The Distribution of Computing: The Knowledge Markets of Distributed Technical Support Specialists

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Abstract

Distributed computing environments place more computer power in the hands of the end-user, and often demand increased technical support. In response, organizations may choose to move technical support personnel close to end-users. This can isolate them from each other, and may limit their ability to share knowledge. Thus, the growth of distributed computing calls for increased ability to share knowledge across organizational boundaries. This paper presents the results of a case study investigating how distributed technologists share knowledge through knowledge markets. We argue that knowledge markets are cultural entities shaped by the underlying work culture of their participants, and that the cultural forces that define knowledge markets are powerful, deeply held and difficult to change. Thus, improving the effectiveness of any given knowledge market will have less to do with the installation of information technology than with the ability to create a facilitating work culture. This study's identification of clique knowledge markets, operating efficiently in parallel to the public knowledge market, may provide a hint of the type of culture that will create fewer knowledge trade barriers.

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INTRODUCTION

Distributed computing, exemplified by client-server systems, is an important trend in organizational computing, with impacts that extend beyond changes to the technological infrastructure (Kling 1980,1982,1987; Sawyer and Southwick, 1996). Distributed computing environments place more computer power in the hands of the end-user. This, in combination with commensurate end-user computing sophistication, demands increased technical support. Thus, as organizations move to distribute their computing into discrete business units, they may also choose to move computer support personnel, referred to in this paper as distributed technical support staff (DTS), to these units.

Moving DTS close to their end-users can, however, inadvertently isolate them from each other. This isolation may limit their ability to share knowledge and can waste organizational resources if several individuals simultaneously work to solve similar problems. Thus, the growth of distributed computing in organizations calls for increased sharing of knowledge among DTS across organizational boundaries (Heckman, 1998).

Because of issues like those facing the DTS, interest in techniques for sharing important job-related knowledge among organizational members is growing. This interest, coupled with the increasing power and flexibility of information technologies, has given rise to the 'knowledge management' movement. In this context, knowledge management is defined as an organized and planned approach to gathering, storing, and distributing knowledge within an organization (Davenport, 1997). One contemporary approach encourages diffusion of existing expertise through naturally occurring "knowledge markets"(Davenport and Prusak, 1998; Ernst & Young CBI, 1997). Knowledge markets draw their participants from groups connected via what some call radial personal networks (Rogers & Rogers, 1976), or communities of practice (Orr, 1990; Seeley-Brown & Duguid, 1991) or communities of interaction (Nonaka and Takeuchi, 1995). In this paper, we use the term "informal social networks" as a broad descriptor that encompasses these concepts. Sharing expert knowledge through informal social networks allows members to reap the benefiits from that learned by the most expert. Furthermore, knowledge transfer via both formal and informal social networks takes advantage of the richness embedded in the social realm. The knowledge market

approach however, assumes that no "trade barriers" exist, and that knowledge flows relatively freely through the marketplace.

The temperamental technical complexity of most organization's computing infrastructures and the rapid pace of technological change require DTS to constantly "learn through work"(Seeley Brown and Duguid, 1991). The DTS are similar to Orr's (1990) technicians in that their work requires frequent non-canonical practice. A need for constant learning from others' experiences makes it imperative that DTS develop a strong social network in order to share information. The physical dispersal of DTS into functional units however, isolates DTS from one another and may impede their ability to share knowledge in this manner. Furthermore, culturally based trade barriers may stymie the flow of knowledge in knowledge markets.

This paper presents the results of exploratory field-research: a case study investigating how distributed technologists share knowledge through knowledge markets. Knowledge markets, an example of natural cooperation or discretionary collaboration, rely upon behavioral factors such as reciprocity, repute, altruism and trust to govern exchanges (Smith, Carrol and Ashford, 1995; Heckman, 1998; Davenport and Prusak, 1998). Knowledge markets are composed of repeated patterns of behaviors – they arise from a group of people sharing knowledge over time. In this case, this suggests that knowledge markets are aspects of the work culture that is created among the DTS who share knowledge using their informal and formal social networks. This perspective leads us to using a cultural approach to understand the DTS knowledge market.

Following the discussion of the importance of knowledge markets in distributed computing environments, the paper continues with a discussionof pertinent literature. This includes a review of current knowledge management work and the connection between this work and social exchange theory. Schein's (1997) model of organizational (or work)cultures is presented as the basis for describing the DTS knowledge market culture. Following that, the third section includes a description of the research approach, data collection and analysis, and the findings. The final section includes a discussion of the findings -- drawing conclusions based on both previous research and the current data -- and suggests directions for future research.

The Importance of Knowledge Markets in a Distributed Environment

Understanding, in detail, the role of knowledge markets in the distribution of knowledge among DTS is critical to organizations for several reasons. First, improving knowledge sharing among DTS may help attract and retain high quality personnel.

Second, consideration of the social context of knowledge management impacts the development of reward systems. Finally, improving knowledge sharing should improve organizational efficiency, effectiveness and performance.

Increased knowledge sharing among DTS will help reduce their work stress and increase their retention. This is an important organizational consideration given that the current shortage of trained IT personnel. More than one IT job in ten is current unfilled (ITAA, 1997). For areas such as DTS, this shortage is exacerbated by the need to have both cutting-edge technical skills and excellent people and management skills. For example, in the course of this study we found that DTS jobs at the studied site turn-over every 30 months and more than 15% of the positions are vacant at any one time.

A thorough understanding of the social context of a knowledge market in any given organization should underlie the development of both the administrative mechanisms (such as reward structures and guidelines of practice) and information systems to gather, store, and disseminate knowledge. The use of incorrect reward systems limits the value of a knowledge management system. For example, Orlikowski (1993) found that the individually-oriented reward structure of the large consulting firm she studied doomed the use of Lotus Notes as a means to manage knowledge among the consulting staff.

Improving knowledge sharing among DTS will improve their ability to support the organization's computing infrastructure. Although the computing infrastructure of each functional unit may vary greatly, DTS often find themselves facing the same kinds of technical and non-technical problems (e.g. "What is the easiest way to keep records of the work I do for my users?"). By sharing expertise and knowledge, DTS can avoid duplicating efforts and wasting organizational resources.

KNOWLEDGE MANAGEMENT, EXCHANGE THEORY AND WORK CULTURE

Knowledge markets are implicitly grounded on assumptions that are central to social exchange theory (Homans, 1950). And, these knowledge markets arise from within the cultural context of the members of that market – in this case the DTS's work culture. The following sub-sections provide a brief overview of all three: knowledge management, the underlying precepts of social exchange theory, and Schein's (1997) model of work cultures in organizations. This model provides a framework for our data analysis and illuminates the underlying cultural assumptions which guide behavior in the knowledge market.

Knowledge Management

The contemporary knowledge management literature is largely normative, suggesting strategies for improving the management of knowledge and information in large organizations (Davenport & Prusak, 1998; Davenport, 1997; Stuart, 1997; Brethenoux, 1997; Blair, 1997; Demarest, 1997, Nonaka and Takeuchi, 1995). Knowledge includes values, insights and contextual information and it distinguishes knowledge from information by characterizing knowledge as an outcome of information (Davenport and Prusak, 1998; Stewart 1997).

Davenport and Prusak (1998) provide a concept for understanding knowledge sharing called a "knowledge market". It depicts organizational actors as knowledge buyers or sellers within a marketplace. The knowledge market draws on the idea of a community's information markets - a concept well defined within the information science literature (e.g. Kingma, 1996; Schwuchow, 1995; Foldi, 1986). Davenport and Prusak (1998) however, focus specifically on information markets *within* organizations. The knowledge market concept defines knowledge buyers as "people trying to solve an issue whose complexity or uncertainty precludes an easy answer". It further defines "knowledge sellers" as "people in an organization with an internal market reputation for having substantial knowledge about a process or subject"(pg. 28).

Social Exchange Theory

The knowledge market concept contains the precepts of social exchange theory. That is, the existence of a knowledge market assumes that knowledge sellers, as rational actors, will evaluate the potential costs and rewards of sharing their knowledge with a particular knowledge buyer. The decision to share knowledge with another results from the seller's conclusion that the buyer can offer some reward - either extrinsic (e.g. help with another problem in the future) or intrinsic (gratitude, friendship).

Exchange theory depicts people as rational profit seekers choosing between alternative actions in order to obtain the greatest value at the lowest possible costs. As Blau (1964) explains "human beings choose between alternative potential associates or courses of action by evaluating the experiences or expected experiences with each other in terms of a preference ranking and then selecting the best alternative" (p.129). Social exchange theory provides a useful theoretical backdrop for explaining *why* individuals choose to exchange knowledge with others (Mohr, 1982; Blau, 1964; Emerson, 1962; Ritzer, 1996). Social exchange theory draws on both economics' rational choice theory and psychology's behaviorism to study dyads and group relationships, or "exchanges", in

terms of the costs and rewards to their participants. Rewards for exchanges may be extrinsic, such as material goods, or intrinsic, such as social approval or friendship.

Work Cultures in Organizations

An organization's culture shapes how it's members work and the knowledge markets in which these members participate. These worker's behaviors, influenced by the behaviors of their peers, are repeated over time and this repitition leads to the formation of cultural norms and culturally accepted forms of action. One of these actions is the formation of the work cutlure's knowledge market(s). Schein's (1997) model is a useful way to describe an organization's work cultures. Table 1 presents the three interacting levels of Schein's (1992) model of culture. Schein defines culture as:

> "a pattern of basic assumptions that the group learned as it solved its problems... that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems (Schein, 1997: p. 12)."

We selected this model for two reasons. First, the model arose from studies of the work cultures of organizations and the DTS work culture is one such example. Second, the model is well known in the broad research community that is interested in the issues of work in organizations.

Table I: Schein's Cultural Model

Artifacts And Creations	Schein describes artifacts as "the visible behavior of the group and the organizational processes into which such behavior is made routine, written and spoken language, artistic production and the overt behavior of its members" (Schein, 1997: p 17).
Espoused Values	"Derived beliefs and morals (which) remain conscious and are explicitly articulated because they serve the normative function of guiding members of the group in how to deal with certain key situations and in training new members how to behave...What people will *say* in a variety of situations... (but not) they will actually *do* in situations where those values should, in fact, be operating" (Schein, 1997: p 20).
Basic Assumptions	"(Beliefs which) have become so taken for granted that one finds little variation in the cultural unit... (defines) what to pay attention to, what things mean, how to react emotionally to what is going on, and what actions to take in various situations" (Schein, 1997: p 22).

This categorization provides a relatively accessible means to understand the cultural forces in play at work. For instance, in an organization promoting the importance and use of cross-functional teams, both the team's weekly status meeting and the individual reward structures are examples of "artifacts." The teamwork slogans on the walls of the meeting room are an example of the work culture's espoused values. However, each individual's quest for personal glory reflects an underlying basic assumption that individual recognition is the best means to earn rewards (and reinforced by individual performance based reward structure artifact) helps to both explain why espoused values are not always enacted and how artifacts reflect deeply-held assumptions of that work culture.

CONDUCTING THE RESEARCH

Data collection employed a multi-method approach including electronic collection of listserv messages, open-ended interviews and participant observation of meetings. This multimethod approach allows the research team to triangulate data from multiple sources in order to both increase validity and gain deeper understanding of the collected data (Jick, 1979; Brewer and Hunter, 1989; Gallivan, 1997). The rest of this section presents information about the site, our data collection efforts and our data analysis.

The Site

This study focused on a group of thirty DTS at a medium-sized, research-oriented university. In the early 1990's the site began a transition away from a mainframe-based computing environment toward a client/server architecture. In the mainframe environment, all computer support services came from a centralized technology support unit (Central IT). In 1991 several business units requested financial assistance from Central IT in order to hire their own computer support personnel to support the growth in desktop computing. In response to these requests Central IT began a formal program to subsidize the salaries of the distributed computer support personnel for the business units. By establishing the subsidy program Central IT leaders hoped to shift some of the costs of the planned desktop-centric client/server change to the business units.

Presently, each DTS reports directly to a supervisor in their business unit, and maintain a "dotted line" relationship with the DTS program coordinator (an employee of Central IT). In exchange for the salary subsidy, Central IT asks that the DTS participate in two monthly meetings with their peers. These are led by the DTS coordinator. In addition, this coordinator maintains a DTS listserv, to which all the DTS (and many

central IT employees) belong. According to the DTS coordinator, the meetings and the listserv are intended to create an atmosphere that will "foster cooperation" between the DTS. The coordinator is unwilling to penalize individual DTS for choosing not to participate in the meetings and the listserv because of the heavy time demands placed on the DTS by their business units, and a "hands off" policy promoted by the VP of Computing at the site.

Revelatory Nature of the Site

The site had several revelatory aspects. First, it lacked any official knowledge management efforts. Absence of any sponsored knowledge management program allowed the researchers to observe the knowledge market in a natural state. Second, the site's commitment to a complete transition to client-server technology means increased responsibility, influence and power for the DTS. A third revelatory aspect is the "federal" IT architecture of the site (Brown, 1997; King, 1983). Fourth, DTS comprise a virtual community of practice (Orr 1990, Seeley-Brown & Duguid, 1991). They infrequently meet physically, but use electronic mail, voice mail and phone calls to communicate with each other. Lessons learned from this study are applicable to many other scenarios involving teams of physically separated technical specialists sharing knowledge through knowledge markets. Given the exploratory nature of the research and the revelatory nature of this site, the case study method is the appropriate research method (Yin, 1990).

Data Collection

The research team used three data collection techniques: electronic collection of postings on the group's listserv, semi-structured interviews with the DTS, and participant observations of bimonthly staff meetings. Site observations and documentation analysis began in March 1996. Listserv data collection ended in January 1997. Observation of meetings and follow up interviews continued until August 1997. The use of different data collection techniques has allowed for the triangulation of findings (Jick, 1979; Brewer and Hunter, 1989).

Data include 248 listserv messages posted to the DTS listserv, 26 formal interviews ranging from 45 to 90 minutes in length, eight informal follow-up interviews, and observations of 24 bimonthly meetings. One researcher conducted all interviews, using the active interview method (Holstein & Gubrium, 1995).

Data Analysis

We analyzed the interview, observation and listserv data using the analytic inductive technique (Shelly & Silbert, 1992, Dewey, 1938; Znaniecki, 1934). Analytic inductive analysis begins by grouping together like data into preliminary categories. Observing commonalties among the grouped data leads to the creation of a definition of these categories and identification of their attributes.

We tested working hypotheses by examining interview, observation and listserv data in the code categories in matrix form (Miles & Huberman, 1994). From this, we created a smaller list of eight to ten prevalent themes expressed by the data. Higher level analysis made use of the theme lists created for each code category. Table II provides an example of the theme lists for a sampling of code categories.

Table II: Theme Lists From a Sampling of Code Categories

DTS Meetings	**Interaction with Others**	**Stress Patterns**
Can't get to know others personally	Can't show your deficiencies	Time vs. overtime
Good way to evaluate others	Group feeling, share ideas, isolation, time together to network	Burnout !
Broadcast oriented style, manager chooses what to talk about	Frustration, annoyance, jobs so diverse that interaction is difficult	Learning curves
Good way to gather new information, get diverse points of view	Interaction takes up too much time	Driven/Drive technology changes
Home unit demands preclude attendance	Social time, friends mostly no time	Freedom in job

THE DTS KNOWLEDGE MARKET CULTURE

Table III summarizes the findings, and provides a framework for the discussion which follows. The findings section is organized so thate each sub-section of text

corresponds to a level of Schein's three cultural model, reflecting the artifacts, espoused values and assumptions of the DTS work culture relative to their knowledge market.

Table III: Cultural Model of the DTS Knowledge Market

Artifacts And Creations	• The Physical Distribution of the DTS Personnel • Listserv • Meetings
Espoused Values	• Cooperation Is Important • We Are A Group
Underlying Assumptions	• I Am Alone In The World • I Can Only Count On My Friends To Help Me • Technical Knowledge Brings Social Power

Artifacts

The artifacts level includes physical manifestations, language, stories, technology and visible traditions (Schein, 1992; Schultz, 1994). In studying the knowledge market culture of the DTS, three important artifacts emerged: The physically distributed environment in which the DTS work; the lack of listserv based knowledge exchange; and the lack of meeting based knowledge exchange. The following paragraphs discuss each of these points in more detail.

Physical Distribution

Most DTS did not see other DTS very often apart from the monthly meetings. Day to day life involved interaction with business unit co-workers, not chatting with other DTS. Most DTS had much stronger personal relationships with users in their business units than with other DTS. For the most part, DTS did not think of each other as co-workers. For example, one DTS explained that he never forwarded jokes to the DTS listserv. He would only forward them to the co-workers he worked with on a daily basis in his business unit.

The DTS' offices were scattered around the campus, and a few had offices quite distant from the others. One of the most physically isolated DTS reported feeling like

"Moses coming out of the hills" when he left his office. Several DTS who had previously worked co-located with other information technology workers reminisced about how much co-location facilitated knowledge sharing. "You can run into someone at the coffee machine and ask them a question, or you can learn new skills just by watching over someone's shoulder".

The Listserv

To understand the use of the listserv, the listserv messages were analyzed by first dividing them into messages from Central IT (CIT), messages from the DTS coordinator (DC) and messages from the distributed technical staff group members (DTS). Following this division, the divided messages were sub-coded into three main message types: offers, help requests, and answers.

First, listserv members can post information offers, which assume some information need and attempt to fulfill that need by forwarding useful information. Second, members can solicit answers to questions through a help request posting. Finally members can post answers to help requests posted by others. Table IV presents a detailed summary of listserv message traffic during the six month observation period.

In general, the DTS did not make heavy use of the listserv to exchange knowledge or information. During the study period, 43% of the DTS did not use the listserv at all. Of the 57% that used the listserv, only four people posted more than two messages, and three DTS accounted for 25 out of the total 34 DTS messages.

Table IV: Overview of Listserv Message Traffic

Total Messages		**248**	**Percentage**
Messages from Central IT			
	CIT Total	**161**	**65%**
	CIT Offers	147	59%
	CIT Help Requests	14	6%
	CIT Answers		
Messages from Distributed Technician Group Coordinator			
	DC Total	**53**	**21%**
	DC Offers	50	20%
	DC Help Requests	1	< 1%

	DC Answers	2	< 1 %
Messages from Distributed Technician Group Members			
	DTS Total	**34**	**14 %**
	DTS Offers	16	6 %
	DTS Help Requests	16	6 %
	DTS Answers	2	< 1 %

Further, the DTS almost exclusively posted questions in which they *did not* admit to any lack of technical skill or understanding. Table IV shows that only 16 questions (6% of the total postings), constituted help requests. Of these, 13 questions requested alternative solutions or the location of a resource. In these two types of questions, the questioner always implied they already had at least one possible solution to their problem; or the questioner asked about the location of a particular resource, not how to use it. In a "stuck" question however, the questioner admitted they did not have the ability to solve a problem. Of all the posted questions, only three fell in the “stuck” category.

Finally, the DTS posted only two answers to the 16 posted questions. Follow up electronic mail based interviews revealed that DTS sent another 22 answers directly to the question asker, completely bypassing the listserv. This suggests that the DTS prefer alternative media, including phone calls and private e-mail, to the listserv for exchanging knowledge.

Findings from current literature shows that introducing computer mediated communications (CMC) technology into an environment will not guarantee cooperative behavior. For example, fear of breaking traditional organizational hierarchy protocols, distaste for aggressive communications styles, reluctance to share certain kinds of expertise, and inability to control others' perceptions of their postings may preclude peoples’ usage of CMC tools like listservs.(Orlikowski & Hofman, 1995; Crowston & Kammerer, 1996; Finholt, 1993, Weisband et al., 1995). The listserv data from this study suggest that cultural/behavioral factors inhibit optimal DTS use of their CMC device.

Meetings

Meetings took place twice a month. Most DTS attended either sporadically or not at all. A small group frequently attended. Typically, a small number of assertive, frequently attending members dominated the meetings by asking questions during the

question and answer period or making other short comments during the DTS coordinator's announcements. The group's coordinator was also an active contributor to the meeting's dialog. Frequently, this bordered on monopolization as he tried to stimulate conversation by asking questions. Many of the other DTS never said anything during meetings. Most DTS seem so used to not talking that when the coordinator directly solicited opinions on a subject during a meeting, they would refuse to answer publicly, suggesting instead that the coordinator solicit opinions via electronic mail.

The period directly before and after the meetings, however, served as a prime opportunity for knowledge exchange among DTS. During this post meeting period, DTS congregated informally and talked in small groups from two to ten minutes. "When you go to the meetings, you end up doing business with people. Someone stops you on the way out and says 'Are you doing this?' and that kind of stuff. It just happens." one DTS explained.

Espoused Values

Schultz (1994), writing about Schein's (1992) cultural model, explains that espoused values consist of "what the organization's members say during and about situations, and not necessarily what they do in situations where these values ought to be in operation (Schultz, 1994: p. 28). We derived the following two espoused values based on the content analysis of the listserv, observations of the meetings and the interviews: cooperation is important and we are a group. The following sub-sections describes these espoused values in more detail.

Cooperation is Important

While all DTS would agree with the statement "knowledge sharing is important", they would want to attach qualifiers. The DTS realize that constant technical change and the continual need for new technical skills makes it impossible to have all the knowledge they need to do their jobs. "DTS are set up to fail." one explained, "Without someone to turn to for help, you are screwed". With a few exceptions, the DTS' attitudes about cooperation varied with their level of experience. Less experienced DTS complained about the need for more cooperation. "If I knew people better" one explained "I would have a better understanding of available resources". More experienced DTS were ambivalent. These interviewees often stressed that they didn't have enough time to fulfill their job duties and help solve someone else's problems. One experienced DTS explained

> There are people who have this kind of job, and what they do is never answer their phone, they don't return phone calls, and its a way of filtering....I can see why some people don't want to get involved, its like opening Pandora's box, and its going to be another drain on you.

Most DTS agreed that one should be able to ask others for help, but stressed that one shouldn't ask for *too much* help. "You have to make the person do it on their own. Offer help - but you can't commit your life." "When you ask someone for help, you have to be respectful, you have to do your homework first and be up to speed on things". They acknowledged cooperation and knowledge sharing as important principals, but didn't think anyone should do anything to encourage more of it. One DTS said: "...it happens when it's called for. I wouldn't overhaul everything…."

We Are A Group

The DTS' group status does not equate to automatic knowledge sharing between its members. Participation in the salary subsidy program, the fact that most work directly with end users, and their representation of their business units' interests in the broader organizational community distinguish the DTS from other IT workers on campus. On a day to day basis however, the group status means little for most DTS. The DTS group members are not obligated to share knowledge with other group members. The DTS' work culture does not particularly encourage knowledge sharing among its members. "If I were a new person, I would get the feeling that cooperation is not an issue in terms of what we do... we don't talk about cooperation. If I walked in I would probably get the feeling that after we meet, we just go by ourselves and do whatever we need to do and that's it".

Assumptions

Schein (1992) explains that groups form cultural assumptions from actions or attitudes that help to successfully solve problems. As these actions or attitudes solve problems over and over again they come to be taken for granted. Soon actors see them as the only right way to do things. Based on analysis of the interview, listserv and observational data, we believe the DTS group holds the following knowledge market related assumptions: I am alone in the world, I can only count on my friends to help me, and technical knowledge brings social power. The following paragraphs discuss each of these in more detail.

I Am Alone In The World

Although the DTS espouse a "group" identification, they readily admit that the heterogeneity of their interests, responsibilities and technologies limits what they have in common. Furthermore, they also admit that they cannot expect other members of the group to assist them with their problems. In a high stress, time-pressed environment, some DTS must refuse to help others in order to ensure that they can finish their primary work tasks. To manage this time pressure, several culture based knowledge exchange principals emerged.

This assumption is reflected in a knowledge exchange criteria that we state as: "you should only ask a question of another if you have tried really hard to answer the question yourself, using readily available reference sources." Some DTS refer to questions which don't meet this criteria as "dumb questions". Another principal asserted that you should only ask questions which can be answered in a short amount of time. For example, you cannot ask "How do I set up a server?" but you can ask "Which server file is the virus update on? Virstop 2.1 or Virstop 2.3?". A similar phenomenon was reported by Pentland (1992), where help desk operators could only ask for a technician's assistance under certain culturally established circumstances .

Some DTS had very little interest in getting to know other members better. Many had already established strong relationships which fulfilled their knowledge needs. This attitude manifested itself in the groups' resistance to participating in social events which would encourage social networking. Some admitted that their lack of interest in the events resulted directly from a general lack of interest in meeting other DTS.

I Can Only Count on my Friends to Help Me

The knowledge exchange criteria described above do not to apply to all interactions however. Many DTS reported reserving knowledge requests which violate the principals for certain people. "I would never post that question to the listserv" one DTS explained "I save all my dumb questions for my friends". Another DTS noted "I don't feel bad calling Joe with my PC questions because when I call, he usually has a couple of Mac questions for me". The unwritten rules that you should only ask a question if you have tried really hard to answer it yourself, or that you should only ask easy answerable questions, did not seem to apply in these special relationships. One DTS admitted that he always called his friend when he had a Mac question because calling his friend was much easier than spending time flipping through a manual.

Technical Knowledge Brings Social Power

The DTS see technology as a means to both learn new skills and gain status among their peers. This glorification of technical knowledge encourages them to customize their business units' systems away from Central IT standards to a format which optimally fulfills their business units' needs and highlights their technical skills. This cultural assumption, however, may lead to a situation where, in increasingly customized environments, DTS may become less able to help each other because of the lack of similarity of their technology.

The appearance of "knowing what you are doing" technically is important for gaining status within the group. All the group's members recognize their need to stay current with technology and all show respect for group members with high levels of technical expertise. As one DTS explained "In your job (in the business unit) interpersonal skills are as important, or more important, than technical skills. But in a (DTS) meeting -- technical knowledge is king!".

The appearance of technical expertise is also important for maintaining relationships with specialists in the Central IT group. One DTS told us of how he worked very hard to post "impressive" answers to questions posted to the listserv which the Central IT specialists subscribed to. The goal, he explained, was to increase the amount of respect the Central IT specialists had for him so that they would be more attentive to his help requests in the future.

DTS preferred not to reveal their technical inadequacies to anyone. "Some people would rather crash and burn than say 'I don't know' and try to get some help" one explained. "I always respond directly to the individual because I'm not confident of the way I have gotten stuff to work. I tend to just hack through it" another noted, in explaining his decision not to respond publicly to a posted question. "I don't want any criticism of my answer" another confided. The lack of "stuck" questions shown in Table IV also supports the explanation that DTS try not to reveal technical inadequacies. Stuck questions required the poster to specifically admit to a lack of knowledge in a specific area.

DISCUSSION

The following questions guide our discussion. How can we shed light on the work lives of DTS personnel? How can we describe the DTS knowledge market culture at this site? How can we provide a useful interpretation of that described culture? Schein's model of organizational cultures guided us to think of our data in terms of artifacts, espoused values and assumptions. We have already described the findings related to

each of these parts of the framework. We will briefly review each of them in providing an exchange theory based interpretation of the DTS knowledge market culture.

Physical Distance Between Each DTS

The artifact of the physical distribution of DTS affects their knowledge market in at least three ways. First, it makes it difficult from them to meet and socialize with each other. They do not accidentally run into each other at the water cooler or the coffee machine. Newly hired DTS in particular, have a difficult time meeting other DTS. Therefore, new DTS must enter the knowledge market without really knowing who the knowledge sellers are. Second, their physical distribution makes it inconvenient for DTS to easily share knowledge. Most DTS must walk some distance to physically meet with another DTS. This makes physical collaboration, often needed in a complicated technical environment, inconvenient. Third, the DTS's physical distribution makes it difficult for them to assess one another's' levels of expertise. This means that DTS must form opinions about each other from sources other than personal contact, including broadcast listserv postings, observed behavior during meetings and rumor.

Knowledge Sharing Behavior On The Listserv and During Meetings

The artifacts of the observed listserv and meeting knowledge sharing behavior impacts the DTS knowledge market in several ways. Social exchange theory posits that the DTS will resist posting to the listserv and speaking during meetings because their publicly broadcast questions may reflect dubiously on them and may damage their reputation as a knowledge seller within the knowledge market. This is similar to findings reported by Crowston and Kammerer (1996). The broadcast nature of both the listserv and the meetings heightens the risk. A message sent to the listserv is forwarded to all members of the knowledge market. Words spoken at a meeting are heard by many members of the knowledge market. Therefore, the costs of posting both questions and answers is quite high. Table V depicts the costs and benefits of for question asking and answering on the listserv and during meetings.

Table V: Outcome Matrix Use of Listserv for Question Asking/Answering on the Listserv or During Meetings

	Costs	Rewards

Posting/Asking a Question	Posting a question others perceive as "dumb" may damage knowledge market reputation.	Getting the correct answer. Others may perceive your question as insightful, positively affecting your knowledge market reputation.
Posting/Announcing an Answer	Posting an answer which others perceive as incorrect or misleading may damage knowledge market reputation.	Posting an answer which others perceive as correct or insightful may positively affect knowledge market reputation.

If others interpret a DTS' broadcasted questions and answers as incorrect, or revealing a lack of knowledge, that DTS' perceived value as a knowledge seller within the knowledge market will decrease. On the other hand, if others interpret the DTS' questions or answers as intelligent and insightful, that DTS' perceived value as a knowledge seller within the knowledge market will increase. Others will sell their knowledge to the DTS more easily, assuming the DTS they will have useful knowledge for them sometime in the future.

Cooperation Is Important & We Are a Group

Both of these espoused values depict an idealistic world in which information flows freely between members of the DTS program. In this ideal world, a knowledge market would not exist. DTS would have the time, resources and interest to share their knowledge and expertise with anyone who needed it. The DTS however, do not exist in an ideal world. The real world constraints require them to make decisions about with whom they will share knowledge and what kinds of knowledge they will share.

Some DTS however, do make special efforts to assist others as much as they can. One can still interpret this apparent selflessness within a social exchange theory framework however. Blau (1964) argues that "beneath this seeming selflessness an underlying 'egoism' can be discovered; the tendency to help others is frequently motivated by the expectation that doing so will bring social rewards (e.g. gratitude, social approval)" (pg. 128). Davenport and Prusak (1998) explain that helping others inflates the value of your knowledge on the knowledge market as others learn through the grapevine that you are a good source of help (pg. 33). Thus, even selflessness is not without value on the knowledge market.

Social exchange theory also helps to explain why DTS cannot always enact the espoused values. The group's underlying assumptions provide a means to more accurately reflect the true nature of the knowledge market among DTS. The three assumptions regarding the DTS's knowledge markets -- I am alone in the world, I can only count on my friends to help me, and truth comes from those with greater expertise or experience – help to shape the way the DTS knowledge market functions. This shaping often contradicts the espoused values. However, these assumptions are reflected in the DTS's artifacts.

I Am Alone In The World

This assumption recognizes a basic rule of the knowledge market. A knowledge exchange depends upon perceived potential for reciprocation in the future. DTS should not assume that others will share knowledge with them. No DTS is obliged to assist any other DTS.

I Can Only Count On My Friends To Help Me

This assumption reveals that the previous assumption is not universally true. In some instances, DTS can assume that others will help them. In these instances, which we call "clique markets", DTS can ask questions without concern for their reputation (see Rodgers & Rodgers, 1976, p. 113). Clique market members have such high intergroup credibility that the group knowledge exchange principals are altered. Table VI provides a matrix showing how social exchange helps to highlight the differences in costs and rewards for knowledge exchanges in public and clique knowledge markets.

Table VI presents two types of markets. Clique markets are private markets in which all parties have such credibility that all exchanges occur without hesitation. The seller automatically assumes that the buyer will reciprocate at some point in the future. The broader knowledge market encompasses all the members of the community – the entire group of DTS in this case.

Table VI: Outcome Matrix Use of Social Networks in Knowledge Markets

	Costs		Rewards	
	Question	Answer	Question	Answer
Open Knowledge Market	Fear of refusal, discomfort at making initial social contact. Asking an inappropriate question may hurt your knowledge market reputation.	Providing an incorrect or misleading answer may hurt knowledge market reputation.	Get the information you need; expand social network	Providing correct answer increases your reputation as a good knowledge seller.
Clique Knowledge Market	You owe your friend a favor in the future	Low – friend will not penalize you for giving incorrect information.	Get the information you need; reinforce social relationship	Reinforce social network.

Truth Comes From Those With Greater Expertise Or Experience

The final assumption acknowledges the major currency within the knowledge markets - technical expertise. Davenport and Prusak list reciprocity, repute, altruism and trust as the currencies of the knowledge market (p. 32). The assumption that a person has quality knowledge to sell or give away however, underlies each of their four price factors. McCallister (1995) defines this as cognition-based trust, or trust in the goodness or correctness of someone's information. The high value of perceived technical expertise within the market helps to explain the lack of listserv and meeting based knowledge exchange. Participants are unwilling to risk damage to their reputations by publicly asking or answering a question.

The Knowledge Markets of the DTS

The combination of Schein's cultural model and social exchange theory provides both a rich description and a useful explanation of the DTS work culture which gives rise to the DTS knowledge market culture. Analysis using both revealed three main practices that inadvertently block the flow of knowledge within the DTS knowledge market. First, the challenging workload of the typical DTS does not allow much time for sharing knowledge. Second, people base their opinions of others primarily on actions observed through meetings and listserv postings. Third, new DTS, be they knowledge buyers or sellers, have a difficult time entering the knowledge market.

Increasing the amount of slack time in a DTS schedule might increase knowledge sharing. Davenport and Prusak argue that slack time is one of the best metrics of a firm's real commitment to knowledge management (p. 93). Employees cannot share knowledge with others, or learn new knowledge, if they don't have time. DTS frequently complain

about their busy schedules, the unpredictable "firefighting" aspects of IT management, and lack of time to do long term planning. Furthermore, the lack of slack time prohibits them from forming, joining or strengthening existing, clique networks. Forming or joining one a clique network requires developing close relationships with other DTS. The current workload does not easily accommodate socially oriented activities that encourage such relationships.

As long as people's opinions of one another are based primarily on public signals such as meeting behavior and listserv postings, DTS will hesitate to speak out in these media. Given that the primary knowledge market currency is perceived technical expertise, the risks of speaking out are often just too great. Reducing these risks would encourage DTS to ask more questions and offer more answers, greatly facilitating the flow of information in the market.

A newly hired DTS has little or no knowledge of any other IT personnel at the site. Confronted with a question, he has no idea who to call for help and must rely on the references of the DTS coordinator. Similarly, if a very expert DTS is newly hired, no one will know of, or be able to take advantage of, her expertise for some period of time. Gaining entrance to the knowledge market takes time, as one must figure out who the key players are.

CONCLUSION

These three factors inhibit the free flow of knowledge in the open, public knowledge market described in this study. Yet they inhibit knowledge flow to a lesser degree in the clique sub-markets that also exist. Thus it would probably be naive to think that removal of these "trade barriers" (even if that were possible) would automatically lead to unencumbered public knowledge movement in this organization. People will still view knowledge sharing as a social exchange, and thus make their decisions to contribute based on perceived costs and benefits. We have argued that, to a significant extent, perceived costs and benefits are a function of deeply held underlying cultural assumptions.

We have attempted to show that knowledge markets are cultural entities shaped by the underlying work culture of their participants. The cultural forces that define knowledge markets are powerful, deeply held and difficult to change. Thus, improving the effectiveness of any given knowledge market will have little to do with the installation of formal information technology mechanisms (such as listservs and groupware), and more to do with a thorough understanding of its underlying work

culture. Increasing the effectiveness of knowledge markets requires a series of difficult changes, including changes to basic assumptions and changes to organizational reward structures to promote and support the new underlying assumptions. Only after an organization has accomplished this will members fully utilize enabling technology mechanisms.

This study's identification of clique knowledge markets, operating efficiently in parallel to the public knowledge market, may provide a hint of the type of culture that will create fewer knowledge trade barriers. Clique knowledge markets operate efficiently because rewards are higher than costs. Perhaps this is because the basis for the clique relationship lies (at least partially) outside of the performance mission of the organization. Table VI suggests that much of the reward obtained through questioning and answering in clique markets is simple reinforcement of the social network. Research in other settings suggests that one of the strongest antecedents of discretionary collaboration is the existence of strong relational bonds that lie outside an organization's performance mission (e.g. Heckman & Guskey, 1998). Thus, future efforts to better understand the kind of work cultures which facilitate effective knowledge management might well focus on those factors and deep assumptions which create commitment, trust, and openness in the cultures of discretionary social groups. Perhaps such groups can help us learn how to reduce the costs associated with public knowledge sharing.

References

Alavi, M., & Keen, P. (1991), "Business Teams in an Information Age", *The Information Society*, 6, 179-195.

Bandura, A. (1971), *Social Learning Theory*. General Learning Press, New York.

Brewer, J. and Hunter, A. (1989) *Multimethod Research: A Synthesis of Styles*. Newbury Park:Sage.

Blair, J. (1997) "Key Issues for Knowledge Management" *Gartner Group Research Note/Key Issues K-KMGT-1650*.

Blau, P. (1964), *Exchange and Power in Social Life*. New York:Wiley.

Brethenoux, E., (1997) "Knowledge Management: Myths and Challenges" *Gartner Group Research Note/Strategic Planning Assumptions SPA-ATS 437*.

Brown, C., Magill, S. (1994) "Alignment of the IS Functions with the Enterprise: Toward a Model of Antecedents" *Management Information Science Quarterly* (18)4, 371-403.

Brown, J., Duguid, P. (1991) “Organizational Learning and Communities of Practice” *Organizational Science*, 2(1).

Crowston, K., & Kammerer, E. (1996), “Communicative Style and Gender Differences in Computer-Mediated Communication”, presentation at the Organizational Communication and Information Systems Division of the Academy of Management Meeting, Cincinnati, OH, August 11-14.

Davenport, T. (1997) *Information Ecology*. Oxford:Oxford University Press.

Davenport, T., Prusak, L. (1998) *Working Knowledge: How Organizations Manage What They Know*. Cambridge: Harvard Business School Press.

Demarest, M. (1997) “Understanding Knowledge Management” *Long Range Planning*, 30(3), 374-384.

Dewey, J. (1938), *Logic, The Theory of Inquiry*. New York:Henry Holt and Co.

Emerson, R. (1962), “Power - Dependence Relations”, *American Sociological Review*, *27*, 31-41.

Ernst & Young CBI (1997) *Executives Perspectives on Knowledge in the Organization*. Boston: Ernst & Young Center for Business Innovation and Intelligence.

Finholt, T. (1993), "Outsiders on the inside: Sharing information through a computer archive." Unpublished dissertation, Department of Social and Decision Science, Carnegie Mellon University.

Foldi, T. (1986) "A Sketchy Introduction to the Problems of the Information Market" *International Forum on Information and Documentation*, 11(1), 3.

Gallivan,M. (1997) “Value in Triangulation: A Comparison of Two Approaches for Comgining Quantitative and Qualitative Methods” in Lee, A. Liebenau, J. and De Gross , J. (Eds.) *Qualitative Method in Information Systems.* (pp. 83-107) Chapman & Hall, New York.

Heckman, R. (1998), “Planning to Solve the ‘Skills Problem’ in the Virtual Information Management Organization”, *International Journal of Information Management* Vol

Heckman, R. & Guskey, A. (1998) “The Relationship Between Alumni and University: Toward a Theory of Discretionary Collaborative Behavior,” *Journal of Marketing Theory and Practice*, forthcoming.

Holstein, J. A., & Gubrium, J. F. (1995), *The Active Interview*. Thousand Oaks, CA: Sage.

Homans, G. (1950), *The Human Group*. Brace, New York: Harcourt.

Information Technology Association of America (1997) "Help Wanted: The IT Workforce Gap at the Dawn of a New Century" (URL: http://www.itaa.org).

Jick, T. (1979) “Mixing Qualitative and Quantitative Methods: Triangulation in Action” *Administrative Science Quarterly*, 24, 602-611.

King, J. (1983) “Centralized versus Decentralized Computing: Organizational Considerations and Managemetn Options” *Computing Surveys* 15(4), 320-349.

Kingma, B. (1996) *The Economics of Information: A Guide to Economic and Cost-Benefit Analysis*. Englewood, Colorado:Libraries Unlimited.

Kling, R., (1987), "Defining Boundaries of Computing Across Complex Organizations" in R. Boland and R. Hirschheim (eds.), *Critical Issues in Information Systems.* New York: John-Wiley & Sons.

Kling, R. and Scacchi, W. (1982), "The Web of Computing, Computing Technology as Social Organization", *Advances in Computers*, Vol. 21, New York: Academic Press.

Kling, R., (1980), "Social Analyses of Computing, Theoretical Perspectives in Recent Empirical Research", *Computing Surveys*, 12(1), 61-110.

McAllister, D. J. (1995), "Affect-and Cognition-Based Trust as Foundations for Interpersonal Cooperation in Organizations", *Academy of Management Journal*, 38(1), 24-59.

Miles, M. B., & Huberman, M. A. (1994), *Qualitative Data Analysis, An Expanded Sourcebook*. Beverly Hills: Sage.

Mohr, L. B. (1982), *Explaining Organizational Behavior*. San Francisco, Jossey-Bass.

Nonaka, I., Takeuchi, H.(1995) *The Knowledge Creating Company*. New York: Oxford University Press.

Orlikowski, W. (1993), "Learning From Notes: Organizational Issues in Groupware Implementation", *The Information Society*, 9, 237-250.

Orr, J. (1990), "Sharing Knowledge, Celebrating Identity, Community Memory in a Service Culture", in D. Middleton & D. Edwards (Ed.), *Collective Remembering* (pp. 169-189), Newbury Park: Sage.

Pentland, B. T. (1992), "Organizing Moves in Software Support Hot Lines", *Administrative Science Quarterly, 37*, 527-548.

Ritzer, G. (1996), *Modern Sociological Theory*, New York: McGraw Hill.

Rodgers, E.M., Agarwala-Rodgers, R.(1976) *Communications in Organizations*, New York: The Free Press.

Sawyer, S. & Southwick, R. (1996) "Implementing Client-Server: Issues from the Field" in *The International Office of the Future* Glasson, B., Vogel, D., Bots, P., and Nunamaker, J. (Eds.) New York: Chapman-Hall.

Schein, E. (1996) *Organizational Culture and Leadership, 2nd Edition*, New York: Josey-Bass.

Schultz, M. (1994), *On Studying Organizational Cultures*. Berlin: Walter de Gruyter.

Seeley-Brown, J., Duguid, P. (1991) "Organizational Learning and Communities of Practice", *Organizational Science*,2(1).

Shelly, A., & Silber, E. (1992), "Qualitative Analysis, A Cyclical Process Assisted by Computer", in G. Hueber (Ed.), *Qualitative Analyse, Computereinstaz inder Socioalforshung*, Munich, Vienna: R. Oldenbourg Verlag, 71-114.

Smith, K., Carrol, S. J., & Ashford S. J. (1995), "Intra and Interorganizational Cooperation, Toward a Research Agenda", *Academy of Management Journal*, 38(1), 7-23.

Stuart, T. (1997) *Intellectual Capital*. New Jersey: Doubleday.

Schwuchow, W. (1995) "Measuring the Information Market(s): A Personal Experience" *Journal of Information Science,* 21(2), 123-132.

Weisband, S., P., Schneider, S. K., & Connolly, T. (1995), "Computer-Mediated Communication and Social Information, Status Salience and Status Differences", *Academy of Management Journal*, 38(4), 1124-1151.

Yin, R. (1990) *Case Study Research: Design and Methods* Newbury Park: Sage.

Znaniecki, F. (1934), *The Method of Sociology*. New York:Farrar and Rinehart Inc.