

## EXECUTIVE SUMMARY

The goal of the study was to investigate the information seeking and searching behavior of engineers at Boeing when they search for information on the Web: on Boeing's intranet and on the Internet. The objectives of the study were to create a description of major patterns of Web use, to examine the effectiveness of these patterns, and to make recommendations for improved system functionality and interface.

The study method was guided by a conceptual framework for work-centered evaluation and design of information systems. Using this framework, we collected data through interviews with nine engineers and observation of their searching while they performed their regular, job-related searches on the Web. The framework was used to analyze the data on two levels: 1) the activities and organizational relationships and constraints of work domains, and 2) users' cognitive and social activities and their subjective preferences during searching.

All nine participants found Web searching important to their work. They were experts in their fields, even though they had various levels of education and different lengths of experience in the profession and at Boeing. They performed a variety of tasks including modeling, structural design, and developing new customers for programs. They worked primarily in teams. The engineers used a range of tools to perform analysis, design, and to communicate with others. Most of their tasks required the use of new information. While they used a variety of information sources, the sources most preferred were other people and the Web, then the library.

Data collected from the actual searches show that the cognitive decisions the engineers made about each search as a whole involved a great deal of planning, selection of information sources, and identification of information needs. At the same time, the engineers were very sure about their information needs and rarely felt the necessity to analyze or modify these needs. Data also show that the main cognitive activity during searching was to make decisions about

relevance, then decisions about eliminating and adding terms. In addition, some engineers spent time in the middle of their searches learning about system functionality.

While searching, the engineers narrowed a search slightly more frequently than they broadened it, and almost half of their attempts to improve a search took place because the results were off target. From among the mental strategies available to them, they most frequently selected browsing and the analytical strategy, in which they used their knowledge about the subject domain and the search system to plan the next steps. Results also show that almost half of the searches were completed successfully, but 20% of the searches came to a dead-end. In over a quarter of the searches, the engineers retrieved some useful information to guide their continued search for answers, usually leading to a person whom they could contact for information.

The participating engineers were very generous in expressing their opinion about both desired and undesired attributes. They revealed the criteria that they used to determine the relevance of information, or to determine why a document was not relevant. In addition, most have developed some personal rules about searching, and expressed their personal preferences about systems' capabilities and interfaces. Considering these personal rules and preferences when designing information systems is very promising because they have the potential to make searching more effective and efficient, and thus to save the engineers' time.

Although each search was conducted in a specific situation, some common patterns of searching behavior emerged. For all participants, ease of use was the most important criteria in selecting a means for looking for information, and reliability and relevance were the most important factors sought in the source of information. All agreed that if information were not directly accessible, the Web could provide names of people to contact, and the Web was a good place to do so. They also agreed that the Boeing intranet did not provide enough information to assist them in their daily work. Each engineer had a favorite search engine and was somewhat

familiar with its capabilities. Most read results pages very carefully but rapidly scanned the pages linked to results. All were very resourceful in finding new search tactics and all conducted highly focused searches.

These results suggest that improved design of information systems for the engineers could be achieved by providing the engineers with support for locating experts and potential collaborators, using search syntax, using mental strategies, browsing results pages, selection of information sources and planning. In addition, it is clear that searching for any type of information will become easier and more fruitful with a well-designed structure used for navigation. A new project could build such a structure to be used to search electronic information sources. Other projects could create a sophisticated directory of experts inside and outside of Boeing, or find specific ways to improve design.