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Improving Work Through HCI: A Case Study on Information Sharing Practices

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Abstract

Companies are realizing the advantage of HCI design principles applied to product and service development. An HCI approach could enhance other areas of the organization as well. This research is focused on the specific organizational problem of information sharing. Research indicates effective information sharing within an organization leads to innovative ideas and enhanced work coordination, both of which result in competitive advantage. We propose that a user-centered approach would improve information sharing across an organization. In this paper, we describe a case study of information sharing practices in a technology product development lab. Observations suggest that an HCI perspective might improve these processes and we offer principles for designing user-centered information sharing systems.

Introduction

Effective information sharing in an organization leads to innovative ideas (Argote and Ingram 2000, Sullivan 1999) and enhanced work coordination (Rouibah and Caskey 2003), both of which result in competitive advantage. While most organizations have no shortage of information, their systems for sharing information might be more effective if they focused more on the people who share information to coordinate work or transform information to knowledge (Sachs 1999, Gold et al. 2001, Davenport et al. 1998). There are many information systems which support the process of information sharing, but the problem arises when information systems do not support the sharing tasks users want or need to engage in.

It is important that information systems be designed with users in mind, since information is useless without people to interpret, apply, and build on it (Stewart 1997). It is also important to understand that such information sharing systems go beyond the computer screen and involve complex interactions between managers, coworkers, and artifacts. The HCI field as a whole strives to understand the user experience—including interactions with technology, artifacts, people, and the environment. We propose that an HCI approach to the problem of information sharing might bring to light critical issues that would inform the design of information sharing systems.

This paper describes a study of the information sharing processes in the research and development lab of a consumer electronics company. The primary author did work for the lab and personally observed some of the information sharing issues that motivated this study. We conducted a case study which involved observing the day-to-day information sharing practices of engineers in this lab and made note of areas where breakdowns occurred.
We found close associations between our findings and HCI theory, suggesting that an HCI approach is relevant to the problem of information sharing and can improve our understanding of this issue.

In the rest of this paper, we review traditional approaches for understanding work processes and identify areas these approaches might not fully address. Next we describe findings from our case study and discuss these findings in terms of HCI and organizational literature. Based on our findings, we make HCI-related recommendations for improving the design of internal applications. We argue that the same user-centered approach that emphasizes the entire user experience and has helped companies succeed in product and service design could do the same for internal system design.

Process approaches to work

Traditional approaches to understanding work processes are good at identifying the tasks and outputs that contribute to organizational goals (Rummler and Brache 1995). These workflow models are helpful for understanding how separate pieces of work fit together and contribute to a broader goal, however they do not tell us about other aspects of how work is done—the ways employees might collaborate or the informal communication that supports the completion of work tasks (Sachs 1995).

Information system design is largely driven by a process perspective of work tasks, but research is beginning to suggest some limitations of using only this perspective (Gold et al. 2001), especially for systems that support complex human activities such as information sharing (Davenport et al. 1998). Understanding the surrounding system of people, artifacts, and organizational culture that mediates these tasks would help us design better systems to support them.

Complex human factors are present in all work systems. People do not use technology information systems in isolation; in fact, the interaction with technology is just part of a larger more complex interaction in a system that involves coworkers, managers, artifacts, and organizational culture. To be effective, these systems must be approached with the same user-centered perspective that companies embrace for the design of the products they produce.

Case study: New product R&D lab

A case study was conducted in the research and development lab of a technology product company. The study focused mainly on the work done in one of the larger units of the lab, comprised of approximately 500 people.

Method

Using the contextual inquiry technique (Beyer and Holtzblatt 1998), we observed and interacted with people from different areas of this unit, including human factors engineers, usability specialists, software developers, testers, and technical writers. We noted the ways people shared information with others in both similar and different roles, and the tools they used to support sharing tasks. We also observed how people collected and used information to make decisions.

Next we conducted affinity diagramming sessions to analyze and interpret our observations. The results were categorized into two separate but related categories—information sharing for work coordination, and information sharing for building knowledge and decision making. Our interpretation of the diagram is fundamentally based on our experience as HCI researchers.

We conducted a “wall walk” session with lab personnel, a method of sharing study data by inviting people from the lab to review and comment on the affinity diagram. The diagram was displayed along the walls of a conference room and people in the lab were free to review the diagram and ask questions. The primary researcher was present in the room; however people were encouraged to add their comments and feedback directly to the diagram. The feedback was incorporated into our analysis and lead to greater understanding of the issues in the lab.
Results

Based on our experience, the issues identified and discussed below are significant contributors to the success of information sharing in an organization. These issues are introduced and then supported by specific observations taken directly from the affinity diagram. Where possible, issues are broken down into component parts that relate directly to HCI and organizational research. However, as to be expected for a systems approach, many of these issues are too complex to be broken apart, and are associated with multiple areas of research.

Internal information systems are difficult to use

The technology information systems used by internal staff to record, transfer and store information are difficult to use. These systems include database interfaces, Word and Excel documents, intranets, and Sharepoint sites. As a result, people we observed during the study were prone to making errors while submitting and retrieving information. We observed people accidentally placing information in the wrong section of a document and referring to information that looked very similar but was actually not the appropriate information for their task. Often, people took extra time to place and retrieve information to avoid these errors, and as a result, interacting with these systems was time-consuming.

It is difficult to use the requirements document because of its size and format:
- Requirements are recorded in a Word document that can reach lengths of 700 pages.
- Information is sometimes in the wrong section or missing.
- Participant caught herself adding content to the wrong section of the document.
- “[Requirements document] is too cumbersome to look through. Like looking for a needle in a haystack.”
- “It’s huge and scary.”

People work around having to use requirements documentation systems:
- The document takes a long time to open from the network, so people download and save a copy of it on their local computers.
- “Just ask [a designer or system engineer] to answer the question from memory.”
“Workarounds contribute to synchronization issues. Making the [documentation system] more accessible would help [prevent] many other problems.”

Many of the lab’s internal applications are developed by its own IT department. Despite the availability of usability labs and testing equipment, none of the applications we asked about had ever been usability tested. System usability is an important component of overall effectiveness. The lab could save a lot of time by testing and making even a few interface-related usability changes to their information systems.

Context determines how people choose to share information

People used several channels to share information, including meetings, hallway conversations, email, instant messaging, Word and Excel documents, written notes, telephone calls, and voicemail messages. People decided which channel to use based on a variety of (often competing) factors: how quickly the information was needed, whether it needed to be 100% accurate or an approximation, the best format for the information, who the information was coming from/going to, the availability of others, and the current stage in the product development cycle.

One possible reason that people use many channels to communicate is because no one channel meets all of their needs. For example, much of the informal communication we observed helped staff coordinate the sharing of information in the formal information systems. The types of coordination tasks we observed included notifying others about something in the system, and clarifying the appropriate action to take with information.

Putting information on the network is not good enough; must notify stakeholders that the information is there:
- Developers email the product team to let them know when new documents are added to the Sharepoint site.

Development context influences how information systems are used:
- Before logging a defect in the tracking system, testers email developers to find out who the defect should be assigned to.
- Depending on the time in product development cycle, discrepancies found during testing are logged as product defects (if early in development) or documentation defects (if late in development). Testers email the human factors engineers to determine what type of defect they have found.

Formal documentation does not drive development:
- Development decisions are made in product team meetings.
- Developers implement code based on meeting discussions.
- The requirements documents record what has been implemented.
- “Documentation is used for two purposes: 1.) Solution that was asked for, 2.) What was implemented.”

At a certain point in the development process, requirements documents switch from planning documents to record documents, as indicated by the last comment from the lab staff. This is an example of how context (development stage) determines how these documents are interpreted and used in the lab.

Clearly, context is important for understanding information sharing practices. Context influenced users’ tasks, goals and motives, all of which should be understood to design effective supporting systems. Technology is part of the overall context but it is not the only factor for how information was shared. We noticed that social and organizational factors, such as job roles and culture were just as (if not more) important.

We observed a lot of independent decision-making when it came to determining how to share information based on context. Factors such as the people involved, the type of information needing to be shared, and work deadlines comprised the context of an information sharing process. Although there were defined procedures for recording and retrieving information, people used the methods best suited for getting a task done and some channels were better suited than others for achieving a result. For example, an email message can communicate the number of defects and the limited amount of time to fix them, whereas an in-person discussion also conveys a sense of urgency that can motivate people to work harder to fix them. In-person conversations add an element of accountability as well, as the receiver can not claim to be unaware of the defect problem.
As the previous example illustrates, sharing information is a social, collaborative activity and perhaps not all activities can be adequately supported through technology (Ackerman 2000).

**People worry about information “freshness”**

The issue of information “freshness” was a significant one. In the rapidly changing environment of product development, plans changed daily, and one of the biggest challenges was keeping everyone informed. When retrieving information, people spent a lot of time trying to determine whether that information was the most current. They often looked at the date the document was modified, if available, to decide whether to accept the information there or check another place to see if the information matched.

**Stale information:**
- Feature documents include embedded screenshots that get out of date very quickly.
- Must check with the source or document author to verify accuracy.

It was not uncommon to find different information about the same thing in separate documents and emails. When this happened, people almost always resorted to asking someone, either in person, by phone, or email, and accepted an answer given this way over anything in a formal document. These findings are related to issues of trust and reliance on people over artifacts when a conflict arose.

**Duplicated information in various documents:**
- Feature documents have a lot of the same information as other planning documents. Most of it is copied and pasted text.
- When plans change, all the instances of that information must be changed too.

**Inconsistency between documents:**
- Designer reviewed three different documents and found three different answers to her question.
- Designer looked up the document revision dates but still decided to call someone to make sure she had the right answer.

**Unequal access to information**

As previously discussed, there are many different ways of sharing information, and people often checked in multiple places to confirm that the information they found was accurate. A small group of people in the lab had access to only some of these information sources and did not realize when they were using outdated information. Although we did not directly observe this situation during the contextual inquiry, different people in the lab talked about this issue, specifically in regards to the product testers who do not work in the same area of the lab as the rest of the product team. The situation described to us involved testers who build test scripts to verify code. Most testers work in a separate area than the rest of the development team, and as a result, rely exclusively on the documentation to write test scripts. Often, a product fails the test and a product defect is logged when the error is not actually in the product code but in the outdated documentation that the test script was based on.

The rest of the development team works in close proximity to one another, so informal hallway meetings and similar interactions communicate new information that trumps the outdated information in documentation. This observation demonstrates two things. First, proximity of work groups affects how smoothly work processes are carried out. The closer the work group, the smoother the work processes. Yet, if it were not for the separate testers, outdated documentation might go unchecked even longer, because communication of close work teams can compensate for outdated documentation.
Duplicated work

While separated group members had less awareness of the work going on in their group, this limited awareness was also found between groups, as many people did not know what work was happening in other groups. We observed people in one unit working together to design and build a new system to track requirements. They did not know that the functionality they were trying to define for this new system had already been built into an application used by a separate unit. A lot of time and effort goes into work that other groups might benefit from, but is duplicated unless an overlap like this one is realized by someone who is aware of work happening in separate places. This realization usually happens when people talk informally.

Duplicated work happens between teams, as well in products over time. The usability group often finds the same usability problems appearing in product after product. Many usability problems are not identified early enough to change in the current product, but can be incorporated into the next product if the problems are shared with that product team. Usability findings are reported in documents and made available to everyone, yet the same problems are occurring. Perhaps different ways of sharing usability information would be more effective.

Documentation system does not represent/capture important information:
- Designers strive for consistency but documentation does not allow for comparing features across products.
- Designers copy text from documentation to ad hoc Excel spreadsheets that compare across products.

Discussion and Recommendations

Better information sharing processes leads to enhanced work coordination and innovation, both of which contribute to competitive advantage. The information systems which support information sharing are crucial for organizational effectiveness and competitive advantage. Picolli and Ives found that the extent that an organization’s processes need to change to adapt to a new technology affects productivity and overall competitive advantage (Picolli and Ives 2005). The more an information system can support the sharing tasks people need to engage in, the more these systems can contribute to organizational competitive advantage.

We developed four HCI-inspired principles that can help in the design of effective information systems. These recommendations combine the findings from the case study, as well as HCI and organizational literature.

Information sharing should be considered a social activity. Information sharing as a social activity is a widely supported idea in the HCI community (Whittaker et al. 1994, Nardi et al. 2002). Our case study supports this idea and suggests that it may be easy to forget it when designing an information system for use in an organizational environment.

We found that the internal information sharing systems in the lab are difficult for the staff to use. We observed people struggling to add content as well as find information they needed with the information systems. People commented that interacting with the large requirements document was tedious, and not as easy to use as more natural forms of communication. As a result, other communication, such as emails and hallway conversations, overrides the information in these systems and amplify other problems discussed above, including information duplication and inconsistency, and staleness.

It is important, especially in an engineering environment, that information be carefully structured and organized. However, approaching the information systems as an artifact that supports a basic social activity could lead to efficiencies and reduce error. Activity theory provides a framework for approaching system design from a basic activity standpoint (Nardi 1996).

Understand the context. People seek out and use information based on their goals. Depending on the task, sometimes general information is all that is needed. Other times, the information needs to be very detailed and accurate if it is to be useful at all. When designing a system for a diverse work group, it is especially important to understand the context of use for each role to ensure the information system supports everyone’s needs.
Organizational process design seeks to understand both individual and organizational goals in order to design information systems that adequately support organizational processes (Katzenstein and Lerch 2000). Our case study findings support the importance of understanding and representing work processes in light of users’ goals. In the research and development environment, one contextual element—the current stage in the product development cycle—is a primary driver of individual goals and work processes. We found that information needs change as a product progresses from early designing and planning to later testing. At different times in development, people need information at varying levels of detail, and will use information from different sources (a formal document versus an informal email).

*Information sharing should be flexible.* Not all contexts or users’ needs can be anticipated. Expect that people will want to use the most effective method of sharing information and allow flexibility where possible. Preece et al. (2002) introduced three key mechanisms: conversation, coordination, and awareness, which are good starting points to be considered in designing useful and usable information sharing systems. The notion of boundary objects is another important concept that provides a perspective to think about and understand shared objects which may support or hinder communication, understanding, and collaboration among people from different communities (Star and Griesemer 1989).

*Conduct system usability tests.* If, like this technology lab, information systems are developed by an internal information technology group, conducting a usability test and incorporating some changes is probably the quickest way to improve the effectiveness of an information sharing application.

Usability issues are not always the most critical issues for every type of system. However, when we consider designing a system that involves complex tasks and information needs to be used and shared, usability issues become one of the most critical issues to be satisfied in design. There is an inverse relationship between system complexity and usability. Often the more information and functionality a system has, the harder it can be to learn and use it to complete tasks efficiently. In addition, a deep understanding of the user—the user’s goals, tasks, and experiences—is necessary to develop a usable system. For information sharing systems, complexity and number of users to support is a challenge. Information sharing is a complex process involving different types of information that should be handled in different ways. In addition, users from different areas of the organization with very different goals and experiences need to be taken into account.

The issues discussed here are not new to the HCI or organizational management literature. However, we think it is important that this study found these issues in this specific type of organizational environment: a product research and development organization, where the need for effective information sharing processes is especially important, as success lies in the acquisition and execution of innovative ideas.

**Conclusion**

In this paper, we propose that an HCI perspective can enhance our understanding and improve the design of organizational information systems.

Traditional approaches to understanding work processes, including the workflow approach, identify the interrelated tasks which contribute to a broader organizational goal; however, they do not tell us about other important aspects of how work is done. An HCI approach, which strives to understand the entire user experience, can bring to light critical issues that can inform the design of information systems. Relevant HCI research areas include usability, computer-supported collaborative work, and computer-mediated communication. Research from organizational management and process design areas supports the need to understand contextual and goal-related information in the design of information systems.

We believe that the findings from this case study conducted in a research and development lab support the importance of an HCI approach to information system design. The information sharing issues identified in this study include usability problems with systems that are difficult to use, contextual factors that affect how people choose to share and use information, issues with information duplication and staleness, and unequal access to information sources. Including an HCI perspective in the design of internal information sharing practices can enhance our understanding of information sharing problems and improve the design of effective systems.

We suggest four HCI-related recommendations based on the case study and related literature. 1.) Approach the design of information systems as artifacts that support a basic social activity; 2.) Study the environmental context to understand the
goals and social context; 3.) Maintain as much flexibility in information sharing systems as possible, and 4.) Conduct usability tests of internal applications.

These HCI-inspired principles can help in the design of effective information systems and contribute to competitive advantage by supporting the sharing tasks that people need to engage in.

Acknowledgments

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