share the information that the learning specialists - not everybody is in a position to talk to the pharmaceutical company X and pick up that knowledge. We can't send everybody to the American Association for Pharmaceutical Sciences annual meeting. We send several people. They learn on our behalf. So the effectiveness of the sharing of information- the whole strategy of this company which is a strategy of a mix of some older strategic concepts in US business and some more modern and some that are tailored to ABC, but our strategy is one of a client driven, rather than market driven- client driven, leveraged core competency strategy.

We have to acquire that information from consultants. We have to contact the FDA by the web site. We have to talk to companies, competitors if we can find a friendly one. So the mechanism for collecting that data and sharing it is to have a folder to which the parties are invited, contribute; a folder where we turn in what we're finding. And there is a folder on there at the moment that is an FDA Regulatory Learning folder. And that's a more futuristic way. When we first started using this, it was more internal, efficiency that multiple users could share the sales forecast or something. More administrative. This is getting more at the core value. So that's looking to the future, I see more and more of that.

Where it's the entry point of acquired learning and the beginning of challenging and sharing. In the very long term, I'd like to see this come to where there's more outside world involvement. Right now we do an activity- some of the users have created sites that outside parties can come to. I see that intensifying. I can see that there would be- there's a lot more going on here that I would love to share with shareholders than I'm prepared to write about in a quarterly report. I can see a time when we can be simply posting. The information's there and continuously updated and no additional burden to us. And for no additional burden, the information that we would love them to see is accessible to shareholders. Control, security, those things are at issue at that point, but in the learning process, since we're client driven, where clients are having an opportunity to make input on shaping the direction we take, being able to come in an easy way that fits with their schedule, that they can do from their desk, without visiting here, reducing our cost of travel. I'm sure you've noticed the burgeoning use of it. And it's not busy work. It's creating effective short cuts and better ways of doing things." (end President's comments)

"Performance improvements- everyone stays up to speed on what the developments are, so if you're missing a deadline, if a project manager was watching that, if that data didn't show up, they would know to call and check on it or do something to keep it on the milestone check off list or pert chart to follow that."

(Client) "It would be nice to be able to go in and look at - have everything there from the study so you could go in and see what people were doing, but we haven't gotten to that point yet. But it would be nice to be able to be able to go in during the study and see the data sheets without them having to send them to you."

"I think it's helped with the marketing efforts because we're putting new contacts in there, so the study directors know right away - we know we need to contact these people rather than going to someone and saying- have you ever heard of these people- have we done work for them before? We can go right in and say- yeah- we know that person- we've done work for them before. I can contact that one."

Table 26: Correlation Analysis of BSCW Usage vs. Performance Improvements (Qualitative Study, n=30)

Correlations			
		Average usage per day per person	Total responses for performance improvement
Average usage per day per person	Pearson Correlation	1.000	.250
	Sig. (1-tailed)	.	.091
	N	30	30
Total responses for performance improvement	Pearson Correlation	.250	1.000
	Sig. (1-tailed)	.091	.
	N	30	30

Table 27: Regression Analysis of BSCW Usage vs. Performance Improvement (Qualitative Study, n=30)

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.250(a)	.062	.029	1.2541
a Predictors: (Constant), Average usage per day per person				

ANOVA(b)						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.932	1	2.932	1.865	.183(a)
	Residual	44.034	28	1.573		
	Total	46.967	29			
a Predictors: (Constant), Average usage per day per person						
b Dependent Variable: Total responses for performance improvement						

Qualitative Study Correlation Analysis: The correlation between average BSCW usage and total performance improvement was .250.

There were no statistically significant findings in either the correlation or regression analyses in the quantitative study between BSCW usage and perceived performance improvements.

However, in the quantitative study, a correlation analysis of Avg. performance improvements vs. Avg. Infrastructure showed a statistically significant result of 367* and average performance improvements vs. Avg. benefits/relative advantage was .666**

** Correlation is significant at the 0.01 level (1-tailed).
* Correlation significant at the 0.05 level (1-tailed)

Table 28 shows the correlation between the categories of relative advantage and performance improvement.

Table 28: Correlation Analysis: BSCW Usage vs. Elements of Relative Advantage (Quantitative Study, n=34)

IV's	Performance Improvements
Accessibility	.306*
Sharability- Internal	.389*
Sharability- External	.453*
Saves Time	.453*
Improves Quality	.430**
Improves Decision-Making	.554**
Improves Customer Satisfaction	.612**
Versions	.534**

** Correlation is significant at the 0.01 level (1-tailed).
* Correlation is significant at the 0.05 level (1-tailed).

In the quantitative study, Table 29 shows the frequency distributions regarding perceptions of performance improvement potential from BSCW usage and knowledge sharing.

Table 29: Performance Improvements from BSCW Use & Knowledge Sharing (Quantitative Study, n=34)

Component of Performance Improvement	Cumulative Valid Percentage
Time savings/ efficiency gains	67%: DID agree
Improved decision making	76%: DID agree
Increase client satisfaction	79%: DID agree
Improved quality and problem solving	70%: DID agree
Increased organizational learning	70%: DID agree
Increased competitive advantage	57%: DID agree

When a cross-tabulation analysis was run on performance improvements vs. job role in the company for both the qualitative and quantitative data, there were no statistically significant results. However, it was interesting that in both studies, there was a trend shown where top leadership perceived the greatest potential for performance improvements from using this technology to share knowledge.

Chapter Summary

This chapter presented the findings of the current study. In summary, the study model presented four major independent variables, each with several sub-variables as influencing the dependent variable, continued and effective BSCW usage to facilitate knowledge sharing. Secondarily, the influence of BSCW usage and knowledge sharing on performance improvement potential was also explored. Frequency statistics were run on all variables to look for patterns in the data. Regression and correlation analyses were run on all variations of the independent vs. the dependent variables to look for statistically significant relationships or causal factors. In the following chapter, these findings will provide the basis for the discussion of what these results may mean as well as any recommendations that can be drawn from them and recommendations for future research in this area.

CHAPTER VI

DISCUSSION AND CONCLUSIONS

This study represented a unique opportunity to explore the effective and efficient use of a new technology after a forced adoption as it unfolded in a service organization. The purpose of this research was primarily to understand which factors influence the continued and effective use of a CSCW (Computer-support collaborative work) technology to facilitate knowledge sharing and how the relevant factors exert an influence. Secondarily, the study attempted to examine the relationship between the continued and effective use of a CSCW technology to facilitate knowledge sharing and any resulting performance improvements within the organization.

What do the study results tell us? A regression analysis of the four primary independent variables (infrastructure, infostructure, infoculture, and individual concerns) with the dependent variable, BSCW usage, in the qualitative study showed a causal relationship where 43% of the variance was attributed to the independent variables ($F= 4.631$, significant at the 0.01 level). However, after examining the alpha reliability and factor analyses for each of the major variables, caution must be taken when attempting to draw any conclusions from these results. Because most of the alpha reliability and factor analyses showed low results, the combined major variables do not fit together as well as originally expected. Therefore, analysis of each subcomponent probably represents a more valid assessment of the study model. Therefore, examining the components of "Infrastructure" represented a better indicator of the results. This analysis revealed a

statistically significant relationship between "Relative Advantage" and BSCW usage to facilitate knowledge sharing at the 0.01 level. In terms of the specific elements of "Relative Advantage", the factor "Improves Customer Satisfaction" was found to be significant at the 0.01 level and "Improves Quality" was significant at the 0.05 level.

Corresponding statistical analyses in the quantitative study did not show these to be statistically significant findings. Due to the vast differences in the way BSCW was used by people in different roles in the company as well as the small sample size (n=34), the lack of statistical significance was not surprising. In contrast, matching the specific usage with each respondent may have reduced the variability in the qualitative study.

In terms of other statistically significant results, a regression analysis of the positive attitudinal components associated with using new technologies showed an r^2 of .352, significant at the 0.024 level. When broken down with part and partial correlation analysis, the perceived relative advantage of the new technology showed the highest correlation with BSCW usage. In addition, a correlation analysis between the independent variables "self motivation to share information" and "perceived need/benefit in sharing information" with the dependent variable "perceived performance improvements" within the "infoculture" variable showed statistical significance in the quantitative study, further supporting the major finding that perceived relative advantage appears to be the major influence on BSCW usage to facilitate knowledge sharing as well as the perceived performance improvements resulting from knowledge sharing.

However, due to the small sample size and the high variability in BSCW usage, these statistics may not reveal other important findings or paint a true picture of what the results mean, particularly with the findings from the qualitative study. However, the rich responses from the respondents interviewed may provide additional insights into the relationships studied.

Examining the variables in the order presented in the Chapter III study model guides the following discussion of the results.

Infrastructure

a. Relative Advantage: The significance of relative advantage was consistent with Rogers (1995) theory that this variable is positively related to the continued and effective use of an innovation as well as the findings of Karahanna et al. (1999) and Chu et al. (1999). Rogers defined "relative advantage" as "the degree to which an innovation is perceived as being better than the idea it supercedes." While these authors focused on the perceived benefits of the innovation (technology) itself, others (Beck, 1999, Pan & Scarbrough, 1999, Reisenberger, 1999) 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. The findings from the qualitative study appear to support this view. Respondents clearly articulated their enthusiasm for using BSCW to share information and knowledge with statements emphasizing the large efficiency, time savings, and quality gains derived from having access to needed information irregardless of time or

physical location. Another benefit cited from relative advantage was the ability to share information with multiple users as well as the issue of accountability introduced by the CSCW system. Accountability provided by a version control system was perceived as increasing quality and timeliness of input. These attributes of relative advantage appeared to be consistent in the qualitative and quantitative studies in terms of respondent's attitudes on their influence on use of BSCW to facilitate knowledge sharing.

b. Compatibility: Many researchers (Rogers, 1995, Desantis & Poole, 1994, McGrath, 1993, Tyre & Orlikowski, 1994) have demonstrated the importance of technologies being compatible with normal work routines for efficient and effective use to occur. Similarly, Ciborra & Patriotta (1996) found that the effectiveness of a new collaborative technology depended on how closely it matched pre-existing work practices and whether it was seen as better than existing tools such as e-mail. However, in this study, issues of hardware and software compatibility as well as compatibility with normal work routines were seen by the users as an expected part of the system. While hardware or software compatibility problems were perceived as a nuisance, they did not appear to influence BSCW use or knowledge sharing in any meaningful way. Responses from the quantitative study similarly showed that compatibility did not appear to influence use of BSCW to facilitate knowledge sharing.

c. Time and Training: Jude-York (1998) discussed the issue of technology overload, asserting that employees who had too much work to do, too many technologies to learn, and not enough time available to get their jobs done would be very resistant to adopting

and using a new technology. While about 48% of the responses in the interviews indicated that BSCW was initially difficult to use (steep learning curve), the respondents quickly followed with the assertion that once they overcame that, it did not pose a problem for continued use. Similarly, while they believed that additional training would be helpful in initial use, it did not influence their continued use of the system. The quantitative study confirmed this. Most respondents inferred that issues of training, time, and compatibility did not influence their use of BSCW to share knowledge.

Again, it should be noted that when examining the alpha reliability and factor analyses, the subcomponents of Infrastructure as well as the other major variables did not support the use of the consolidated use of those major variables. Therefore, the results of these studies support the view that each of the sub-variables should be examined individually. In the context of infrastructure, this was very apparent by the vast differences in responses to relative advantage vs. compatibility and training/time.

Infostructure

Failla (1996) discovered that if no-one took ownership of a collaborative knowledge-sharing technology and maintained it for relevance, recency, and usefulness, it was not deemed to be valid by the users. Similarly, Ciborra (1996) found that a large collaborative database in a pharmaceutical company was not updated and thus, not trusted, and rarely used. In addition, if users did not know who had access to the information, they were more reluctant to contribute their knowledge. In this study, the interview respondents confirmed the importance of information that was recent and relevant. As one respondent said: "If you don't have real recent information, you're really

nowhere!" The major message appeared to be that all users, including executives and managers, as well as people in other functional areas needed to have the most recent and relevant information available to make the best decisions or to effectively track trends or keep up with client requirements. Because the BSCW system automatically monitored who entered information and when, the issue of accountability became a driving force behind the input of information. However, many respondents in the interviews stated that it was an issue of personal and professional responsibility to enter information in a timely manner, often driven by project or department needs. In addition, many respondents stated that managers should also be responsible for making sure their employees input relevant information in a timely manner. It was interesting that many respondents appeared to perceive this issue as a professional work ethic issue; an expected part of their jobs rather than as a motivating influence on using BSCW to share knowledge. The results from the quantitative study appeared to support these results where a majority of respondents indicated that managers should play a role in managing the information and information input should be driven by department or project needs.

Infoculture

There was strong support throughout the diffusion, knowledge-management, and collaborative technology literature bases for the influence of an organizational culture in which the leadership promoted a collaborative culture to share knowledge, trust and communication, and a reward/compensation structure to reinforce it.

a. Leadership: Many researchers including Pan & Scarbrough (1999), Reisenberger (1999), and Puccinelli (1998) among others stressed the critical need for strong and active

executive commitment to and support of a collaborative technology to facilitate knowledge sharing. They suggested that leaders not only championed the collaborative system and knowledge sharing, but also possessed the power and authority to invest in the needed technology, create the collaborative culture to enable it, and to create reward/incentive structures to reinforce it. 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.

b. Reward/Incentive/Compensation Structures: Scheraga (1998) suggests that the best way to overcome employee resistance to sharing their knowledge was to reward them for it. Reisenberger (1999) similarly contends that top management needs to develop new reward systems to recognize and reward knowledge sharing activities. In fact, Pan &

Scarbrough (1999) documented the success of rewarding employees for sharing their valuable knowledge at Buckman Laboratories. Rogers (1995) found that the main function for incentives was to increase the degree of relative advantage for the innovation. In this study, many respondents in the interviews acknowledged the benefit of some sort of incentive or reward system with the belief that people do what they are rewarded for. Interestingly, a large number of respondents indicated that incentives would be useful to initially help people overcome their initial fear of or resistance to using a new technology or sharing knowledge. They asserted that once people overcame the initial resistance to using the system, they would perceive the relative advantage in using it, which would become a motivating factor in its continued use. However, the responses were divided among those who perceived a strong tie between use of BSCW and their annual performance appraisals and those who expressed the opinion that usage and knowledge sharing was just an expected part of their job and no incentives/rewards should be needed. Finally, as mentioned, many expressed the belief that the relative advantage/benefits of using the system would provide the greatest motivation for using it effectively, further supporting the discussion earlier in this chapter. Thus, this research appears to support Rogers proposal that incentives could increase the degree of relative advantage by motivating potential users to adopt the technology, implement knowledge sharing, and then acknowledge the relative advantages it affords. The results in the qualitative study appeared to be supported by results in the quantitative study. Approximately half of the respondents indicated that performance appraisals would influence their use of the system to facilitate knowledge sharing while about 60% indicated that they perceived it to be an expected part of their job.

c. Peer Influence: In the diffusion of innovation literature (Rogers, 1995), the importance of opinion leaders is emphasized, suggesting that opinion leaders often serve as social models whose behaviors are imitated by other members of the social system. Alange et al. (1998) further contend that opinion leaders often help their colleagues to "unlearn" deeply entrenched practices in order to break with the status quo inertia before a new technology is fully adopted and used. Within the context of this study, it was interesting that virtually no respondents perceived that they were influenced by opinion leaders on their own adoption and continued use of BSCW to share their knowledge in either the qualitative or quantitative studies. However, this finding should be received with caution because this technology was relatively new to this organization and still in an early maturity phase of use. It may be possible that as the system matures and more users are added to it, peer influence and opinion leaders may exert a much greater influence as it diffuses throughout lower levels of the organization.

d. Trust and Communication: Pan & Scarbrough (1999) state that "trust must be one of the company's core values. For knowledge sharing to become a reality, you have to create a climate of trust in your organization. You cannot empower associates you do not trust and who do not trust you." This sentiment was shared with other researchers, including Barker (1998) who suggest that "the preconditions necessary for a learning organization that shares knowledge includes the elements of trust, commitment, and perceived organizational support." Other authors (Schultz, 1996, Solomon, 1998, Coutu, 1998, McCune, 1998) emphasize that trust and effective communication are important

when working in a digital environment, since knowledge sharing and collaboration still represent social processes, though in a digital context.

The results from this study indicated that most respondents perceived a good climate of trust and communication already existed within the company as exemplified by the following quotes: "I think we would share information. I mean, we do now." "I think that the President/CEO definitely has that mission. He conveys many times that communication is very open and he wants it open and he wants everyone to put everything out on the table because it's a much easier and more efficient way to communicate and get things done. I think with BSCW, it gets everything out there, it identifies who said it, when they said it and you can attach priorities as well. So it's pretty clear and pretty open and I've never heard of someone not putting something on there because they didn't want somebody else to know about it." This appeared to be consistent with results from the quantitative study where 97% of the respondents indicated that information should be shared within their departments.

Therefore, sharing information or knowledge was not a problem for them using this new method. However, it was interesting that "sharing information for the common good of the company" had a significant correlation with BSCW at the 0.01 level. Thus, despite the feeling that trust and communication were good, it was still the perceived relative advantage that produced a significant result in this context. However, an interesting dichotomy in perceptions emerged between perceptions and comfort levels of trust and communication in knowledge sharing inside verses outside the company. While most respondents trusted the flow of knowledge with colleagues inside the company, this

attitude changed to apprehension and distrust when sharing information or knowledge outside the company because of the sensitive issue of client confidentiality and associated security and liability issues. There appeared to be a fear of information falling into the wrong hands once it left the confines of the organization as shown in the following quote: " Client information is confidential, so if I were access it from my home, which I can do, we do want to make sure it's secure." In the quantitative study, about 50% of the respondents perceived that information should be shared outside of the company. This appears to support the hesitation or fear of sharing information with clients, cooperators or other outside stakeholders.

Individual Concerns

a. Prior Technology Experience: Alange et at. (1998) suggest that technological change often results from an existing technological foundation. Tyre & Orlikowski (1994) also found that prior technological experience helped users more quickly adapt to and use new technologies more effectively and efficiently. In the qualitative study, respondents indicated that their prior experience with technology greatly helped them to learn and use this new technology, BSCW, more quickly and effectively. Interestingly, in a correlation analysis, the perceived relative advantage of the new technology showed a significant correlation with average BSCW use. Therefore, while the responses from the users supported prior research on the influence of prior technology experience on continued use, the issue of relative advantage once again showed a significant relationship with use. Basically, while prior experience appeared to help people learn this new system, it did not appear to be a significant motivating factor in using BSCW to share information or

knowledge. However, prior experience with technologies may also influence the perception of relative advantage since experienced technology users would understand the benefits more than inexperienced users. In fact, interview responses supported this view. Respondents who did not possess as much technology experience expressed more confusion about the system and what it did whereas experienced technology users appeared to understand the value of the system and how it could facilitate knowledge sharing. In the quantitative study, about half the respondents indicated that prior experience with technology influenced their use of BSCW to facilitate knowledge sharing. Therefore, this factor does not appear to represent a significant motivating influence on use.

b. Adopter Categories (Attitudes): While this variable was imprecise in its measurement, the basic positive verses negative attitudes towards change and technologies in general were assessed. From his research, Rogers (1995) contends that earlier adopters may be less dogmatic than later adopters and also have a more favorable attitude towards change and technology than later adopters. In this study, while there were no statistically significant correlations between attitudes and BSCW use, interview responses did demonstrate very different attitudes that would appear to influence use. On one hand, respondents who were eager and enthusiastic about technologies and change appeared to be more willing to initially adopt and then continue to use BSCW. On the other hand, those respondents with more negative attitudes towards change and technology (including BSCW) also demonstrated greater resistance to using BSCW, often complaining about having to use it. In the quantitative study, the majority of responses indicated that

attitudes towards technologies did not influence their use of BSCW to facilitate knowledge sharing.

c. Security Concerns: Most respondents did not have security concerns with using BSCW to share knowledge and information with colleagues within the company. This mirrors their responses in the area of trust and communication. However, there were security concerns regarding client confidentiality when using BSCW to share knowledge outside the firm with clients or cooperators (suppliers). These results were supported in the quantitative study. It appeared that most people trusted the technology due to the built-in safety mechanisms, particularly the "invitation process" in which the "owner" of a particular shared workspace had the authority to grant access (invite) those people he/she wished to share the information with. However, there was a feeling of apprehension about who would see the information once it left the organization. Therefore, there appears to be a correlation between the variables of trust/communication and security concerns dealing with sharing knowledge inside verses outside the organization. The results from the quantitative study appear to support this view. Approximately 63% of the respondents indicated that they did not perceive security problems using BSCW inside the company and about half of the respondents did not perceive security problems using it outside the company.

Performance Improvements

Were there any performance improvements attributable to using BSCW to share knowledge in this study? While there were no statistically significant correlations between BSCW usage to facilitate knowledge sharing and resulting performance improvements in either the qualitative or quantitative studies, there were many statements in the interviews to support the evidence of tangible performance improvements in this organization. In addition, the results indicated that top leadership appeared to perceive the potential for current and future performance improvements from knowledge sharing enabled by a collaborative technology more than users in other jobs.

a. Time savings: Several respondents documented specific, quantifiable time-savings from using BSCW to share information and knowledge. For example, the IACUC (International Animal Care and Use Committee) documented that since using BSCW to share information, they have been able to reduce their meetings from once per month to once per quarter. Similarly, several managers and top executives documented a reduction in the number of meetings required in different functional areas and projects as illustrated by the following quote: "We had projection meetings and those took forever and have everybody who's doing invoicing sitting in a room for 2 hours projecting what you're going to make for the next month and that was a waste of time. I can now be in and out of BSCW in 10 minutes, get my stuff done, and everybody else does the same thing, and it's all right there." Another typical documentation of time savings were people who said that they could input their information into BSCW rather than making paper copies for multiple people and manually distributing them. Rather, they could have the information

available in a central location when they needed it rather than spending valuable time calling or tracking down people to find the information they needed, thus also preventing bottlenecks. Because time represents one of the most valuable resources in the agricultural chemical and pharmaceutical industries, saving time represents the ability to finish projects and submit them for (EPA or FDA) agency approval faster, thus representing a huge competitive advantage for all players in this supply chain. As Mancini (1998) stated: "A month's delay in approval can mean millions of dollars in lost revenue." And, as one manager in the study said: "Time is gold!!" In the quantitative study, approximately 67% of the respondents perceived that using BSCW to facilitate knowledge sharing did result in time-savings.

b. Decision-making: There were many responses in the interviews demonstrating the value of BSCW to facilitate knowledge sharing in improving decision-making within the organization, exemplified by the following quote: "It allows managers and top executives to make better decisions by having access to more timely information." It is well known that the more information that is available, current, and relevant, the better the quality of the decisions as opposed to "educated guessing" based on incomplete information. Thus, the value of having current, relevant, easily accessible information and knowledge to decision-makers was verified in this study and represents a performance improvement that was influenced by the use of this collaborative technology, BSCW, to enable knowledge sharing. Approximately 76% of the respondents in the quantitative study supported this view.

c. Client satisfaction: The top executives and middle managers envisioned the usefulness of BSCW to share valuable information/knowledge with clients. Specifically, project managers who regularly share proposals, study status information, and final reports with clients saw great value in having that information available to clients who could access and provide feedback on it as exemplified by the following quote: "I could see it as a really good cooperative- especially if you're working with overseas clients." The one client interviewed commented that "It would be nice to be able to go in and look at – have everything there from the study so you could go in and see what people were doing." Therefore, this issue was seen as providing future performance improvements in terms of enhancing communication with clients, reducing time in the studies by sharing information on a real-time basis, and ultimately improving overall client satisfaction. Approximately 79% of respondents in the quantitative study agreed with this view.

d. Quality and problem solving: While the issues of quality and problem solving are difficult to quantify, respondents did document qualitatively how BSCW has resulted in several specific performance improvements in these areas. For example, BSCW was regularly used to track client concerns in different studies throughout the organization. Several respondents reported that by sharing these client comments and concerns with all of the quality assurance people and managers in the organization, they had been able to establish trends or patterns of recurring problems and take corrective actions to solve those specific problems. Thus, they were able to correct those problems, improve the quality of those processes, and thus, improve the overall quality of the organization.

Approximately 70% of the respondents in the quantitative study indicated that quality and problem solving were improved by using BSCW to facilitate knowledge sharing.

e. Organizational learning and competitive advantage: This issue was probably expressed most eloquently by the President/CEO of the organization who said: "We share the view that knowledge is the key to our competitiveness and to remaining sustainable over time. If you look at that, there are two dimensions to that. One is to have the processes by which you learn the knowledge, and having learned it, share it. You've got to disseminate what we've learned so that the organization can change, adjust, and be successful. And the role that BSCW plays for us fundamentally is as a knowledge sharing system." Other respondents documented the value of BSCW to facilitate organizational learning with examples like inputting relevant information from conferences, trade shows, publications, and agency guidelines for associates to access and learn from. In terms of sharing ideas, respondents also saw the potential for sharing ideas, standard operating procedures, and company reports with associates, shareholders, and other relevant stakeholders. In the quantitative study, most respondents did agree that using BSCW to facilitate knowledge sharing could produce the performance improvements mentioned. A majority of respondents in the quantitative study supported this view.

While this study did not show a statistically significant or quantitatively measurable link between knowledge sharing enabled by a CSCW technology and organizational performance improvements, it did show a qualitative correlation and some anecdotal quantifiable links such as the reduction in the number of meetings in certain departments.

Therefore, based on these results, a revised study model was developed to reflect the emerging themes including the significance of relative advantage, leadership, and reward/compensation structures to support the use of a CSCW-type technology to facilitate knowledge sharing. In the next section, this new model is presented and explained.

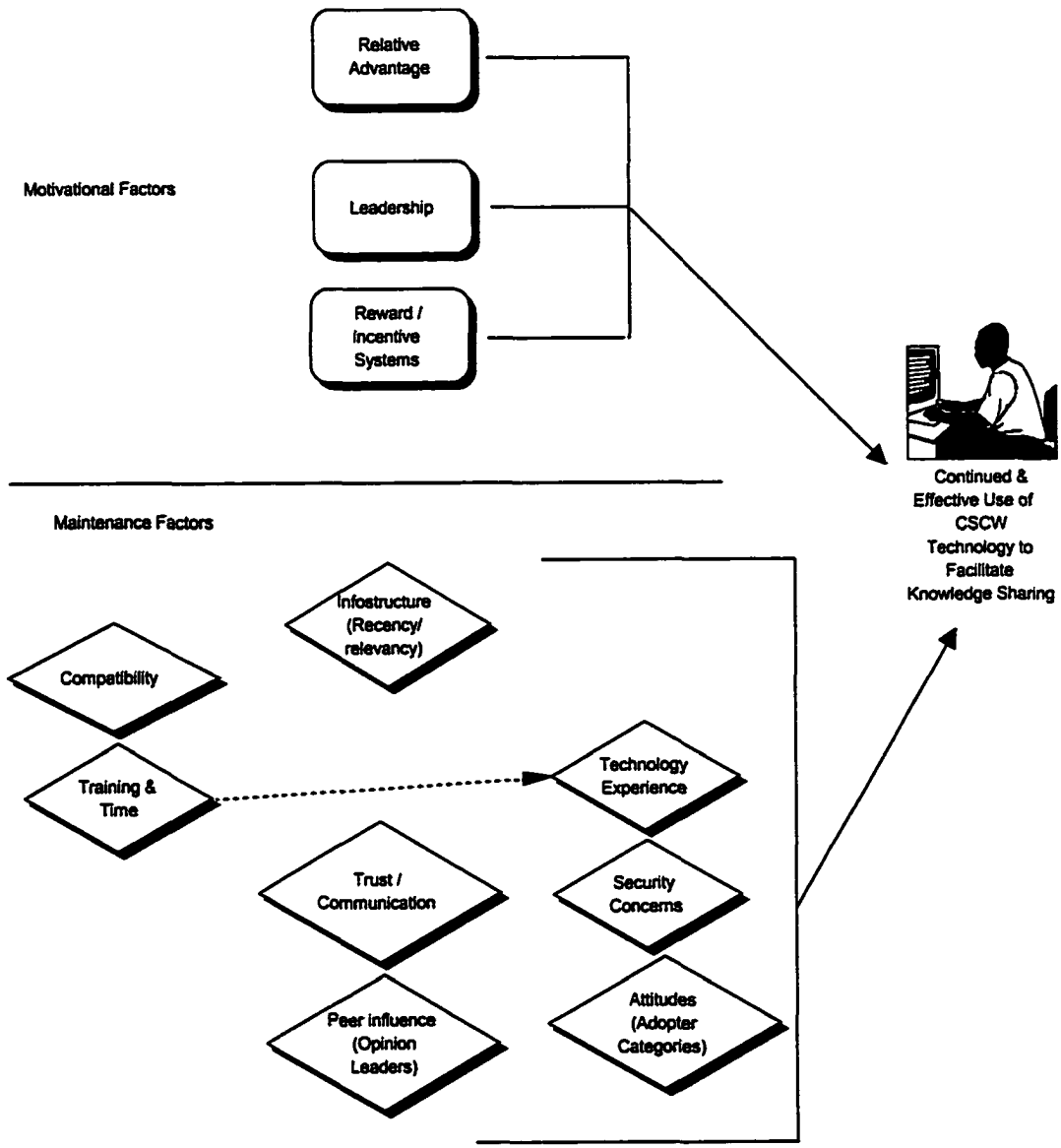
Conclusions

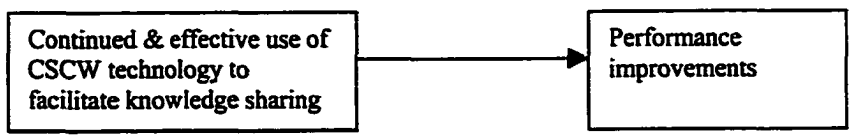
Based on the emerging themes from the results of this study, a new model, which will be called the "Motivation- Maintenance Technology Implementation Model" is proposed. The foundation for this model lies in respondent perceptions. Most respondents indicated that only certain factors (independent variables) truly motivated them to effectively and continually use BSCW to share information and knowledge. These factors included the relative advantage of the system, the influence of leadership, and the reward/compensation structures associated with using the technology and sharing knowledge. In contrast, the other factors (independent variables) from the original study model were expected or assumed to be available for them. These results were surprisingly analogous to an old, classic management theory called "Herzberg's two-factor model" (Hellriegel & Slocum, 1996). In his classic theory, Herzberg concludes that there are two separate and distinct factors that influence job satisfaction or dissatisfaction. The factors associated with positive factors are called motivational influences. In contrast, factors that were associated with dissatisfaction were called hygiene factors. Herzberg contends that these hygiene factors (such as working conditions, company policies, salary, status and job security) are necessary to maintain job satisfaction, but are expected by associates. In and of themselves, they do not contribute to increased job satisfaction. On the other hand, the factors called motivation factors (such as the challenge of the work itself, responsibility, recognition, achievement, advancement and growth) do motivate employees.

This theory then serves as a useful framework for the discussion of the results from this research because of the perceived similarities. Figure 28 shows this proposed new study

model, called the "Motivation- Maintenance Technology Implementation Model". The original study model shown in Chapter III proposes that the major independent variables "infrastructure", "infostructure", "infoculture", and "individual concerns", with their associated sub-variables would exert an influence on the continued and effective use of a CSCW (computer-supported collaborative work) technology to facilitate knowledge sharing. The primary research question asked which of these variables and sub-variables exerts an influence and in what ways they exert an influence?

Figure 28: Maintenance-Motivation Technology Implementation Model





As discussed earlier in the chapter, regression and correlation analyses showed that the variable "relative advantage" showed a statistically significant relationship with BSCW usage in the qualitative study at the 0.01 level. This finding was further supported with significant relationships between perceived relative advantage of the new technology within the "individual concerns" variable. In addition, a correlation analysis between the independent variables "self motivation to share information" and "perceived need/benefit in sharing information" with the dependent variable "perceived performance improvements" within the "infoculture" variable showed statistical significance in the quantitative study. This supports the major finding that perceived relative advantage appears 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 from the literature that a strong leadership that supports knowledge sharing, enabled by a collaborative technology, was also a very important influence on these users. Similarly consistent with the literature, leadership support also included some form of reward/incentive structures to motivate individuals to share their knowledge and use this system to do so. 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 & 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 might need to 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.

Did this technology change processes or the way people worked or communicated in this case? In certain respects, using BSCW to share knowledge did exert basic changes in both processes and communication patterns as well as resulting performance improvements. First, users had to rethink the way they shared information. In traditional processes, they would copy paper documents, distribute them, and spend significant amounts of time contacting the collaborators to receive feedback. Using BSCW, a new way of communicating emerged where users were expected to input information and also expected to take on additional responsibility for checking the system and responding to new information in the system more rapidly than was formerly expected. Communication patterns were thus basically altered as well as the processes for communicating and working on documents. In addition, patterns of tracking processes and problems were altered in a similar manner. With BSCW, users could now examine trends in processes which were previously unavailable and develop new work patterns to continually observe the new knowledge and act upon it in ways that were not used before. Finally, managers also adapted their work habits to continually input relevant information, train their subordinates to follow this new patterns, and learned to become accustomed to having relevant and recent information available for more timely decision making. Thus, BSCW did appear to alter the way people worked and communicated in this case study.

Contribution to the Literature

What did this study contribute to the literature base? First, the results showed unequal influences of the different variables on BSCW usage to facilitate knowledge sharing. Relative advantage emerged as the most significant influence followed by leadership and a supporting reward/compensation structure. This was inferred by the frequency of responses in the qualitative and the quantitative studies as well as by the richness of the responses in the interviews. In terms of the relationship between continued, effective use of a CSCW technology to facilitate knowledge sharing and subsequent performance improvements in the organization, there was qualitative evidence for such a relationship. The case study demonstrated qualitatively that sharing information with BSCW saved significant amounts of time in different processes, improved decision-making, quality and problem solving. Thus, this research can serve as a framework for practitioners to introduce and implement CSCW technologies to facilitate more effective and efficient knowledge sharing strategies within their own organizations.

Recently, academicians and business practitioners have acknowledged that in our new knowledge-based economy, certain factors characterize successful companies. First, companies must be able to consistently acquire and create new knowledge. This knowledge acquisition may contribute to improved quality and efficiency, new and improved products or services, reduced costs, and improved responsiveness to customers, all in a faster time frame relative to competition. In addition, knowledge drives decision support by making relevant information and knowledge readily available to decision makers. To achieve this, companies should disseminate this knowledge rapidly to people

in the organization who can use this knowledge effectively. While these concepts are readily recognized and acknowledged, implementation can be difficult to achieve. This research addressed this implementation issue, adding several ideas to the knowledge base.

First, given the complexity and interdependence of factors influencing use of a CSCW technology and knowledge sharing, this research highlights several variables and emphasizes the importance of context for each variable. Not surprisingly, the results from this study are context specific to the Contract Research Organization studied. However, with the recognition of situation specific factors, it may be possible to generalize these findings relative to other organizations. People in organizations should recognize that complex relationships exist between using a collaborative technology to facilitate knowledge sharing and organizational culture. Based on each unique organizational culture, different behaviors would emerge as well as differences in perceptions and attitudes within different job roles or functional areas. This could greatly influence each of the factors discussed below.

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 improvements in client satisfaction by increasing turnaround time and solving client concerns. 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 using this CSCW technology in recognizing potential rewards or punishments for their effective use (or lack of) in providing information and knowledge required by their bosses. Therefore, organizations should understand that there should be a clear reason for using a collaborative technology to share knowledge but also learn to recognize the specific relative advantage for each distinct user group. Each organization should clearly conceptualize and communicate the role a collaborative technology and knowledge sharing can play in the organization and clearly communicate the specific benefits (relative advantage) it may provide to each unique user group.

Another generalization that emerged from this research was the importance of leadership. While relative advantage was shown to be context specific, the role of leaders in promoting and supporting a new innovation appears to be more general. Because leaders have the power and authority to shape the organization, the importance of their support of a new technology can be generalized. Leaders also have the power and authority to

develop reward/compensation structures needed to support the implementation of a new technology like the one studied here as well as the new concept of knowledge sharing. The specific types of structures developed would be unique to each organization because leaders also have different perspectives and priorities regarding technology and knowledge sharing. However, the role of leadership in providing the support and resources may be similar. In addition, 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. The accountability factor is tied to the reward/compensation structure because people who believe they are being held accountable for use and effective knowledge sharing also perceive an associated reward or punishment connected with their actions. Therefore, the associated issue of accountability may be generalized to other organizations who are attempting to

implement a CSCW technology to facilitate knowledge sharing. When people are held accountable for sharing valuable, relevant information using a system such as the one in this study, the implementation will be more effective. 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.

Limitations of the Research

Due to the scope of this project, the sample size was small. In addition, because this CSCW technology represented a new system to the organization studied, it was used it for different purposes and at different levels of intensity, introducing great variability in usage patterns over time. Therefore, it was not surprising that few statistically significant results were found, particularly in the quantitative study. However doing a qualitative study followed by a quantitative study did serve to clearly demonstrate the advantages and disadvantages of each approach. The different research methods produced different results, lending support for a combined research approach. The richness of the open, candid responses from face-to-face interviews provided a richness and depth of

information that could not be replicated with a numerically-based survey. These interviews provided insights into why and how people related to this new technology and knowledge sharing. On the other hand, the value of quantifying respondent's attitudes and perceptions with a larger sample size would have quantified the results and added greater validity and generalizability to the study results. This study would have benefited greatly from a sample size of 340 rather than 34. However, with an entire user population of 47, this was not possible.

In addition, this CSCW technology was used by people in different roles within the organization and for vastly different purposes. Therefore, the actual usage varied dramatically as well as perceptions of performance issues and factors motivating usage. For example, the leadership used this technology intensively for decision-making, were heavily influenced by the relative advantage of access to current information, and saw great potential for organizational learning and client communication. In contrast, the quality assurance associates used this technology on a moderate to infrequent basis to track client problems, saw the major relative advantage as solving client problems, but saw it primarily as an internal communication tool. Therefore, while relative advantage was perceived by all groups as a motivational factor, issues relating to the other factors such as security, management of the information, prior technology experience, or influence on use were perceived very differently, depending on each users role in the organization. Associates perceived use and influence on their use very differently from the leadership team. Thus, in defining the limitations, small sample size, different job roles, and different usage patterns emerged as the greatest factors influencing variations

in both actual usage of the CSCW technology to facilitate knowledge sharing as well as the perceptions of the factors influencing its use. Finally. Interviewer bias cannot be ignored. Despite an attempt to remain objective and impartial in the interviewing and coding process, there still exists a possibility for interviewer bias in the interpretation of the results despite an independent coder reliability check. The same potential for bias may also exist in the questions developed for the web-based survey. Despite review by independent researchers, questions may inadvertently have introduced bias into the study via leading or ambiguous questions. Low variability in several of the responses may be the result of this limitation.

Suggestions for Future Research

Additional empirical studies would help to establish or refute the proposed causal relationships between the other proposed independent variables in the original study model and knowledge-sharing, enabled by a CSCW technology. Specifically, the strength of the correlation between compatibility, training/time, peer influence, trust/communication, technology experience, security concerns, and attitudes towards technology & change could be explored in future studies as well as the major independent variables that did show some correlations.

Because of the scope of the study and the limitations imposed by the field research conditions, these findings should be validated by additional research. In terms of the generalizability to other contexts, organizations, or industries, similar research could be conducted in other situations to establish whether there was consistency in the results. In

addition, there may be cultural considerations influencing the independent variables that would warrant further exploration, especially for multinational corporations.

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 the findings in this study. If access was granted to study time-in-process within an organization for specific tasks before and after or with and without the use of a knowledge sharing digital system, this would also help establish a more quantifiable relationship. Similarly, if a researcher was able to measure the level of innovation 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 conducting customer satisfaction surveys.

Finally, the potential for performance improvement extends to many other dynamic technological systems such as e-commerce. In both business-to business and business-to-consumer applications, this study model could be used to explore which factors similarly influence use in different contexts. Given the potential improvements in time/efficiency, customer satisfaction, and innovation enabled by Internet and e-commerce technologies, there could be many different research projects in this area.

Chapter Summary

In conclusion, this study further validated prior research findings that perceived relative advantage is a strong motivating influence on the use of a new technology, such as the CSCW technology used in this study, to facilitate knowledge sharing. A strong leadership committed to the technology and knowledge sharing as well as reward/incentive systems to support it were also shown to be motivating influences. Furthermore, the results support the hypothesis that knowledge sharing, enabled by a CSCW technology leads to organizational performance improvements including time savings, improved decision making, improved quality of processes and improved problem solving. There was an inferential link between knowledge sharing and client satisfaction as well as improved innovation by sharing ideas and knowledge.

Appendix A: E-Mail Interview Requests

E-Mail Letter for Qualitative In-Depth Interviews

Dear _____:

I am working on my PhD at the University of Missouri. My dissertation involves the diffusion of collaborative technologies within organizations. The contribution I hope to make is to isolate and identify factors that contribute to the effective use of a collaborative technology and knowledge sharing, ultimately leading to performance improvement within the organization. The basic idea is that sharing information and knowledge will allow better access to ideas and knowledge, resulting in improved decision making, problem solving, significant time savings and innovation.

Dr. Halliday has graciously allowed me to study the diffusion and use of BSCW at ABC Laboratories and I have signed a confidentiality statement with him. I have also promised him not to bother the folks at ABC too much. However, I would like to ask your permission to drop by your office some time in the next 3 – 5 weeks to ask you about your perceptions in using BSCW. The interview would be at your convenience and only take about a half hour.

If you might be able to spare a half hour any time between 9:30 am and 1:30 pm during the next few weeks or so, I would greatly appreciate your help with this! If you would please let me know a time that would be convenient for you, that would be great!

Thank you for your help. I look to hearing from you!

Sincerely,

Nory Jones
jonesnb@missouri.edu

E-mail Letter for Quantitative Survey

Dear _____:

Happy New Year! I hope you had a great holiday!

Well, I'm down to the VERY LAST part of my research and I wondered whether I could ask you for just one LAST favor?

Based on all the great information from the interviews, I have developed a short "point & click" web-based survey to quantify everyone's responses. I think that you may find it interesting to go through the survey because it represents a summary of the results from all the interviews.

Therefore, if I could ask you for just a few more minutes of your time to fill out this survey, I would greatly appreciate your time and help!! To complete the survey, just click on this link which will take you to the survey page: http://web.missouri.edu/~c734496/bscwsurvey.htm.

I'll post the results to BSCW when the analyses are complete. Thank you so much for all your help!!

Nory

Appendix B: Interviews Questions (Qualitative Research)

The Diffusion of a Collaborative Technology to Facilitate Knowledge Management
Interview Questions

Today's date:
Place and time:
Subject's name:
Gender:
Job Title:
Approx. age
Degree:

---

1. What do you do and what do you use BSCW for?

2. What have you found to be beneficial about using BSCW? What do you like about it?

(Prompts if needed: time, sharing information, accessibility, etc.)

3. Is there anything you find frustrating / troublesome /awkward about using BSCW? What would you say is the real benefit of using it / would do you like about it?

(Prompts if needed: compatibility with hardware, software, normal work routines, training & time to learn & use system? E.g. What type of compatibility problems have you encountered? How have you had to adapt your normal work routines to use BSCW? How much time & training (support) do you think people need to effectively use BSCW?)

4. Can you comment on what you perceive to be rules relating to using BSCW and how they have affected you?

(Prompts: Should there be rules to manage the information? Why or why not? Is the information well-managed? How should it be managed? Is the information recent? Relevant? Obsolete?)

5. Can you tell me who exerted the greatest influence on your use of BSCW & in what way they influenced you?

(Prompts: what about top execs, managers? What about your peers/colleagues; someone or several people you respect and trust?)

6. If there were some additional rewards to using BSCW, how would this affect you in using it or even finding new uses for it?

(Prompts: how could incentives or rewards improve use of BSCW and sharing knowledge inside or outside ABC?)

7. Can you comment of how you feel about trust and communication within your department and within ABC as a whole and how this would affect your use of BSCW or sharing your knowledge with others?

(Prompts: How do existing communication networks facilitate or impede sharing knowledge with BSCW? How could existing communication networks be facilitated to encourage knowledge-sharing using BSCW?)

8. Have you ever used a system like BSCW before? How do you feel about using computers and the Internet? Do you tend to seek out new technologies; do you consider yourself a technology enthusiast?

(Prompts: How did you feel when you first encountered BSCW? What made you overcome your resistance to it? How do feel about it now? How do you normally feel when confronted with new changes?)

9. Do you ever have any security concerns about using BSCW to share knowledge or information? (inside or outside the company)

10. Can you comment on what potential BSCW and knowledge sharing might have in helping you, your department, or ABC Labs to improve in any way? If so, how? If not, why not?

(Prompts: problem-solving? Time savings? Increased innovations, creativity, idea generation?)

Appendix C: Web-Based Survey (Quantitative Research)

BSCW – Knowledge Sharing Survey

Instructions: Please click on the response that best describes how each of these factors **influences your use of BSCW** as a tool to facilitate the sharing of data, information, or knowledge at ABC Laboratories, Inc.

Your responses are completely confidential. When you complete the survey and click on the submit button, this page is submitted to me anonymously without a return e-mail address.

Your responses are extremely valuable in understanding what motivates people to accept or reject a new technology and their willingness to use a collaborative technology such as BSCW to share knowledge or information for the ultimate purposes of improved communication, time- savings, decision-making, and learning within the organization. I greatly appreciate your time and help with this project!! Nory Jones

1. Below is a list of benefits associated with the use of BSCW. For each benefit please note **the extent to which it influences your own use of BSCW.**

	Has no influence on my use of BSCW				Strongly influences my use of BSCW
The ability to input or access information at any time, from any place.	O	O	O	O	O
The ability to share a central document with multiple people inside ABC Laboratories.	O	O	O	O	O
The ability to share a central document with multiple people outside the company (e.g. clients, cooperators, etc.).	O	O	O	O	O
Version controls that allow people to make changes and archive previous versions of the document.	O	O	O	O	O
The potential to save significant amounts of time in my work.	O	O	O	O	O
The potential to improve performance through shared suggestions.	O	O	O	O	O
The potential to make better decisions based on the most current information available when I need it.	O	O	O	O	O

The potential to improve responsiveness to client needs by sharing their comments with relevant people.	O	O	O	O	O

Comments?

2. For each item listed below, please indicate the extent to which it influences your **willingness to use BSCW** on a regular basis to share your data, information or knowledge.

	Has no influence on my use of BSCW				Strongly influences my use of BSCW
Technical problems using BSCW such as Apple vs. PC platform incompatibility.	O	O	O	O	O
Software problems with BSCW in terms of inputting or accessing information.	O	O	O	O	O
Compatibility with my normal work routines.	O	O	O	O	O
Existing tools available to me such as e-mail, other company internal drives, etc. as alternatives to BSCW	O	O	O	O	O
Difficulty in learning or using BSCW; steep learning curve.	O	O	O	O	O
Lack of time - too many other things to do.	O	O	O	O	O
Ease in using BSCW to share many different types of information with people **inside** the company.	O	O	O	O	O
Difficulty in sharing information with people **outside** of ABC because of the difficulty of teaching them how to use it.	O	O	O	O	O
Our president and CEO.	O	O	O	O	O
My manager(s).	O	O	O	O	O
My colleagues.	O	O	O	O	O
Self-motivation to share information.	O	O	O	O	O
Sharing information helps me and helps others in the company; perceived need in sharing	O	O	O	O	O
Being held accountable for inputting needed information by having this on my performance appraisal.	O	O	O	O	O

Expected part of my job. No rewards or incentives are needed.	O	O	O	O	O
Monetary or non-monetary rewards should be given to people who take the initiative to input valuable information/knowledge or who are very diligent about maintaining/updating the information on the system.	O	O	O	O	O

	Has no influence on my use of BSCW				Strongly influences my use of BSCW
An intrinsic motivation to help others, help the company, by using a tool like BSCW to share information & knowledge.	O	O	O	O	O
My manager knows whether I use BSCW or not (e.g. I use BSCW because I know my manager monitors my use of it)	O	O	O	O	O
My expertise with computers, software & technology.	O	O	O	O	O
True enjoyment & eagerness to learn and use new computer systems, and software like BSCW.	O	O	O	O	O
Feeling uncomfortable or incompetent with computers or software like BSCW.	O	O	O	O	O
Prior experience with new technologies and software systems.	O	O	O	O	O
Using new systems like BSCW only because it's a required part of my job.	O	O	O	O	O
Insufficient time to continually learn new systems - too many other things to do.	O	O	O	O	O

3. For each item listed below, please check the answer that best represents how strongly you agree or disagree with each statement and whether it influences your use of BSCW or not (last column). (Please note that when the terms "data, information, and knowledge" are used, this is not meant to imply any sensitive or confidential information that you would not be able to share.)

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Data, information and knowledge should be shared with everyone throughout my department.	O	O	O	O	O
Data, information and knowledge should be shared with everyone throughout the entire company.	O	O	O	O	O
I am willing to share my data, information, and knowledge outside the company with my clients, cooperators or suppliers.	O	O	O	O	O
I do not think there are any security problems with using BSCW to share any of my data, information or knowledge with ABC associates.	O	O	O	O	O
I do not think there are any security problems with using BSCW to share data, information or knowledge with people **outside** of ABC such as clients or cooperators.	O	O	O	O	O
I think there is a great danger that hackers can access confidential information on a web-based system like BSCW.	O	O	O	O	O
I do not understand how BSCW works, so I am hesitant about using it to share confidential data or information.	O	O	O	O	O
Managers should be in charge of managing the information on BSCW to make sure it is recent and relevant and the correct people have access to it.	O	O	O	O	O
The IT department should be in charge of managing the information on BSCW to make sure it is recent and relevant and the correct people have access to it.	O	O	O	O	O
I should input information onto BSCW on a routine basis; e.g. using it daily like e-mail.	O	O	O	O	O
I only need to input or look at information on BSCW on an as-needed basis; e.g. in time for meetings, report or budget deadlines, etc.	O	O	O	O	O
There should be training on BSCW in terms of when to input information, how long it should stay on there, who should have access to the information, etc.	O	O	O	O	O
"Success breeds success"; I use BSCW because of the benefits derived from using it.	O	O	O	O	O

Comments?

4. For each item listed below, please indicate how much you think that sharing data, information or knowledge by using BSCW could help you, your department, or ABC Laboratories, Inc.

	No performance improvement				Great performance improvement
Time savings/efficiency gains. (e.g. reducing meetings, making current info available)	O	O	O	O	O
Improved decision-making. (e.g. having the most current information always available to you.)	O	O	O	O	O
Increased client satisfaction. (e.g. improved responsiveness by having client information available to all relevant parties.)	O	O	O	O	O
Improved quality and problem solving. (e.g. having information available from tracking internal processes and problems and making improvements.)	O	O	O	O	O
Increased organizational learning. (e.g. sharing information on new trends, competition, processes, technologies, client needs.)	O	O	O	O	O
Improved competitive advantage: (e.g. decreasing time to complete reports, increasing client responsiveness, improving processes or increasing innovation.)	O	O	O	O	O

Comments?

5. How often do you normally use BSCW to input, access or look at information?

Every day	> 2 times each week	Approx. once each week	> 2 times each month	Approx. once each month	Less than. once each month	Never
O	O	O	O	O	O	O

6. Over the next year, what is your expected usage of BSCW?

Every day	> 2 times each week	Approx. once each week	> 2 times each month	Approx. once each month	Less than. once each month	Never
O	O	O	O	O	O	O

7. How many people do you normally communicate with using BSCW on a weekly basis?

1-2	3-4	5-6	7-8	9-10	>10
O	O	O	O	O	O

8. Other factors that would motivate you to use BSCW more often or effectively to share your knowledge or other comments?

The following optional demographic information will be used for correlation with the other responses.

9. Are you: O Male O Female

Your position at ABC:

Executive/ Top Management	Middle Management	Marketing/ Business Development	QA / Compliance	Associate
O	O	O	O	O

Your age range:

O Under 25	O 25-35	O 36-45	O 46=55	O over 55

Thank you for your time in completing this survey!! Your responses are valuable in this research. Please click on the Submit button to send your results. If you have any questions, please feel free to contact me at: jonesnb@missouri.edu

Submit Cancel

Appendix D: Qualitative Code Report

BSCW Coding Summary

Name: _____

Gender: 1=male, 2=female

Age

1	<25
2	26-35
3	36-45
4	46-55
5	>55

Role:

Role1	Leaders (Upper level executives)
Role2	Managers (Middle management)
Role3	QA, compliance
Role4	Business development, marketing
Role5	Data entry people

Uses:

Use1	Financial: sales, invoices, budgeting, forecasting
Use2	Track and identify internal problems and processes
Use3	Sales and marketing: information, leads.
Use4	Information sharing and review

Benefits/ Relative Advantage:

Ben1	Accessibility (24/7, no physical constraints): **inputting or accessing information**; can work on and input information any time or place.
Ben2	Sharability: multiple users can work on same document; **Internal.**
Ben3	Sharability: can share information with clients; **External**
Ben4	Saves time
Ben5	Improves quality & problem solving
Ben6	Improves decision-making
Ben7	Improves customer satisfaction
Ben8	Historical record of all prior versions
Ben9	Accountability
Ben10	Resource Management

Problems:

Prob1	Technical problems: hardware or software compatibility
Prob2	Not aware of system
Prob3	Not understanding system or its benefits
Prob4	Difficulty in learning system: steep learning curve, cumbersome, not user-friendly
Prob5	Not part of normal work routine (incompatible with work routines)
Prob6	Time pressures
Prob7	Prefer other existing tools (e-mail, internal drives, etc.)
Prob8	No problems

Rules:

Rule 1	Routinization of process
Rule 2	Self-managed/controlled by invitation process
Rule 3	Managed by IS department
Rule 4	Training needed for technology, etiquette, routinization
Rule 5	Driven by department or project requirements/needs
Rule 6	Requires manager to oversee information input, updating, etc. (authority, accountability)

Influences:

Infl 1	Jake (President/CEO)
Infl 2	Accountability
Infl 3	Success breed success (recognition of relative advantage of system; perceived need)
Infl 4	Pressure from outside forces (clients, agency requirements)
Infl5	Managers or peers

Incentives/rewards:

Reward1	Ties to performance appraisal (accountability)
Reward2	Expected part of job (no reward needed)
Reward3	Incentives needed to overcome initial resistance to trying it or making it routine
Reward4	Incentives/rewards for sharing valuable knowledge
Reward5	Intrinsic motivation to share knowledge
Reward6	Perceived relative advantage in using it
Reward7	Disincentives; use it or else!

Trust/Communication:

T1	Based on existing culture.
T2	Scientist hoard knowledge
T3	Relative advantage to sharing knowledge; common good of company
T4	Competition between divisions or different knowledge; no need to share knowledge
T5	Client confidentiality

Computer Experience:

Comexp1	Just a user
Comexp2	High level of expertise
Comexp3	Not competent or comfortable with computers
Comexp4	Eager to learn new technologies
Comexp5	Age-related attitudes
Comexp6	Accepting of (resigned to) continual changes and new technologies
Comexp7	Prior experience with technology helps adapt to new; comfortable with computers
Comexp8	Perceived for new technology (relative advantage)

Security:

Sec1	No security concerns (system has built-in security, inviting system)
Sec2	Client confidentiality issues
Sec3	Fear of hackers from the Internet
Sec4	Not understanding system

Potential Performance Improvements:

Perform1	Time savings/ efficiency gain
Perform2	Accessibility (Ability to input/capture information, knowledge)
Perform3	Sharability
Perform4	Better decision making
Perform5	Increased client satisfaction
Perform6	Increased quality
Perform7	Increased learning within organization

REFERENCES

Aggarwal, P., & Cha, T. (1997). Surrogate buyers and the new product adoption process: a conceptualization and managerial framework. *Journal of Consumer Marketing, 14*(4-5), 391-401.

Alange, S., Jacobsson, S., & Jarnehammar, A. (1998). Some aspects of an analytical framework for studying the diffusion of organizational innovations. *Technology Analysis and Strategic Management, 10*(1), 3-21.

Anonymous. (1997). Worldwide Vision. *Informationweek, 649*, 246-250.

Anonymous. (1998). Contract Research Toolkit. *Supply Management, 3*(12), 45.

Anonymous. (1999). Knowledge-sharing roundtable. *Informationweek, 731*, 6ER-12ER.

Barker, R. T. (1998). The role of communication in creating and maintaining a learning organization: Preconditions, indicators, and disciplines. *The Journal of Business Communication, 35*(4), 443-468.

Barker, R. T., & Camarata, M. R. (1998). The role of communication in creating and maintaining a learning organization: Preconditions, indicators, and disciplines. *Journal of Business Communication, 35*(4), 443-467.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management, 17*, 791-800.

Bassi, L., Cheney, S., & Lewis, E. (1998). Trends in workplace learning: Supply and demand in interesting times. *Training & Development, 52*(11), 51-75.

Beckman, J. (1999). The Current State of Knowledge Management. In J. Liebowitz (Ed.), *Knowledge Management Handbook* (pp. 1-22). Boca Raton: CRC Press.

Bierly, P., & Chakrabarti, A. (1996). Determinants of Technology Cycle Time in the U.S. Pharmaceutical Industry. *R&D Management, 26*(2), 115-126.

Bikson, T. K. (1996). Groupware at the World Bank. In C. U. Ciborra (Ed.), *Groupware & Teamwork* : John Wiley & Sons, Ltd.

Chrisensen, L. (1991). *Experimental Methodology*. (Fifth ed.). Boston: Allyn and Bacon.

Ciborra, C. I. (1996a). What does groupware mean for the organizations hosting it? In C. I. Ciborra (Ed.), *Groupware & Teamwork* (pp. 1-19). New York: John Wiley & Sons.

Ciborra, C. U. (1996b). Groupware & Teamwork: Invisible Aid or Hindrance. In C. U. Ciborra (Ed.), *Groupware & Teamwork* (pp. 1-21). New York: John Wiley & Sons, Ltd.

Ciborra, C. U. (1996c). Mission Critical: Challenges for Groupware in a Pharmaceutical Company. In C. U. Ciborra (Ed.), *Groupware & Teamwork* (pp. 91-120). New York: John Wiley & Sons, Ltd.

Ciborra, C. U., & Patriotta, G. (1996). Groupware & Teamwork in New Product Development: The Case of a Consumer Goods Multinational. In C. U. Ciborra (Ed.), *Groupware & Teamwork* (pp. 121-142). New York: John Wiley & Sons, Ltd.

Ciborra, C. U., & Suetens, N. (1996). Groupware for an Emerging Virtual Organization. In C. U. Ciborra (Ed.), *Groupware & Teamwork* (pp. 185-209). New York: John Wiley & Sons, Ltd.

Coleman, D. (1999). Groupware: Collaboration and Knowledge Sharing. In J. Liebowitz (Ed.), *Knowledge Management Handbook* . Boca Raton: CRC Press.

Coutu, D. L. (1998). Trust in virtual teams. *Harvard Business Review, 76*(3), 20-21.

Daugherty, P. J., Germain, R., & Droge, C. (1995). Predicting EDI technology adoption in logistics management: The influence of context and structure. *Logistics and Transportation Review, 331*(4), 309-325.

Davenport, T. H. (1999). Knowledge Management & The Broader Firm: Strategy, Advantage & Performance. In J. Liebowitz (Ed.), *Knowledge Management Handbook* . Boca Raton: CRC Press.

Davenport, T. H., DeLong, D. W., & Beers, M. C. (1998). Successful Knowledge Management Projects. *Sloan Management Review, 39*(2), 43-57.

DeSanctis, G., & Poole, M. S. (1994). Capturing the complexity in advanced technology use: Adaptive structuration theory. *Organization Science, 5*(2), 121-147.

Dong, D., & Saha, A. (1998). He came, he saw, (and) he waited: An empirical analysis of inertia in technology adoption. *Applied Economics, 30*(7), 893-908.

D'Souza, M. E. (1996). *The Development & Evaluation of a Computer-Supported Collaborative Work System to Enhance Product Development.* Unpublished Doctoral Dissertation, Clemson University, Clemson.

Elliott, S., & O'Dell, C. (1999). Sharing knowledge & best practices: The hows and whys of tapping your organization's hidden reservoirs of knowledge. *Healthcare Forum Journal, 42*(3), 34-37.

Failla, A. (1996). Technologies for Co-coordinating in a Software Factory. In C. U. Ciborra (Ed.), *Groupware & Teamwork* (pp. 61-88). New York: John Wiley & Sons, Ltd.

Greengard, S. (1998). Will Your Culture Support KM (Knowledge Management)? *Workforce, 77*(10), 93-94.

Hellriegel, D., & Slocum, J. W. (1996). *Management.* (Seventh ed.). Cincinnati: South-Western College Publishing.

Hord, S. M., Rutherford, W. L., Huling-Austin, L., & Hall, G. E. (1998). *Taking Charge of Change.* (Third ed.). Austin: Southwest Educational Development Laboratory.

Howells, J., & Howells, J. (1999). Research and technology outsourcing. *Technology Analysis & Strategic Management, 11*(1), 17-29.

Hu, P. J., & Chau, P. Y. K. (1999). Examining the Technology Acceptance Model Using Physician Acceptance of Telemedicine. *Journal of Management Information Systems, 16*(2), 91-113.

Iacobucci, D. (1996). Network Models of the Diffusion of Innovations. *Journal of Marketing, 60*(3), 134-135.

Irwin, J. G., Hoffman, J. J., & Geiger, S. W. (1998). The effect of technological adoption on organizational performance: Organization size and environmental munificence as moderators. *The International Journal of Organizational Analysis, 6*(1), 50-64.

Jude-York, D. (1998). Technology enhanced teamwork: Aligning individual contributions for superior team performance. *Organization Development Journal, 16*(3), 73-82.

Kaplan, R. S., & Norton, D. P. (1992). The Balanced Scorecard- Measures that Drive Performance. *Harvard Business Review, 70*(1), 71-80.

Kaplan, R. S., & Norton, D. P. (1996). Using the Balanced Scorecard as a Strategic Management System. *Harvard Business Review, 74*(1), 75-85.

Karahanna, E., Straub, D. W., & Chervany, N. L. (1999). Information technology adoption over time: A cross-sectional comparison of pre-adoption and post-adoption beliefs. *MIS Quarterly, 23*(2), 183-213.

Lewis, R. (1998). Membership and Management of a 'Virtual' Team: The Perspectives of a Research Manager. *R & D Management, 28*(1), 5-13.

Liff, A. (1998). Fostering online collaboration and community. *Association Management, 50*(9), 33-38.

Mancini, J. (1998). $500 million just doesn't seem to go very far anymore. *Inform, 12*(3), 6-8.

Mark, G., & Wulf, V. (1999). Changing interpersonal communication through groupware use. *Behaviour & Information Technology, 18*(5), 385-395.

McCracken, G. (1988). *The Long Interview.* (Vol. 13). Newbury Park: Sage Publications.

McCune, J. C. (1998). Working together, but apart. *Management Review, 87*(8), 45-50.

McDermott, R. (1999). Why information technology inspired but cannot deliver knowledge management. *California Management Review, 41*(4), 103-117.

Mcgee, M. K. (1999). Lessons from a cultural revolution - Proctor & Gamble is looking to IT to change its entrenched culture - and vice versa. *InformationWeek*, 46-50.

McGrath, J. E., Arrow, H., Gruenfeeld, D. H., Hollingshead, A. B., & O'Connor, K. M. (1993). Groups, tasks, and technology: The effects of experience and change. *Small Group Research, 24*, 406-420.

McGregor, J., & Gomes, C. (1999). Technology uptake in small and medium-sized enterprises: Some evidence from New Zealand. *Journal of Small Business Management, 37*(3), 94-102.

McLagan, P., & Nel, C. (1995). The dawning of a new age in the workplace. *Journal for Quality & Participation, 18*(2), 10-15.

Nambisan, S., & Wang, Y. M. (1999). Roadblocks to Web technology adoption? *Communications of the ACM, 42*(1), 98-101.

Naude, A. (1999). Contract Research Organizations Grow From the Core. *Chemical Market Reporter, 256*(7), FR17-FR18.

Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science, 5*(1), 14-37.

Orlikowski, W. (1996). Evolving with Notes: Organizational Change and Groupware Technology. In C. U. Ciborra (Ed.), *Groupware & Teamwork* (pp. 23-59): John Wiley & Sons, Ltd.

Pan, S. L., & Scarbrough, H. (1998). A socio-technical view of knowledge-sharing at Buckman Laboratories. *Journal of Knowledge Management, 2*(1), 55-66.

Pan, S. L., & Scarbrough, H. (1999). Knowledge management in practice: An exploratory case study. *Technology Analysis & Strategic Management, 11*(3), 359-374.

Pelton, C. (1999). Share the knowledge. *Informationweek, 737*(188-190).

Puccinelli, B. (1998). Overcoming resistance to change. *Inform, 12*(8), 40-41.

Riesenberger, J. R. (1998). Executive Insights: Knowledge-- the source of sustainable competitive advantage. *Journal of International Marketing, 6*(3), 94-107.

Rogers, E. M. (1995). *Diffusion of Innovations*. (Fourth ed.). New York: The Free Press.

Ross-Flanagan, N. (1998). The virtues(and vices) of virtual colleagues. *Technology Review, 101*(2), 52-59.

Rumizen, M. C. (1998). Report of the second comparative study of knowledge creation conference. *Journal of Knowledge Management, 2*(1), 77-81.

Satzinger, J. W., Garfield, M. J., & Nagasundaram, M. (1999). The creative process: The effects of group memory on individual idea generation. *Journal of Management Information Systems*, 143-153.

Scheraga, D. (1998). Knowledge management competitive advantages become a key issue. *Chemical Market Reporter, 254*(17), 3-6.

Schultz, B. (1996). Collaboration by design. *Network World, 13*(3), SS22-SS24.

Senge, P. M. (1997). Creating Learning Communities. *Executive Excellence, 14*(3), 17-18.

Solomon, C. (1995). Global Teams: The Ultimate Collaboration. *Personnel Journal, 74*(9), 49-58.

Solomon, C. (1998). Sharing Information Across Borders & Time Zones. *Workforce, 3*(2-Supplemental), 12-18.

Thong, J. Y. L. (1999). An integrated model of information systems adoption in small businesses. *Journal of Management Information Systems, 15*(4), 187-214.

Townsend, A. M., DeMarie, S. M., & Hendrickson, A. R. (1998). Virtual teams: Technology & the workplace of the future. *Academy of Management Executive, 12*(3), 17-29.

Tyre, M. C., & Orlikowski, W. J. (1994). Windows of opportunity: Temporal patterns of technological adaptation in organizations. *Organization Science, 5*(1), 98-119.

Wigg, K. M. (1999). Introducing Knowledge Management into the Enterprise. In J. Liebowitz (Ed.), *Knowledge Management Handbook* . Boca Raton: CRC Press.

Wynn, E. (1996). Groupware in a Regional Health Insurer: Local Innovations & Formative Context in Transition. In C. U. Ciborra (Ed.), *Groupware & Teamwork* (pp. 211-236): John Wiley & Sons, Ltd.

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