

ITERATIVE USABILITY TESTING OF A CORPORATE INTRANET

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This paper details an effort to apply usability techniques to the redesign of a corporate intranet. The process included interviews, a heuristic review and three rounds of user testing. The goal of the project was to determine whether user performance and attitude improved across the three tests, and, if so, to suggest design principles which might account for this improvement.

Intranets have become an important part of the business infrastructure for many companies. While they are often used to deliver organizational information, some intranets have evolved to become an integral part of the company's actual business processes and task workflow. Intranets have a tendency to grow through accretion rather than design, however, and as more of a company's information resources are added, the intranet can outgrow its ability to make the information easily available. User testing of the site can help developers design an intranet that is efficient and easy to use.

Headings:

World Wide Web

Web Sites – Evaluation

User-Interfaces-Testing

Intranets

Table of Contents

Abstract.....	i
Table of Contents	ii
Introduction.....	1
Literature Review.....	7
Intranets	7
Summary of Intranet Literature.....	14
Usability.....	15
Summary of Usability Literature.....	34
Methodology	36
Phase I – Background.....	38
Phase II – Heuristic Evaluation.....	40
Phase III – User Testing	41
Findings and Discussion.....	47
Phase I Findings	47
Phase II Findings.....	49
Phase III Findings – Quantitative.....	55
Phase III Findings – Qualitative.....	61
Conclusions.....	68
Bibliography	70
Appendix A – List of Heuristics	73
Appendix B – Testing Document	74
Appendix C – Heuristic Report	86

Introduction

In the last few years, web-based intranets have become an important part of the business infrastructure for many companies. According to Bigdoli (1999), “all Fortune 500 companies either have established an intranet or are planning to establish one shortly.” A 1998 survey of the top 200 UK companies showed that 48% had an intranet in use and 77% of those that did not had plans to introduce one (Drennan, 1999).

An intranet is a web application which uses client-server technology and is viewed through a browser in the same way as web pages on the WWW. However, because the intranet runs on a company’s internal network behind a firewall¹, it is only available for viewing inside the company.

Switching to an intranet for electronic delivery of information to employees has many advantages. One advantage is the savings in printing and distribution costs. In addition, because intranet content can be updated quickly, the information is likely to be more current and accurate than printed material. For companies with geographically, even globally, distributed offices, there is the additional benefit that material can be made

¹ A firewall is part of the server software that denies access to computers not on the server’s network.

available to all parts of the organization immediately. Because the intranet is a web-based application, it is platform-independent which eliminates the need for a host of specialized applications to access information in different formats. Browser technology is easy to learn, is already available on most desktop computers, and requires only a minimal investment, such as additional servers or database connectivity software. More bandwidth is usually available on internal servers, so performance is faster, and because of the firewall, security is better controlled. Probably the biggest advantage of the intranet is that the flow of information can be controlled by the user. Employees have access to the information they need when they need it.

Intranets typically contain information such as human resource policies and forms, financial information, calendars to coordinate team-wide schedules, new employee orientation, training, and inventory and product information. Some intranets have evolved from general information delivery to become an integral part of the company's actual business processes and task workflow. Newspapers use intranets as a way to provide their journalists with quick access to accurate and up-to-date resources, as well as archives of past articles (Drennan, 1999). Healthcare organizations, such as CareGroup Healthcare System of Boston, have linked intranets to databases to create resources that give healthcare workers instant, secure, and remote access to patient records. Selected

information can be made available to insurance companies through extranets², eliminating costly and time-consuming mistakes (Henry, 2000).

Training is another area where intranets have filled a corporate need. Use of streaming video for online education and training courses has saved time and money by replacing in-person or video training courses. Training departments can use the intranet to advertise and administer their training materials, conduct needs analysis, receive feedback, and make training records available on-line (Mullich, 1999). Manufacturing companies use their intranets to provide immediate and up-to-date training on work process instructions and to provide real-time feedback between the manufacturing floor and the design and engineering areas (Haywood, 1999). Wooliams (1998) has argued that, “unless the intranet is seen as the nervous system of the business and not just an information notice board it will not achieve its potential” (p. 69) and that true cost savings cannot be realized until the intranet is integrated with business processes and driven by business objectives.

Although intranets have begun to take a more central place in the corporate information infrastructure, in many companies the intranet began as a grass-roots effort. Isolated individuals throughout the company or a small team, often in the library or a technical area, begin to publish collections of often-used resources or information on a

² An extranet is a web document, residing on a company’s private network, which allows the secure sharing of business information with suppliers, vendors, customers, or other businesses.

specific project to share with other employees. Other departments add their own pages, and soon the intranet has grown to contain a large portion of the information assets of the company. The reason for this bottom-up trend in intranet development, according to Ryan (1997), is that the technology needed for intranet development is inexpensive, based on open standards, and is already available on most desktop computers. Because implementation of intranets requires no additional major purchase of hardware or software, the intranet often grew without the notice of high-level management.

However, this process is driven by accretion rather than design and usually without the benefit of any overarching strategy or development plan. Intranets that follow this model often lack an underlying structure or cohesive navigation scheme. Although they contain a wealth of valuable information, users are frustrated in finding the information they are looking for. Intranet developers, like Kenneth Varnum of Ford Motor's Research Library and Information Services, eventually realize that their "intranet had outgrown its ability to contain all the information we had linked together. Even we could not find resources that we had organized in various hierarchical menus on our site" (Varnum, 1999, p. 53). This very typical situation highlights the need for periodic assessment and redesign of intranets. User input and usability guidelines and testing can ensure that design efforts result in an intranet that is easy and efficient and supports employees in their work.

Designing for usability on intranets is important for several reasons. The first is that intranets contain a wide variety of types of information – news (which changes daily), electronic forms, training materials, or interfaces for workflow processes. The information not only differs in its format and function, but is generated by a varied group of content providers who often bring different, sometimes conflicting agendas to the table. This means that the number of pages on a company's intranet is usually higher, according to Nielsen (2000a) between 10 and 100 times higher, than on a company's external site. Having a consistent navigation structure and labeling scheme that is in tune with users' thinking is critical if users are to be able to find the information they need on the intranet.

The second reason that usability is important for intranets lies in their purpose. The goal of the intranet is for users to be able to increase their productivity by quickly finding the information they need to complete their tasks. For most public internet sites, where users are one-time or intermittent visitors, facilitating exploration by browsing and enhancing user satisfaction are the primary goals. On an intranet site, however, users will become expert users through frequent use, so memorability, efficiency, and error reduction are the important attributes. "As more and more job functions move online, the efficiency with which employees can use the intranet becomes a major determinant for the productivity of your organization" (Nielsen, 2000, p. 270).

In one sense, understanding users and their tasks should be easier on the intranet. Developers have access to better information about users, their tasks, and the software and hardware they use. However, the range of tasks that users might want or need to do on an intranet is much broader than on a public internet site with a more focused scope. This is another reason why usability is so important for intranets.

An intranet that is organized to help users find information or complete their transaction quickly is doing its job of making employees more effective. And, although it may be stating the obvious, the sole purpose of the intranet is to be of use to employees, to increase their effectiveness and provide information they need to help them serve customers or patients or vendors. If it does not serve its users, the intranet fails at its purpose. Testing of the site with real users, to understand their thought processes, perceptions, and work needs, is essential to ensure that the intranet succeeds.

This paper describes a project that applied usability techniques and testing to the redesign of a corporate intranet. The process included interviews, a heuristic review and three rounds of user testing which collected both quantitative and qualitative data. The study looks at whether user performance and attitudes improved across the three tests, and attempts to uncover design principles that can be applied to intranets to improve usability.

Literature Review

In order to understand how usability can be useful in intranet design, it is necessary to review the literature on the development and use of intranets and on the application of usability principles and testing to web-based information systems. The literature reviewed here includes research and case studies, evaluation and comparison of methods, recommendations for best practices and directions for future research.

Intranets

The amount of research on intranets is limited, perhaps because of their proprietary nature and because the intranet phenomenon is relatively new. When this project began, most of the available intranet literature focused on the benefits of intranets and advice on technical set up. However, more substantial literature on the use and impact of intranets has begun to appear. The intranet literature reviewed considers best practices for intranet development and implementation, recommendations for redesign of an existing intranet, and discussion of the organizational impacts of intranets.

The Role of Intranets

Wooliams (1998) argues that the reason many intranets have failed to live up to their potential to reduce costs and increase revenue is that, in developing intranets, companies focus on the technical aspects of the project and ignore the business goals of the company. In order to be cost-effective, intranets need to reflect the business structure and processes of the company. The intranet should be treated as the core of the business's information system rather than simply as an electronic bulletin board. According to Wooliams (1998), most intranets begin as a one-way channel for information distribution to employees, and for large companies, the switch to an intranet for this type of information delivery can yield immediate savings in print and distribution costs. However, for smaller companies, with lower print and distribution costs, savings will come when their intranet moves from being a means for information distribution to a means of information sharing. This shift results in the creation of a knowledge-sharing culture that makes better use of a company's assets. The organizational structure becomes flatter and more responsive to business changes and customer needs. The final step in intranet evolution comes when the intranet is integrated with business processes throughout the company. This stage, according to Wooliams (1998), affords companies the greatest opportunity for the cost savings and increases in efficiency and productivity that the intranet's champions promise.

Intranet Development Process

There is consensus in the literature on the need for following a systematic development plan when designing an intranet. Steps in this plan should include the a complete information audit, creation of a task force, and development of content creation standards and design guidelines.

Wooliams (1998), Bigdoli (1999), Woodun and O'Donnell (1998), and Hobbes (1998) all recommend the information audit as the starting point of any intranet design process. According to Woodun and O'Donnell (1998), the information audit “consists of the complex task of identifying, analysing, accounting, and synthesising an organization’s information resources” (p. 200). The audit takes into account a company’s mission, business processes, methods of communication, organizational structure and culture. It catalogues all the information resources of the company – everything from documents, reports, and manuals to Post-it notes stuck on employees’ computer monitors.

The information audit identifies all the information sources, services, and systems of the company and allows developers to map the ways that information flows through the company. The results of the information audit can be used to define user requirements, identify content authors, develop security and privacy policies, create the information structure (the definition of major categories and relationships) and the

publishing model (the definition of the workflow of the intranet publishing process), and outline a content management strategy.

Another important part of the intranet development process is the creation of a task force to direct the intranet development process. The team would ideally include representatives from all the user groups, and the legal, technical, and marketing sections (Bigdoli, 1999). The task force would ensure that all parties are involved in decisions on intranet policy, user requirements, and content management strategy. In addition, Wooliams (1998) contends that the involvement of top management is crucial if the intranet is to become the core of the company's information infrastructure, instead of a project whose focus is primarily technological. He sees the need for effective focus from senior management as an important distinction between the intranet and the company's public internet site, which might more appropriately fall to the company's technical and marketing sections. This is a logical conclusion since the literature suggests that changes in business practices, social processes, and the roles of information providers and users that an intranet brings can be just as important as its technical aspects.

Organizational Changes

The decentralized nature of the intranet requires changes in the level of control that most companies are accustomed to having over their information distribution process. Woodun and O'Donnell (1998) suggest that companies be proactive in recognizing these changes and adopt "an attitude of enabling independent decisions and

actions, thereby resulting in a more flexible structure” (p. 204). They recommend developing a decentralized content creation policy, encouraging the formation of virtual teams made possible by increased communication across departments, and balancing the need for information “push” by management and information “pull” by employees who can now access the information they need at the time they need it. They also add that users/employees have to take more responsibility for determining their own information needs and taking the initiative to get the information when they need it (Woodun and O’Donnell, 1998).

Vishik (1997) reports on the experience of Schlumberger, an international technology company, in dealing with the changes that the intranet brought to their organization. As more information became available through the intranet, the role of the company’s internal information brokers changed from managing access and retrieval of information to determining resource selection and design. End users became responsible for the retrieval and evaluation of the information resources they needed and, if they were authors, for publishing and content management as well. Since anyone could publish information, the concern was that the quality of the resources could suffer and retrieval become more difficult. The company dealt with this situation by developing a systematic process for evaluating and publishing internal information resources. The process included user participation in resource selection; choosing tools for intranet publication and management; development of style guidelines for content publishers; and a system

for personalized “push” of content to various user groups. Domain experts, information professionals, and end users co-created the intranet by collaborating on content creation, evaluation, and selection. The intranet was treated not just as a collection of resources, but also a “giant testing ground for new business process and models of communication” (Vishik, 1997, p. 112).

Carlson (1999) argues that the potential of technology to create effective change in organizations cannot be realized until it is seen in the context of the organization’s culture, structure, and human resources policies. She examines different types of technological tools – automated process management, computer-supported collaborative work, data mining, and netware applications, such as intranets – to see how these tools can be leveraged to increase productivity, facilitate change, and improve workforce abilities. She found that intranets are particularly effective at building community by using narrative as a way to break stereotypes of corporate top-down rhetoric. They also work to facilitate change by presenting new products, attitudes, and initiatives through a medium that is itself novel and innovative (Carlson, 1997).

Intranet Redesign

The best practice principles for intranet development discussed above have been developed through trial and error in different companies. For those companies who were early adopters of intranets, the concern is often with the redesign of an existing intranet that has become unmanageable. In many cases, the intranet was begun by a single individual or small team, and grew in a haphazard way without the benefit of an information audit, site-wide navigation or architecture scheme, or company-wide input. These intranets can soon become overgrown with links, making it difficult, if not impossible, to find information on them.

Varnum (1999) details the process undertaken by Ford Motor's research library to redesign and streamline their intranet. It became obvious when the librarians themselves couldn't find information that their intranet had outgrown its structure and was no longer useful. In approaching the task of redesign, they considered their user groups and the features they would need, and how the design would accommodate future growth. The four basic requirements they identified were a sound, comprehensive subject organization; tools that allow users to customize the site to their needs; a clean and consistent graphic interface; and a move from static pages to database-generated pages which allow for easy updates and expansion. According to Varnum, "developing the basic intellectual underpinning of the entire site, was the single most important part of the

design process” (p. 55) since it made it easier for users to find the information they needed and for the site to grow and still remain cohesive (Varnum, 1999).

In a similar case study, Doran (1999) describes an intranet redesign effort at Weyerhaeuser that focused on development of a metadata scheme to improve searching and content management on their intranet. This was another case where the intranet had developed in a haphazard fashion and became overgrown and unusable. The article documents the process of the development of the metadata system, including the metadata scheme, controlled vocabulary, and tools for generating metadata by the content authors. The system underwent user testing at several points in the process and resulted in a content management infrastructure, including standards, tools, and processes, and a search engine that is better able to help users find information on the site (Doran, 1999).

Summary of Intranet Literature

According to the literature reviewed here, the success of a company’s intranet depends on several factors. First, the intranet should be treated as the hub of a company’s information infrastructure and as such, should be driven by the company’s business goals and, if possible, integrated with its business processes. Second, the development of the intranet should follow a systematic plan that includes a comprehensive audit of all information resources in the company. A task force should be formed to guide the development process that includes involved departments, representatives of different groups of users, and senior management. The task force should be aware of organizational changes that may occur as information roles and responsibilities shift and

should be ready to use the particular strengths of the intranet to facilitate and capitalize on these changes. Finally, whether they are developing or redesigning their intranet, companies should involve users in the design process by actively eliciting their input and by checking their designs with iterative user testing.

Usability

Usability is a branch of human factors, a field of study that looks at the relationship between humans and technology. The goal of the human factors field is to design the physical and cognitive components of information systems to make them safe, efficient and comfortable for people to use. Usability is concerned with the design of those elements of the system which aid the user in completing tasks, such as the interface, user support systems, and ergonomic design. Website usability is concerned with the web interface and the organization of content. Nielsen (2000a) has said that the application of usability design and testing in developing intranets is similar in most respects to usability design and testing of websites in general. This section looks at definitions of usability, the practice of setting usability goals and objectives, and best practices and case studies of user testing and usability in designing websites in general, and intranets in particular.

Definition of Usability

Bernard Shackel and Jakob Nielsen both begin their definition of usability by placing it in the larger context of system acceptability. Usability is one factor among several that influence users to accept a system for purchase or use. According to Shackel (1991), usability along with utility (the system's functionality) and likeability (how the system is perceived by users) are balanced against the costs of the system (capital, maintenance, social, and organizational costs) to arrive at a decision about acceptability. For example, a portal/search engine site could be an example of a system that has high utility (numerous features, such as stocks, people search, news, shopping) but low usability (a cluttered interface or animated images that makes it hard to scan) and low likeability (cookies or registration required). This combination might cause the user to abandon the site for another. On the other hand, if a system's functionality is valuable to the user, and changing requires some cost in purchasing or learning a new program, then the system's usability will have to be very poor to convince the user to change to a different system. The ease with which users can make that change on the web makes usability of critical concern to website design.

Another important point in defining usability is that it cannot be defined in the abstract, but must be tied to the tasks, users, and environment of the system that is being designed or evaluated. Shackel's formal definition of usability is

“the capability in human functional terms to be used easily and effectively by the specified range of users, given specified training and user support, to fulfil the specified range of tasks, within the specified range of environmental scenarios.” (Shackel, 1991, p. 24)

Once the specifics of the system are defined through requirements analysis, usability criteria can be set that will measure usability for that combination of users, tasks, tools and context. Consider, for example, a system that will be used daily by a well-defined group of users using a limited configuration of software and hardware to do specific tasks. Testing of such a system will need to focus on different attributes than a system that will be used by intermittent users who access the system through a wide array of hardware and software and approach their tasks from a wide range of perspectives.

It follows that, in order to evaluate the usability of a system, not only must the range of users, tasks, and environmental scenarios be clearly defined, but quantifiable and measurable values must be set in order to determine the degree of ease of use and effectiveness that the system should achieve. The values are important in creating design specifications, establishing usability goals, evaluating design iterations and negotiating decisions on trade-offs. According to Shackel (1991), managers and users should be closely involved in the process of defining usability attributes and values to make sure that the goals set are realistic and relevant. He recommends creating a chart of usability goals and requirements, specifying details of the attributes, the means and unit of measuring the attributes, the planned value, the current value, and the worst case value.

Nielsen (1993) suggests setting a range of acceptable values, rather than a single mean value, since users can vary widely.

Shackel (1991) identifies two usability attributes - effectiveness and ease of use.

Effectiveness is measured in terms of human performance, while ease of use is measured in subjective terms of attitude and user perception. Nielsen's (1993) attributes are memorability, learnability, efficiency, few and non-catastrophic errors, and subjective satisfaction. For a system which has expert users from frequent use, little variation in environment or tasks, and possibly mandatory use, the attributes that would be most important would be efficiency and memorability. For another system, which has mostly intermittent or first-time users, variation in environment and tasks, and voluntary use, the usability attributes of subjective satisfaction, learnability, and error reduction would be of greatest importance.

Objective performance measures, such as time and errors, are typically used to measure effectiveness, while subjective attitude measures, taken from questionnaires and qualitative interview data, are used to measure ease of use. The two types of measures, Shackel (1991) says, are complementary, not exclusive, and both are required for a balanced assessment. "Performance measures cannot be the sole criterion because the human may readily achieve a given performance, but still not prefer to do the task or use the tool because it is very inconvenient or awkward, so that he may well prefer (i.e., find

more usable) another similar tool which gives less speed or more errors but is easier or more convenient.” (Shackel, 1991, p.35)

The third point to understand about usability is the difference between formal experimental usability testing and less formal discount usability methods. Rubin (1994) states that classical experimental models of testing require a hypothesis to be tested, and tightly controlled conditions, including control groups. Participants must be randomly chosen and the sample size must be large enough to measure statistical significance between groups. He argues that this methodology is often inappropriate for most testing situations, where the objective is not to test a hypothesis, but to improve products. He advocates a less formal, iterative approach, but with attention paid to experimental rigor.

The elements of his approach include:

- development of problem statements or test objectives instead of a hypothesis,
- a representative sample of users chosen randomly or otherwise,
- observation of users while using or reviewing the product,
- collection of qualitative and quantitative performance data and preference measures, which lead to recommendations for improvements.

Nielsen (1994) also highlights the need for rapid evaluation and for adapting techniques to fit organizational constraints. He contends that, while traditional and full usability testing and methods will undoubtedly provide the best chance of finding and fixing a greater number of usability problems, organizations rarely include usability testing because of the perception that it is too expensive and time-consuming and requires high levels of expertise. He claims that, on the contrary, it is possible to find most

usability problems with a small number of users and simplified techniques, such as heuristic evaluation and modified user testing, and that these techniques can be taught to and used by people without usability expertise.

Nielsen (2000b) contends that most of the usability problems can be found by the first few test users. He recommends between three and five test users for general usability testing, and claims that 85% of usability problems can be found in a thorough walk-through by this small group. Spool and Schroeder (2001) dispute these findings, claiming that, in their studies of web site usability, only 35% of the total usability problems had been found in the first five users tested. The number of tests that are planned is also a factor in determining the number of users required for each test. According to Rubin (1994), if multiple tests are planned, “you can feel confident testing fewer participants” (p. 128). He recommends using at least eight participants if at all possible (Rubin, 1994).

Laskowski and Downey (1997), discussed below, found a number of characteristics of websites which suggest that rapid evaluation and iterative design are necessary for their evaluation. This rapid evaluation approach would be impossible without discount usability techniques.

Heuristic Evaluation

Heuristic testing is a usability evaluation method in which a group of usability specialists systematically review an interface to see if it conforms to a set of accepted guidelines.

Because it can be conducted quickly and at less expense than user testing, it is considered a discount usability technique. “The goal of heuristic evaluation,” Nielsen (1993) says, “is to find the usability problems in a user interface design so that they can be attended to as part of an iterative design process” (p. 155). Heuristics are “general rules that seem to describe common properties of usable interfaces” (Nielsen, 1993, p. 158). In the past, these lists of heuristic rules could number in the hundreds. Nielsen, as part of his effort to advance discount usability methods, narrowed the list to ten basic principles. Developed in 1994 by Nielsen and Mack, this list has become accepted as a standard and in recent years has been revised and used in a number of projects to evaluate web interfaces (Levi and Conrad, 1996; Borges et al., 1998).

DeJong and Van Der Geest (2000) propose a framework for evaluating sets of web usability heuristics. They provide the following criteria for evaluating heuristics:

- What type of the information do the heuristics cover? Is it general or specific?
- How can the validity of the heuristics be determined? Are they based on standards, theory, research, or the views and experience of practitioners?
- How are the heuristics presented? Are they in the form of instructions, requirements, or questions? Are the answers yes/no or open-ended? Are the usability guidelines high-level (looking for abstract general problems) or low-level (looking for specific guidelines)?
- How will the heuristics be used? Are they designed for the planning or evaluation stage; for development of a process or a product?

In order for a set of heuristics to be successful, DeJong argues, the rationale for the selection of items should be clear so that developers can judge the usefulness of certain sets of heuristics for particular projects. In addition, the structure of the heuristics

should be meaningful enough for designers to be able to understand the intent and read between the lines. Finally, the heuristics should be formulated in a way that is geared to the way that they will be used in the design process. Future heuristic research should focus on developing a better understanding of the way that heuristics are used, of what the heuristics actually did to improve usability, and how heuristic evaluation compares to other types of usability methods (DeJong, 2000).

Borges et al. (1998) describe the process they used in developing a set of web heuristics which were subsequently verified by user testing to measure improvement. Their goal was to create a set of short, simple, and practical guidelines that could be used by developers without usability training to correct the most common usability mistakes. They developed a set of low-level specific guidelines aimed at correcting the problems they found in a heuristic review of 10 university websites. Their recommendations included such things as the size of headers, page length, consistency in use of icons, number and naming of links, use of color, and inclusion of an alphabetical site index. The guidelines were then used to create prototypes that were tested with users. The versions revised according to the heuristics scored significantly higher in almost all cases. Since the goal was to create a set of heuristics that non-usability professionals could use, the study did not include a usability expert critique of the sites to compare the number of problems found. The guidelines they developed are an example of what DeJong and Van Der Geert (2000) call “low-level” guidelines, very specific and non-abstract and

there is a question about how well these heuristics would apply to other types of pages. However, the process of testing the heuristics to measure improvement in usability is in line with DeJong's recommendations for heuristic research.

Regardless of the set of heuristics being used, the evaluation process is the same. Nielsen (1993) recommends using multiple evaluators. His studies suggest that a single evaluator will find only 35% of the usability problems, but that number improves to 63% with three evaluators, and 75% with five evaluators. The total number of evaluators would depend on time and resources available, but Nielsen recommends using at least three evaluators, if possible.

The evaluators review the interface in isolation from each other to prevent any bias. They usually go through the interface twice, depending on the size of the system being evaluated and the time available. The result of the review is a list of usability violations found in the interface, with each violation being tied to one or more of the heuristics. Reviewers should also include problems that are found that may not necessarily be tied to one of the heuristics on the list, but which still may present a usability problem. The results can be in the form of a written report, or sometimes the verbal comments of the evaluators are collected and compiled by an observer.

The fact that the heuristic evaluation looks at the features of the interface, and does not involve completion of tasks, means that it can be used with a paper prototype

(early in the development process. However, the emphasis on interface features over task flow is a possible drawback of the heuristic process.

Another possible drawback is that, while the heuristic process does identify possible problems and can explain why they are believed to be problems, it cannot specifically address the issue of how to fix the problems that are identified or how to choose from possible redesign options. Nielsen (1993) recommends a debriefing session after the heuristic evaluation is completed where the evaluators can brainstorm about possible fixes to the problems found. This debriefing session is also a good opportunity to discuss the positive aspects of the design, since that is also something that the heuristic evaluation does not normally address.

Levi and Conrad (1996) describe a study of the heuristic evaluation of a prototype website by the Bureau of Labor Statistics. The study looked at the difference in the heuristic results between two groups of evaluators. One group had received some usability training, while the other group was chosen from the website's developers

The study found similarities in the findings from the two groups. The number of violations found and the proportion of violations attributed to each heuristic was roughly the same for both groups. The severity rating judgments for each heuristic were also similar for each group, with the average severity rating for the UI group being 3.06, and for the developers 2.81.

One of the differences between the two groups was in the heuristics most cited. The usability group found more consistency violations, while the developer's group found more violations in the progressive level of detail. The other major difference between the two groups was in the severity ratings among the heuristics. The lowest severity rating and highest variance in agreement came in the heuristic for Aesthetic and Minimalist Design, while the greatest severity rating and lowest variance in agreement came for Navigational Feedback and Progressive Level of Design. These results suggest that for more objective heuristics, such as navigation and hierarchy, the severity is greater and these violations should be given a high priority. The more subjective heuristics have a lower severity, but it is also more difficult to pinpoint specific rules to handle them.

Finally, there was a difference in the broad themes each group emphasized. The UI group was concerned with broad usability issues such as consistency, navigation, and visual clutter, while the developer group was more attuned to content-related problems, such as missing links and inconsistent granularity.

One major weakness of the heuristic method, they found, was that they had no baseline (such as empirical results from users testing) against which to measure their results. They had no way to verify Nielsen's (1993) claim that a high percentage of problems can be found using the heuristic evaluation method and that the problems that were found were representative of all the usability problems present.

Doubleday et al. (1997) compared the heuristic and user testing methods in terms of speed, cost, effectiveness, strengths and weaknesses of each method, and the types of problems each method best addressed. They found that the heuristic method was faster, cheaper, and found many errors. However, it missed some important problems that were found through user testing. While the heuristic evaluation found 86 usability problems, as opposed to the 38 problems found by end user testing, 15 of those 38 problems, or 39%, were missed by the heuristic evaluation. The authors' explanation for this finding is that many of the problems identified by the heuristic evaluators were related to the features of the interface because, as Nielsen (1993) points out, they were observing the system. The end users, on the other hand, were actually using the system, so the problems they found were related to task flow and performance.

A strength of the heuristic method, they found, was that it helped to explain the cause, and possible fixes, of the usability problems found. User testing can identify symptoms of usability problems, by observing users working on tasks, but it cannot explain why users encounter the difficulties they do. Heuristic evaluation, because it matches the usability problem to one or more of the usability guidelines, can often offer a reason, and solution, for the problem. This is useful in a design context, since it enables the problem to be fixed without inadvertently causing another usability problem. However, user testing is required to identify those problems that stem directly from "the users' knowledge, or lack of it, when interacting with a system. Heuristic evaluators

cannot place themselves in users' shoes, hence they miss errors" (Doubleday, et.al, 1997, p. 109).

The authors also point out that simply comparing the total number of problems found using the two methods may not be as valuable a measure as factoring in the severity of the problems found. "Fixing as many usability problems as possible is all to the good, but from the user's point of view the quality of improvement will also depend on the severity of the error" (Doubleday et al., 1997, p. 104). Of the six errors with the highest severity ratings, three were missed by the heuristic evaluators.

Their conclusions were that, while the heuristic method is good at finding usability problems in the interface, it was not as useful for finding the task-related problems. They disagreed with Nielsen's implication that the number of usability problems that are found by the evaluators can accurately be judged to be a proportion of all the usability problems present in the system. Their findings would suggest that there are additional types of problems that are only found through usability testing, with the proviso that the experimental tasks used in the user testing are chosen carefully. "User testing is uneven in operation and will miss any feature not encountered in the task. It is thus very dependent on the quality of the experimental tasks" (Doubleday et al., 1997, p. 108). End user testing found fewer errors at greater cost than heuristic testing, but some of the problems uncovered in the user test would have gone undetected if heuristic evaluation had been the only method used.

Case Studies of Web Usability Testing

Yu, Prabhu and Neale (1998) describe the user-centered process that the authors undertook in revising the design of the top-level pages of the corporate website for Kodak. The site had been in place for two years. It averaged around a million hits daily and attracted a diverse and regular group of users. The complete site contained over 25,000 pages and included an on-line store, a popular web-postcard site, and content directed at its business and manufacturing customers. The design process was restricted to the structure of the top level and was focused on users needs and how the site structure could aid in information retrieval (Yu et al., 1998).

Marchionini and Hert (1997) outline a multifaceted evaluation approach used in a usability study designed to recommend improvements to three large websites maintained by the Bureau of Labor Statistics (BLS). The multifaceted approach means that data was collected from the following six sources:

- Discussions with BLS staff involved in content creation and maintenance, document analysis, and creation of a site map to define the structure;
- Interviews with help desk workers and other support staff at BLS;
- Content analysis of email from users;
- Focus group discussion with staff who refer users to the site (such as librarians) and with a group of potential end users;
- Usability testing (using scenarios and observation of users);
- Server transaction logs.

The multiple methods of data collection insure coverage of a wide range of user needs and tasks. It also means that the BLS staff responsible for creation and administration of many sections of the three sites will be involved in the testing effort, thereby enlisting their support of the new design.

Three lessons can be gleaned from this paper. First, there are characteristics of web systems that make testing their usability more challenging than traditional software or interface systems. The content and performance level of web sites are always in flux, due to changes in network use and the state of the internet. Users of websites, therefore, are accustomed to interacting with a system that is dynamic in terms of content and performance. This makes their expectations and use of the system different from a more static type of application software. The second lesson is that large institutional websites, are not usually created and maintained by a single designer, but by a collection of designers in committees across the organization, each with their own agenda, guidelines, and priorities, similar to intranets. According to Marchionini and Hert (1997), social and political factors can play a major role in the design process. The aspect of organizational dynamics involved in the evaluation of websites is discussed in Laskowski and Downey (1997) as well. This suggests that an effective usability study should include as many stakeholders as possible, and requires an awareness of the organizational dynamics involved. Finally, another challenge with institutional web sites is what Marchionini and Hert (1997) call the “inertia effect.” Users who frequent large institutional websites

invest time in learning how to use and navigate the site. Any changes will be disruptive to these users. Usability tests in such circumstances must be comprehensive and show compelling evidence for any recommended changes.

Laskowski and Downey (1997), HCI researchers from the National Institute of Standards and Technologies, present four case studies of web evaluations they have conducted within their organization. The cases ranged from redesign of existing websites to the creation of a conceptual design (where there was no design or architecture to evaluate) to the full development and testing of a testbed site. From their experiences, they have discovered common characteristics both of the websites themselves and of the organizational issues involved in creating and maintaining these websites. Some of the website characteristics that they found in their studies were:

- Information constantly changing and evolving;
- Relationship-rich content and structure;
- Users from different groups with different objects using the same material;
- Requirement of constant and ubiquitous access;
- Evolving browser technology.

The organizational constraints that they found present in most of the projects were:

- Multiple levels of stakeholders;
- Lack of knowledge about usability and methodology;
- Designer and evaluator often the same person;
- Limited access to domain experts and users;
- Difficulty with distinguishing organizational hierarchy from prominent information and nonlinear ordering;
- Scarce resources; and
- Tight time deadlines.

Some of these constraints are similar to the issues mentioned in Marchionini and Hert and are part of Nielsen's (1994) justification of the need for discount usability in some contexts. These particular challenges and constraints create a need to adapt and revise traditional usability methods to support the rapid and continuous evaluation required for web-based information systems in organizations. They found that "summative evaluation and formal usability lab studies take too much time and cost too much" (Laskowski & Downey, 1997, p. 4). They advocate the creation of a "toolbox of rapid evaluation techniques that meet the needs of the web as a medium" (Laskowski & Downey, 1997, p.

4). Some of the techniques and requirements they propose are:

- Heuristic evaluation using standard best practice guidelines;
- Use of automated tools, to check browser compatibility, to check for broken links, and to index pages for searching;
- Task-based scenarios that test the system from different users' points of view to validate the information model and test performance;
- Availability of information about users, tasks, and domain;
- High degree of diplomacy and organizational savvy for evaluators;
- Record-keeping of design iterations, rationales, and evaluation results.

The authors admit that problems with this approach may still remain. Their rapid evaluation approach is good for identifying minor usability problems, but it remains to be seen if the techniques will also identify major design problems. Also, since the scenarios are the only place where actual users and tasks are involved, the scenarios need to be carefully designed to fully test the usability criteria. It is also important to have a

dependable way to quickly measure design improvements to see whether and how much usability is improved.

Usability Testing and Intranets. Nielsen (2000a) states that user testing for intranets should follow the same guidelines as those for external internet sites. Three case studies describe the efforts of companies to improve the usability of their intranets by studying users and their tasks and testing their designs with users.

Hobbs (1998) identifies two issues related to intranets that may create usability problems. The first is “content cram” or the effort to put as much content onto the intranet as quickly as possible. In such cases, Hobbs says, “good design is ignored in favour of speed” (Hobbs, 1998, p. 63). The second problem comes when intranet development is assigned to graphic designers, who may not be trained in usability principles. The result is “a beautiful intranet that is awkward to use” (Hobbs, 1998, p. 64). She recommends a systematic development process, similar to that detailed in the intranet section of this literature review, that includes a full-scale documentation audit, user involvement in setting of testing requirements, and a timetable for intranet implementation that includes testing of the technical limits of the network. The evaluation methods she discusses include interactive user feedback in the form of questionnaires, surveys and newsgroups, and covert feedback in the form of server log analysis. Results can give developers a picture of how the intranet is being used, what may be missing, and provides a continuous monitoring of intranet use and usability.

Fabris (1999) describes a case study of the development of an intranet for Bay Networks. Different sections of the company developed and maintained their own pages of information, but there was no organized way to share this information across the company. The goal of the intranet redesign was to understand how to organize, package, and cross-reference the information on the site so that people could find information easily. The effort entailed extensive user analysis and feedback to understand how people looked for information. The design team conducted card-sorting exercises in which people categorized information into similar groups and also studied the way that information flowed through the company, noting especially where gaps occurred and how to bridge them. After they had thoroughly studied the user preferences, workflow, and security and access issues, they designed and tested a prototype with users, and, after revisions, tested the full system with another group of users. Usability of the redesigned intranet was greatly improved.

Rosen(1999) describes a case study of the redesign of the intranet at the Bose Company. Rather than conducting user surveys, they decided to observe users actually using the intranet . The description of their intranet is familiar – grass-roots driven with information organized by department and becoming less usable as more information was added. The users were observed using the intranet at their desk as they completed a series of tasks. Observers noted browser paths, search terms, and recorded user comments. The observers used the information to identify patterns, prioritize the

problems found, and brainstorm solutions. The changes were implemented and then tests were repeated. Rosen says, “Through observation, we have been able to discover patterns in expectations and behavior that we can act upon. Observed results are usable in a way that survey results are not” (Rosen, 1999, p.60).

Summary of usability literature. The usability literature reviewed here suggests that the in order for a usability evaluation to be valid, several factors must be considered. The usability requirements for the system must be framed with respect to the specific users, tasks, and context of that system, and not to an abstract concept of usability. Both performance and user satisfaction measures are required for a balanced assessment, and quantifiable values must be set for usability attributes in order to determine if the system meets usability specifications and to evaluate ongoing design changes. In most cases, less formal evaluation methods, such as heuristic review combined with quick rounds of user testing, are better suited to meet the need for rapid and ongoing evaluation required for web-based information systems. A multi-faceted approach to data collection is preferred since it ensures a wide coverage of users and tasks, and also allows for verification of findings by comparison of data collected by different methods. It is important to find ways to actively engage as many stakeholder and user groups as possible in the usability design process. User input is necessary in setting usability requirements, devising representative tasks for user testing, and in resolving the

organizational aspects of system development. Usability is especially important for intranets because of the diversity and large volume of content being generated from multiple authors across the company. Intranets can benefit from user-centered design and usability testing.

Methodology

The methodology for the study consisted of three phases. In Phase I, members of the web development team and the head of the company's library were interviewed on the mission, purpose, and goals of the intranet. Phase II consisted of a heuristic review of the intranet by three evaluators. Finally, in Phase III, three rounds of user testing were conducted, with eight users per test. The test users performed a series of eight tasks while thinking aloud, with data being collected on number of tasks completed, task completion time, and number of searches completed. Test users also completed a post-test user satisfaction questionnaire. The decision to retest was made when substantive design changes had been made to the interface.

The Setting

The company under study is a not-for-profit hospital and medical service corporation located in the Southeast. They have 2600 employees located in two main facilities and six regional sales offices, and have been in business since the early 1980's. The company is divided into nine functional divisions. The largest of these is Customer Service, whose employees deal with individual and corporate subscribers and with

medical providers. There are several other line divisions plus several support divisions such as Human Resources and Information Services.

The intranet was begun in 1998 by a member of the Information Services department working in the corporate library. It consisted of organizational news items and a general resource page created by the library, called "Find It," that answered their most frequently asked questions. The intranet expanded to include orientation for new employees, on-line training, and some small applications that allowed submission of Human Resources forms and requests for computer service. Individual departments began to create and add pages. The intranet grew until, at the time of the time of this study (January 2000), it contained 20,000 pages. The intranet web development team had begun receiving complaints that the intranet was confusing to use and that it was increasingly difficult to find information. Since use of the intranet was voluntary at that time, they suspected that many people were electing not to use the intranet for their information needs.

An intranet task force had been formed to integrate the efforts of the various departments and to provide guidance and direction. The task force consisted of a steering committee made up of executive managers from the different departments and the director of the web development team, and a working group that included members of the

web development team and individuals from each division, called unit publishers, who were responsible for intranet content and publishing in their section.

In the fall of 1999, the company planned to upgrade all desktop computers and increase their network capacity. This meant that all CPUs and monitors would be capable of supporting the same high-level browser configuration. The web development team decided this would be an opportune time to reorganize the intranet and recognized the need for user feedback and testing as part of the reorganization effort.

The Study Design

The research plan for the study consisted of three phases:

- Phase I: Collect background on current use of the intranet, users and tasks, business structure, mission and purpose of the intranet.
- Phase II: Heuristic evaluation
- Phase III. Iterative rounds of user testing.

Data was collected using a variety of techniques – interviews, company documents, heuristic evaluation, and formal user testing. This multi-faceted approach was chosen because it allows for verification of findings among the different methods, and assures that a greater number of usability problems will be found and corrected.

Phase I - Background

The purpose of Phase I was to gather information on the company's user groups, on the current intranet site and any additional features that were planned for the redesign. An

understanding of how the site was being used was important so that the new version did not inadvertently take away some vital functionality. It was also important to understand the company's goals, mission, organizational culture, and structure in order to consider all the possible functions and features that the intranet would need to address, and to make sure that all user groups were considered in recruiting test users and developing tasks for the usability testing.

The first interviews were conducted with the corporate librarian and members of the intranet development team about the history, purpose, and design rationale of the current intranet, plans for its future development, and any reports of problems or complaints they had received. Documents were reviewed that outlined business goals, organizational structure, and the company's mission. These documents summarized the company's plans for moving from a narrow focus on inter-departmental functions to a more global focus on the company's core business processes and activities that cut across organizational boundaries.

Based on the results from the preliminary phase, the objectives of the usability testing process were to assess the navigational elements, the organization of the top-level pages, the use of the search engine, and the general ability of users to find specific information on the site.

Phase II – Heuristic Evaluation

The author and two students from the UNC's School of Information and Library Science conducted a heuristic evaluation of the intranet. The set of heuristics used was that developed by Levi and Conrad (1996) for their evaluation of the Bureau of Labor Statistics website (see Appendix a) which were, in turn, derived from Nielsen's 10-item list (1993) supplemented with hypertext-specific principles from Shneiderman and Kearsley (1989, cited in Levi and Conrad, 1996). This set of heuristics was chosen because they could be easily applied to a website, had been used and refined in a similar study, contained both high level and low level guidelines, and were presented in a form that made sense and was easy to comprehend. It was also felt that this set of usability heuristics would be easy for the intranet developers to learn and use in their design efforts.

The other two reviewers were given the background information on the site from Phase I and a copy of the heuristics, and asked to evaluate the site for usability problems. The review took an hour and a half, followed by a two-hour debriefing session to synthesize the findings. The advantage of having multiple reviewers, as Nielsen suggests, was apparent in that each reviewer approached the task differently, and focused their efforts on different sections of the site. One reviewer focused on the top-level page and one level below, while the others drilled down into one or more division sections. This

resulted in a comprehensive evaluation of the site in a short time. The evaluators compared notes on the usability violations found and looked for patterns of usability problems present across the site. These broad themes, and recommendations for solutions, were compiled into a report, reviewed by the other evaluators and then presented to the web team.

Phase III – User Testing

The purpose of Phase III was to observe users as they used the site to complete a series of tasks. Even though the heuristic evaluation was useful in discovering potential usability problems, the only way to truly test the usability of the site would be to gather a representative group of users, give them representative tasks to perform, and observe and measure how well they were able to complete those tasks. The specific goals of the user test were to find out:

- whether users could navigate effectively,
- whether the link names were predictive enough for users to make good guesses about their contents,
- whether the grouping of topics seemed logical,
- what paths users would choose to find information, and
- users' subjective impressions of the site and details about their current use of the intranet.

Three rounds of testing were conducted in February, June, and September 2000. The decision to retest was made when substantive changes had been made to the interface.

The tasks and the testing procedures were identical for each test with one exception.

Members of the web development team, after receiving instruction, participated as observers for some sessions of the first round of testing. This was done at the request of the members and head of the web development team since one of their goals was to incorporate usability testing into their development process. The procedures were strictly followed and the author supervised the testing. During the second round of testing, several unit publishers watched the testing, but did not participate. The third round of testing was conducted by the author alone.

Preparation. In advance of the actual testing, the testing documentation was developed, users were recruited and scheduled, and the developers were sent background information on usability principles and testing.

The test document contained four parts. Part 1 collected information about the user such as department, level of web experience, frequency of use and familiarity with the intranet content. Part 2 was a script read by the observer to all test users explaining the purpose, guidelines and instructions for the test. Part 3 was the set of tasks to be performed, and Part 4 was a short questionnaire to be completed by the user, asking for their subjective impressions, comments, and suggestions. A copy of the testing document is attached as Appendix B.

The tasks were chosen to target a broad range of available services and information useful to employees. In addition, the tasks were selected to focus on how

users navigated from the top-level of the site. The eight tasks covered training, holidays, ergonomics consultation, location and details about facilities, volunteer opportunities, and the five core behavioral competencies of the company.

Choosing Users. The test users were to be drawn from the employees of the company who make up the users of the intranet. The concern was to make sure that all possible user groups were included as test participants. This meant that every department and as many types of jobs as possible should be represented. It was also advantageous to have a broad range of computer and web experience, and length of time with the company. Users in the first round of testing were recruited by the intranet developer team from acquaintances and fellow employees they had worked with on team projects. Users in the second and third round of testing were recruited by the intranet unit publishers from each department. From the demographic section of the test and from interaction with the users during testing, it appears that the recruitment process was successful: the participants included both novice and experienced users, a variety of job categories, and both recent and long-term employees. All departments were represented.

The question of how many users should be tested depends on the type of testing being done. If the study had been testing a hypothesis or comparing multiple interfaces, it would have been more important to have a larger number of users. Conversely, if multiple tests are planned, then fewer users per test is acceptable. Nielsen claims that 3-5

users will find 85% of the usability problems (Nielsen, 1993), while Spool and Schroeder's (2001) study shows that in some cases only 35% of the usability problems had been found by the first 5 users. Rubin (1994) recommends at least 4 and optimally 8 users per test. Since it was relatively easy to recruit users, we tested 8 different users in each round of testing, for a total of 24 users.

Choosing the testing location. All three rounds of testing took place in the training lab at the company's facility. The training lab was chosen because it was convenient for the test users, and it was large enough that the developers could observe the testing but still be unobtrusive. The idea of conducting one round of testing in the user's office environment was considered in order to observe the web site being used in a naturalistic context. Once it was determined that the intranet was not being used for job-specific tasks, however, this idea was abandoned as not likely to yield any additional information relative to the inconvenience to the test users that field testing would cause. Video-taping of the sessions was considered and rejected as being too distracting to the users. Sessions were audio-taped in order to capture users' comments.

Pilot Test. A pilot test of the test document was conducted using members of the web development team. The reason for using the developers was to save the recruited users for the actual testing, and to give the developers some experience with being observers and test subjects. In retrospect, it would have been better to use two of the actual test users for the pilot test, since two of the tasks, which the developers had no

problem completing, had to be dropped after the first test because they were ill-defined and caused confusion unrelated to the interface.³ This experience corroborates Rubin's (1994) comments that the importance of conducting a thorough pilot test of the testing materials and tasks cannot be underestimated.

Testing. Before the test began, a consent form, which explained the study and their rights as a test subject, was given to the users to read and sign. Users were given the option of allowing or denying permission for the session to be audio-taped. All users agreed to the audio-taping of their session. Users were then read the script, which explained the purpose of the study and the guidelines. They were instructed to think out loud as they worked and to attempt the task using navigation before using the search. They were told to return to the home page if they became lost and begin again, and that the observer would stop them at five minutes. They were assured that it was the interface being tested, not their performance. The script, as part of the testing document, is included in Appendix B.

During the test, the observer noted the time to complete the task, the selected navigation paths, use of the search engine and search terms used, and user comments and impressions. If the time to complete the task went to five minutes, the observer stopped the user and moved to the next task. After all eight tasks were completed, the user was asked to complete a questionnaire. At the end of the test, users were permitted to ask

³ These two tasks are not represented in Appendix B.

questions about tasks, and were encouraged to talk about their experience with the testing and the intranet, in general.

The quantitative and qualitative data was analyzed, problems were identified, and recommendations made in a report to the web development team. The web development team implemented some of the recommendations, and also developed their own solutions to the problems identified. When the interface had been revised substantially, a new test was scheduled. By comparing the data across the three tests, it is possible to evaluate whether the interface became more usable based on the number of tasks successfully completed, decreased time to complete the task, decreased need for searching, and positive questionnaire scores.

Findings and Discussion

The study yielded four sets of data – the preliminary results from the first phase of data collection, the results of the heuristic evaluation, the quantitative performance and user satisfaction scores from the user test and post-test questionnaire, and the qualitative data from the observer's notes and audio-taped user comments during the testing. Each of these sets of results is described and discussed here.

Findings from Preliminary Background Review .

Based on the interviews conducted with the web development team and the corporate librarian, it was determined that the intranet was being used primarily to make organizational information available to employees. Computer-based training modules, as well as registration for instructor-led classes, were being offered via the intranet as an incentive to promote its use. Employees could also use the intranet to place a request with the IT group for technical assistance. The librarian and the head of the web team both expressed a desire to see the intranet expand to include more interactive work processes that spanned departments, such as claims processing, and the ability to track the progress of projects underway in one department that had impact on other

departments. These expanded functions were not planned for the immediate site revision, but were part of the future direction considered in design plans.

Based on the discussions and documented business plans, the agreed-upon goals of the intranet were to:

- Enhance the five core behavioral competencies of the company.
- Provide an overview of the company's major processes and activities so that employees could understand what the other sections do and where their department's efforts fit into the whole.
- Make important company and industry news available to employees.
- Provide information on resources, benefits, policies, and other types of information that employees need.

The web development team felt that the main problem with the current site was that users had difficulty finding information on it. The current navigation did not give users a good indication of all the information available. Even when users knew that an information item was available on the intranet, they had problems locating it. In addition, the search engine was not very effective. The web team suspected that employees had become frustrated and were not making much use of the site. They wanted recommendations for the navigation and information architecture of the new intranet design. They were also interested in using the study to become trained in usability principles and user testing, both for themselves and for the departmental unit publishers.

Heuristic Evaluation Findings.

Prior to beginning redesign, the heuristic evaluation was conducted. The usability violations identified by the evaluators were tied primarily to the heuristics of Navigational Feedback, Progressive Level of Detail, Consistency, and Minimization of Memory Load. Since the version of the site evaluated in the heuristic review was due to be revised, the evaluators looked for patterns in the usability violations that were found. These patterns were used to develop broad usability recommendations that the web development team could use as guidelines for the redesign. These problem areas and recommendations are described briefly below. The complete heuristic report is attached as Appendix C.

Site Organization. The most important recommendation for improved usability from all three evaluators was to develop better organization of the site's contents, i.e. an improved information architecture. Like the intranets discussed in the literature review, this intranet began as an employee information resource with other content areas being added over time. While the site contained lots of diverse and valuable information, the information was not linked very well in terms of relationships, categories, or how users approach the information. In addition, the top-level navigation did not provide a sufficient overview of what was available at the lower levels.

Information was grouped on the site by organizational division. Areas of content were found in the section of the site devoted to the division that "owned" that

information. The organization by division theme was reinforced by placing the division links at the top of the navigation bar of the main home page and by having the navigation frame of each section color-coded. This meant that if the user was searching for specific information, he or she first had to determine which division had responsibility for that information. This could present a barrier to the user, particularly when functions or initiatives had moved from one division to another. It was suggested that the developers consider alternate (but concurrent) organizing strategies, such as organization by related topic (for example, an index of all training opportunities located on one page), by project (one directory page for a company initiative that crossed division boundaries), or by task (links to instructions for completing forms included on the same page as access to forms). This recommendation did not extend to a reorganization of the underlying file/directory architecture. This would have been a huge undertaking and could well have resulted in a less usable site. The idea was to redesign and expand the navigation to provide alternative ways for users to access the content.

A design exercise was suggested that would have the web development team create a diagram of the current site contents, using markers on a whiteboard or color-coded post-it notes. The purpose of the exercise would be to give the development team a visual overview of the entire site and enable them to identify connections between sections, categories of information, and logical grouping of content. Once the categories and relationships had been identified, and the possible alternative organization schemes

fleshed out, then the navigation and the major section pages could be redesigned to collect, categorize, and outline the information. The results of the exercise would also serve as system documentation, and could be used to create a company-wide web style guide, as guidelines for future redesign, and orientation for new web development team members.

Navigational Feedback. The evaluators identified several specific navigational problems within the site.

- Consistent and Logical Navigation

The left navigation bar was not consistent within each division section in terms of the number, name, and order of links. One division page might have four topics in the navigation bar, while another page, in the same division, might have nine (different) topics. The link names and order also differed from page to page. This was found across all the sections of the site, and was likely the result of the accumulation of content over time. Consistent navigation is critically important for usability, especially for intranets with their broad range of content topics and developers, and content that changes so frequently. In addition, the order of links in the navigation bar guides users through the content in a logical way and should also remain consistent, whenever possible, across divisions.

- Indication of Hierarchy

The evaluators found the lack of hierarchical indicators in the left navigation bar of

many pages to be a navigation problem. Having all links left-justified suggests that they were all on the same level, when in fact some links were sub-topics. Presenting the hierarchy in the navigation bar gives users a better understanding of the relationship between topics and helps to orient them in the site.

- “You are Here”

It was suggested that developers give the user an indication of where they are within the site by highlighting the current page’s link in the side or bottom navigation.

Another possible solution was to include a breadcrumb navigation header at the top of lower-level pages, such as [Top Page](#) → [Section Main page](#) → [Section Subsite](#), This helps users form a mental model of the site’s overall architecture, orients them within the site, and makes the hierarchical relationships explicit

- Links in One Section that Lead to Another Section

Evaluators found it misleading when a link from one section’s navigation led them without warning into another section. The shift was disorienting because the navigation bars were color-coded to each section and it was assumed that all the links buttons that were the same color were in that division section. This was not the case. Clicking a link on an orange navigation bar, might lead to a page in the “blue” section. Even more confusing, there was no link back to the previous orange section. This confusion is a byproduct of the information being organized according to

division. Solutions were discussed including indicating some color hint on the link as to its origin.

- Site Map

Finally, it was suggested that a site map would be helpful in giving users an overview of the content. Considering the breadth of the site, this would be a big undertaking. However, the results of the design exercise might make it somewhat easier. This function could possibly be automated. Developers were cautioned to consider how the map would be maintained before implementing it. It would be better not to include a site map than to have an inaccurate and outdated one.

Other Problems. Two other categories of problems were identified that were of lesser severity. One problem was with pages that contained no actual content, but only a listing of links, that duplicated the navigation bar. Many of these links-only pages could be collapsed or consolidated, which would bring the actual content one level higher. However, determination should be made on a case by case basis since some of these pages did provide additional valuable information.

Another problem was the use of acronyms and jargon. The evaluators were not familiar with many of the corporate titles for initiatives or programs and so did not feel qualified to say whether employees would have easily understood link names that used acronyms or corporate language. User testing would be more able to determine if this was a problem.

Another possible problem was standardization of formatting. Since the web development team had expressed a desire to allow divisions some creative latitude in developing pages, the evaluators did not target minor formatting inconsistencies. However, it was noted that, in general, intranets are more task-directed than public intranet sites, and the focus should be on helping the user get on with their work. When the screen is taken up with graphics, large fonts, or animation that pulls the user's attention away from the content, then usability does suffer. It was suggested that a set of guidelines be drawn up by the web development team, possibly even including a list of the usability heuristics, that will help content developers keep their design within the bounds of usability.

Elements of the Design Which Promoted Usability. The evaluators did find elements of the site's design that were used effectively.

The overall aesthetic of the interface was clean and uncluttered. Content was easy to read, and formatting and fonts were consistent for the most part. A contact footer, which gave page author, phone number, and revision date, was present on each page.

Chunking of documents was not found to be a problem in the heuristic evaluation, since most of the documents reviewed were short enough to be easily scanned. However, since many of the documents on the intranet are on-line versions of paper-based manuals, it can be expected that there will be examples of longer documents.

The evaluation identified both high level and low level usability problems. The problem areas and recommendations addressed task-oriented aspects, such as site organization, redundant pages, and use of acronyms, as well as interface-oriented aspects, such as hierarchy and consistency in navigation and formatting. A review of the user testing data was necessary to see if the usability problems identified by the heuristic evaluators were the same problems encountered by the test users.

User Test Findings - Quantitative

The quantitative performance data, shown in Table 1, included number of tasks completed, task completion time, and number of searches.

Table 1. Performance Data from User Testing

	<u>Test1</u>		<u>Test 2</u>		<u>Test 3</u>	
	Mean Task Completion Time in minutes (std/dev)	Tasks Completed No. of Searches	Mean Task Completion Time in minutes (std/dev)	Tasks Completed No. of Searches	Mean Task Completion Time in minutes (std/dev)	Tasks Completed No. of Searches
Task 1	5.72 (2.10)	4/8 completed 4 searches	.98 (.96)	8/8 completed 0 searches	1.17 (1.03)	8/8 completed 0 searches
Task 2	1.44 (2.28)	7/8 completed 0 searches	.59 (.72)	8/8 completed 1 search	1.53 (1.08)	8/8 completed 1 search
Task 3	2.28 (1.54)	8/8 completed 1 search	2.99 (2.90)	6/8 completed 3 searches	1.64 (.66)	8/8 completed 2 searches
Task 4	3.13 (2.03)	7/8 completed 0 searches	3.82 (2.48)	6/8 completed 2 searches	2.17 (2.32)	7/8 completed 1 searches
Task 5	4.88 (2.36)	4/8 completed 2 searches	3.73 (.86)	8/8 completed 7 searches	2.58 (1.84)	7/8 completed 6 searches
Task 6	1.15 (1.27)	8/8 completed 1 search	1.82 (2.56)	7/8 completed 3 searches	.64 (.67)	8/8 completed 2 searches
Task 7	4.06 (2.20)	6/8 completed 4 searches	.88 (.65)	8/8 completed 1 search	1.43 (1.00)	8/8 completed 3 search
Task 8	3.67 (2.74)	6/8 completed 1 search	2.65 (1.35)	8/8 completed 3 searches	1.78 (2.27)	7/8 completed 1 searches

Note: Cut-off time was 5.0 minutes for task completion during testing. For statistical analyses, tasks that were not completed were coded as 7.0 minutes and task times shown in Table 1 reflect this method of calculation.

The task times shown in Table 1 are the mean times in minutes for each task for each test. For analysis purposes, tasks that were not completed were coded as 7.0 minutes⁴. Task completion times were fastest for Tasks 1, 2, and 7 in Test 2. For all other tasks, completion time showed the most improvement in Test 3. A statistically significant improvement in task completion time was detected using analysis of variance with post hoc analysis using Duncan's multiple range test for Task 1 (finding the company holidays) and Task 7 (finding volunteer opportunities) between Test 1 and Tests 2 and 3. Task 1 and Task 5 (finding the behavioral competencies) presented users with the most difficulty in completing the tasks in Test 1. Almost all users were able to complete the tasks in Tests 2 and 3. The percentage of total tasks completed improved from 78% completed in Test1 to 92% completed in Test 2 to 95% completed in Test 3.

Use of the search facility was highest for Tasks 1 and 7 in Test 1, and for Task 5 in Tests 2 and 3. Since users were told to resort to the search only when they were unable to complete the task using navigation, this finding would suggest that the navigation was problematic for completion of Tasks 1, 5, and 7. This assumption is corroborated by the fact that Tasks 1 and 5 also gave users the most difficulty with task completion. Also, the fact that Tasks 1 and 7 showed the greatest improvement in task completion times

⁴ Cut-off time was 5.0 minutes for task completion during testing. 7.0 minutes was considered plausible for extended task completion time. Task times shown in Table 1 reflect this method of calculation.

between Test 1 and Tests 2 and 3 suggests that the navigation improved between Test 1 and Tests 2 and 3.

Some possible reasons for this improvement in task completion times and percentage of tasks completed in Tests 2 and 3 were changes in the interface, including the availability from the top level of a drop-down navigation box that contained many sub-site topics listed in alphabetical order, and an Employee Resource page which consolidated employee resource information from several divisions on one page. The increase in task completion rates for Task 5 in Tests 2 and 3 seem to be related to an increased tendency for users to search. The information to complete Task 5 was located on a page several layers down, with little navigational clues to reach it. It appears that in Tests 2 and 3, users gave up trying to complete the task using the navigation and relied on the search facility almost exclusively to complete this task.

The fact that improvements in time and percentage completed did not occur in a pattern across all the tasks rules out the possibility that it may have been caused by the web developers acting as observers in Test 1. Had this been the case, the influence would have been seen, positive or negative, in each task. A more likely explanation can be found in the changes to the interface and organization mentioned above. This explanation is discussed further in the section on Qualitative Data.

Quantitative subjective data came from the post-test questionnaire scores. This data, along with the corresponding questionnaire item, is shown in Table 2.

Table 2. Post-Test Questionnaire Scores

1. Overall, finding specific information was:

Difficult	1	2	3	4	5	Easy	<u>Test1</u>	<u>Test 2</u>	<u>Test 3</u>
							2.37 (0.92)	3.5 (0.53)	3.63 (0.51)

2. Organization of the intranet home page was:

Not effective for finding Information	1	2	3	4	5	Very Effective	<u>Test 1</u>	<u>Test 2</u>	<u>Test 3</u>
							2.5 (0.92)	3.5 (0.53)	3.81 (0.65)

3. Options for navigating from page to page were:

Confusing	1	2	3	4	5	Logical	<u>Test 1</u>	<u>Test 2</u>	<u>Test 3</u>
							2.75 (0.71)	3.0 (1.1)	3.44 (0.50)

4. The search tool was:

Useful	1	2	3	4	5	Not useful	<u>Test1</u>	<u>Test 2</u>	<u>Test 3</u>
							3.25 (0.71)	2.75 (1.67)	1.57 (1.13)

5. Most of the information was:

Buried deep in t he site	1	2	3	4	5	Accessible in a few clicks	<u>Test 1</u>	<u>Test 2</u>	<u>Test 3</u>
							2.5 (0.92)	2.76 (0.46)	3.63 (1.19)

6. When I was looking for information, I

Felt lost	1	2	3	4	5	Felt I knew where I was	<u>Test1</u>	<u>Test 2</u>	<u>Test 3</u>
							2.5 (1.19)	3.38 (0.74)	3.36 (1.1)

7. How did you feel while working on this site?

Confused	1	2	3	4	5	Comfortable	<u>Test 1</u>	<u>Test 2</u>	<u>Test 3</u>
							3.0 (1.29)	3.75 (0.88)	4.13 (0.64)

Note: Numbers listed in bold are the mean scores for each item, with standard deviation listed in parentheses. Direction of scale for Question 4 was reversed before statistical calculation.

The questionnaire scores improved with each round of user testing. Statistical significance was identified, using analysis of variance with post hoc analysis using Duncan's multiple range test, for Question1 (ease of finding specific information) between

Test 1 and Test 2 and 3. Statistical significance was identified for Questions 2 (organization of home page) and Question 5 (depth of information) between Test 1 and Test 3. The design changes mentioned earlier could also account for users finding information easier to find and not buried so deep within the website. The improvement in the organization of the home page in Test 3 will be discussed further in the Qualitative Data Analysis section

It is generally agreed that users' answers to questionnaires cannot always be accepted at face value. They may give a more positive answer than the performance data would warrant. To check the validity of the questionnaire answers, test times for each individual user were averaged and correlated with their questionnaire scores. For each questionnaire item, the two sets of data were correlated below .05. This suggests that the increase in user satisfaction reflected in the questionnaire scores was related to their experience with the interface during the test, and not on a desire to please the observer. It was also an indication that the questionnaire items were relevant to the way the system was used during the testing.

Summary of quantitative findings. Task completion times improved across the three tests, with statistical significance found in task completion times for Task 1 and Task 7 between Test 1 and Tests 2 and 3. Percentage of tasks completed also increased across the three tests. Questionnaire scores improved with each round of testing. Statistical significance was found in the increase in scores for Question 1 between Test 1 and Tests

2 and 3, and for Questions 2 and 5 between Test1 and Test 3. Questionnaire scores and average task completion times for each individual were compared and the two sets of data were correlated below .05 for each questionnaire item. Possible reasons for the improvement were changes made between Test 1 and Test 2 in the interface and organization of topics that aided navigation and brought information that was buried in the site closer to the top level.

User Testing Findings - Qualitative

The qualitative data collected during the user testing phase consisted of observer notes and user comments during the user test, and answers to the open-ended questions in the post-test questionnaire. As the qualitative data was being compiled and analyzed, several categories of user behavior or comments emerged that seemed especially useful in generating recommendations for usability improvements. These included:

- associative connections that users made between information areas,
- patterns of confusion about particular link names or the information hierarchy,
- the structuring of tasks from a user point of view, and
- elements of page layout that caused problems.

The qualitative data also provided insight into how elements such as consolidation pages, the drop-down navigation box, and the search engine were used. These are discussed in detail below.

Associative Connections – This information was very useful in understanding how and where users expected to find certain information. For example, in Task 1, which asked users to find the list of company holidays, the most popular search path seen in Test 1 was through HR Policies to Paid Time Off. Although a consolidated calendar page was available in Test 2 and 3, which provided a quick route to the holiday calendar, several users still went to Paid Time Off. Creating a link from the Paid Time Off page to the holiday calendar provides an additional access point and speeds up search time for users that approach the information through that connection.

Confusing Links. The observation data uncovered examples of link labels that users consistently found confusing or misleading. For example, the Employee Resources page contained a link titled “Job Aids & CBTs”, which led to the page for on-line computer training. Users interpreted this link to mean all types of information that would make their job easier, including ergonomics or organizational training. Another example was the acronym CBT (Computer-Based Training), which was unfamiliar to many users. The page that presented facility maps was another example of a misleading link, but through color rather than wording. Room labels on the page were shown in blue, which caused several users to mistake them for active links.

Task Flow from the User Perspective The two training tasks (Task 4 and Task 8) provided a good example of a page intended to help users complete a task (locate a training class or module) that was difficult for users because the design was modeled on

the way the department was structured rather than on the way the task is actually performed. The company offers two types of training – computer/technical training and organizational development. To complete this task, users first had to decide which type of training the instruction they were looking for would fall under. The technical training is further subdivided into instructor-led training and online (or Computer-Based Training). Users in Tests 2 and 3 repeatedly suggested having one consolidated training page that listed all the types of training available with links to the appropriate area. Instead, they were forced to choose how they wanted to take the class before they could see what all the training options were. As one user said, “If I want training on something, I’m a lot more likely to want to know about all of the FrontPage training of any sort than I am to have already made the decision in my mind that I need a CBT or an on-line or an instructor-led. I’m a lot more likely to come at it from a topical standpoint first and then worry about the delivery mechanism after.” Armed with this information about how users approach the task of choosing a training class, developers could design the pages in line with the way users actually work.

Consolidation Pages. Pages that consolidated and grouped topics by user categories rather than by organizational division were very helpful to users and were probably one of the main reasons for the improvement in the test times between Test 1 and Tests 2 and 3. Instead of having to figure out which division administered volunteer programs, ergonomics counseling, or holiday calendars, users could use the Employee

Resources page as a jumping off point to a wide range of employee information. Users in Tests 2 and 3 commented that this resource page had become their preferred way to find important employee information of all kinds. By providing this type of user-oriented organization, it is more likely that users will voluntarily elect to use the intranet as their primary information resource for company information.

Use of the Drop-down Navigation Box. Developers created a drop-down box, between Test 1 and Test 2, that listed many of the sub-site topics in alphabetical order. The purpose of the drop-down box was to bring some of the information buried in the site closer to the surface. The box was located in the center section of the main intranet page and was designed so that the top five lines or so of the sub-site list were visible as the default. The drop-down box was extremely successful as a navigation tool in Test 2 and was by far the most popular way for users to begin the tasks. It did not always guarantee that people completed the tasks faster, since they sometimes had problems with the second level pages. However, it was very useful as a starting point, and as a way for people to grasp the wealth of information contained in the lower levels. Between Test 2 and Test 3, the main intranet page was redesigned to resemble an information “portal” with links to external business sites and search engines. The previous intranet navigation links were still available. The drop-down navigation box remained, but in order to save on screen real estate, it was redesigned so that, instead of five lines of subsite topics being visible, only one line of the list was visible with a generic message, “Go to...”. Use of

the drop-down box dropped to nearly zero in Test 3. After the first four users in Test 3, the box was expanded to five lines, and it again became the first choice for navigation. This suggests that it is not enough just to include navigational options. Users also need visual clues that help them understand their purpose of these elements and how they can be used.

Search. Although all test users but one, used the search engine at least once during their session, the extent to which the search results were helpful varied widely from task to task. Users commented that they did not usually use the search, because the results were too cryptic, there were too many results, or the information they were looking for yielded no results. A better understanding of how pages were indexed, and the information from the page that was listed in the search results could be used to improve the performance of the search engine.

Other Qualitative Information. Information about how the intranet was being used was gathered from user's comments during the testing. Several users said that they often used division organization charts to look up a title or contact information for a person. Users who had supervisory responsibilities, said they often looked up information about hiring and promotion policies, and used the HR forms. They also referred new employees to the intranet as a way to orient themselves in the company. Other popular sites mentioned were the job listings page, and a Resource Toolkit page

created for Customer Services. These areas of the intranet should be included in tasks for future testing.

Summary of qualitative findings. The qualitative data gleaned from observations and user comments during testing yielded insights into the associations that users made between information areas, common confusion about link names, and elements of page layout and navigation that caused problems and that were helpful. Users' comments during the training tasks demonstrated how to approach the design of the training section from the users' points of view. In addition, detailed feedback on problems that users encountered with the search engine provided developers with ways to improve this feature. Information on the ways that employees used the intranet daily was also important in identifying areas that could be given priority in future designs and testing.

Conclusions

The qualitative data obtained from watching and listening to users during testing was useful in detecting patterns of usability problems and was of practical interest to the web development team in developing design improvements. However, the quantitative data was necessary in determining whether there was any actual improvement in the usability of the intranet over time.

The changes in the interface that caused the improvement in usability between Test 1 and Tests 2 and 3 were related to were gathering and connecting information across the different sections of the site and bringing buried information closer to the top level. Examples of these ideas were creating consolidated pages of similar topics, creating a listing of sub-sites available from the main page, and creating associative links between information in different divisions.

These ideas, linking information based on related categories, breaking down the barriers between divisions, and providing a better overview of the site, are the same as those covered in the recommendations for better site organization generated via the heuristic evaluation. Other interface-related problems identified in the heuristic evaluation, such as consistency, hierarchy, redundant pages, and variation in formatting,

did not appear to have created as many difficulties for users in the testing as the more task-related problems did. This may have been because the most glaring problems had already been fixed by the time of the user testing. There was some overlap in the problems discovered by the two methods, but more usability problems were found and corrected by using both methods, than would have been found using only heuristic evaluation or only user testing.

There were two aspects of the testing process that, in retrospect, could have been more effective. One involved the pilot test. As mentioned previously, had the pilot test been conducted with some of the users, rather than the web developers, problems would have been detected that arose during the user tests. Also, the order of the tasks should be switched between tests to rule out any chance of having the first task in each test be influenced by the users getting used to the testing process.

The participation of the web development team and unit publishers in the testing was not seen to be a problem. In fact, it was beneficial in that the more they were able to see the usability methods, the more convinced they were of the benefits to the site's design from the usability process.

Based on the performance and attitude measures, it appears that usability of the intranet had improved by the end of the Test 3. Also, based on the observations and comments of the users, design elements were identified which accounted for the

improvement. Finally, usability methods and awareness had become part of the design process and would be used in ongoing redesign efforts.

References

Bernard, Ryan (1997) Chapter 9 “Managing the Corporate Intranet” in *The Corporate Intranet : create and manage an internal web for your organization*. New York : Wiley Computer Pub., pp. 314-329.

Bigdoli, H. (1999). An integrated model for introducing intranets. *Information Systems Management*, 16 (3) 78-87.

Borges, J.A., Morales, I., and Rodriguez, N.J. (1998). Page design guidelines developed through usability testing in *Human Factors and Web Development*, ed. Chris Forsythe, Eric Grose, and Julie Ratner. Mahwah, N.J.: Lawrence Erlbaum Associates, pp. 137-152.

Carlson, Patricia (1999). Information Technology and Organizational Change. *Proceedings on the seventeenth annual international conference on Computer documentation* (September 12 - 14, 1999, New Orleans, LA USA), pp. 26-35.

DeJong, M. and Van Der Geest, T. (2000). Characterizing Web Heuristics. *Technical Communication*. 47(3), 311-326.

Doran, K. (1999). Metadata for a corporate intranet. *Online*, 23 (1) 43-50.

Doubleday, A., Ryan, M. Springett, M, Sutcliffe, A.(1997). A comparison of usability techniques for evaluating design. *Proceedings of the conference on Designing interactive systems: processes, practices, methods, and techniques* (August 18 - 20, 1997, The Netherlands), pp.101-110.

Drennan, J. (1999). The introduction of intranets into the newspaper industry. *ASLIB Proceedings*, 51 (8) 269-274.

Fabris, P. (1999). You think Tomaytoes, I think Tomahtoos. *CIO WebBusiness* [Online] available http://www.cio.com/archive/webbusiness/040199_nort.html [Nov.25, 2000].

Haywood, R. (1999). From paper to intranet (work processes posted on the Intranet). *IIE Solutions*, 31(2) 47-49.

Henry, Amanda M. (2000) High-tech healthcare. *Intranet Journal* [Online]. Available http://itmanagement.earthweb.com/intra/intman/article/0,,12274_621761,00.html [Nov 20,2000].

Hobbs, B. (1998). Usability and the intranet: making information work online in *Online Information 98. Proceedings of the 22nd International Online Information Meeting*(London, England, Dec. 8-10, 1988), 61-67.

Laskowski, S.J. and Downey, L.L. (1997). Evaluation in the Trenches: Toward Rapid Evaluation. *Position Paper for Workshop on Usability Testing WWW Sites (CHI'97, Atlanta, GA.* [Online]. Available http://www.itl.nist.gov/iaui/vvrg/position_paper.html [March 20, 2001].

Levi, Michael and Conrad, F.G. (1996). A Heuristic Evaluation of a World Wide Web Prototype. *Interactions Magazine*, (3)4, 50-61.

Marchionini, G., Hert, C. (1997). "Usability Testing for Large Institutional Web Sites." *Position paper for Workshop on Usability Testing WWW Sites (CHI '97, Atlanta, GA).* [Online] Available <http://www.acm.org/sigchi/web/chi97/testing/marchion.htm>) [March 20, 2001].

Mullich, J. (1999). Reinvent your Intranet. *Intranet Journal* [Online]. Available http://itmanagement.earthweb.com/intra/intman/article/0,,12274_611331,00.html) [Nov.25, 2000].

Nielsen, J. (1993) *Usability Engineering*. Boston, MA: Academic Press.

Nielsen, J. (1994) Guerilla HCI: Using discount usability engineering to penetrate the intimidation barrier In Bias, R.G. and Mayhew, D.J. (Eds.), *Cost-Justifying Usability*. Boston: Academic Press, 245-272.

Nielsen, J. (2000a). *Designing Web usability*. Indianapolis, Ind.: New Riders.

Nielsen, J. (2000b). Why You only Need to Test Five Users, Jakob Nielsen's Alertbox, March 19, 2000 [Online]. Available <http://www.useit.com/alertbox/20000319.html>). [March 20, 2001].

Rosen, S. (1999). Actions Speak Louder than Words. *Communication World*. 16(6), 60.

Rubin, J. (1994) *Handbook of Usability Testing*, New York: John Wiley & Sons.

Shackel, B. (1991). Chapter 2, Usability, Context, Framework, Definition, Design and Evaluation in Shackel, B. and Richardson, S. (Eds.), *Human Factors for Informatics Usability*. New York: Cambridge University Press, pp. 21-38.

Spool, J., Schroeder, W. (2001). Testing Web Sites; Five users is Nowhere near Enough. *Extended Abstracts of the Conference on Human Factors in Computing Systems (March 31-April 5, 2001, Seattle, WA USA)*, pp. 285-286.

Varnum, K.T. (1999). Lessons Learned – Designing a Second-generation Intranet. *Online*, 23 (1) 52-57.

Vishik, Clare (1997). Internal Information Brokering and Patterns of Usage of Corporate Intranets. *Proceedings of the international ACM SIGGROUP conference on Supporting group work: the integration challenge (November 16 - 19, 1997, Phoenix, AZ USA)*, pp. 111-118.

Woodun, C., O'Donnell, R.. (1998). Intranets: a methodology for implementation in *Online Information 98. Proceedings of the 22nd International Online Information Meeting (London, England, Dec. 8-10, 1998)*, pp.197-206.

Wooliams, B. (1998). Intranet evolution: the intranet is your business in *Online Information 98. Proceedings of the 22nd International Online Information Meeting (London, England, Dec. 8-10, 1998)*, pp. 69-74.

Yu, J., Prabhu, P., Neale, W. (1998) A User-Centered Approach to Designing a New Top-Level Site Structure for a Large and Diverse Corporate Web Site. *Proceedings from the Fourth Conference on Human Factors and the Web, (June 5, 1998 Basking Ridge, NJ)* [Online]. Available <http://www.research.att.com/conf/hfweb/proceedings/yu/> [Nov. 20, 2000].

Appendix A

Usability Heuristics

- **Speak user's language** - Create a natural and logical order to information; predictive label to links.
- **Consistency** in terminology, graphics, layout, formatting, font, and labels across the site.
- **Minimize memory load** - use recognition rather than recall; provide users with the information they need, rather than forcing them to remember across pages.
- **Flexible and efficient system** - accommodate diverse user levels and goals; include instructions where needed; provide easy access to frequently needed items.
- **Aesthetic & minimalist** - visually pleasing; uncluttered; eliminate irrelevant & distracting information.
- **Use chunking** - Documents should be short and focus on one topic; don't force users to cross multiple pages to complete a thought.
- **Progressive level** - General information appears before specific; navigation to frequently accessed items should appear at or near top of site; Encourage digging but only as far as necessary to access information.
- **Navigational feedback** - User should be able to tell where they are in the site, where they can go next, and how to return to their original starting point; interface should provide overviews and previews, predictive links; site map.
- **Don't lie to user** - Erroneous links or misleading or missing information.

Appendix B
Testing Document

Intranet Usability Test Observer Comment Form

Name of observer:

User:
User's Dept:

Date:

Please describe your experience with web browsers and tools:

- ☐ beginner
- ☐ intermediate
- ☐ advanced

How familiar are you with the content of the CompanyXYZ intranet?

- ☐ not at all familiar
- ☐ familiar with my department's content
- ☐ familiar with a good amount of the content on the intranet
- ☐ very knowledgeable about the intranet

How often do you visit the CompanyXYZ intranet?

- ☐ more than once a day
- ☐ daily
- ☐ weekly
- ☐ now and then, not on a regular basis
- ☐ never use the intranet

Read this to the tester before you begin:

Answers to the following tasks can be found somewhere on the CompanyXYZ Intranet site. This study is designed to test those elements of the site which relate to how usable the site is in helping users complete their tasks. These elements would include such things as how users navigate around the site, the grouping of topics, how well the link names help users predict the kind of information they will lead to, and the users' overall impression of the site as a information tool. Starting at the Intranet home page, find the page that contains the answer to each question. Please think out loud as you work through each task. This will help us understand your assumptions and thought processes as you explore links. A member of the

study team will observe you as you work. If you find yourself stuck, you may return to the home page and begin again. If you have been unable to answer the question within five minutes, move on to the next question.

Remember, this is not an evaluation of your performance, but of the interface and its ability to help you find information you need. Any feedback you can offer on the interface is welcome. After you have finished searching, there is a brief questionnaire to fill out. Thanks again for your participation.

**1. Find the list of company holidays
for the year 2000?**

time started: _____
time stopped: _____

URL of answer:

browsing path:

User's Process:

Used the search tool: ____ yes ____ no

Search words used:

Browsing: (indicate path)

Did the user find the answer? ____ yes ____ no

Has the user visited this site previously before taking this test? ____ yes ____ no

Describe issues/problems:

2. Find the page that tells how an employee is chosen to participate in the College for Corporate Change? time started: _____
time stopped: _____

URL of answer:

browsing path:

User's Process:

Used the search tool: ____ yes ____ no

Search words used:

Browsing: (indicate path)

Did the user find the answer? ____ yes ____ no

Has the user visited this site previously before taking this test? ____ yes ____ no

Describe issues/problems:

3. Find the page that gives the table capacity for the Headquarters Café 1 room.

time started: _____
time stopped: _____

URL of answer:

browsing path:

User's Process:

Used the search tool: ____ yes ____ no

Search words used:

Browsing: (indicate path)

Did the user find the answer? ____ yes ____ no

Has the user visited this site previously before taking this test? ____ yes ____ no

Describe issues/problems:

4. Find the page that tells how to sign up for the on-line course "FrontPage 98"?

time started: _____
time stopped: _____

URL of answer:

browsing path:

User's Process:

Used the search tool: ____ yes ____ no

Search words used:

Browsing: (indicate path)

Did the user find the answer? ____ yes ____ no

Has the user visited this site previously before taking this test? ____ yes ____ no

Describe issues/problems:

5. Find the page that lists the five core behavioral competencies for Company XYZ.

time started: _____
time stopped: _____

URL of answer:

browsing path:

User's Process:

Used the search tool: ____ yes ____ no

Search words used:

Browsing: (indicate path)

Did the user find the answer? ____ yes ____ no

Has the user visited this site previously before taking this test? ____ yes ____ no

Describe issues/problems:

6. Find the page that tells how an employee can get information about ergonomics.

time started: _____
time stopped: _____

URL of answer:

browsing path:

User's Process:

Used the search tool: ____ yes ____ no

Search words used:

Browsing: (indicate path)

Did the user find the answer? ____ yes ____ no

Has the user visited this site previously before taking this test? ____ yes ____ no

Describe issues/problems:

7. Find the page that lists current volunteer opportunities.

time started: _____
time stopped: _____

URL of answer:

browsing path:

User's Process:

Used the search tool: ____ yes ____ no

Search words used:

Browsing: (indicate path)

Did the user find the answer? ____ yes ____ no

Has the user visited this site previously before taking this test? ____ yes ____ no

Describe issues/problems:

8. Find the page that tells the day and time of the next Company XYZ desktop training class.

time started: _____
time stopped: _____

URL of answer:

browsing path:

User's Process:

Used the search tool: ____ yes ____ no

Search words used:

Browsing: (indicate path)

Did the user find the answer? ____ yes ____ no

Has the user visited this site previously before taking this test? ____ yes ____ no

Describe issues/problems:

Post-Test Questionnaire

Please describe your experience during this test:

1. Overall, finding specific information was:

Difficult 1 2 3 4 5 Easy

2. Organization of the intranet home page was:

Not effective
for finding
Information 1 2 3 4 5 Very Effective

3. Options for navigating from page to page were:

Confusing 1 2 3 4 5 Logical

4. The search tool was:

Useful 1 2 3 4 5 Not useful

_____ Check here if you didn't use the search tool

5. Most of the information was:

Buried deep
in t he site 1 2 3 4 5 Accessible in
a few clicks

6. When I was looking for information, I

Felt lost 1 2 3 4 5 Felt I knew where I was

7. How did you feel while working on this site?

Confused 1 2 3 4 5 Comfortable

Do you have any additional suggestions or comments for improving the Intranet interface?

Are there any additional functions you would like to see added to the Intranet?

Appendix C

Heuristic Evaluation of COMPANY XYZ Intranet

Heuristic testing is a technique for assessing the usability of a system by having an expert (or group of experts) evaluate the system using a set of accepted design principles.

Heuristic testing is one of several types of testing that can be used for evaluation and, whenever possible, should always be used in conjunction with testing by the actual users of the site, whose input through formal testing or qualitative feedback is the true test of a site's usability.

The heuristic evaluation of the Company XYZ intranet was conducted by Ron Berquist, Beth Fowler, and Kelly MacLaughlin, students of UNC's School of Information and Library Science. It took place on January 6, 2000 in the Information Center at the corporate facility in Chapel Hill, N.C.

In order to determine the usability of a site or system, it is necessary to start with the purpose and goals of the site. If the site does not meet its goals, then it cannot be said to be useful to users. Likewise, if the goals and purposes are vague or ill-defined, then it is very hard to determine when the site has achieved its aim of being effective and useful. Based on interviews with member of the IT team, the purposes of the Company XYZ intranet site are:

- To enhance the five core behavioral competencies of the company
- To provide an overview of the company by allowing employees to understand what each section of the company does and where their sections fits into the whole.
- To make important company and industry news available to employees
- To provide employees with information about employee resources and benefits

The following is the list of usability heuristics (adapted from Jakob Nielsen) used for the evaluation.

- **Speak user's language** - Create a natural and logical order to information; predictive label to links.
- **Consistency** in terminology, graphics, layout, formatting, font, and labels across the site.
- **Minimize memory load** - use recognition rather than recall; provide users with the information they need, rather than forcing them to remember across pages.
- **Flexible and efficient system** - accommodate diverse user levels and goals; include instructions where needed; provide easy access to frequently needed items.

- **Aesthetic & minimalist** - visually pleasing; uncluttered; eliminate irrelevant & distracting information.
- **Use chunking** - Documents should be short and focus on one topic; don't force users to cross multiple pages to complete a thought
- **Progressive level** - General information appears before specific; navigation to frequently accessed items should appear at or near top of site; Encourage digging but only as far as necessary to access information
- **Navigational feedback** - User should be able to tell where they are in the site, where they can go next, and how to return to their original starting point; interface should provide overviews and previews, predictive links; site map.
- **Don't lie to user** - Erroneous links or misleading or missing information.

Findings:

Good points:

- The aesthetic look of the site interface

The overall aesthetic of the site is clean and uncluttered. Content is easy to read. Consistency of formatting and fonts is good for the most part. The navigation bar across the top of the main pages is present across all the pages, allowing users to return to the main page or access the search page with one click. This consistency does not extend to the left navigation bar, however, and this creates a usability problem.

- The use of color to denote different divisional sections of the site

This is a good device for orienting the user within the site, and is used effectively. There is some concern that links on a navigation bar that send the user into a different division are somewhat misleading. This is discussed under “Areas for Improvement.”

- The footer containing author, and modification date

This is a very good feature and is used throughout the site. It would be helpful to include, in addition to the phone extension of the author, an in-line email address. This would enable the user to send email to the page's author directly. There were

some slight differences in how the footer was formatted from page to page (for example, in some cases the author's name was bolded and in other places not). This is a minor point, but if the footer could be included as a standardized template script, then it would be easy to keep it consistent on all pages.

- **Chunking of documents**

This was not found to be a problem in the heuristic evaluation, since most of the documents reviewed were short enough to be easily scanned. However, since many of the documents on the intranet are on-line versions of paper-based manuals, it can be expected that there will be examples of longer documents. Any documents that are more than two screen long should have overview links at the top of the document that allows users to move to specific sections in the document and to return easily to the top of the page. It would be good to review longer documents for possible strategies to separate them logically into smaller documents.

Related to document length, it was noted by one evaluator that some pages were just a page of links that duplicated the navigation bar. These pages of links can be useful in some cases, but in most cases are redundant. This issue is discussed in more detail in the Areas for Improvement section.

- **Multiple search tools**

There are three ways to search the site. The White Pages can be used to find information about people; the "Find It" Section, compiled by the Information Resources section, contains a list of frequently asked questions; and finally a search engine that allows users to enter query terms to find information. One suggestion is to group these three resources together and identify them as "Search Tools" or "Finding Information on COMPANY XYZ" and include them in the side navigation bar of each page. This would be in addition to, and not replacement of, the Search link in the top navigation bar.

Example:

Search Tools

White Pages

Find It - FAQ

Search

Areas for Improvement:

- Organization of Content

One of the major areas for improvement that the evaluators recommend is the need for better organization of the site's content. Like most intranets, the site began as an employee information resource with other content areas being added over time. The site now contains lots of diverse and valuable information, but this information is not linked very well in terms of relationships, categories, or how users approach the information, and the navigation does not provide a sufficiently complete overview of what's available.

One way of considering content organization would be to look at the organizing principle. The principle currently being used to organize content is by organizational division. Pages "belong" to certain divisions. This means that if the user is searching for specific information, he first has to determine which division would handle this information and then decide what it's listed under. This organization scheme presents a barrier for users, particularly when functions or initiatives move from one division to another. There are some content sections in the navigation bar (Employee Resources, Policies and Procedures) which have begun to group information by category rather than organizational division, but the majority of the site is organized by division. Placing the division links prominently at the top of the navigation bar reinforces this scheme. However, there are parallel ways of organizing content, such as organization by categories (for example, all training opportunities could be contained on one page), by projects (a company initiative that crosses division boundaries) or by task (instructions for completing HR forms could be included on the same page as the access to forms). It would not be necessary to dismantle the underlying file/directory architecture (this would be a huge undertaking and could well result in a less usable site) but to redesign the navigation to provide several ways for users to approach the content.

The first step would be to get a good understanding of the information that's currently on the site. One of the evaluators suggested that a useful design exercise would be for the web development team to spend an afternoon or two in a room creating a diagram of the current site contents. This could be done with markers on a whiteboard or with color-coded post-it notes. The purpose of the exercise would be to give the development team a visual overview of the site and enable them to identify connections between sections, categories of information, what areas would naturally link to others, and logical grouping of content. The goals and purpose of the site would be posted as well, to make sure that the new organization scheme supports them. This exercise would identify pages that could be consolidated or eliminated

(for example, those pages which are a restatement of navigation bar links) or information that needs to be updated or discarded. The results of this exercise could be written up and would provide valuable system documentation for developing company standards for web documents, for future site expansion, and for orienting new web development team members. Once the categories and relationships are identified, and the possible alternative organization schemes fleshed out, then the navigation and the major section pages could be redesigned to collect, categorize, and outline the information.

The issue of how far down into the site this organization redesign will go is one that will have to be worked out. Certainly if the top-levels of the site are organized one way, but the user gets lost as they move further down into the division sections, this will not be good for usability. But it should be easy to include navigation back to the higher-level categories. For example, presume there is a high-level training page (perhaps under the top-level Employee Resources category) which includes links to computer training, wellness training, and organizational training, all of which belong to different divisions. At each division training page, there would be a link to allow the user to return back to the main training page. This could be done for sections that provide news as well. Again, the point is not to scrap everything that is there now, but to reorganize it and add different categories of information.

- Navigational Feedback

Navigation is another major area that evaluators found room for improvement. Navigational feedback is critically important for usability, especially in a site like this with such a broad range of content topics and developers, and content that changes so frequently. Unless great care is taken with regard to navigation, including predictive label names for links, orienting the user, and providing an "escape" to return to the starting place, users will become lost or not ever find the information they're seeking.

Consistent Navigation Bar Across Division Pages

One of the major problems that all the evaluators found was inconsistency in the left navigation bar within sections. This is a major usability problem. For example, one page in Strategic Services has four topics in the navigation bar; another page has nine (different) topics. This was found to be the case across all the sections of the site, and is likely the result of the accumulation of content over time. Lack of consistent navigation is disorienting to the user. They can't figure out how they got to the page or how to return since the navigation options are completely different from the page they just came from (It should be noted that it was not immediately apparent to two

of the evaluators that the title link at the top of the divisional navigation bars was a active link.) . More importantly, it gives the impression that the information within the division section is fragmented and not "all of a piece". The navigation bar for each section should be consistent on each page, and should give the user an idea of all of the content available in that section. This doesn't mean that links to each page in the section have to be available from the top level of the navigation bar at all times. This would result in a cluttered and confusing navigation bar. But the content should be categorized logically and these top categories should be available from each page. The idea of using expanded mouse-over menus that give further category information or divisional information was discussed. This would be a valuable way of giving users a preview of the information available. Great care needs to go into the naming and order of links, and into the categorizing of the section contents. The design exercise mentioned earlier should help with this.

"You are Here"

It would be helpful to indicate in some way where the user is in the site. Graying out the current page's link in the side and bottom navigation would accomplish this (some pages currently do this in the bottom navigation links). Another option would be to include a Yahoo-like hierarchical listing at the top of the page.

Example:

Home Page → Strategic Services → TAG → Submit Ticket Online

This presentation not only orients the user, but also helps form a mental model of the site's overall architecture and makes the hierarchical relations explicit,

Progressive Level of Detail - Hierarchical Distinctions

The evaluators saw the lack of hierarchical distinctions in the navigation bar of many pages as a navigation problem. Having all links left-justified gives the impression that they are all on the same level, when in fact some links are sub-topics. Presenting the hierarchical organization in the navigation bar gives users a better understanding of the relationship between topics and helps to orient them in the site. Again, the site design exercise will help to establish the hierarchy and will be helpful in designing the navigation.

Logical Ordering of Links and Order of Links Consistent Across Division

Some thought should be given to the ordering of links in the navigation bar. This requires some knowledge about the content in determining which topics should come

in which order, but the order of links is an important way for users to be guided through content. In addition, this order should remain consistent, whenever possible, across divisions. Naturally, each division will have a different set of links, but if, for example, Mission Statement, Organization Chart, and Division FAQs are included for each division, they should come in the same order in the navigation bar.

Links in One Section that Lead to Another Section

Evaluators remarked that they found it misleading when a link on a section page led them into another section. For example, the "Spend Smart Policies" link on the Finance Page actually leads to a Strategic Services page. It seemed disorienting because the link on the Finance Page was blue, and yet the resulting page was in the orange section. Worse yet, there is no link back to the previous page. Solutions were discussed involving including some color hint on the link as to its origin. This confusion is a byproduct of having the information so divided according to the division that "owns" it. In any case, it was suggested that there be some way of notifying users when a link leads to a different section.

Navigation Links Across Bottom should match Side Navigation

Most pages have navigation links across the bottom of the page which duplicate the side navigation. This is a good idea, especially on lengthy pages where the side navigation has been scrolled out of sight. However, in some cases the labeling and ordering of links across the bottom is different from the side. They should always be the same.

Site Map

Finally, it was suggested that a site map would be helpful in giving users an overview of the content. Considering the breadth of the site, this would be a big undertaking. However, the results of the design exercise might make it somewhat easier. It's possible that this function could be automated. In any case, thought should be given to whether resources are available to keep it updated. If not, then it would be better not to include a site map than to have an inaccurate and outdated one.

- Pages of Links (No Content)

Some of the evaluators thought that pages that contained no actual content, but only a listing of links were redundant and inefficient in that the user is required to click twice to get to the content. In most cases this is true, since the list of links is really a duplication of the links in the navigation bar and doesn't offer any additional information. An example of this type of page is the 2000 Budget Information page in Finance. In other cases, the list of links did contain additional information that might

help the user decide among options. An example of the latter type of page is the HR Staffing forms page. Even though it is a list of links leading to the forms, it also explains what PDFs are and anticipates any printer problems the user is likely to run into. It is expected that many of these links-only pages could be collapsed or consolidated, which would bring the actual content one level higher. But determination should be made on a case by case basis because some of these pages do provide additional valuable information. This determination can be done during the design exercise. Also, since many of these pages are created by the division, there may be political ramifications to removing or reorganizing them. Removing those that are redundant will increase usability, but the navigation and information organization issues are much higher priority.

- Use of Acronyms and Jargon

Evaluators were not familiar with many of the corporate titles for initiatives or programs and so did not feel qualified to say whether employees would have easily understand link names that used acronyms or corporate language. Care should be taken with acronyms to make sure users understand what they mean. Likewise, label wording for links should be chosen for clarity and good predictive ability whenever possible.

- Standardization of Format

There was some discussion of the variation in fonts and formatting found among the site pages. For the most part, variation within limits is not considered to be a usability problem. However, when the first screen is taken up with graphics and large fonts, or when animation is included which pulls the user's attention away from the content, then usability does suffer. The web development team has expressed an interest in allowing divisions some creative latitude in developing pages, and the evaluators agree that variation can be used to catch the reader's interest and keeps the page from being boring. However, it should be noted that, in general, intranets are more task-directed than public intranet sites, and the main focus should be on helping the user complete their task and get on with their work. It is suggested that a set of guidelines could be drawn up by the web development team, possibly even including a list of the usability heuristics, so that content developers keep their design within the bounds of usability.

The major recommendations are:

- Organize site contents to identify categories of information, relationships, and develop alternate top-level navigation design.
- Navigation
 - Division-level navigation bars should be consistent across division pages.
 - Provide user with a "You are Here" orientation.
 - Make sure navigation indicates hierarchy.
 - Ordering of links in navigation should be logical and consistent across division, as much as possible.
 - Make sure that the order and labeling of side and bottom navigation links are consistent.
 - Consider ways to identify links that lead to another section
 - Consider inclusion of a site map.
- Determine relevance of pages of links with no content
- Choose wording of label links for clarity and predictability. Take care with acronyms and corporate language.
- Develop a set of development guidelines that keep page design within usability standards.