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Naturalistic Observation for Understanding Users: How Technology Professionals Use & Communicate Information at Work

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This study examines how design engineers and technical professionals (hereafter referred to as engineers) in innovative high-tech firms in the U.S. and India communicate and use information in their daily work activities including research, development, and management. By observing engineers in the workplace, it extends our understanding of the engineering workplace, and the information environment in the workplace. This study will provide information useful for improving communication and information methods for accessing information and communicating in the workplace, which will ultimately lead to better job performance, facilitate innovation, and encourage economic growth. This poster focuses on the methodology the researchers used to gather data for the study. Researchers conducted a series of daylong workplace observations with 108 engineers engaged in product design and testing in four U.S. and two India based firms. Using naturalistic observation provided researchers with the ability to see engineers in their workplace carrying out their daily work rather than depending on self-reported data which may be incomplete. The poster focuses on the naturalistic observation method, how it was employed, and lessons learned in conducting the work in the U.S. and India.

Why this study?

Prior research indicates that engineers spend nearly 58% of their workdays communicating, and how they collect and communicate information can vary greatly between different engineering environments. Tenopir and King (2004) note that engineers collect and communicate information in extremely different ways depending on the nature of their work. Research also shows that development professionals are more likely to rely on oral communications with subject area experts on their development teams to fill subject specific information needs, than they are to access a range of documents (Tenopir & King, 2004). Additionally, engineers tend to resist change in terms of using information or adopting new technologies and innovations. This is an important problem since design engineers are some of the heaviest users of information and innovative information technologies on a daily basis. (Tenopir & King, 2004)

Engineers' resistance to change and the variation in their communication and information habits, makes it challenging to design better information delivery and communication systems, products, and services. This study addresses that challenge by providing a picture of the specific communication and information seeking methods engineers use daily in their normal work environments.

Study Overview

The study was conducted in the U.S. in summer 2005 and in India in December 2005. It was led by a team of University of Tennessee researchers. The work in India was a collaboration with researchers from University of Mysore.

This research was supported by funding from the Institute of Electrical and Electronic Engineers (IEEE). The IEEE team identified innovative hi-tech firms in the software, hardware, medical device, and telecommunication industries. IEEE then contacted the targeted companies, provided details of the study, assured them of confidentiality, and asked them to participate. Non-disclosure agreements were signed with all firms that agreed to participate in the study. Once a part of the study, management within each firm designated which technical professionals would be included as participants. Four U.S. companies and two India companies provided access to their work-sites. India companies were included in this research because India is acknowledged as a major force in technology innovation.

It is important to set the context of the study in order to better understand the study's methodology. A total of 107 design engineers and technical professionals participated in the study. Study participants were active members of a design and development team for

a product, service or system. Participants had a variety of project roles and responsibilities, and their work experience at the firms ranged from new hires to experienced, senior staff. For easier reference in this report we are referring to our participants as engineers, and throughout the report when we use the term engineers we are also referring to the technical professionals in the sample. Two thirds of the sample (67%) were engineers at U.S. based companies and the remaining third were at India based companies. These engineers were observed for a total of 593.5 working hours (406.4 working hours in the U.S., 187.1 working hours in India). The term working hours is used because our observations include multitasking minutes in which the engineer may be engaging in two or more activities at one time.

Company A (USA)

Company A designs and manufactures semiconductors with applications in automotive and consumer electronics, industrial control, motor control, networking, and wireless industries. Company A is also making advances in software design. Company A has design, research, manufacturing, and/or sales operations in more than thirty-two countries. It is headquartered in the southwestern U.S. **Participants**: 22 Engineers (18 men, 4 women) were observed for a total of 8440 minutes (140.7 hours).

Company B (USA)

Company B is one of the world's leading manufacturers of microcomputer processing chips. Company B also produces computer networking and communications products. Company B's operations are carried out in 294 offices and facilities worldwide. It is based on the West Coast of the U.S. **Participants**: 29 Engineers (24 men, 5 women) were observed for a total of 9031 minutes (150.5 hours).

Company C (USA)

Company C designs, develops, manufactures, and distributes cardiovascular medical products. It has operations throughout the U.S. and Europe and is based in the Upper Midwest. **Participants**: 9 Engineers (9 men; 0 women), were observed for a total of 3720 minutes (62 hours).

Company D (USA)

Company D is a world leader in information technology and specializes in the production and development of information technologies, including computer systems, software, networking systems, storage devices and microelectronics. Company D has manufacturing and research operations in North America, Asia, and Europe. Observations were made in the Southeaster U.S. office. **Participants**: nine Engineers, (7 men, 2 women) were observed for a total of 3190 minutes (53.2 hours).

Company E (India)

Company E is one of India's largest corporations operating in seven areas of business including information systems and communications, engineering, materials, services, energy, consumer products and chemicals. The group exports to 140 countries across the globe. Observations were made in Bangalore, India. **Participants**: twenty-two Engineers, (20 men, 2 women) were observed.

Company F (India)

Company F is a global leader in consulting and IT services. Company F works with its customer's extant assets to produce new business models and solutions as well as leveraging technology and software. Company F also maintains offices in China, Belgium, Germany, the United Kingdom, Australia, Italy, France, Sweden, Switzerland, Canada, and Japan. Observations were made in Bangalore, India. **Participants**: twelve Engineers, (11 men, 1 woman) were observed.

Naturalistic Observation

Naturalistic observation, also known as shadowing, has been used in a number of studies to observe the information behaviors of security analysts (Baldwin & Rice, 1997), psychology academics (Eager & Oppenheimer, 1996), and social services departments (Wilson & Streatfeild, 1981). It has also been used to study information behaviors engaged for the electronic environment among music students (Notess,2004), and web interface test participants (Thompson, 2003). One study (Fidel et al, 2004), employed naturalistic observation as one of the tools to better understand the information needs of Microsoft engineers. There has not been another study that has used naturalistic observation to study the communication and information seeking habits of engineers at multiple organizations and in multiple countries. Therefore the methodology for this study was tailored to meet the needs of the population being studied and the goals of the study.

Some prior studies that used naturalistic observation required the observer to maintain a socially acceptable distance from the person being observed, and required that the observer not interfere with the tasks or habits of the worker (Eager & Oppenheimer, 1996; Thompson, 2003). However, those focused on information seeking/behavior (Fidel et al, 2004; Notess,2004; Wilson & Streatfeild, 1981) allowed the observer to interact with the participant to clarify issues related to the information or communication event.

For this study, design engineer and technical professionals were observed in their workplace as they conducted their daily responsibilities. The events of an entire workday were captured (including lunch, meetings, etc). Data collected included observations about the physical work environment, the nature of communication, the use of information, and the range of technology used.

This study allowed research team members to directly communicate with the participants at various points throughout the workday. These discussions were used for clarification of what they were observing in order to get detailed explanations about information resources and communication processes being utilized. These conversations also have the ability to build a sufficient level of trust and comfort with the participant. In addition, this communication also allowed the engineers being observed to communicate their feelings or thoughts about certain types of software or communications methods. Observed engineers could also respond to events observers may have witnessed in the structured interview.

Observers were instructed to talk with the engineer/technical professional participants for any of the following reasons:

- A software package or process that is not easy to identify. Record any information about what an unfamiliar software package does and how the company may have

modified it for internal use.

- Circumstances of an event. For example, determine whether a phone call is scheduled, whether it is personal or is business related, and whether the person being observed received the call on a land line or mobile phone.
- Any questions the participant may have about the methodology and purpose of the study.
- Any conversation the person being observed begins that may be related to the study, the work environment, the working process, the information seeking process, or communication in the workplace.

Structured Interviews

Secondly, structured interviews were conducted with each participant at the conclusion of the observation period. These interviews collected demographic data and information about the participant's work roles and responsibilities as well as questions about preferences and opinions of information resources. The interviews also explored how technical professionals believed work patterns and information use might change in the future. If permission was given, the interview was audio recorded so the data could be transcribed.

While the naturalistic observation component of the study allowed observers to collect actual incidents regarding communication and information events, such as intranet searching or email use, the structured interview allowed observers to collect feedback from the engineers themselves on the structures and methods currently in place to facilitate communication and information needs. Lastly, breaks and meals were also recorded so we could get a balanced view of the work day.

To protect the proprietary nature of the work that was being observed, observations were recorded at a general level of granularity. For example, the data did not include specific product and personnel names, activities, or proprietary information, and the specifics of a communication event such as the name of the other participant were not recorded. Information and communication events were categorized by the researchers in the following way.

Research Instruments and Procedures

During the observations, the data were recorded on an instrument designed specifically for this study. The coding sheet was designed to permit the observer to non-intrusively record their observation of the information and communication events that the participant

utilized as well as the technologies that were used. A copy of the coding sheets can be seen on the poster.

After observations at the first company, the team made revisions to the observation form and added a special form designed to capture the context, activities and key events that occurred during meetings. No new or different data was collected at the later firms, the new sheets simply made the coding process easier. The meeting data collection instrument captured communication and information events, as well as details about the number and nature of meeting attendees, room layout, time, and technology available and used. The meeting data collection instrument can be seen on the poster.

The observations were classified as either communication events or information events and were monitored and recorded in ten (10) minute increments. After each 10 minute period, the observer began entering data on a new coding sheet. Both the duration during the ten-minute increments and the total duration were recorded.

After the data were collected, a data set was developed to standardize terminology and to provide a consistent way to handle data collected in each communication and information event type. For each event the time, duration, total time, type of event, technological medium, description, and an explanation of the event was coded and entered into the data file. Research team members coded their own data for each person they observed. Information from the observation sheets was collected by the data manager and a master file was constructed.

Researchers also used a project-designed drawing form to sketch the participant's office/cubicle to capture the physical layout of the workspace. These sketches included notations about desk space, shelf space and the presence of information containers such as books or journals.

Team members also transcribed the interviews, and produced written descriptions of the cubicles/offices from the drawings. Data from the meeting forms was recorded on a Word document, and submitted to the Meeting data manager to create a master file of meeting data.

At a mutually agreed time during the observation, the researcher conducted a short, structured interview. If the respondent gave permission, the interview was recorded. In all interviews the team member took brief notes. The interview lasted no more than 45 minutes and asked questions about the interviewee's position, job description and duties, how he or she used information, and a few personal background questions.

In order for this research study to be approved by the Institutional Review Board at the University of Tennessee, it was agreed that all project data would be stored in secure

facilities. In order to ensure participants' anonymity, all tapes on which interviews were recorded were destroyed after transcription. Moreover, the participants' names were not used on the data collection instruments. To protect the participants' identity, each participant was assigned a code number which was used to label all the data instruments. The participant's name was only associated with this code number on the Principal Investigator's master sheet.

Poster Contents

1. Training Manual: Key parts of the training for observers will be presented.
2. The Rules of Observation: The rules developed for our observers- six graduate students in the US and seven graduate students in India - will be posted.
3. The Observation Instruments: The instruments designed for the study and used by all the observers to record their observations will be displayed
4. Lessons Learned: Many important lessons about conducting this type of research were learned. For example, observer placement in a room, building rapport, and gaining management trust were all important keys to successful data gathering. Additionally, there were key differences in conducting this research in India and the U.S.

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