

Air Force Institute of Technology

AFIT Scholar

Theses and Dissertations

Student Graduate Works

3-2005

Web Usability Guidelines for Air Force Knowledge Now Web Site

Gary A. Felax

Follow this and additional works at: <https://scholar.afit.edu/etd>



Part of the [Graphics and Human Computer Interfaces Commons](#)

Recommended Citation

Felax, Gary A., "Web Usability Guidelines for Air Force Knowledge Now Web Site" (2005). *Theses and Dissertations*. 3812.

<https://scholar.afit.edu/etd/3812>

This Thesis is brought to you for free and open access by the Student Graduate Works at AFIT Scholar. It has been accepted for inclusion in Theses and Dissertations by an authorized administrator of AFIT Scholar. For more information, please contact richard.mansfield@afit.edu.



**WEB USABILITY GUIDELINES FOR AIR FORCE KNOWLEDGE NOW WEB
SITE**

THESIS

GARY A. FELAX, Captain, USAF

AFIT/GIR/ENV/05M-04

**DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY**

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

The views expressed in this thesis are those of the author and do not reflect the official policy or position of the United States Air Force, Department of Defense, or the United States Government.

AFIT/GIR/ENV/05M-04

WEB USABILITY GUIDELINES FOR AIR FORCE KNOWLEDGE NOW WEB SITE

THESIS

Presented to the Faculty

Department of Systems and Engineering Management

Graduate School of Engineering and Management

Air Force Institute of Technology

Air University

Air Education and Training Command

In Partial Fulfillment of the Requirements for the
Degree of Master of Science in Information Resource Management

Gary A. Felax, BS

Captain, USAF

March 2005

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.

AFIT/GIR/ENV/05M-04

WEB USABILITY GUIDELINES FOR AIR FORCE KNOWLEDGE NOW WEB SITE

Gary A. Felax, BS
Captain, USAF

Approved:

/signed/

Dr. Kevin L. Elder, Ph.D., (Chairman)

8 March 2005
date

/signed/

Dr. Dennis D. Strouble, Ph.D., JD, (Member)

8 March 2005
date

/signed/

Capt. David D. Bouvin (Member)

8 March 2005
date

Abstract

The Department of Defense Net-Centric Data Strategies number one key attribute is to ensure data is visible, available, and usable when and where needed to accelerate decision-making. The Internet provides opportunities for quick and efficient disseminating of information to the public, distributing information throughout the Air Force, and accessing information from a variety of sources.

In 2002, the Air Force CIO designated the Air Force Knowledge Now (AFKN) as the center of excellence for Knowledge Management. The site is a one-stop resource, providing access to a great depth and breadth of information. This study seeks to determine how usable and accessible the web interface is to its customers.

A literature review determined the usability inspection method called Heuristic Evaluation to be most favorable for this type of evaluation. The researcher conducted a case study using heuristic evaluation to determine the site usability compliance rate. A second case study using web content accessibility guidelines was then performed to determine the sites accessibility compliance rate. The study finally presented a comparative analysis of the usability and accessibility checklists to determine if any overlap occurred between the two or if one is a subset of the other.

This exploratory research finds more emphasis on web usability and accessibility should be explored in the future for AFKN.


Acknowledgements

I would like to thank my loving wife and children for supporting me during these past eighteen months. Their love, patience and understanding have given me the will and strength to make it through this difficult process.

A number of folks helped me directly with my research. First and foremost, my advisor, Dr. Kevin Elder, made my thesis experience as pain free as could possibly be. I thank him for guiding me while letting me expand my knowledge in the research area. Thanks to my readers, Dr. Dennis Strouble and Captain David Bouvin for providing their helpful opinions and time to my research effort. Finally, I would like to thank Dr. Elder's thesis group for all the lunchtime discussions, slide reviews, and support during my defense. I also want them to know how much of a pleasure it was to work with such an excited and professional group. The thesis process was easier and went much smoother for everyone because of this group.

Gary A. Felax

Table of Contents

	Page
 Abstract.....	iv
Acknowledgements.....	v
Table of Contents.....	vi
List of Figures.....	viii
List of Tables	ix
I. Introduction	1
Problem Statement.....	2
Background.....	2
Scope.....	3
Thesis Overview	5
II. Literature Review.....	6
Introduction.....	6
Air Force Knowledge Now	6
Air Force Knowledge Management Web Site	6
AFMC Help Center.....	7
AF Deskbook	8
AFKN Integrated Environment.....	9
The Technology Acceptance Model	10
Homepage Design.....	13
Usability Inspection and Heuristic Evaluation	15
Accessibility.....	34
Defining Accessibility	35
Accessibility Guidelines	36
Chapter Overview	50
III. Methodology	51
Introduction.....	51
Methodology	51
Case Study Approach.....	52
Leedy and Ormrod’s criteria for selection of methodology.....	53
Yin’s criteria for selection of methodology	57
Case Study Design	58
Data Collection	62
Usability/Accessibility Compliance Calculation	65
Comparative Analysis.....	67

Chapter Overview	67
IV. Results.....	69
Introduction.....	69
Usability Guidelines.....	69
Usability Guidelines vs. Knowledge Now site	69
Individual Section Compliance Ratings.....	70
Overall Usability Compliance Rating.....	82
Accessibility standards vs. Knowledge Now site	84
Individual Priority Compliance Ratings	84
Overall Accessibility Compliance Rating.....	88
Usability Guidelines vs. Accessibility standards	89
Chapter Overview	90
V. Discussion	91
Introduction.....	91
Recommendations.....	91
Limitations of Research	96
Concurrent Studies.....	97
Suggested Future Research	98
Chapter Overview	99
Appendix A: Heuristic Evaluation Checklist.....	100
Appendix B: Accessibility Checklist.....	121
Priorities.....	121
Priority 1 checkpoints	121
Priority 2 checkpoints	122
Priority 3 checkpoints	124
Bibliography	126
Vita.....	131

List of Figures

Figure	Page
1. Air Force Knowledge Management.....	7
2. AFMC Help Center.....	8
3. Air Force Deskbook.....	9
4. Air Force Knowledge Now (25 Aug 04)	10
5. Technology Acceptance Model	11
6. Dasgupta et al. (2002) Research Model.....	12
7. - Integrated Model of Continued Technology Usage	13
8. FedEx.com (31 Dec 04).....	20
9. FedEx Package/Envelope Services (31 Dec 04).....	23
10. FedEx Office/Print Services (31 Dec 04)	24
11. FedEx Login Screen (31 Dec 04).....	25
12. BBC Web Site (31 Dec 04).....	27
13. Amazon Web Site (31 Dec 04).....	29
14. eBay Help Page (31 Dec 04).....	31
15. Amazon Recommendations Page (31 Dec 04)	33
16. My eBay Sign-In Page (31 Dec 04).....	34
17. Relevant Situations for Different Research Strategies.....	57
18. The Inductive Logic of Research in a Qualitative Study	59
19. Knowledge Now Site (600x800)	94
20. AF Deskbook Web Page.....	95

List of Tables

Table	Page
1. Article Compilation.....	17
2. Summary of Evaluation Technique's.....	18
3. Usability/Accessibility Compliance Rate.....	67
4. Visibility of System Status Compliance Rate.....	70
5. Match Between System and the Real world Compliance Rate.....	71
6. User Control and Freedom Compliance Rate.....	72
7. Consistency and Standards Compliance Rate.....	73
8. Help Users Recognize, Diagnose, and Recover From Errors Compliance Rate.....	74
9. Error Prevention Compliance Rate.....	75
10. Recognition Rather than Recall Compliance Rate.....	76
11. Flexibility and Minimalist Design Compliance Rate.....	77
12. Aesthetic and Minimalist Design Compliance Rate.....	77
13. Help and Documentation Compliance Rate.....	78
14. Skills Compliance Rate.....	79
15. Pleasurable and Respectful Interaction with the User Compliance Rate.....	80
16. Privacy Compliance Rate.....	81
17. Individual Section Compliance Overview.....	82
18. Overall Website Usability Compliance Rate.....	83
19. Priority 1 Checkpoints Compliance Rate.....	85
20. Priority 2 Checkpoints Compliance Rate.....	86
21. Priority 3 Checkpoints Compliance Rate.....	87

	Page
22. Individual Checkpoint Compliance Overview.....	88
23. Overall Website Accessibility Compliance Rate.....	89
24. Summary of Investigation Questions.....	90

I. Introduction

The number one key attribute to the Department of Defense Net-Centric Data Strategy is:

“Ensuring data are visible, available, and *usable* when needed and where needed to accelerate decision-making.”

The strategy goes on to state; this Strategy expands the focus to visibility and accessibility of data rather than just standardization. It also recognizes the need for data to be usable for unanticipated users and applications, as well as for those that have been predefined (Stenbit, 2003).

The Internet provides opportunities for quick and efficient disseminating of information to the public, distributing information throughout the Air Force, and accessing information from a variety of sources. Information may be sent between offices or individuals, or be displayed on the web. The Air Force’s goal for the Internet is to provide maximum availability at acceptable risk levels for Air Force members needing access for the execution of official business (AFI33-129, 2001).

With the evolution of the Internet the Home Page is considered the starting point or center of an organizations info-structure on the World Wide Web. A typical home page will consist of hypertext links that provide pointers to other web documents (AFI33-129, 2001). Unfortunately, the web pages currently offered by Air Force organizations vary greatly in content and format. Some sites offer valuable information in an appealing

fashion while others present information of negligible value in an unappealing way (Gilroy, 1995). More recently these differences in content and format have transcended into concerns of usability and accessibility.

Problem Statement

The presence of computer and information technologies in today's organizations has expanded dramatically over the years. Some estimates indicate that, since the 1980s, about 50 percent of all new capital investment in organizations has been in information technology. Yet, for technologies to improve productivity, they must be accepted and used by employees in organizations (Venkatesh, Morris, Davis, and Davis, 2003).

Mr. John Gilligan (AF CIO) designated the Air Force Knowledge Now (AFKN) web site as the Air Force Center of Excellence in Knowledge Management. But is the site truly usable and accessible by recommended guidelines? AFKN team leaders need to know. The current research will explore the usability and accessibility of the AFKN web site, while applying the theories of the Technology Acceptance Model (TAM) in order to gain a better understanding of the use and acceptance of the site.

Background

The Knowledge Now web site is the culmination of several knowledge management efforts: the Air Force Knowledge Management site, AFMC Help Center and the Air Force portion of the Defense Acquisition Deskbook. The goal of the Knowledge Now site is to provide a one-stop resource with access to a greater depth and breadth of information to assist in Air Force duties.

Effective Knowledge Management enables the transfer and retention of expertise and organizational knowledge across boundaries and is a key component in the Air Force strategy. As stated by Air Force Chief Information Officer, Mr. John Gilligan:

“The Air Force Knowledge Now, currently managed by HQ AFMC/DR, has not only achieved successful implementation within AFMC, but in multiple organizations across the Air Force, demonstrating a successful strategy. With your support, I would like to adopt the approach developed by Air Force Knowledge Now (AFKN) Air Force-wide. I would also propose that we leverage the expertise and success of the AFKN team by designating the Air Force Knowledge Now office as the Air Force Center of Excellence for Knowledge Management.” (Gilligan, 2004).

Human-computer interaction (HCI) theory provides readily available constructs in the form of usability inspection methods that should allow web site designers to help users feel more comfortable using their site. One usability inspection method that is particularly appealing is heuristic evaluation which involves having a small set of evaluators examine the interface and judge its compliance with recognized usability principles (the “heuristics”) (Nielsen, 1994). The method’s appeal stems from its ability to identify many usability problems while being easy to learn and relatively inexpensive to use. Using heuristic evaluation to identify usability factors that inhibit users from easily accessing information, and thereby interfering in the decision making process, may provide insights into why some individuals may not find the site easy to use.

Scope

Research Question

This research seeks to answer the question: Are appropriate common practice web usability and accessibility guidelines being followed on the Air Force Knowledge Now web site?

Investigative Questions

Multiple questions will be addressed in order to answer the research question:

1. What is the appropriate usability guidelines identified in the literature?
2. How well does the Knowledge Now web site follow appropriate usability guidelines identified in the literature?
3. How well does the Knowledge Now web site adhere to the federally mandated accessibility guidelines presented in Section 508 of the Rehabilitation Act?
4. When usability guidelines are followed, are they sufficient in complying with the Section 508 of the Rehabilitation Act standards?

Proposed Methodology

The study will be completed in four phases. In the first phase, a qualitative analysis of literature will be conducted to identify heuristics for the development of usability guidelines. In the second phase, these heuristics will be applied to determine how the Knowledge Now site compares to the guidelines. The third phase will use the federally mandated Section 508 of the Rehabilitation Act web accessibility standards to analyze the web site using a case study approach. Finally, a comparative analysis of the usability and accessibility guidelines will be conducted to determine whether one method of evaluation could accomplish the objectives of the other.

Limitations

The most notable limitation of this study is in the application of the heuristic evaluation method by other than three to five evaluators. Nielsen (1994) states while a single evaluator can perform the evaluation, he/she will find less than 35 percent of the

usability problems in an interface, and that heuristic evaluations are most effective when conducted by three to five evaluators. For this study two evaluators will be used.

Although two evaluators is better than one, doubling the 35 percent findings of usability problems by adding another evaluator is not realistic. Recognizing an appropriate amount of usability and accessibility problems is expected.

Even though the results of using heuristic evaluation improve with the more you know and the more carefully you apply the method, one of its virtues is that the “intimidation barrier” is very low, leading to immediate gratification (Nielsen, 1994). Even with the possibility of immediate gratification this will still be considered a limitation for a lack of evaluator practical experience in using the heuristic evaluation method.

Future study in this area could include using three to five evaluators. More study could also be done to determine the overall usability and accessibility status of the entire population of Air Force web sites.

Thesis Overview

This chapter has provided a brief introduction to web usability, accessibility, and the Air Force Knowledge Now site. Chapter II expands on the AF Knowledge Now site, builds a case for evaluating web sites through heuristic methods, and presents accessibility guidelines. Chapter III presents the methodology used to test the hypotheses, and describes the development of the instrument used to evaluate the web site. Chapter IV presents the analysis of the data collected. Chapter V presents the conclusions reached from this study and recommendations for further research in this area.

II. Literature Review

Introduction

This chapter begins with an overview of the Air Force Knowledge Now site. The overview includes the goal, structure, and operation of the Knowledge Now web site. In the next section, literature from usability inspection methods of user-interface design is reviewed to identify system design characteristics that may discourage, or prevent, users from using or returning to a web site is presented. The third section will review accessibility inspection methods literature to identify section 508 standards and characteristics that will be used in comparison with usability guidelines.

Air Force Knowledge Now

The Knowledge Now site is the culmination of several Knowledge Management efforts:

- Air Force Knowledge Management web site
- AFMC Help Center
- AF Deskbook

A recap of each distinct effort, describing the separate origins and telling the "stories" associated with their collective integration into Knowledge Now follows.

Air Force Knowledge Management Web Site

The original Air Force Knowledge Management web site (see Figure 1) effort began in 1998, in response to the Air Force IG CaNDI Aircraft report dated 18 June 1998. It started as a "Lessons Learned" endeavor and covered a vast range of Air Force

topics. The original site included high-value links to a variety of Air Force resources, as well as access to Communities of Practice (CoPs) (Air Force Knowledge Now homepage, 2004).

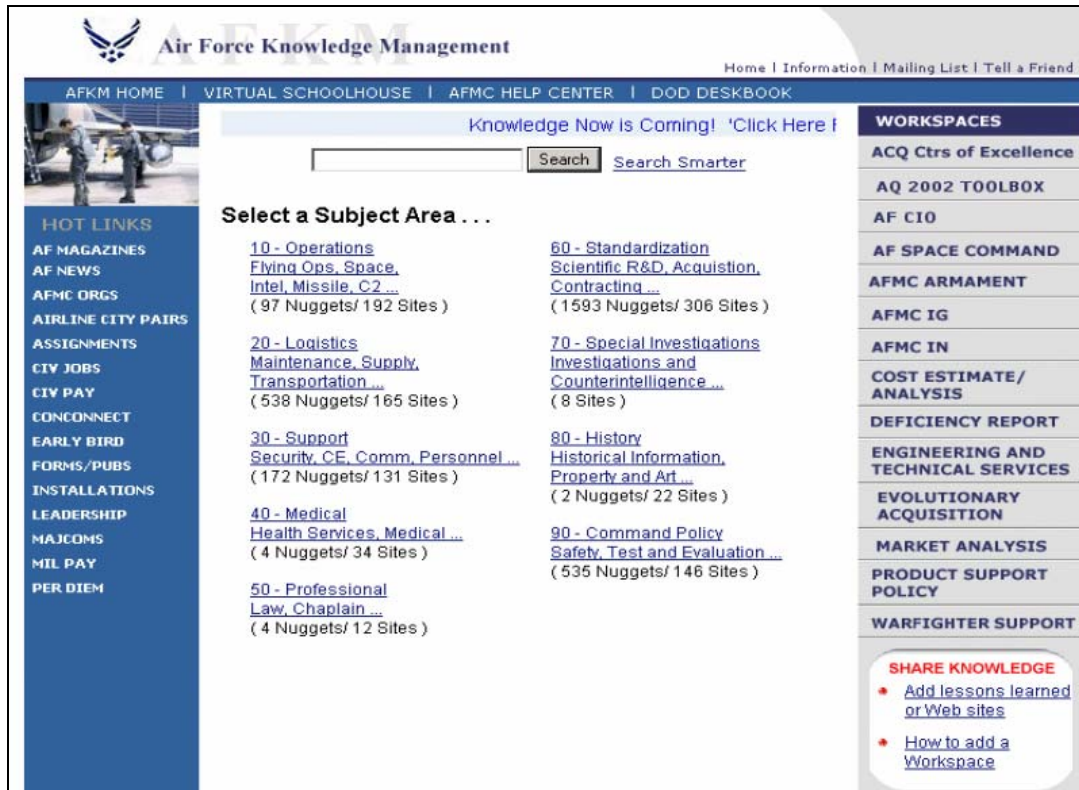


Figure 1. Air Force Knowledge Management

AFMC Help Center

The AFMC Help Center (see Figure 2) was deployed in 2000, borne out of the need to support Air Force efforts in Kosovo. Initially, a staff of 24 was assigned to answer questions on a wide variety of AFMC topics during the Kosovo crisis. After this mission-essential need had been fulfilled, former AFMC commander General Babbitt (Ret) expressed a desire to continue this approach for providing timely access to AFMC information (Air Force Knowledge Now homepage, 2004).



Figure 2. AFMC Help Center

AF Deskbook

In May 2002, the Deskbook (see Figure 3) Joint Program Office (JPO) relocated from Wright-Patterson AFB to Ft. Belvoir under the direction of the Defense Acquisition University (DAU). Each service was directed to take control of their content, with DAU maintaining mandatory OSD documents. That same month, in response to a memo from AFMC Commander General Lyles, the AFMC Knowledge Now Support Team captured both mandatory and discretionary content and placed it into a Community of Practice (CoP), thus creating the AF Deskbook (Air Force Knowledge Now homepage, 2004).



Figure 3. Air Force Deskbook

AFKN Integrated Environment

The resulting product from the integration of the Air Force Knowledge Management, AFMC Help Center and AF Deskbook web sites is the Air Force Knowledge Now (see Figure 4), also commonly referred to as AFKN or Knowledge Now. AFKN is available to Air Force personnel and others with .mil access. Essentially, it functions as a one-stop resource, providing access to a great depth and breadth of information. Inclusive of robust search capabilities, high-value Internet links, e-learning technologies, collaborative Communities of Practice (CoPs), performance support tools, and a repository of lessons learned and best practices, the aim is to accelerate war fighter support by improving AF employee job performance. As such, highlights include quick

and easy access to various resources and tools for capturing, sharing, and growing work-related knowledge (Air Force Knowledge Now homepage, 2004).



Figure 4. Air Force Knowledge Now (25 Aug 04)

The Technology Acceptance Model

The Technology Acceptance Model (TAM) introduced by Davis (1986) has explained acceptance of information technology for over a decade. The goal of TAM is to provide an explanation of the determinants of computer acceptance that is generally capable of explaining user behavior across a broad range of end-user computing

technologies and user populations, while at the same time being both parsimonious and theoretically justified (Davis, Bagozzi and Warshaw, 1989).

Davis, Bagozzi and Warshaw (1989) state, the TAM posits that two particular beliefs, *perceived usefulness* and *perceived ease of use*, are of primary relevance for computer acceptance behaviors (see Figure 5). Perceived usefulness (U) is defined as the prospective user's subjective probability that using a specific application system will increase his or her job performance within an organizational context. Perceived ease of use (EOU) refers to the degree to which the prospective user expects the target system to be free of effort. According to TAM, U and EOU have a significant impact on a user's attitude toward using the system (A), defined as feelings of favorableness or unfavorableness toward the system (Dillon and Morris, 1996).

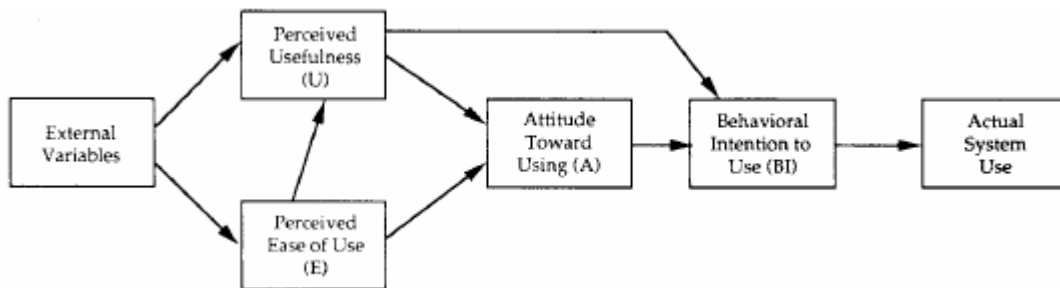


Figure 5. Technology Acceptance Model

Gasgupta, Granger, and McGarry (2002) extended the Technology Acceptance Model to an e-collaboration environment (see Figure 6), which follows closely with this study.

Their findings showed that the TAM holds up well in the new WEB environment.

Perceived ease of use has a positive impact on perceived usefulness of a system.

Additionally, perceived usefulness and prior use of the system has a significant impact on

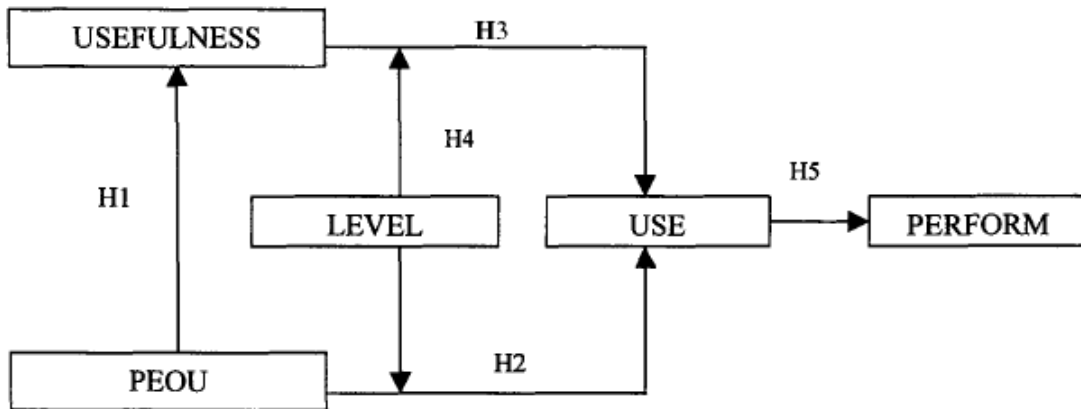


Figure 6. Dasgupta et al. (2002) Research Model

actual use of the system (Dasgupta, Granger, and McGarry, 2002). To expand, one of the main findings from many usability studies is that sites work best when they follow the convention users know from other sites (Nielsen and Tahir, 2002). The more sites do things a certain way, the more usability will usually increase by complying with that convention. Even when a convention may be sub-optimal from a theoretical perspective, in practice it will work well because users will know how it works (Nielsen and Tahir, 2002). Venkatesh et al. (2002), further extended and tested the TAM (see Figure 7). They noted that perceived usefulness had a very strong positive effect on intention to use information technology; yet training interventions did not influence perceived usefulness. In addition, perceived ease of use had a strong influence on intention over and above that of perceived usefulness while intrinsic motivation exerted a significant indirect influence on intention. Given the strong direct and indirect influences of ease of use and intrinsic motivation, technology acceptance initiatives should focus on interventions designed to

increase perceptions that the technology is easy and enjoyable to use (Venkatesh, Speier, and Morris, 2002).

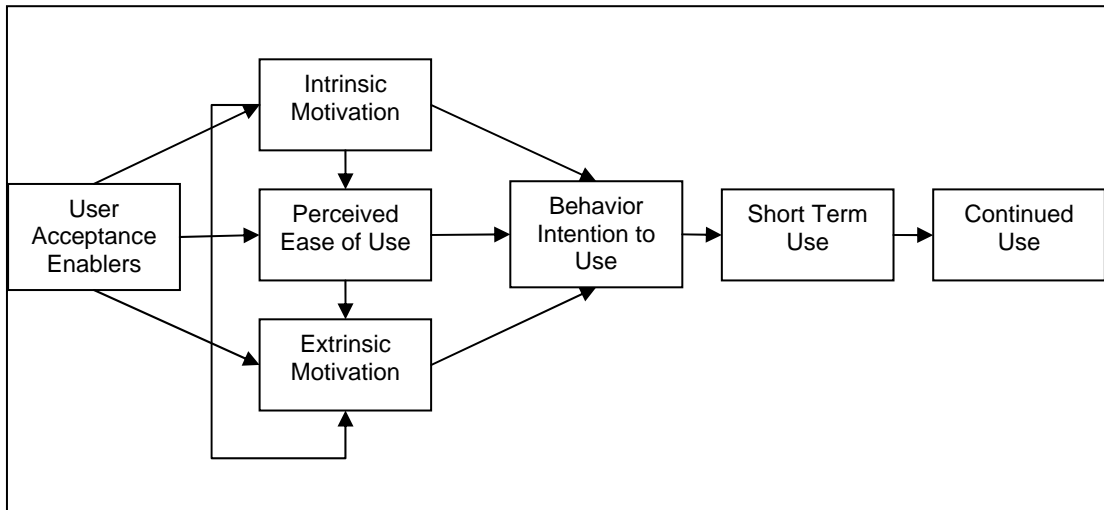


Figure 7 - Integrated Model of Continued Technology Usage

Homepage Design

This last TAM excerpt correlates well with usability of information systems. Palmer (2002) states, web sites provide the key interface for consumer use of the Internet. Web site success is significantly associated with Web site download delay (speed of access and display rate within the Web site), navigation (organization, arrangement, layout, and sequencing), content (amount and variety of product information), interactivity (customization and interactivity), and responsiveness (feedback options and FAQs) (Palmer, 2002). Head (1999) also states, a well-designed tool is one that is easy to interpret and is satisfying to use. In fact, many software developers say that the best designs are ones that users never give a second thought about. They describe this quality as invisibility and it is the hallmark of effortless user interaction and good design, In

contrast, a poorly designed tool is far from invisible, taking far too much time to use and delivering few results for our work in return. Whether an interface design is a good one or a poor one is a complex and involved issue. But one thing is certain for users; issues of design quality begin with a resource's interface (Head, 1999).

People on a project don't always accept the truth about the findings. User testing is guaranteed to present information about what is good or bad about design, what people want, and what people do. The methods have been proven over twenty years. What is difficult is when you tell other people on the project this what we have found and they may or may not believe it (Head, 1999).

For information-seekers the briefer the contact with the site, the more favorable the experience. A key component of Web design for information retrieval is conciseness. From usability tests, a profile of how Web users flock for information is emerging. In particular, Web users scan sites for content, instead of reading the text word-for-word. Users also spend little time trying to figure out how a site is organized. Most users ignore graphics and seek out textual links for navigation instead (Head, 1999).

Nielsen and Tahir (2002) describe the homepage and users accessing them as having multiple goals. Sometimes a user arrives at a homepage to find out what the company does. Inexperienced users often feel overwhelmed by homepages that don't clearly help them understand their options. When they can't understand a website, users may become embarrassed and blame themselves; you will rarely hear from them. They will just leave the site and turn to places that feel more welcoming. More savvy users are often very unforgiving. If their current specific need isn't met on any given trip to the

website, they will remember that and hold it against the website (Nielsen and Tahir, 2002).

The challenge is to design a homepage that allows access to all important features without cramming them onto the page itself, too often overwhelming new users. Focus and clarity is key, as is an understanding of user's goals (Nielsen and Tahir, 2002).

Usability Inspection and Heuristic Evaluation

Usability Inspection (UI) is a sub-discipline of the Human-Computer Interaction field, which has roots in numerous disciplines including computer graphics, operating systems, human factors, ergonomics, industrial engineering, cognitive psychology, and the systems part of computer science (Hewett, Baecker, Card, Carey, Gasen, Mantei, Perlman, Strong, and Verplank, 2003). UI is the generic name of a set of methods based on having evaluators inspect or examine usability-related aspects of a user interface (Mack and Nielsen, 1994).

There are two recent themes in all of these approaches to usability inspection. One is the notion that usability is multifaceted and must be assessed by using a variety of different measures. A second common characteristic of usability inspection methods is their dependence on subjective assessments in the form of user judgments. Thus, usability is not intrinsically objective in nature, but rather is closely intertwined with an evaluator's personal interpretation of the artifact and his or her interaction with it. Nonetheless, all usability evaluation approaches begin with the basic assumption that it is possible to identify, at varying levels of granularity, what the features of a "usable" system might be (Agarwal and Venkatesh, 2002)

Inspection methods are now widely used to depict usability problems of the product because of its cost-performance for the evaluation. Before they have been developed and proposed, the most frequently used method to evaluate the usability of the product has been the user testing. But the inspection method is claimed to be more convenient than the user testing because it may take only a few days to complete the usability report while the user testing may take as long as a month (Kurosu, Matsuura and Sugizaki, 1997).

Among the inspection methods, the heuristic inspection method proposed by Nielsen is the most popular and frequently used (Kurosu, Matsuura and Sugizaki, 1997). Nielsen's work has been well document and is widely used (see Table 1) by academia and industry in referencing usability and Heuristic evaluation. From the twenty articles chosen for this study Nielsen was referenced in 80 percent of them and in most was referenced multiple times. Far exceeding all other referenced authors on usability and heuristic documents. Heuristic evaluation is a discount usability engineering method for quick, cheap, and easy evaluation of a user interface design. Heuristic evaluation is done as a systematic inspection of a user interface design for usability. The goal of heuristic evaluation is to find the usability problems in the design so that they can be attended to as part of an iterative design process (useit.com, 2004).

Table 1. Article Compilation

	Article/Book/White Paper Title	Author	Source	Referenced		
				1	2	3
1	Assessing the Reliability of Heuristic Evaluation for Website Attractiveness and Usability	Alistair Sutcliffe	IEEE, 2002	Nielsen, J - Ref. 2 times	Nielsen, J. & Molich, R.	Spool, J., Scanlon, T., Snyder, C., Schroeder, W. & Deangelo, T.
2	Categorical Inspection Method - Structured Heuristic Evaluation (sHEM)	Masaaki Kurosu, Sachiyo Matsuura, Masamori Sugizaki	IEEE, 1997	Nielsen, J - Ref. 4 times	Molich, R. & Nielsen, J.	
3	Usability Evaluations Versus Usability Testing: When and Why?	Stephanie Rosenbaum	IEEE, 1989	Wixon, D., and Whiteside, J.	Bury, K., Reed, P., Roberts, T., Tognazzini, B., Wchansky, A.	Mills, C. and Dye, K.
4	Usability of E-Government Web-Sites for People with Disabilities	Chaomeng James Huang	IEEE, 2002	Nielsen, J - Ref. 2 times	Paciello, M.	Letourneau, C.
5	Evaluating web resources for disability access	Murray Rowan, Peter Gregor, David Sloan, and Paul Booth	ACM, 2000	Nielsen, J - Ref. 4 times	Petrie, H., Colwell, C., Engelen, J., and Evenepoel, F.	Waddell, C.
6	Testing Web Applications	Giuseppe Lucca, Anna Fasolino, Grancesco Faralli, and Ugo Carlini	IEEE, 2002	Cloyd, M.	Gellersen, H. and Gaedke, M.	Stout, G.
7	A Comparison of Three Usability Evaluation Methods: Heuristic, Think-Aloud, and Performance Testing	Robert Virzi, James Sorce, and Leslie Herbert	Proceedings of the Human Factors and Ergonomics Society 37th Annual Meeting, 1993	Nielsen, J.	Nielsen, J. & Molich, R.	Bailey, R., Allen, R., and Raiello, P.
8	User Interface Evaluation in the Real World: A Comparison of four Techniques	Robin Jeffries, James Miller, Achleen Wharton, and Kathy Uyeda	ACM, 1991	Nielsen, J. & Molich, R.	Smith, S. and Mosier, J.	Shneiderman, B.
9	How we do it: heuristic evaluation	OCLC		Nielsen, J.	Jeffries, R., Miller, J., Wharton, C., and Uyeda, K.	Karat, C., Campbell, R., and Fiegel, T.
10	Complementarity and Convergence of Heuristic Evaluation and Usability Test: A Case Study of UNIVERSAL Brokerage Platform	Lai-Chong Law and Ebba Hvannberg	ACM, 2002	Nielsen, J. Ref. 6 times	Nielsen, J. & Molich, R.	Shneiderman, B.
11	Assessing a Firm's Web Presence: A Heuristic Evaluation Procedure for the Measurement of Usability	Ritu Agarwal and Viswanath Venkatesh	Information Systems Research, 2002	Nielsen, J.	Mack, R. and Nielsen, J.	Keeker, K.
12	Developing and validating an instrument for measuring user-perceived web quality	Adel Aladwani and Prashant Palvia	Information & Management, 2002	Barron, A., Tompkins, B., and Tai, D.	Gehrke, D. and Turban, E.	Hager, D., Kibler, C., and Zack, L.
13	Web Site Usability, Design, and Performance Metrics	Jonathan Palmer	Information Systems Research, 2002	Nielsen, J.	Levi, M. and Conrad, F.	Pearrow, M.
14	Universal Usability	Ben Shneiderman	ACM, 2000	Laux, L., McNally, P., and Paciello, M.	Shneiderman, B.	Meij, H. and Carroll, J.
15	Improving Web Usability Through Visualization	Ed Chi	IEEE, 2002	Nielsen, J.	Manning, H., McCarthy, J. and Souza, R.	Pitkow, J.
16	The Latest Web Trend: Usability?	Elizabeth Moeller	IEEE, 2001	Nielsen, J.	Berners-Lee, T.	Pearrow, M.
17	Participatory Heuristic Evaluation	Muller, Matheson, Page, and Gallup	Interactions, 1998	Nielsen, J.	Nielsen, J. & Landauer, T.	Nielsen, J., and Mack, R.
18	Evaluating Usability Evaluation Techniques	Bonnie John	ACM, 1996	Nielsen, J.	Nielsen, J. & Mack, R.	Jeffries, R., Miller, J., Wharton, C., and Uyeda, K.
19	Challenges of HCI Design and Implementation	Brad Myers	Interactions, 1994	Nielsen, J.	Nielsen, J. and Landauer, T.	Nielsen, J. and Phillips, V.
20	User-centered information design for improved software usability	Henry Pradeep	Book, 1998	Nielsen, J.	Rubin, J.	Laurel, B.

When compared (see Table 2) to other user interface inspection methods (Usability testing, Guidelines, and Cognitive Walk-through) the heuristic evaluation technique produced the best results (Jeffries, Miller, Wharton, and Uyeda, 1991). The Heuristic evaluation identified many more problems, identified the more serious problems, and provided all this at a low cost.

Table 2. Summary of Evaluation Technique's

	Advantages	Disadvantages
Heuristic evaluation	Identifies many more problems Identifies more serious problems Low cost	Requires UI expertise Requires several evaluators
Usability testing	Identifies serious and recurring problems Avoids low-priority problems	Requires UI expertise High Cost Misses consistency problems
Guidelines	Identifies recurring and general problems Can be used by software developers	Misses some severe problems
Cognitive Walk-through	Helps define users' goals and assumptions Can be used by software developers	Needs task definition methodology Tedious Misses general and recurring problems

During another comparison the Heuristic evaluation out-performed the Think-Aloud Evaluation and Performance Test inspection methods. The heuristic evaluation identified the largest number of problems, even though there were four less evaluators than the other methods and it was quicker (the heuristic evaluation was completed in about half the elapsed time) to conduct. The results support the efficacy of conducting heuristic analyses of user interfaces (Virzi, Sorce, and Herbert, 1993).

The Heuristic Evaluation method involves a small group of evaluators who inspect an interface and judge its compliance with some set of recognized usability principles – the “heuristics” (Nielsen, 1994). Nielsen developed an original list of general heuristics that evaluators can choose from to meet the requirements of the evaluation being conducted.

A heuristic describes qualities or characteristics that are a part of a usable interface. To help guide evaluators during an inspection, Pierotti (2002) developed a checklist of items (see Appendix A), or characteristics, for each of Nielsen’s heuristics that evaluators should look for to determine how well a system conforms to the heuristic. Many of these items can be applied to the design of the Knowledge Now site and will be used in this study. These heuristics and their relationships are summarized in the paragraphs below.

Visibility of System Status

Nielsen (1994) asserts that the system should always keep the user informed about what is going on, through appropriate feedback within reasonable time. Every display should present the user with a title or header that describes the screen contents (Pierotti,

2002). The FedEx site (see Figure 8 below) presents a good example of providing a title or header above each section to inform the user. If pop-up windows are used to display error messages, the window should not obscure the field the error message pertains to (Pierotti, 2002). Other important characteristics include some sort of system feedback for every operator action, which can be in the form of an indication that the next module can be started when the current module has been completed, a visual indication of where to place objects that are to be moved, or a message to the user informing them of what is going on when there are lengthy delays in system processing (Pierotti, 2002).

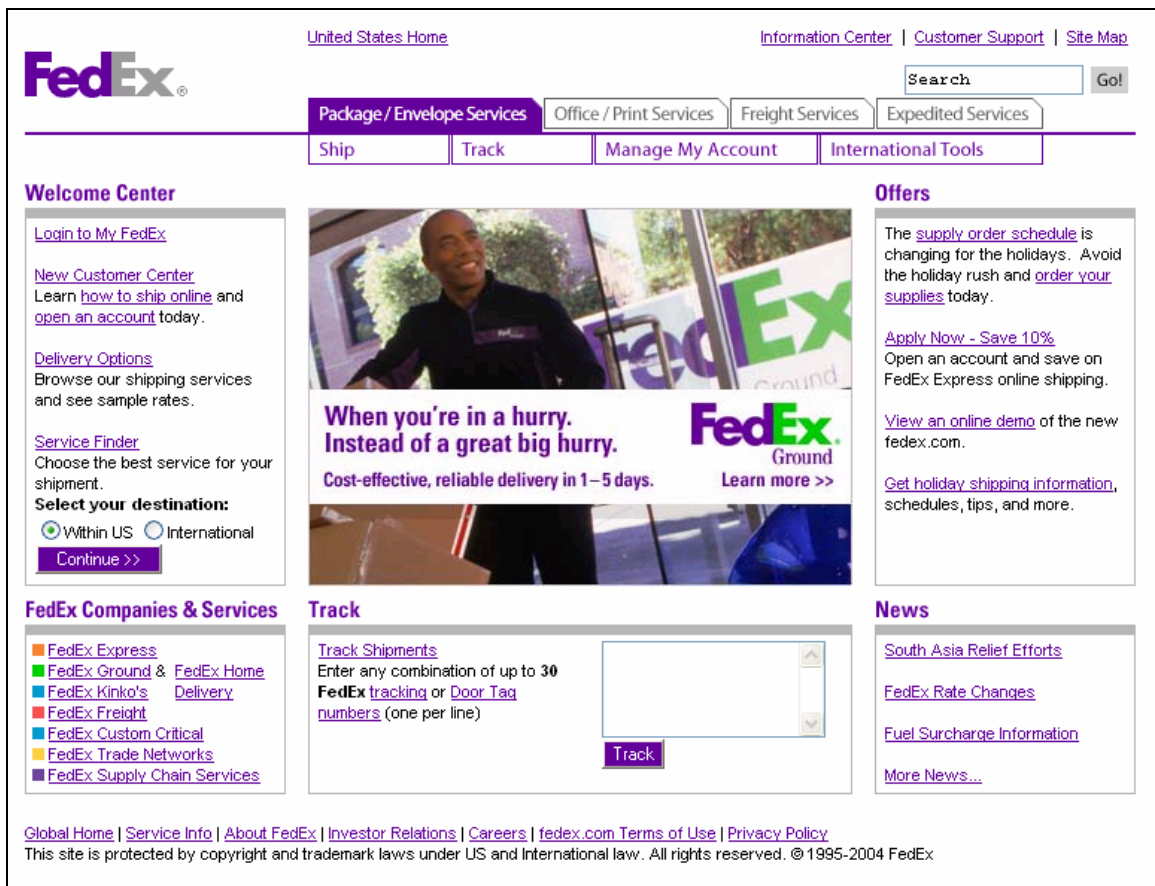


Figure 8. FedEx.com (31 Dec 04)

Match between the System and the Real World

The system should speak the user's language, with words, phrases, and concepts familiar to the user, rather than system-oriented terms (Nielsen, 1994). The FedEx site (see Figure 8 above) fulfills this concept very well with its simple drop down menus, section titles and self-explaining links. Sites that use many unfamiliar terms and complex sentences will be more difficult to use than sites that use familiar words in simple sentences. Follow real-world conventions, making information appear in a natural and logical order (Pierotti, 2002).

User Control and Freedom

According to Nielsen (1994), users should be free to select and sequence tasks (when appropriate), rather than having the system do this for them. In systems that use overlapping windows, it should be easy for the user to rearrange the windows on the screen, be able to switch between the windows, and each window should allow both vertical and horizontal scrolling (Pierotti, 2002). As new windows appear on the screen, users can become disoriented and lose track of where they were before the new windows appeared. This disorientation can cause the user to become frustrated while trying to find where he/she came from. If there are multiple menu levels, the system should provide a mechanism to allow the user to go back to previous menus, (Pierotti, 2002). While browsing through the FedEx site (see Figure 8 above) the header section remains the same. This makes it easy for the user to switch between the different pages and helps alleviate confusion or disorientation.

Consistency and Standards

Nielsen also suggested that users should not have to wonder whether different words, situations, or actions mean the same thing (Nielsen, 1994). Formatting standards should be followed consistently in all screens within a system (Pierotti, 2002). Users should expect normal Web conventions to apply. An example of this would be underlined text. The Online Computer Library Center warns designers to not refer to missing information (broken links) (OCLC, 2003). On the World Wide Web, underlined text is used to identify a hyperlink (see Figures 9 and 10 below), so a user will expect a new Web page to appear when they click on the text and otherwise could become confused if nothing happens. Repeated failure to access information may begin to erode his or her confidence in the reliability in the source of information.

Other characteristics to look for when evaluating consistency and standards include labeling of icons. Especially look for system specific icons, as they may be unfamiliar to the user (Pierotti, 2002). The following two figures (see Figures 9 and 10 below) show how FedEx provides users with format consistency across the different services they provide. Although only the Package/Envelope Services and Office/Print Services pages are shown below the Freight Services and Expedited Services also contain this same header format.

United States Home | Information Center | Customer Support | Site Map

FedEx

Search Go!

Package/Envelope Services | Office/Print Services | Freight Services | Expedited Services

Ship | Track | Manage My Account | International Tools

Welcome Center

[Login to My FedEx](#)

[New Customer Center](#)
Learn [how to ship online](#) and [open an account](#) today.


[Delivery Options](#)
Browse our shipping services and see sample rates.

[Service Finder](#)
Choose the best service for your shipment.

Select your destination:

Within US International

[Continue >>](#)



Who else would you trust to deliver something this big?

2005 National Championship FedEx Orange Bowl
Tuesday, January 4, 2005 8:00 pm ET

Offers

The [supply order schedule](#) is changing for the holidays. Avoid the holiday rush and [order your supplies](#) today.

[Apply Now - Save 10%](#)
Open an account and save on FedEx Express online shipping.

[View an online demo](#) of the new fedex.com.

[Get holiday shipping information](#), schedules, tips, and more.

FedEx Companies & Services

- [FedEx Express](#)
- [FedEx Ground & FedEx Home](#)
- [FedEx Kinko's Delivery](#)
- [FedEx Freight](#)
- [FedEx Custom Critical](#)
- [FedEx Trade Networks](#)
- [FedEx Supply Chain Services](#)

Track

[Track Shipments](#)

Enter any combination of up to **30 FedEx tracking** or **Door Tag numbers** (one per line)

[Track](#)

News

- [South Asia Relief Efforts](#)
- [FedEx Rate Changes](#)
- [Fuel Surcharge Information](#)
- [More News...](#)

Global Home | Service Info | About FedEx | Investor Relations | Careers | fedex.com Terms of Use | Privacy Policy
This site is protected by copyright and trademark laws under US and International law. All rights reserved. © 1995-2004 FedEx

Figure 9. FedEx Package/Envelope Services (31 Dec 04)

The screenshot shows the FedEx Kinko's website interface. At the top right, there are links for 'Information Center', 'Customer Support', and 'Site Map'. Below the logo, a search bar is present. The main navigation bar includes 'Package / Envelope Services', 'Office / Print Services' (highlighted), 'Freight Services', and 'Expedited Services'. A secondary bar lists 'In-Store Services', 'Online Printing', 'Packing / Shipping', and 'Commercial Solutions'. The 'Welcome Center' section on the left provides a 'New Customer?' link and a list of actions: 'Learn' about online printing, 'Visit' the site tour, 'View' frequently asked questions, and 'Call' or write with questions. The central banner features a family photo and the text 'give THEM A Smile' and 'CREATE CUSTOM PHOTO CALENDARS AND GREETING CARDS ONLINE NOW >>'. The 'Features' section on the right highlights 'Digital Photo Prints in Minutes' and 'Healthcare Document Solutions'. The 'FedEx Companies & Services' section lists various service types with color-coded icons. The 'Find a FedEx Kinko's' section has a 'Find locations' button and a link to find locations by city. The 'Print to a FedEx Kinko's' section promotes an online document ordering service with a 'Get started >>' button. The footer contains a 'Global Home' link and a copyright notice for 1995-2004 FedEx.

Figure 10. FedEx Office/Print Services (31 Dec 04)

Help Users Recognize, Diagnose, and recover From Errors

Pierotti defines that error messages should be expressed in plain language and specifically points out that there should be no codes (Pierotti, 2002). Error messages should imply that the user is in control, the system is at blame, and should indicate what action the user needs to take to correct the error (Pierotti, 2002). If you enter the wrong User ID or Password in the FedEx login screen (see Figure 11 below) you are informed that your Login was incorrect, that they are case sensitive, and then you are pleasantly asked to “Please try again”.

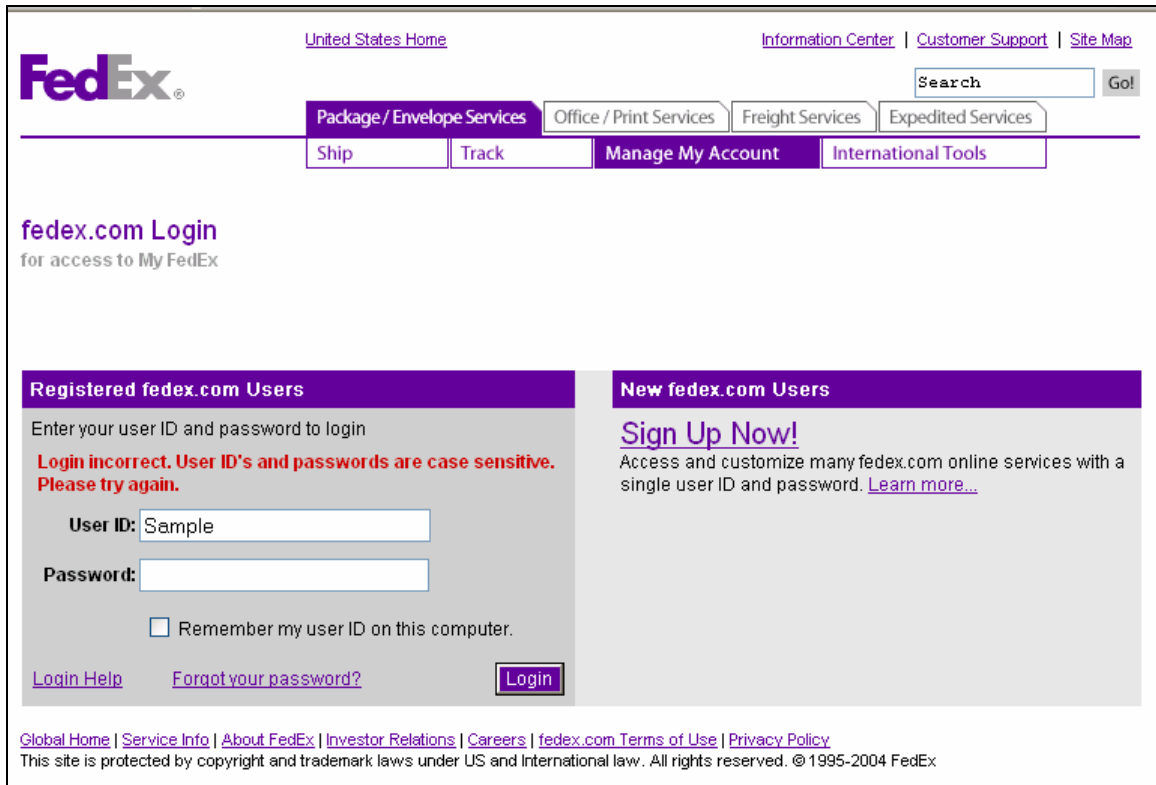


Figure 11. FedEx Login Screen (31 Dec 04)

Error Prevention

Nielsen also suggested that even better than good error messages is a careful design, which prevents a problem from occurring in the first place. Anticipate problems and design screens to avoid them (Nielsen, 1994). Menu choices should be logical, distinctive, and mutually exclusive. Data inputs should be case-blind whenever possible and the system should prevent users from making errors whenever possible (Pierotti, 2002). All of the examples (FedEx, Amazon, and BBC) presented in this section provide good error prevention.

Recognition Rather Than Recall

Nielsen also suggested making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate (Nielsen, 1994). Zones should be separated by spaces, lines, color, letters, bold titles, rules lines and shaded areas (Pierotti, 2002). Much like the other web sites displayed in this section the BBC News site (see Figure 12 below) adequately separates the different zones for easier reading.

BBC News World Edition interface as of December 31, 2004. The page features a top navigation bar with links for News, Sport, Weather, World Service, and Languages. A search bar is located in the top right corner. Below the navigation bar, the main headline reads "LATEST: Militant groups threaten anyone who votes i_". The page is updated as of Friday, 31 December, 2004, at 16:30 GMT.

The main content area is divided into several sections:

- Push to speed up tsunami relief:** World leaders step up plans for a united response to Asian tsunamis as the 124,000 confirmed dead are mourned. Includes an animated guide, a country hit at-a-glance, and a video titled "Tsunami strikes".
- South Sudan peace accords signed:** Sudan's government signs final agreements with southern rebels to end one of Africa's longest civil wars.
- Scores die in Argentina club fire:** At least 175 people die and hundreds are hurt in a fire at a nightclub in the Argentine capital, Buenos Aires.
- Ups and downs:** The world economy's fortunes in 2004. Includes a table of market data and an "OPEN" button.
- Loving memory:** A look at the major entertainment figures who died in 2004.
- On the homefront:** Bush may need to focus on domestic concerns in 2005.

Other top stories include:

- ASIA QUAKE DISASTER IN DEPTH >>** Photo Journal: The day the sea swept my community away. Includes links to "Tamil Tigers grapple with disaster", "Tsunami mother's terrible choice", "In pictures: Relief effort begins", "Reporters' log: Asia disaster", "Can you help trace the missing?", and "Asian disaster: How to help".
- OTHER TOP STORIES:** Iraqi militants threaten voters; US probes 'laser-tracked' flights; Jazz giant Artie Shaw dies at 94.

The page also features a sidebar with navigation options for various regions (Africa, Americas, Asia-Pacific, Europe, Middle East, South Asia, UK, Business, Health, Science/Nature, Technology, Entertainment) and languages (Arabic, Spanish, Russian, Chinese). There are also sections for "BBC SPORT", "BBC WEATHER", and "BBC ON THIS DAY".

At the bottom of the page, there are links for "News alerts", "E-mail services", "Desktop ticker", "Mobiles/PDAs", and "RSS version". A footer section includes "NEWSWATCH" and links for "Notes and corrections", "Feedback", "About BBC News", "Profiles", and "History".

Figure 12. BBC Web Site (31 Dec 04)

Flexibility and Minimalist Design

Accelerators-unseen by the novice user-may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions and provide alternative means of access and operation for users who differ from the “average” user (Nielsen, 1994). The Amazon site (see Figure 13 below) provides its normal services to everybody who accesses the site. It also provides a recommendation section (see Figure 15 below) for users who have previously accessed and browsed their site. This feature can accelerate their shopping experience.

The system should provide function keys for high-frequency commands. If data entry screens are used, users should have the option of either clicking directly on a field or using a keyboard shortcut (Pierotti, 2002).

Didn't love your holiday gift?  Sell it today to someone who will on **Amazon Marketplace** ([Sell Your Stuff](#))

Hello, Gary A. Felax. We have [recommendations](#) for you. (If you're not Gary A. Felax, [click here](#).)

BROWSE

- Your Favorites** [Edit](#)
- Books
- Featured Stores**
- Apparel & Accessories
 - Electronics
 - Jewelry & Watches
- New Stores**
- In Beta ([What's this?](#))
- Musical Instruments
 - Gourmet Food
 - Health & Personal Care
 - Beauty
 - Sports & Outdoors
- Books, Music, DVD**
- Books
 - DVD
 - Magazine Subscriptions
 - Music
 - Video

Special Features

- [Amazon.com Mobile Access](#)
- [Amazon Credit Account](#)
- [Early Adopters](#)
- [Free e-Cards](#)
- [Friends & Favorites](#)
- [Gift Certificates](#)
- [Honor System](#)
- [Purchase Circles](#)
- [Wedding Registry](#)



Amazon.com Visa Card
Apply and
SAVE



American Red Cross

Together, we can save a life

All of us at Amazon.com are deeply saddened by the loss of lives resulting from the South Asia earthquake and tsunamis on December 26. We are offering customers the ability to make donations directly to the American Red Cross to aid the evacuation of survivors and the dispersal of first aid. One hundred percent of your donation will go to the American Red Cross. You will receive a confirmation e-mail that may be used as a receipt. Thank you in advance for making any donation to help in this time of great need.

[Donate with 1-Click to the South Asia Earthquake and Tsunami Disaster Relief Efforts here](#)

Big Clearance Savings

Find hot deals on digital cameras, TVs, MP3 players, and more during our [Year-End Clearance](#), while supplies last!

Happy Holidays from Hogwarts

Harry Potter fans, rejoice! J.K. Rowling has announced that [Harry Potter and the Half-Blood Prince](#), book 6 in her wildly popular [Harry Potter series](#), will be released on July 16, 2005. [Pre-order now and save 40%](#).

For a Limited Time, Grab Two Anime DVDs for \$20



Build your anime DVD collection in a hurry with our selection of [two DVDs for \\$20](#) from Geneon and Tokyopop. Better yet, pick four and qualify for FREE Super Saver Shipping. Titles include:

- [Tenchi Universe: On Earth I](#)
- [Real Bout High School](#)
- [Cardcaptors: Tests of Courage](#)
- [Reign: The Conqueror](#)

▶ [See all 40 titles](#)

New and Future Releases

The Da Vinci Code



A reviewer, [Read more](#) ([Rate this item](#))

- [NHL 2-Pack Figures: Jason Smith and Jose Theodore](#) by T M P Int. ([Rate it](#))
- [GO VIDEO VR2940 DVD Recorder/vhs Combo](#) by GO VIDEO ([Rate it](#))
- [The Best Year of Your Life](#) by Debbie Ford ([Rate it](#))
- [iTunes \\$15 Prepaid Card](#) by Apple Computer ([Rate it](#))

Where's My Stuff?

- Track your [recent orders](#).
- View or change your orders in [Your Account](#).
- See our [animated demo!](#)

Shipping & Returns

- See our [shipping rates & policies](#).
- [Return](#) an item (here's our [Returns Policy](#)).

Need Help?

- Forgot your password? [Click here](#).
- [Redeem](#) or [buy](#) a gift certificate.
- [Visit our Help department](#).

Figure 13. Amazon Web Site (31 Dec 04)

Aesthetic and Minimalist Design

Nielsen also suggests that dialogues should not contain information that is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility (Nielsen, 1994). A screen should only display information essential to decision making (Pierotti, 2002). Borenstein (1991) refers to it simply as the KISS rule. KISS stands for “Keep It Simple Stupid.” The FedEx site (see Figures 8-11 above) provides a great example of the KISS rule while still presenting the required information. While pictures and other web graphics can beautify a site, web designers should be sure information the user needs is not being lost in the presentation. Color should be used with discretion and menu titles should be brief, yet long enough to communicate their meaning to the user (Pierotti, 2002).

Help and Documentation

Even though it is better if the system can be used without documentation, Nielsen suggests that it may be necessary to provide help and documentation, and any such information should be easy to search, focused on the user’s task, list concrete steps to be carried out, and not be too large (Nielsen, 1994). The help function should be visible on every screen within a site, it should be easy to access and return from the help system, and the information provided by the help system should be relevant to the user’s task (Pierotti, 2002). The eBay site (see Figure 14 below) provides the help function to the user on each one of its Buy, Sell, My eBay, and Community pages. The format of each page header is the same, making it easy for the user to complete the task at hand. The

Amazon site (see Figures 13 and 15) also provides a similar help function with a consistent header location.

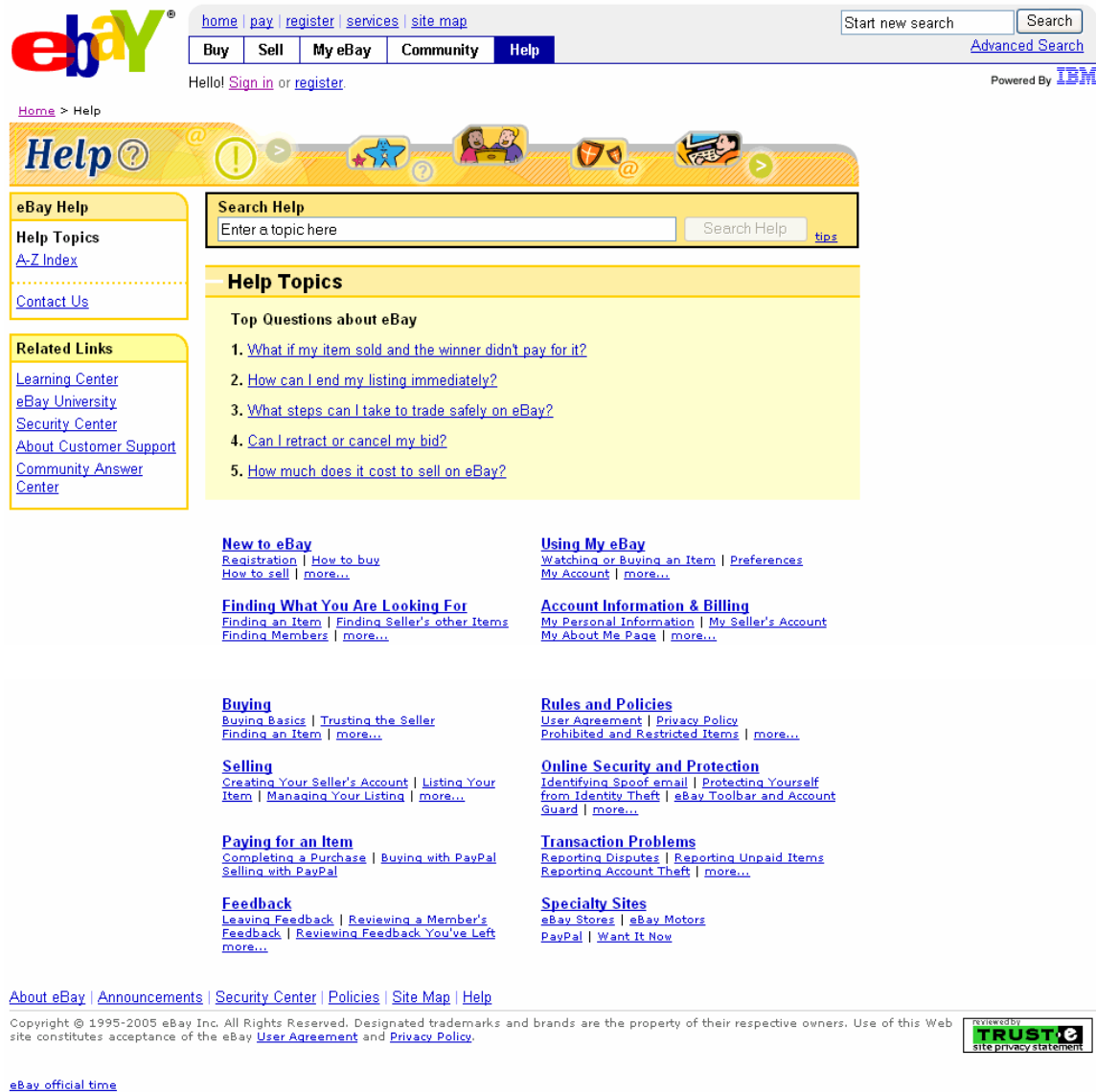


Figure 14. eBay Help Page (31 Dec 04)

Skills

Beyond the other characteristics, Nielsen states in his Flexibility and Efficiency of Use heuristic that the system should support, extend, supplement, or enhance user's

computer skills, background knowledge, and expertise – not replace them (Nielsen, 1994). In most cases, the target humans are relatively unsophisticated (Borenstein, 1991). Pierotti (2002) renames this heuristic to “Skills” and this name will be used throughout this study. Pierotti (2002) also states that window operations should be easy to learn and use, and the system should provide support for novice and expert users, and that the cursor should be positioned in the textbox when the user enters a screen that contains one. Users should not have to spend more time learning how to use the site, nor should they have to make unnecessary control inputs. The Amazon web site (see Figure 13 above) provides a good example of supporting both the novice and expert users.

Pleasurable and Respectful Interaction with the User

The user’s interactions with the system should enhance the quality of her or his work-life. The user should be treated with respect. The design should be aesthetically pleasing with artistic as well as functional value (Pierotti, 2002). Color should be used with discretion, to draw attention, communicate organization, indicate status change, and establish relationships (Pierotti, 2002). The Amazon site does a good job of enhancing the quality of the users visit. With their Recommendation page (see Figure 15 below) the user is presented with items that closely relate to items recently purchased or viewed. They also offer pages to create wish lists or purchase gift certificates, which add functional value.

Recommended for Gary A. Felax (If you're not Gary A. Felax, click here.)

BROWSE RECOMMENDED

Just for Today

- Your Watch List (Beta)

Recommendations

Your Favorites Edit

- Books

More Stores

- Baby
- DVD
- Electronics
- Outdoor Living
- Tools & Hardware
- Kitchen & Housewares
- Magazine Subscriptions
- Music
- Computers
- Camera & Photo
- Software
- Toys & Games
- Video
- Computer & Video Games

Improve Your Recommendations


Gary, improve what we recommend to you by editing your collection:

- Items you own (9)
- Items on your Wish List (0)
- Items you've rated (0)
- Items you've marked "Not interested" (0)

Recommendations for you are based on 9 items you own and more.

[More results](#)

view: All | [New Releases](#) | [Coming Soon](#) | [Bargains](#) | [Your Watch List](#) (Beta)

- 

The Mind of War: John Boyd and American Security
by Grant T. Hammond
Average Customer Review: ★★★★★
Publication Date: August 2004
Our Price: \$12.21 **Used & new** from \$8.95

[Add to cart](#) [Add to Wish List](#)

[Why was I recommended this?](#)

Rate this item I own it Not interested


[See related items](#)
- 

Colossus: The Price of America's Empire
by Niall Ferguson
Average Customer Review: ★★★★★
Publication Date: April 22, 2004
Our Price: \$16.35 **Used & new** from \$9.00

[Add to cart](#) [Add to Wish List](#)

[Why was I recommended this?](#)

Rate this item I own it Not interested


[See related items](#)
- 

Certain To Win: The Strategy Of John Boyd, Applied To Business
by Chet Richards
Average Customer Review: ★★★★★
Publication Date: June 24, 2004
Our Price: \$20.99

[Add to cart](#) [Add to Wish List](#)

[Why was I recommended this?](#)

Rate this item I own it Not interested

[See related items](#)
- 

Maneuver Warfare Handbook (Westview Special Studies in Military Affairs)
by William S. Lind
Average Customer Review: ★★★★★
Publication Date: May 1, 1985
Our Price: \$34.00 **Used & new** from \$19.99

[Add to cart](#) [Add to Wish List](#)

[Why was I recommended this?](#)

Rate this item I own it Not interested

[See related items](#)

Did you make changes on this page? [Refresh](#) your recommendations.

[More results](#)

Where's My Stuff?

- Track your [recent orders](#).
- View or change your orders in [Your Account](#).
- See our [animated demo!](#)

Shipping & Returns

- See our [shipping rates & policies](#).
- [Return](#) an item (here's our [Returns Policy](#)).

Need Help?

- Forgot your password? [Click here](#).
- [Redeem](#) or [buy](#) a gift certificate.
- [Visit our Help department](#).

Figure 15. Amazon Recommendations Page (31 Dec 04)

Privacy

Pierotti suggests that the system should help the user to protect personal or private information belonging to the user or his/her clients (Pierotti, 2002). The protected areas should be completely inaccessible by those not authorized. Confidential areas should be password protected and the privacy feature should be effective and successful (Pierotti, 2002). The “My eBay” page (see figure 16 below) provides a good example of protecting a users privacy.

The screenshot shows the eBay sign-in interface. It has a header with the eBay logo and 'My eBay' text. Below the header, there are two main sections: 'New to eBay?' and 'Already an eBay user?'. The 'New to eBay?' section includes a 'Register >' button. The 'Already an eBay user?' section includes input fields for 'eBay User ID' and 'Password', each with a 'Forgot' link. There is also a 'Secure Sign In >' button and a checkbox for 'Keep me signed in'. At the bottom, there is a 'PASSPORT Sign In' button and a footer with copyright information and a 'TRUSTe' logo.

Figure 16. My eBay Sign-In Page (31 Dec 04)

Accessibility

In 2002 it was estimated that 54 million Americans (about 20 percent) of the U.S. population are legally classified as people with disabilities and many others could claim that status. As the population grows older, so will the numbers of people with diminished

physical abilities (Davis, Kendall, and Meeks, 2002). However, according to Forrester Research leading sites don't offer accessible alternatives for the blind and visually impaired. Millions of affected users plus the low cost of fixes add up to missed opportunities for companies and their agencies (Manning, Dalton, Dorsey, and Belanger, 2003).

In the Air Force we generally think of military members as not having disabilities. However, we sometimes forget the number of civilians impacted every day by Air Force web sites. According to a recent report in Airman magazine, the civilian strength in 2004 was 141,147 (Airman, 2005). Fitzgerald (2004) states, in AFKN Communities of Practice (CoP) over 51 percent of CoP participants were civilian. Combine civilian contractors to this and the numbers increase to over 62 percent. These civilian employees and contractors may contain disabilities and cannot be forgotten when considering web site accessibility.

Making the web more accessible for users with various disabilities is to a great extent a matter of using HTML the way it was intended: to encode *meaning* rather than *appearance*. As long as a page is coded for meaning, it is possible for alternative browsers to present that meaning in ways that are optimized for the abilities of individual users and thus facilitate the use of the Web by disabled users (Useit.com, 1996).

Defining Accessibility

Accessibility can be interpreted as a set of technical requirements that, if followed, will result in applications and web pages that are readable by assistive technologies, such as screen readers or screen magnifiers. Those technical requirements

generally prescribe that an application should provide a logical keyboard navigation option and useful information about the interface, including status of an object, associated labels, and required actions. A common example is the need to include ALT text attributes for images and input fields so that screen readers can announce content that is more meaningful than the words "image" or "input field" (Carignan, 2004).

Accessibility can also be interpreted as meeting a set of functional performance criteria that, if achieved, will result in applications and web pages that are usable by people with disabilities. Those functional performance criteria generally ensure that people with different disabilities can complete a task and have a user experience comparable to that of users who do not have a disability (Carignan, 2004).

Making technology more accessible to people with disabilities is an area that has been quite under appreciated. For a large number of people who just happen to have physical disability, computers provide a greatly empowering experience that allows them to truly connect to the world, except when the design cuts them out. A lot of really big sites, including some government sites are not really accessible to disabled users (Pack, 2001).

Accessibility Guidelines

Section 508 of the Rehabilitation Act as amended by the Workforce Investment Act of 1998 presents the Electronic and Information Technology requirements for Federal Departments and Agencies. It requires all Federal Departments and Agencies to comply with set accessibility guidelines. Section 1A states that when: developing, procuring, maintaining, or using electronic and information technology, each Federal

department or agency shall ensure, unless an undue burden would be imposed on the department or agency, that the electronic and information technology allows, regardless of the type of medium of the technology--individuals with disabilities who are Federal employees to have access to and use of information and data that is comparable to the access to and use of the information and data by Federal employees who are not individuals with disabilities (Department of Justice, 2004).

The World Wide Web Consortium (W3C), an organization interested in all aspects of the web, sponsors the most extensive set of programs and initiatives devoted to the issue of web accessibility for people with disabilities (Carter and Markel, 2001). In 1999, W3C editors developed a checklist for User Agent Accessibility Guidelines. It provides a list of all checkpoints from the User Agent Accessibility Guidelines 1.0, and is organized by concept as a checklist for user agent developers. The checklist (see Appendix B) contains 3 priority levels and each checkpoint is assigned a priority that indicates its importance for users with disabilities. The evaluators will use this checklist which provides links to detailed explanations for each checkpoint during the site evaluation. The priority levels include:

Priority 1

A Web content developer **must** satisfy this checkpoint. Otherwise, one or more groups will find it impossible to access information in the document. Satisfying this checkpoint is a basic requirement for some groups to be able to use Web documents. (Chisholm, Vanderheiden, and Jacobs, 1999a). The priority 1 checkpoints are broken down into the following sections:

In General

Chisholm, Vanderheiden, and Jacobs (2000a) state that the developer must ensure that information is not conveyed through color alone. For example, when asking for input from users, do not write "Please select an item from those listed in green." Instead, ensure that information is available through other style effects (e.g., a font effect) and through context (e.g., comprehensive text links).

Sections can be defined and styled by default (through style sheets) as follows:

- They are surrounded by a border.
- They use a different background color.
- They begin with the word "Example" or "Deprecated Example".
- They also end with the phrase "End example", but that phrase is hidden by default with 'display: none'. For user agents that don't support style sheets or when style sheets are turned off, this text helps delineate the end of an example for readers who may not be able to see the border around the example.

The developer should avoid causing the screen to flicker until user agents allow users to control flickering. A flickering or flashing screen may cause seizures in users with photosensitive epilepsy and content developers should thus avoid causing the screen to flicker. Seizures can be triggered by flickering or flashing in the 4 to 59 flashes per second (Hertz) range with a peak sensitivity at 20 flashes per second as well as quick changes from dark to light (like strobe lights) (Chisholm, Vanderheiden, and Jacobs, 2000a).

Chisholm, Vanderheiden, and Jacobs (2000a) provide a list of writing style suggestions. These should help make the content of your site easier to read for everyone, especially people with reading and/or cognitive disabilities.

1. Strive for clear and accurate headings and link descriptions. This includes using link phrases that are terse and that make sense when read out of context or as part of a series of links (Some users browse by jumping from link to link and listening only to link text.) Use informative headings so that users can scan a page quickly for information rather than reading it in detail.
2. State the topic of the sentence or paragraph at the beginning of the sentence or paragraph (this is called "front-loading"). This will help both people who are skimming visually, but also people who use speech synthesizers. "Skimming" with speech currently means that the user jumps from heading to heading, or paragraph to paragraph and listens to just enough words to determine whether the current chunk of information (heading, paragraph, link, etc.) interests them. If the main idea of the paragraph is in the middle or at the end, speech users may have to listen to most of the document before finding what they want. Depending on what the user is looking for and how much they know about the topic, search features may also help users locate content more quickly.
3. Limit each paragraph to one main idea.
4. Avoid slang, jargon, and specialized meanings of familiar words, unless defined within your document.
5. Favor words that are commonly used. For example, use "begin" rather than "commence" or use "try" rather than "endeavor."

6. Use active rather than passive verbs.
7. Avoid complex sentence structures.

And if you use images and image maps

Text is considered accessible to almost all users since it may be handled by screen readers, non-visual browsers, and braille readers. It may be displayed visually, magnified, synchronized with a video to create a caption, etc. As you design a document containing non-textual information (images, applets, sounds, multimedia presentations, etc.), supplement that information with textual equivalents wherever possible (Chisholm, Vanderheiden, and Jacobs, 2000a).

And if you use tables

For data tables, identify row and column headers and for data tables that have two or more logical levels of row or column headers, use markup to associate data cells and header cells (Chisholm, Vanderheiden, and Jacobs, 1999a). Chisholm, Vanderheiden, and Jacobs (2000c) also provide the following recommendations:

- Identify structural groups of rows (THEAD for repeated table headers, TFOOT for repeated table footers, and TBODY for other groups of rows) and groups of columns (COLGROUP and COL).
- Label table elements with the "scope", "headers", and "axis" attributes so that future browsers and assistive technologies will be able to select data from a table by filtering on categories.

- Do not use `PRE` to create a tabular layout of text -- use the `TABLE` element so that assistive technologies may recognize that it is a table.

And if you use frames

Title each frame (`<TITLE>A simple frameset document</TITLE>`) to facilitate frame identification and navigation (Chisholm, Vanderheiden, and Jacobs, 2000c).

And if you use applets and scripts

Chisholm, Vanderheiden, and Jacobs (1999a) state, ensure that pages are usable when scripts, applets, or other programmatic objects are turned off or not supported. If this is not possible, provide equivalent information on an alternative accessible page.

For example, ensure that links that trigger scripts work when scripts are turned off or not supported (e.g., do not use "javascript:" as the link target). If it is not possible to make the page usable without scripts, provide a text equivalent with the `NOSCRIPT` element, or use a server-side script instead of a client-side script, or provide an alternative accessible page (Chisholm, Vanderheiden, and Jacobs, 1999b).

And if you use multimedia

Chisholm, Vanderheiden, and Jacobs (2000a) state, the developer must provide an auditory description of the important information of the visual track of a multimedia presentation. Auditory descriptions of the visual track provide narration of the key visual elements without interfering with the audio or dialogue of a movie. Key visual elements

include actions, settings, body language, graphics, and displayed text. Auditory descriptions are used primarily by people who are blind to follow the action and other non-auditory information in video material.

For any time-based multimedia presentation (e.g., a movie or animation), synchronize equivalent alternatives (e.g., captions or auditory descriptions of the visual track) with the presentation. Auditory presentations must be accompanied by text transcripts, textual equivalents of auditory events. When these transcripts are presented synchronously with a video presentation they are called captions and are used by people who cannot hear the audio track of the video material (Chisholm, Vanderheiden, and Jacobs, 2000a).

Priority 2

A Web content developer **should** satisfy this checkpoint. Otherwise, one or more groups will find it difficult to access information in the document. Satisfying this checkpoint will remove significant barriers to accessing Web documents (Chisholm, Vanderheiden, and Jacobs, 1999a). The priority 2 checkpoints are broken down into the following sections:

In General

There are several priority 2 General checkpoints. The first being, to ensure that the foreground and background color combinations provides sufficient contrast when viewed by someone having color deficits (Chisholm, Vanderheiden, and Jacobs, 1999a). They also include:

- When an appropriate markup language exists, use markup rather than images to convey information.

For example, use MathML to mark up mathematical equations, and style sheets to format text and control layout. Also, avoid using images to represent text -- use text and style sheets instead (Chisholm, Vanderheiden, and Jacobs, 1999b).

- Create documents that validate to published formal grammars.

For example, include a document type declaration at the beginning of a document that refers to a published DTD (e.g., the strict HTML 4.0 DTD) (Chisholm, Vanderheiden, and Jacobs, 1999b).

- Use style sheets to control layout and presentation.

For example, use the CSS 'font' property instead of the HTML FONT element to control font styles (Chisholm, Vanderheiden, and Jacobs, 1999b).

- Use relative rather than absolute units in markup language attribute values and style sheet property values.

For example, in CSS, use 'em' or percentage lengths rather than 'pt' or 'cm', which are absolute units. If absolute units are used, validate that the rendered content is usable (Chisholm, Vanderheiden, and Jacobs, 1999b).

- Use header elements to convey document structure and use them according to specification.

For example, in HTML, use H2 to indicate a subsection of H1. Do not use headers for font effects (Chisholm, Vanderheiden, and Jacobs, 1999b).

- Mark up lists and list items properly.

For example, in HTML, nest OL, UL, and DL lists properly (Chisholm, Vanderheiden, and Jacobs, 1999b).

- Mark up quotations. Do not use quotation markup for formatting effects such as indentation.

For example, in HTML, use the Q and BLOCKQUOTE elements to markup short and longer quotations, respectively (Chisholm, Vanderheiden, and Jacobs, 1999b).

Chisholm, Vanderheiden, and Jacobs (1999a) also state that the developer should avoid causing content to blink, avoid auto-refreshing pages, and do not use markup to redirect pages automatically.

Avoiding non-W3C and non-standard features (proprietary elements, attributes, properties, and extensions) will tend to make pages more accessible to more people using a wider variety of hardware and software. When inaccessible technologies (proprietary or not) must be used, equivalent accessible pages must be provided. Developers should also avoid deprecated features of W3C technologies (Chisholm, Vanderheiden, and Jacobs, 1999b).

For example, in HTML, don't use the deprecated *FONT* element; use style sheets instead (e.g., the 'font' property in CSS).

And if you use tables

Chisholm, Vanderheiden, and Jacobs (1999a) state that the developer should not use tables for layout unless the table makes sense when linearized. If a table is used for layout, do not use any structural markup for the purpose of visual formatting.

And if you use frames

You should describe the purpose of frames and how frames relate to each other if it is not obvious by frame titles alone (Chisholm, Vanderheiden, and Jacobs, 1999b).

For example, in HTML, use "longdesc," or a description link.

And if you use forms

Developers should ensure that the label is properly positioned for all form controls with implicitly associated labels. The label must immediately precede its control on the same line (allowing more than one control/label per line) or be in the line preceding the control (with only one label and one control per line) (Chisholm, Vanderheiden, and Jacobs, 1999b).

The developer should also associate labels explicitly with their controls.

For example, in HTML use LABEL and its "for" attribute.

And if you use applets and scripts

Chisholm, Vanderheiden, and Jacobs (1999b) state, the developer should avoid movement in pages. When a page includes moving content, provide a mechanism within a script or applet to allow users to freeze motion or updates. Using style sheets with scripting to create movement allows users to turn off or override the effect more easily.

Chisholm, Vanderheiden, and Jacobs (1999b) also state that developers should ensure that any element that has its own interface can be operated in a device-independent manner. Device-independence means that users must be able to interact with

a user agent (and the document it renders) using the supported input and output devices of their choice and according to their needs. Input devices may include pointing devices, keyboards, braille devices, head wands, microphones, and others. Output devices may include monitors, speech synthesizers, and braille devices. This does not mean that user agents must support every input or output device. User agents should offer redundant input and output mechanisms for those devices that are supported. For example, if a user agent supports keyboard and mouse input, users should be able to interact with all features using either the keyboard or the mouse (Chisholm, Vanderheiden, and Jacobs, 2000c).

Priority 3

A Web content developer **may** address this checkpoint. Otherwise, one or more groups will find it somewhat difficult to access information in the document. Satisfying this checkpoint will improve access to Web documents. (Chisholm, Vanderheiden, and Jacobs, 1999a). The priority 3 checkpoints are broken down into the following sections:

In General

The developer may specify the expansion of each abbreviation or acronym in a document where it first occurs.

For example, in HTML, use the "title" attribute of the ABBR and ACRONYM elements. Providing the expansion in the main body of the document also helps document usability (Chisholm, Vanderheiden, and Jacobs, 1999b).

The developer may also identify the primary natural language of a document.

For example, in HTML set the "lang" attribute on the HTML element. In XML, use "xml:lang". Server operators should configure servers to take advantage of HTTP content negotiation mechanisms so that clients can automatically retrieve documents of the preferred language (Chisholm, Vanderheiden, and Jacobs, 1999b).

Chisholm, Vanderheiden, and Jacobs, (1999a) provide the following checkpoints that the developer may address:

- Provide navigation bars to highlight and give access to the navigation mechanism.
- Group related links, identify the group (for user agents), and, until user agents do so, provide a way to bypass the group. When links are grouped into logical sets (for example, in a navigation bar that appears on every page in a site) they should be marked up as a unit. Navigation bars are usually the first thing someone encounters on a page. For users with speech synthesizers, this means having to hear a number of links on every page before reaching the interesting content of a page.
- If search functions are provided, enable different types of searches for different skill levels and preferences. Most search facilities require the user to enter keywords for search terms. Users with spelling disabilities and users unfamiliar with the language of your site will have a difficult time finding what they need if the search requires perfect spelling. Search engines might include a spell checker, offer "best guess" alternatives, query-by-example searches, similarity searches, etc.

- Place distinguishing information at the beginning of headings, paragraphs, lists, etc. This is commonly referred to as "front-loading" and is especially helpful for people accessing information with serial devices such as speech synthesizers.
- Provide information about document collections (i.e., documents comprising multiple pages.).

For example, in HTML specify document collections with the LINK element and the "rel" and "rev" attributes. Another way to create a collection is by building an archive (e.g., with zip, tar and gzip, stuffit, etc.) of the multiple pages.

The performance improvement gained by offline processing can make browsing much less expensive for people with disabilities who may be browsing slowly.

- Provide a means to skip over multi-line ASCII art. Preferably, developer may avoid ASCII art (character illustrations) and use real images instead since it is easier to supply a text equivalent for images (Chisholm, Vanderheiden, and Jacobs, 2000c).

The developer may also create a style of presentation that is consistent across pages. A consistent style of presentation on each page allows users to locate navigation mechanisms more easily but also to skip navigation mechanisms more easily to find important content. This helps people with learning and reading disabilities but also makes navigation easier for all users. Predictability will increase the likelihood that people will find information at your site, or avoid it when they so desire (Chisholm, Vanderheiden, and Jacobs, 2000a).

And if you use images and image maps

Chisholm, Vanderheiden, and Jacobs (2000a) state that developers may provide redundant text links for each active region of a client-side image map. Text is considered accessible to almost all users since it may be handled by screen readers, non-visual browsers, and braille readers.

And if you use tables

Chisholm, Vanderheiden, and Jacobs (1999b) state that when you use tables the developer may provide summaries for tables.

For example, in HTML, use the "summary" attribute of the TABLE element.

They may also provide abbreviations for header labels.

For example, in HTML, use the "abbr" attribute on the TH element.

Developers may provide a linear text alternative (on the current page or some other) for all tables that lay out text in parallel, word-wrapped columns. Tables used to lay out pages where cell text wraps pose problems for older screen readers that do not interpret the source HTML or browsers that do not allow navigation of individual table cells. These screen readers will read across the page, reading sentences on the same row from different columns as one sentence (Chisholm, Vanderheiden, and Jacobs, 2000c).

And if you use forms

The developer may include default; place-holding characters in edit boxes and text areas.

For example, in HTML, do this for TEXTAREA and INPUT (Chisholm, Vanderheiden, and Jacobs 1999b).

Chapter Overview

This chapter provided an overview of the Air Force Knowledge Now sites origin, goals, structure, and operation. Existing literature was presented to identify heuristics that may influence web usability. The distinct guidelines have been offered as possible factors that may influence usability with the objective to create a checklist tailored to provide common usability standards. Accessibility checkpoints were also looked at for comparison from the literature review. An explanation of the three checkpoint priorities was discussed along with a brief description of some of these checkpoints. The following chapter describes the methodology, which will be followed to test the proposed hypotheses.

III. Methodology

Introduction

The methodology describes the research process necessary to properly evaluate and answer the given research questions. In Chapter 2, the literature review determined which usability and accessibility guidelines would complement this research study. In this chapter, the rationale for choosing the methodology, the approach, the research design factors, and the data collection issues that arise when using the guidelines established in the previous chapter will be discussed. Case study methodology will be used extensively for this research effort. Finally, the comparative analysis approach will be briefly discussed along with how it will be used in the research.

Methodology

The methodology used in this thesis is broken down into three separate phases. The first phase incorporated a qualitative analysis of applicable literature, to include; research articles, reports, white papers, and other text based documents. The literature review was designed to compare several usability evaluation methods: heuristic, think-aloud, performance testing, software guidelines, cognitive walkthroughs, and usability testing. From this review a common theme and suitable evaluation method for this study was found, which answers investigative question number one of this study:

1. What is the appropriate usability guidelines identified in the literature?

Once these guidelines were established the second phase utilized the guidelines to analyze the Air Force Knowledge Now (AFKN) web site using a case study approach to answer investigative question number two of this study:

2. How well does the Knowledge Now web site follow appropriate usability guidelines identified in the literature?

Once question two is completed, the federally mandated Section 508 of the Rehabilitation Act web accessibility standards were used to analyze the web site using a case study approach to answer investigative question number three of this study:

3. How well does the Knowledge Now web site adhere to the federally mandated accessibility guidelines presented in Section 508 of the Rehabilitation Act?

The selection and details of when and how to use the case study approach for each of the above questions will be further explained in the following sections.

The fourth and final phase evaluated the usability and accessibility guidelines through a comparative analysis to determine whether one method of evaluation could accomplish the objectives of the other. This analysis will answer investigative question number four of this study:

4. When usability guidelines are followed, are they sufficient in complying with the Section 508 of the Rehabilitation Act standards?

Case Study Approach

Several definitions for the case study methodology have been presented over the years. Case studies, in which the researcher explores in depth a program, an event, an activity, a process, or one or more individuals represent a few of the options. The case(s)

are bounded by time and activity, and researchers collect detailed information using a variety of data collection procedures over a sustained period of time (Stake, 1995).

The case study approach to qualitative research constitutes a specific way of collecting, organizing, and analyzing data (Patton, 2002). In a case study, a particular individual, program, or event is studied in-depth for a defined period of time (Leedy and Ormrod, 2001). The researcher will explore a topic when the theory base is unknown (Creswell, 2003). The researcher attempts to test the validity of certain assumptions, claims, theories, or generalizations within real-world contexts (Leedy and Ormrod, 2001). By evaluation it provides a means through which a researcher can judge the effectiveness of particular policies, practices, or innovations (Leedy and Ormrod, 2001). A case study may be especially suitable for learning more about a little known or poorly understood situation (Leedy and Ormrod, 2001). A multiple case study (which appears in this study) also allows for comparisons, theory building, or proposition of generalizations (Leedy and Ormrod, 2001). Both Leedy and Ormrod, and Yin offer more precise determinations of when the case study approach might be appropriate.

Leedy and Ormrod's criteria for selection of methodology

Leedy and Ormrad (2001) first differentiate between the Qualitative and Quantitative research approaches before discussing the different designs. Leedy and Ormrod (2001) also discuss five research characteristics: purpose, process, data collection, data analysis, and reporting findings. These characteristics aid the researcher in making a more informed decision as to which approach best applies to their particular area of study. Each of the five characteristics will now be discussed in further detail.

Purpose

The purpose is divided into two categories. Quantitative researchers seek explanations and predictions to establish, confirm, or validate relationships and to develop generalizations that contribute to theory. Qualitative researchers seek a better understanding of complex situations and may use their observations to build theory (Leedy and Ormrod, 2001). While seeking to understand what usability and accessibility evaluation methods would best accomplish this research study a comprehensive literature review was completed. Once the two evaluations are designed and completed, the observed data can be used to perform a comparative analysis of the methods used. This analysis will build the theory for this study. All three areas in this study are qualitative in nature.

Process

Leedy and Ormrod (2001) also discuss the nature of the research process. Here quantitative research processes provide carefully structured guidelines and researchers choose methods that allow them to objectively measure the variable(s) of interest. Qualitative research process is more holistic and “emergent”, with the specific focus, design, measurement instruments, and interpretations developing and possibly changing along the way (Leedy and Ormrod, 2001). From the literature review the usability and accessibility measurement instruments were determined. The data from these instruments will be collected to form an interpretation on whether these usability and accessibility guidelines indeed overlap.

Data Collection

Leedy and Ormrod (2001) state that during Quantitative data collection researchers identify variables, then collect data specifically related to those variables from a population, or from one or more large samples that represent a population. In Qualitative data collection the researchers operate under the assumption that reality is not easily divided into discrete, measurable variables. Qualitative researchers are often described as being the research instrument because the bulk of their data collection is dependent on their personal involvement (interviews, observations) in the setting (Leedy and Ormrod, 2001). Evaluators should not be associated with the project/site. It is very important that the evaluators not discuss among themselves the problems they found during the evaluation. They should look for points where they are confused or feel the user would be confused. These points should be described, evaluated for severity, extent, and the heuristic/checkpoint that was violated or noted reported (OCLC, 2004). From the usability and accessibility testing, visual observations to determine responses to checklist criteria will be critical to the data collection effort. These evaluation responses will not be discrete, measurable variables and will depend on the researchers personal involvement to perform a qualitative analysis to answer the questions.

Data Analysis

For data analysis Leedy and Ormrod (2001) state that all research requires logical reasoning. Quantitative researchers tend to rely on deductive reasoning while qualitative researchers make considerable use of inductive reasoning. They make many specific

observations and then draw inferences about larger and more general phenomena (Leedy and Ormrod, 2001). From the data collected an inference will be made to determine whether the Air Force Knowledge Now web site complies with usability and accessibility guidelines. Also, from the usability and accessibility data collections a comparative analysis will be used to evaluate the results. This analysis will make specific observations and then draw inferences on whether usability guidelines are sufficient in complying with the federally mandated accessibility standards. A qualitative design is therefore more appropriate for this study.

Report Findings

Leedy and Ormrod (2001) state, to report findings quantitative researchers typically reduce their data numbers and employ the power of interpretation to depict the norm, or average of the groups performance. Qualitative researchers construct interpretive narratives from their data and try to capture the complexity of the phenomenon under study. The report consists of a more personal, literary style, and often includes the participants' own language and perspectives. Qualitative research occurs within natural contexts and so is more "true to life" like in this study (Leedy and Ormrod, 2001).

Leedy and Ormrod draw distinctions for each method of approach, allowing the researcher to determine which is best. From the five research characteristics discussed in this section: purpose, process, data collection, data analysis, and reporting findings it was determined that each was qualitative in nature. Because this research more closely meets the criteria expressed for qualitative research, these designs were examined more

extensively. They include case study, ethnography, phenomenological, grounded theory, and content analysis. From these designs the case study approach was determined to provide the best fit for the study and will be explained in more detail later in this chapter.

Yin’s criteria for selection of methodology

Yin (2003) states, there are several ways of doing social science research. These include: experiments, surveys, histories, analysis of archival information, and case study. When selecting a research method each strategy has peculiar advantages and disadvantages, depending on three conditions: (a) the type of research question posed, (b) the extent of control an investigator has over actual behavioral events and (c) the degree of focus on contemporary as opposed to historical phenomena (Yin, 2003). Figure 17 displays these three conditions and shows how each is related to the five major research strategies.

Strategy	Form of Research Question	Requires Control of Behavioral Events?	Focuses on Contemporary Events?
Experiment	how, why?	Yes	Yes
Survey	who, what, where, how many, how much?	No	Yes
Archival analysis	who, what, where, how many, how much?	No	Yes/No
History	how, why?	No	No
Case Study	how, why?	No	Yes

Figure 17. Relevant Situations for Different Research Strategies

Yin (2003) goes on to say, case studies are the preferred strategy when “*how*” or “*why*” questions are being posed, when the investigator has little control over events, and when the focus is on a contemporary phenomenon within some real-life context.

Answering Yin's three conditional questions: this study focuses on the Air Force Knowledge Now web site, and "how" it performs against the usability and accessibility guidelines developed from the literature review. The researcher has no control over behavioral events in this study. Direct observation techniques will be used to evaluate web site guideline compliance. The focus of this study is on contemporary events (how usable the web site is), which is important to the site owner and customers.

Case Study Design

Creswell states, qualitative research is fundamentally interpretive. This means that the researcher makes an interpretation by analyzing the data for themes or categories (Creswell 2003). This can be broken down further as seen in figure 18 below, with the inductive logic approach of research in a qualitative study.

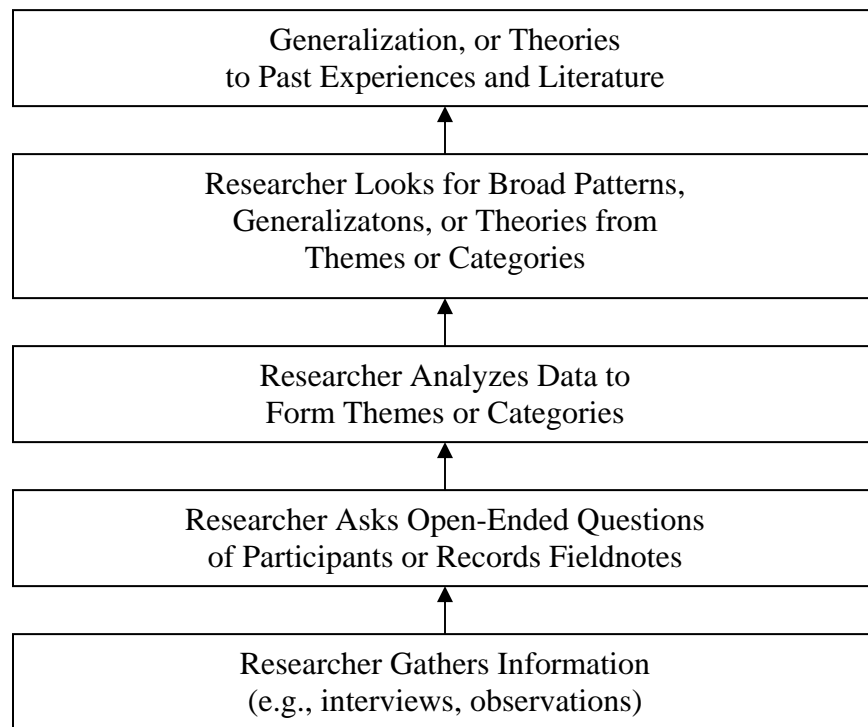


Figure 18. The Inductive Logic of Research in a Qualitative Study

Corresponding with the figure above, Leedy and Ormrod (2001) contend a case study approach typically involves the following five steps:

1. Organization of details about the case.
2. Categorization of data.
3. Interpretation of single instances.
4. Identification of patterns.
5. Synthesis and generalization.

Step 1: Organization

The specific “facts” and background data about the case are arranged in a logical order (Leedy and Ormrod, 2001). Data was collected and analyzed on usability and accessibility guidelines by a comprehensive literature review.. A heuristic evaluation was determined to be the best choice to collect data for the usability study while the federally mandated guidelines from Section 508 of the Rehabilitation Act were used for the accessibility study of the Air Force Knowledge Now web site. The data from these two studies will then be comparatively analyzed to determine commonalities within the two sets of guidelines. From this, an explanation of how the case study was conducted and how it contributes to our knowledge of the web site and whether usability and accessibility guidelines overlap each other can be provided.

Step 2: Categorization

The researcher begins by gathering detailed information from participants and forms this information into categories or themes (Creswell, 2003). For this study, categories were identified to help cluster the data into three meaningful groups (Leedy and Ormrod, 2001). The data collected was grouped by usability, accessibility and usability vs. accessibility. Following the literature trend, the groups of usability and accessibility were kept separate from each other and a separate case study was conducted for each. Once the two case studies were completed the data was comparatively analyzed to create the third group, which determined if a common theme (guideline overlap) was found.

Step 3: Interpretation

Qualitative research is fundamentally interpretive and the researcher makes an interpretation of the data (Creswell, 2003). Specific documents, occurrences, and other bits of data are examined for the specific meanings that they might have in relation to the case (Leedy and Ormrod, 2001). In this study an interpretation of the literature was made to determine that the heuristic evaluation method should be used to perform the usability testing. From the literature it was also determined that the federally mandated Section 508 of the Rehabilitation Act standards should be used to perform the accessibility testing. Using these guidelines, an interpretation by the researcher was made on each question to provide the answers. Finally, a comparative analysis of the usability and accessibility case studies data was performed to determine if an overlap of the two sets of testing guidelines exists. As shown, this study contained many occurrences for an interpretation of documents and data in relation to the case.

Step 4: Patterns

Any trends or themes that the data suggests will be supported in the study to provide a complete and unbiased account of the case as possible. Pattern theory uses metaphor or analogies so that relationship “makes sense” (Creswell, 2003). Pattern theories are systems of ideas that inform (Creswell, 2003). The data can be interpreted and scrutinized for underlying themes or patterns that characterize the case more broadly than a single piece of information can (Leedy and Ormrod, 2001). In this study the researcher will use a heuristic, then an accessibility checklist to perform two individual case studies. The data obtained from these studies will be scrutinized for underlying themes or patterns using a comparative analysis. If a pattern(s) is found, an interpretation

will be made to determine if an overlap of the guidelines exists. If an overlap in guidelines does exist, new theories on usability and accessibility can be defined.

Step 5: Synthesis and Generalization

An overall portrait of each case is constructed. Conclusions are drawn that may have implication beyond the specific cases that have been studied (Leedy and Ormrod, 2001). Theory may appear in different points of a qualitative study. As an end point it is a generated theory, a pattern, or a generalization that emerges inductively from data collection and analysis (Creswell, 2003). From this study of the Air Force Knowledge Now web site a generalization may emerge: Are the findings from this study applicable to web sites throughout the Air Force? This study is limited to testing just one site; however, further research could test a group of sites to determine if a true pattern emerges.

Data Collection

The data required to complete the selected research strategy came from research articles, reports, white papers, the two usability and accessibility case studies, and the comparative analysis of these studies. From this compilation, data was collected in each one of the four phases of this study. Leedy and Ormrod (2001) state, data are those pieces of information that any particular situation gives to an observer. Data collection can be obtained through six different techniques. These include but are not limited to: documentation, archival records, interviews, direct observations, participant observation, and physical artifacts. For this study data collection will mainly be done through

documentation, archival records, and direct observations. Yin (2003) provides three principles to maximize the benefits of data collection:

Principle 1: Use Multiple Sources of Evidence

A major strength of case study data collection is the opportunity to use many different sources of evidence (Yin, 2003). The idea behind qualitative research is to purposefully select participants or sites (or documents or visual material) that will best help the researcher understand the problem and the research questions (Creswell 2003). Using multiple sources of evidence promotes development of converging lines of inquiry, which is a process of triangulation (Yin, 2003). Ultimately the researcher must look for convergence (triangulation) of the data: Many separate pieces of information must all point to the same conclusion (Leedy and Ormrod, 2001). Thus, any finding or conclusion in a case study is likely to be more convincing and accurate if it is based on several different sources of information (Yin, 2003). In phase 1 of this study, a comprehensive literature review discussed prior research and determined the usability and accessibility research instruments to help direct the researcher to the chosen methodologies. Phase 2 was comprised of a case study of the Air Force Knowledge Now web site using the heuristics methodology selected from phase 1. Phase 3 also comprised a case study of this same web site. For this the federally mandated Section 508 of the Rehabilitation Act standards were used to perform the evaluation. In phase 4, the evidence presented from both phase 2 and 3 was comparatively analyzed for patterns and overlap to develop theories.

Principle 2: Create a Case Study Database

Documentation and data collected during a case study must be organized properly for further secondary analysis or reference. Yin (2003) states, the documentation commonly consists of two separate collections:

1. The data or evidentiary base
2. The report of the investigator, whether in article, report, or book form

For case studies, notes are likely to be the most common component of a database (Yin, 2003). These notes could reflect information about the documents or other material as well as key ideas in the documents. Also documented might be demographic information about the time, place, and date of the field setting where the observation took place (Creswell, 2003). Notes will be taken during both the usability and accessibility case studies. These notes will be derived from observations and interpretations of the Air Force Knowledge Now web site and the usability and accessibility guidelines being used to evaluate them. Notes will also be taken during the comparative analysis of the usability and accessibility guidelines. Finally, a complete and documented analysis of these studies will be presented in the results chapter of this thesis.

Principle 3: Maintain a Chain of Evidence

Reliability of the information collected in a case study is increased with an accurate chain of evidence. An external observer should be able to trace the steps in either direction (from conclusions back to initial research questions or from questions to conclusions) and derive the same conclusion as the original study (Yin, 2003). If these objectives are achieved, a case study will also contain construct validity, thereby

increasing the overall quality of the case (Yin, 2003). In this study a chain of events will ultimately be created during each phase. Phase 1 will provide evidence to support which usability and accessibility methodology is appropriate to use in this study. Phase 2 and 3 case studies will provide support and evidence on how well the Air Force Knowledge Now web site performed against the guidelines determined for use in phase 1. In phase 4 the researcher will theorize and provide evidence for or against usability and accessibility guideline overlap. From each of the phases described here and the evidence provided an analogy can then be derived as to whether the Air Force Knowledge Now web site currently complies with usability guideline or not. This chain of evidence presented can truly be followed in both directions.

Usability/Accessibility Compliance Calculation

Once the data is collected an assessment of how well the current webpage complies with the usability and accessibility guidelines will be completed. Nielsen and Tahir (2002) developed a compliance rate plan of action to determine how well a site complies with the usability guidelines. Following this plan, each question in the usability and accessibility checklists will be scored accordingly: Yes (1 point) and No (0 points). If a guideline doesn't apply (N/A) because of the nature of the site it will not be scored.

Web site assessment and scoring will be performed using two AFIT student evaluators, both of whom are conducting web usability thesis studies. Evaluator one has over 19 years total experience working with mainframe and desktop computers. In the last five years evaluator one has acquired software-programming experience in the Perl, HTML and JavaScript languages and has worked as a project manager and system

administrator. Evaluator two has experience using MySQL database administration, HTML, performing basic graphical and web design, and worked for a year as a web administrator.

Each of the thirteen sections to the usability checklist will be calculated separately to provide a compliance rating for each. Once completed, an overall usability compliance rating will be calculated. This same concept will be used to assess accessibility. Each of the three sections to the accessibility checklist will be calculated separately, then an overall accessibility compliance rating will be determined.

Ratings will be determined by the following:

Sections: The final “Yes” count for the section will be divided by the total number of guidelines that were scored. This will determine the compliance rating. This rating will then be compared to table 1 below to determine the level of usability/accessibility compliance.

Overall Compliance Rating: The final “Yes” count for the entire checklist will be divided by the total number of guidelines that were scored. This will determine the compliance rating for the entire usability/accessibility checklist being evaluated. This rating will then be compared to table 3 below to determine the level of usability/accessibility compliance.

Table 3. Usability/Accessibility Compliance Rate

Compliance Rate	Description
90 to 95%	Perfect website. Follows almost all usability/accessibility guidelines that apply to that particular site and does something different, but appropriate, in the remaining cases.
80 to 90%	Website is in good shape. Consider making a few minor fixes to areas where the site violated guidelines.
50 to 80%	Start a redesign project to produce a new homepage. Your current homepage is definitely not a disaster, but it is bad enough that isolated modifications to individual areas will not suffice.
below 50%	The site is probably not serving your customers well with the current approach to web design. Most likely, you should abandon the entire current site and start over from scratch. Rethink your Internet strategy and base your new approach on studies of your customers and their real needs.

Comparative Analysis

The last step in completing this study is to conduct a comparative analysis of the usability and accessibility guidelines produced from the qualitative literature review. Patton (2002) states, that understanding unique cases can be deepened by comparative analysis. Comparisons can also be important in illuminating differences between programs in evaluation (Patton, 2002). In this study, each set of guidelines will be laid out, compared, and analyzed to determine if there is any overlap between the two, if one is a virtual subset of the other, and/or if one is completed will it satisfy the requirements of the other.

Chapter Overview

This chapter presented the selection criteria for the methodologies employed in this research. After a thorough review of Leedy and Ormrod's criteria for selection of

methodology and the five research characteristics: purpose, process, data collection, and report findings the qualitative research approach was selected. Then the case study approach was broken down into two parts and presented. The first of these was the case study design. Leedy and Ormrods five-step approach to design: organization, categorization, interpretation, patterns, and synthesis and generalization will be used in this study. Data collection was the second part and was taken from Yin. Yin provided three principles to maximize the benefits of data collection to include: multiple sources of evidence, case study database, maintain a chain of evidence. Each of these areas was discussed and interrelated in determining the Air Force Knowledge Now web site usability and accessibility compliance. Finally, in order to answer the remaining research question a comparative analysis was determined most appropriate. The analysis will facilitate the requirement to compare the usability and accessibility guidelines to determine if any overlap between the two exists.

IV. Results

Introduction

The intent of this study was to identify a set of usability guidelines to test against the Knowledge Now site and determine if they are sufficient to comply with Section 508 of the Rehabilitation Act standards. This chapter presents the analysis and findings from the Heuristic Evaluation Checklist, as well as the Section 508 Checklist comparison to support or refute the hypotheses presented. The arrangement will follow the outline of the research questions.

Usability Guidelines

Investigative Question 1: What is the appropriate usability guidelines identified in the literature?

A review of current literature on heuristic evaluation yielded an existing graphical user interface evaluation tool, called “Heuristic Evaluation – A System Checklist” (Pierotti, 2002)(see Appendix A), that could easily be adapted for use in evaluating the Knowledge Now web site. Based on Nielsen’s (1994) heuristics, the checklist provides a set of design characteristics for each heuristic that can be used to evaluate web sites. The three-point “Yes-No-N/A” scale was used to determine compliance, non-compliance, or non-applicability for each heuristic.

Usability Guidelines vs. Knowledge Now site

Investigative question 2: How well does the Knowledge Now web site follow appropriate usability guidelines identified in the literature?

To provide a complete view, the results for this question are broken down into two sections. First, the individual section compliance rating results are provided and second the overall compliance rating and explanation is given.

Individual Section Compliance Ratings

The following sections describe each of the heuristic's characteristics and how the Knowledge Now web site compared.

Visibility of System Status

The first heuristic, Visibility of System Status, was used to evaluate whether the system kept the user informed about what is going on, through appropriate feedback within reasonable time (Nielsen, 1994). Table 4 summarizes the sections compliance ratings for the visibility of system status heuristic.

Table 4. Visibility of System Status Compliance Rate

Visibility of System Status	Matched	Yes	No	% Compliance
Evaluator 1	21	13	8	62%
Evaluator 2	21	12	9	57%
Average	21	12.5	8.5	60%

The compliance rate for this section suggests that a complete redesign project to produce a new homepage should be started. Your current homepage is definitely not a disaster, but it is bad enough that isolated modification to individual areas will not suffice

(Nielsen and Tahir, 2002). The evaluation showed there isn't a consistent icon design scheme and stylistic treatment across the system. Menu options and page design were found to be significantly different from the homepage to subsequent Deskbook and Communities of Practice (CoP) pages. Finally, after the user completes an action (or group of actions) the User Info update page does not indicate that the action was updated and the next group of actions can be started.

Match Between System and the Real World

The heuristic of Match Between System and the Real World was used to evaluate whether the system spoke the user's language, with words, phrases and concepts familiar to the user, rather than system oriented terms (Nielsen, 1994). See Table 5 for the compliance rate for this heuristic.

Table 5. Match Between System and the Real World Compliance Rate

Match Between System and the Real World	Applied	Yes	No	% Compliance
Evaluator 1	12	7	5	58%
Evaluator 2	12	7	5	58%
Average	12	7	5	58%

The compliance rate for this section suggests that a complete redesign project to produce a new homepage should be started. Your current homepage is definitely not a disaster, but it is bad enough that isolated modification to individual areas will not suffice (Nielsen and Tahir, 2002). The evaluation showed that the sites icons are not concrete and familiar and the menu choices are not ordered in the most logical way, given the user, the item names, and the task variables. It was also found that the selected colors do not

correspond to common expectations about color codes. Finally, this section determined the menu choices don't fit logically into the categories they are under.

User Control and Freedom

The heuristic for User Control and Freedom was used to evaluate whether users could easily recover from unintended actions without having to go through an extended dialogue (Nielsen, 1994). Table 6, shows the compliance rate for this heuristic.

Table 6. User Control and Freedom Compliance Rate

User Control and Freedom	Applied	Yes	No	% Compliance
Evaluator 1	12	12	0	100%
Evaluator 2	12	11	1	92%
Average	12	11.5	0.5	96%

The evaluation determined that this site is a "Perfect website" (Nielsen and Tahir, 2002). The site follows almost all usability guidelines that apply and does something different, but appropriate, in the remaining cases. A slight difference in opinion by the evaluators was noted during this section. This illustrates the subjective nature of this study and the experience level of the evaluators.

The evaluation showed that evaluator 2 determined users could not set their own system, session, file, and screen defaults. The main researcher for this study disagreed with this determining that the settings could be changed in the control panel window of the operating system.

Consistency and Standards

The heuristic for consistency and standards was used to evaluate whether users had to wonder if different words, situations, or actions mean the same thing. Table 7 shows the compliance rate for the characteristics evaluated for this heuristic.

Table 7. Consistency and Standards Compliance Rate

Consistency and Standards	Applied	Yes	No	% Compliance
Evaluator 1	28	16	12	57%
Evaluator 2	28	18	10	64%
Average	28	17	11	61%

The compliance rate for this section suggests that a complete redesign project to produce a new homepage should be started. Your current homepage is definitely not a disaster, but it is bad enough that isolated modification to individual areas will not suffice (Nielsen and Tahir, 2002). The evaluation showed that there is no formatting consistency between the homepage and its subsequent Deskbook and CoP pages. Second, the award winning icons on the homepage are not labeled. Third, attention-getting techniques are not being used only for exceptional conditions or for time-dependent information. Fourth, the scrolling text bar is presenting common user tasks. Finally, saturated blues have not been avoided for text, but have been used extensively for the privacy notice.

Help Users Recognize, Diagnose, and Recover From Errors

The heuristic for Help Users Recognize, Diagnose, and recover from Errors was used to evaluate whether error messages were expressed in plain language with no codes

(Pierotti, 2002). Table 8 shows the compliance rate for the characteristics evaluated for this heuristic.

Table 8. Help Users Recognize, Diagnose, and Recover From Errors Compliance Rate

Help Users Recognize, Diagnose, and Recover From Errors	Applied	Yes	No	% Compliance
Evaluator 1	17	13	4	76%
Evaluator 2	17	9	8	53%
Average	17	11	6	65%

The compliance rate for this section suggests that a complete redesign project to produce a new homepage should be started. Your current homepage is definitely not a disaster, but it is bad enough that isolated modification to individual areas will not suffice (Nielsen and Tahir, 2002). A slight difference in opinion by the evaluators was noted in four of the questions in this section. Reviewing the questions and reasons for there answers, the main researcher determined that this difference illustrates the true subjective nature of the study and the experience level of the evaluators. However, the difference did not impact the overall evaluation of this sections findings and compliance rate.

The evaluation showed that not all error messages are worded so that the system, not the user, takes the blame. Some error messages are also grammatically incorrect, don't avoid the use of exclamation points, and don't inform the user of the error's severity.

Error Prevention

The heuristic for Error Prevention was used to evaluate whether careful design helped to prevent problems from occurring in the first place by designing screens to avoid them (Nielsen, 1994). Table 9 shows the compliance rate for the characteristics evaluated for this heuristic.

Table 9. Error Prevention Compliance Rate

Error Prevention	Applied	Yes	No	% Compliance
Evaluator 1	4	2	2	50%
Evaluator 2	4	2	2	50%
Average	4	2	2	50%

The compliance rate for this section suggests that a complete redesign project to produce a new homepage should be started. Your current homepage is definitely not a disaster, but it is bad enough that isolated modification to individual areas will not suffice (Nielsen and Tahir, 2002). The evaluation showed that data entry screens and dialog boxes don't indicate the number of character spaces available in a field and that some menu choices are not logical, distinctive, and mutually exclusive on the homepage.

Recognition Rather Than Recall

The heuristic for Recognition Rather Than Recall was used to evaluate whether objects, actions, and options were visible so users don't have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate (Nielsen, 1994). Table 10 shows the compliance rate for the characteristics evaluated for this heuristic.

Table 10. Recognition Rather Than Recall Compliance Rate

Recognition Rather Than Recall	Applied	Yes	No	% Compliance
Evaluator 1	26	16	10	62%
Evaluator 2	26	17	9	65%
Average	26	16.5	9.5	63%

The compliance rate for this section suggests that a complete redesign project to produce a new homepage should be started. Your current homepage is definitely not a disaster, but it is bad enough that isolated modification to individual areas will not suffice (Nielsen and Tahir, 2002). The evaluation showed that text areas on the homepage do not have “breathing space” around them and the white space was not used effectively to create symmetry and lead the eye in the appropriate direction. Second, the help and Frequently Asked Questions are separated and not grouped into logical zones. Third, borders are not used to identify meaningful groups. Finally, color-coding is not consistent throughout the system. For example, the links on the homepage are two different colors.

Flexibility and Minimalist Design

The heuristic for Flexibility and Minimalist Design was used to evaluate whether the site allowed users to tailor frequent actions and provide alternative means of access and operation for users who differ from the “average” user (Nielsen, 1994). Table 11 shows the compliance rate for the characteristics evaluated for this heuristic.

Table 11. Flexibility and Minimalist Design Compliance Rate

Flexibility and Minimalist Design	Applied	Yes	No	% Compliance
Evaluator 1	4	4	0	100%
Evaluator 2	4	3	1	75%
Average	4	3.5	0.5	88%

The compliance rate for this section suggests that the homepage is in good shape. Consider making a few minor fixes to areas where the site violated guidelines (Nielsen and Tahir, 2002). The evaluation noted the system does not offer “find next” and “find previous” shortcuts in the homepage help and search functions.

Aesthetic and Minimalist Design

The heuristic for Aesthetic and Minimalist Design was used to evaluate whether dialogues used contained information that was irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility (Nielsen, 1994). Table 12 shows the compliance rate for the characteristics evaluated for this heuristic.

Table 12. Aesthetic and Minimalist Design Compliance Rate

Aesthetic and Minimalist Design	Applied	Yes	No	% Compliance
Evaluator 1	10	7	3	70%
Evaluator 2	10	7	3	70%
Average	10	7	3	70%

The compliance rate for this section suggests that a complete redesign project to produce a new homepage should be started. Your current homepage is definitely not a disaster, but it is bad enough that isolated modification to individual areas will not suffice (Nielsen and Tahir, 2002). The evaluation required that only information essential to decision making should be displayed on the page. Instead the homepage provides several sections (Award Winning CoP, What is a CoP, We can create a CoP, and Vote) that are not essential to decision making. Next, not all meaningful groups of items are separated by white spaces or a significant amount of white space. Finally, field labels consist of sentences and questions instead of being brief.

Help and Documentation

Nielsen (1994) stated in the Help and Documentation heuristic that though it would be better if the system can be used without help and documentation, it might be necessary to provide it. Any such information should be easy to search, focused on the task, and not be too large. Table 13 shows the compliance rate for the characteristics evaluated for this heuristic.

Table 13. Help and Documentation Compliance Rate

Help and Documentation	Applied	Yes	No	% Compliance
Evaluator 1	21	16	5	76%
Evaluator 2	21	12	9	57%
Average	21	14	7	67%

The compliance rate for this section suggests that a complete redesign project to produce a new homepage should be started. Your current homepage is definitely not a

disaster, but it is bad enough that isolated modification to individual areas will not suffice (Nielsen and Tahir, 2002). A slight difference in opinion by the evaluators was noted in four of the question for this section. The subjective nature of the questions disagreed upon for this section determined the difference in compliance ratings given. This again illustrates the subjective nature of the study and the experience level of the evaluators. However, the difference did not impact the overall evaluation of this sections findings and compliance rate.

The evaluation showed that the help system interface is not consistent with the navigation, presentation, and conversation interfaces of the application it supports. Also, navigation of information is not easy and the presentation of the visual layout is not well designed.

Skills

This heuristic, as summarized by Pierotti (2002) dictates that the system should support, extend, supplement, or enhance the user’s computer skills, background knowledge, and expertise -- not replace them. Table 14 shows the compliance rate for the characteristics evaluated for this heuristic.

Table 14. Skills Compliance Rate

Skills	Applied	Yes	No	% Compliance
Evaluator 1	8	6	2	75%
Evaluator 2	8	6	2	75%
Average	8	6	2	75%

The compliance rate for this section suggests that a complete redesign project to produce a new homepage should be started. Your current homepage is definitely not a disaster, but it is bad enough that isolated modification to individual areas will not suffice (Nielsen and Tahir, 2002). The evaluation showed that when a user enters a screen or dialog box the cursor is not already positioned in the next field the user is most likely to need.

Pleasurable and Respectful Interaction with the User

The heuristic for Pleasurable and Respectful Interaction with the User was used to evaluate whether the user’s interactions with the system should enhance the quality of her or his work-life. The user should be treated with respect. The design should be aesthetically pleasing with artistic as well as functional value (Pierotti, 2002). Table 15 shows the compliance rate for the characteristics evaluated for this heuristic.

Table 15. Pleasurable and Respectful Interaction with the User Compliance Rate

Pleasurable and Respectful Interaction with the User	Applied	Yes	No	% Compliance
Evaluator 1	7	1	6	14%
Evaluator 2	7	2	5	29%
Average	7	1.5	5.5	21%

The compliance rate for this section suggests that the site is probably not serving your customers well with the current approach to web design. Most likely, you should abandon the entire current site and start over from scratch. Rethink your Internet strategy and base your new approach on studies of your customers and their real needs (Nielsen

and Tahir, 2002). The evaluation showed that each individual icon is not a harmonious member of a family of icons. The owl icon on the homepage takes you to file maintenance. However, this same icon on the Deskbook page doesn't have a text box and takes you to a help screen. Second, the amount of required window housekeeping has not been kept to a minimum. Instead, an extreme amount of information is shown on the homepage and the page doesn't use the whole screen. Finally, color has not been used effectively to draw attention, communicate organization, indicate status changes or establish relationships.

Privacy

The heuristic for Privacy was used to evaluate whether the system helps the user to protect personal or private information belonging to the user or his/her clients (Pierotti, 2002). Table 16 shows the compliance rate for the characteristics evaluated.

Table 16. Privacy Compliance Rate

Privacy	Applied	Yes	No	% Compliance
Evaluator 1	3	3	0	100%
Evaluator 2	3	3	0	100%
Average	3	3	0	100%

The compliance rate for this section suggests that the site is a "Perfect website" (Nielsen and Tahir, 2002). The site complied with all areas studied for protecting users personal or private information.

Overall Usability Compliance Rating

To determine the overall Air Force Knowledge Now web site compliance rating the final “Yes” count for the entire checklist will be divided by the total number of guidelines that were scored. This will determine the compliance rating for the entire website the usability checklist evaluated. Table 17 provides an overview of each section evaluated and is displayed as the average (last row in each individual table) and is put together here for easy review.

Table 17. Individual Section Compliance Overview

Section Average	Applied	Yes	No	% Compliance
1. Visibility of System Status	21	12.5	8.5	60%
2. Match Between System/Real World	12	7	5	58%
3. User Control and Freedom	12	11.5	0.5	96%
4. Consistency and Standards	28	17	11	61%
5. Help Users Recognize, Diagnose...	17	11	6	65%
6. Error Prevention	4	2	2	50%
7. Recognition Rather than Recall	26	16.5	9.5	63%
8. Flexibility and Minimalist Design	4	3.5	0.5	88%
9. Aesthetic and Minimalist Design	10	7	3	70%
10. Help and Documentation	21	14	7	67%
11. Skills	8	6	2	75%
12. Pleasurable and Respectful...	7	1.5	5.5	21%
13. Privacy	3	3	0	100%

Table 18 shows the compliance rate for the overall heuristic evaluation of the website. The table is broken down to show each evaluator’s Yes/No response totals and compliance rate along with the studies overall average from both evaluators.

Table 18. Overall Website Usability Compliance Rate

Overall Website Usability	Applied	Yes	No	% Compliance
Evaluator 1	173	116	57	67%
Evaluator 2	173	109	64	63%
Average	173	112.5	60.5	65%

Answering Investigative Question 2, while using the heuristic evaluation checklist (see Appendix A) and the methodology established earlier in Chapter 3 the compliance rate for the overall Air Force Knowledge Now website suggests that with a compliance rate of 50%-80%, the design team should; “Start a redesign project to produce a new homepage. The current homepage is definitely not a disaster, but it is bad enough that isolated modifications to individual areas will not suffice (Nielsen and Tahir, 2002)”. Given the opinions and experience level of the evaluators, their familiarization with the web site, and the subjective nature of this study, the compliance rate for each evaluator was very similar. The overall compliance rate would not increase enough to become a “Website is in good shape” with the addition of more evaluators. However, the sites compliance rate could decrease if more evaluators found more usability problems. This could possibly lower the overall compliance rate to below 50 percent. This would then indicate that the website is probably not serving your customers well with the current approach to web design and suggests to abandon the entire site rather than start a redesign effort.

Accessibility standards vs. Knowledge Now site

Investigative question 3: How well does the Knowledge Now web site adhere to the federally mandated accessibility guidelines presented in Section 508 of the Rehabilitation Act?

To provide a complete view of the results for this question the results are broken down into two sections. First, the individual priority level compliance rating results are provided and secondly the overall accessibility compliance rating and explanation is given.

Individual Priority Compliance Ratings

The following sections describe each priority's checkpoints and how the Knowledge Now web site compared.

Priority 1

A Web content developer **must** satisfy this checkpoint. Otherwise, one or more groups will find it impossible to access information in the document. Satisfying this checkpoint is a basic requirement for some groups to be able to use Web documents. (Chisholm, Vanderheiden, and Jacobs, 1999a). Table 19 shows the compliance rate for the priority 1 checkpoint evaluation of the website.

Table 19. Priority 1 Checkpoints Compliance Rate

Priority 1 Checkpoints	Applied	Yes	No	% Compliance
Evaluator 1	7	4	3	57%
Evaluator 2	7	2	5	29%
Average	7	3	4	43%

The compliance rate for this section suggests that the site is probably not serving your customers well with the current approach to web design. Most likely, you should abandon the entire current site and start over from scratch. Rethink your Internet strategy and base your new approach on studies of your customers and their real needs (Nielsen and Tahir, 2002). A significant difference in opinion by the evaluators was noted in this section and illustrates the subjective nature of the study and the experience level of the evaluators. For example, the evaluators disagreed on whether the site used the clearest and simplest language appropriate for a site’s content, which is very subjective in nature. They also disagreed on whether the site identified the row and column headers for data tables. This difference identifies an experience level difference between evaluators. The difference did impact the overall rating for this sections findings and compliance rate.

The evaluation showed the site doesn’t provide a text equivalent for every non-text element. The sites award winning ribbon icons don’t have an “alt”, non-text element. Second, the site doesn’t ensure the pages are usable when scripts, applets, or other programmatic objects are turned off or not supported. Third, device-dependent attributes are not used to provide redundant input mechanisms to the user (ie. specify two handlers for the same element. – use “onclick” with “onkeypress”). Lastly, the KN video provides no captions or visual descriptions of the visual track during the presentation.

Priority 2

A Web content developer **should** satisfy this checkpoint. Otherwise, one or more groups will find it difficult to access information in the document. Satisfying this checkpoint will remove significant barriers to accessing Web documents (Chisholm, Vanderheiden, and Jacobs, 1999a). Table 20 shows the compliance rate for the priority 2 checkpoint evaluation of the website.

Table 20. Priority 2 Checkpoints Compliance Rate

Priority 2 Checkpoints	Applied	Yes	No	% Compliance
Evaluator 1	19	9	10	47%
Evaluator 2	19	9	10	47%
Average	19	9	10	47%

The compliance rate for this section suggests that the site is probably not serving your customers well with the current approach to web design. Most likely, you should abandon the entire current site and start over from scratch. Rethink your Internet strategy and base your new approach on studies of your customers and their real needs (Nielsen and Tahir, 2002). The evaluation showed the site doesn't ensure that foreground and background color combinations provide sufficient contrast when viewed by someone having color deficits and the design code should use numbers, not names to define page colors. The homepage defines its colors by name (lime, black, white, and pink) and by numbers. Second, the site should avoid causing content to blink. For this checkpoint, further description states that the BLINK and MARQUEE elements should not be used, as they are not part of any W3C specification for HTML. The site has a marquee on the homepage. Third, the site has many links that are in the form of sentences. Link text

should be terse and clearly identify the target of each link. Lastly, the site does not provide a site map to inform the user about the general layout of the site.

Priority 3

A Web content developer **may** address this checkpoint. Otherwise, one or more groups will find it somewhat difficult to access information in the document. Satisfying this checkpoint will improve access to Web documents. (Chisholm, Vanderheiden, and Jacobs, 1999a). Table 21 shows the compliance rate for the priority 3 checkpoint evaluation of the website.

Table 21. Priority 3 Checkpoints Compliance Rate

Priority 3 Checkpoints	Applied	Yes	No	% Compliance
Evaluator 1	13	4	9	31%
Evaluator 2	13	2	11	15%
Average	13	3	10	23%

The compliance rate for this section suggests that the site is probably not serving your customers well with the current approach to web design. Most likely, you should abandon the entire current site and start over from scratch. Rethink your Internet strategy and base your new approach on studies of your customers and their real needs (Nielsen and Tahir, 2002). A slight difference in opinion by the evaluators was noted in this section and illustrates the subjective nature of the study and the experience level of the evaluators. The difference did not impact the overall rating for this sections findings and compliance rate.

The evaluation showed the site doesn't provide a navigation bar to create a set of paths a user may take through your site. This would increase the likelihood that the user will reach the information they seek. Next, a linear text alternative for all tables that lay out text in parallel and word-wrapped columns was not included. Lastly, a consistent style of presentation should be created across all pages. The Air Force Knowledge Now homepage design is completely different than it subsidiary Deskbook, and Communities of Practice pages.

Overall Accessibility Compliance Rating

To determine the overall Air Force Knowledge Now web site Accessibility compliance rating the final "Yes" count for each priority will be divided by the total number of checkpoints that were scored. Table 22 provides an overview of each checkpoint evaluated and is displayed as the average (last row in each individual table) and is put together here for easy review.

Table 22. Individual Checkpoint Compliance Overview

Checkpoints	Applied	Yes	No	% Compliance
Checkpoint 1	7	3	4	43%
Checkpoint 2	19	9	10	47%
Checkpoint 3	13	3	10	23%

Table 23 shows the compliance rate for the overall website accessibility compliance rating. The table is broken down to show each evaluator Yes/No response totals and compliance rate along with the studies overall average from both evaluators.

Table 23. Overall Website Accessibility Compliance Rate

Overall Website Accessibility	Applied	Yes	No	% Compliance
Evaluator 1	39	17	22	44%
Evaluator 2	39	13	26	33%
Average	39	15	24	38%

Answering Investigative Question 3, the compliance rate for the overall Air Force Knowledge Now website suggests that with a compliance rate of below 50%, the design team should; “The site is probably not serving your customers well with the current approach to web design. Most likely, you should abandon the entire current site and start over from scratch. Rethink your Internet strategy and base your new approach on studies of your customers and their real needs (Nielsen and Tahir, 2002)”. Given the opinions and experience level of the evaluators, their familiarization with the web site, and the subjective nature of this study, the compliance rate for each evaluator was very similar. The overall compliance rate would not increase enough to reach the next higher level in the compliance rate table with the addition of more evaluators. However, the sites compliance rate could decrease as more evaluators found more accessibility problems.

Usability Guidelines vs. Accessibility standards

Investigative question 4: When usability guidelines are followed, are they sufficient in complying with the Section 508 of the Rehabilitation Act standards?

When comparing the usability guidelines developed in chapter 2 to the Accessibility checklist, each set was laid out, compared, and analyzed to determine if

there is overlap between the two, if one is a virtual subset of the other, and/or if one is completed will it satisfy the requirements of the other.

When answering Investigative Question 4 through comparison, only 18 out of 65 accessibility checkpoints were comparable with the usability guidelines used in this study. The usability guidelines focus on the physical layout, content, and appearance of a website. In contrast, the accessibility checkpoints focus on the physical layout, plus the coding language used, and the way it was used to ensure accessibility reading devices can see the content on the website.

A subjective interpretation of the two determined that with only a 28% overlap, the guidelines and checkpoints do not represent a subset of each other and if one is completed it will not satisfy the requirements of the other.

Chapter Overview

This chapter explained the results obtained from the four investigative questions studied in this thesis. Table 24 provides a summary of the questions. These results are discussed further in the final chapter.

Table 24. Summary of Investigative Questions

Investigative Questions	Result
1. Appropriate usability guidelines identified in the literature	Yes
2. Does Knowledge Now web site follow usability guidelines	No
3. Does Knowledge Now web site follow accessibility guidelines	No
4. If usability guidelines are followed, do they satisfy accessibility guidelines	No

V. Discussion

Introduction

Chapter IV presented the results of this research effort. However, detailed results of this research were not included and are not included here. This was not an oversight by the researcher. The intent of this research was to provide recommendations for fixing the usability and accessibility problems found in this research. Fixing only the items found in this research will in turn create more problems and will not resolve the overall usability and accessibility issues like a complete redesign will. The recommendations from the analysis will be presented below. Then, the limitations of the research will be examined and some suggestions for future research will be presented.

Recommendations

In the introduction of this thesis the following overarching research question for this study was presented: *Are appropriate common practice web usability and accessibility guidelines being followed on the Air Force Knowledge Now web site?*

From the results presented in Chapter IV, it can be seen that according to the heuristic guidelines utilized in this research the AFKN homepage was not considered very usable or accessible and that a redesign effort should be started. Fixing the usability and accessibility problems through redesign will provide a better site for its customers. However, it is important to realize that this does not guarantee the site will be successful or attract old or new customers by making these corrections. In fact, once users are “turned off” to a system, fixes to that system, redesign, or encouragement from others are

not likely to play a major role in getting users to adopt the system over time (Venkatesh, Speier, and Morris, 2002).

If management decides to produce a new web page it is important to get user “buy-in” during technology design and /or selection to help eliminate usability problems early in the design process. Waiting until a system is deployed and then collecting feedback from users to assist with bug fixes or revisions is probably dangerous at best (Venkatesh, Speier, and Morris, 2002).

Accessibility

With Section 508 of the Rehabilitation Act mandating accessibility, the researcher recommends addressing this area first before it is federally enforced. Fitzgerald’s (2004) study, which states that over 61 percent of CoP users are civilian and contractors, supports the need for addressing the accessibility issues.

The results to Investigative Question 4 showed that 18 accessibility checkpoints were directly related to the usability heuristics. Thus, complying with all the accessibility checkpoints will provide a starting point to continue the usability compliance portion of the site. Some common areas found include:

- Providing a text equivalent for every non-text element.
- Ensure that all information conveyed with color is also available without color, for example from context or markup.
- Avoid causing the screen to flicker.
- Use the clearest and simplest languages appropriate for a site’s content.

- Ensure that foreground and background color combination provide sufficient contrast when viewed by someone having color deficits or when viewed on a black and white screen.
- Clearly identify the target of each link.
- Divide large blocks of information into more manageable groups where natural and appropriate.
- Provide navigation bars to highlight and give access to the navigation mechanism.
- Create a logical tab order through links, form controls, and objects.
- Create a style of presentation that is consistent across pages.

Good examples to follow were provided in chapter 2 for many of the common areas noted above. The FedEx (see Figure 8-11) and Amazon (see Figure 13) sites present excellent examples of clearly identified links, good use of space, manageable groups of information, and clear and simple language. Refer to these before starting a redesign effort.

Usability

The studies main focus was on the usability of the Knowledge Now homepage, however the Deskbook, My CoP, and Edit User Info pages where also viewed when conducting the evaluations. From this, it was noticed that the subsequent pages presented a better usability design than the homepage did. There was also a consistency among these pages that was not seen in the homepage. They all contain the same banner and menu across the top that could be adopted for the homepage. This would help eliminate the problem of on-line instruction, field label, and color inconsistency between pages.

Even after setting the browser screen resolution to 800x600 the homepage does not use the whole screen (see figure 19). There is wasted space on both sides of the page that could be utilized with a better design. Provide “breathing space” or borders around text areas to create logical zones and symmetry. This will also help lead the users eye in the appropriate direction of information needed. Refer to the FedEx (see Figure 8-11) and Amazon (see Figure 13) sites as they present excellent examples for the above recommendations.

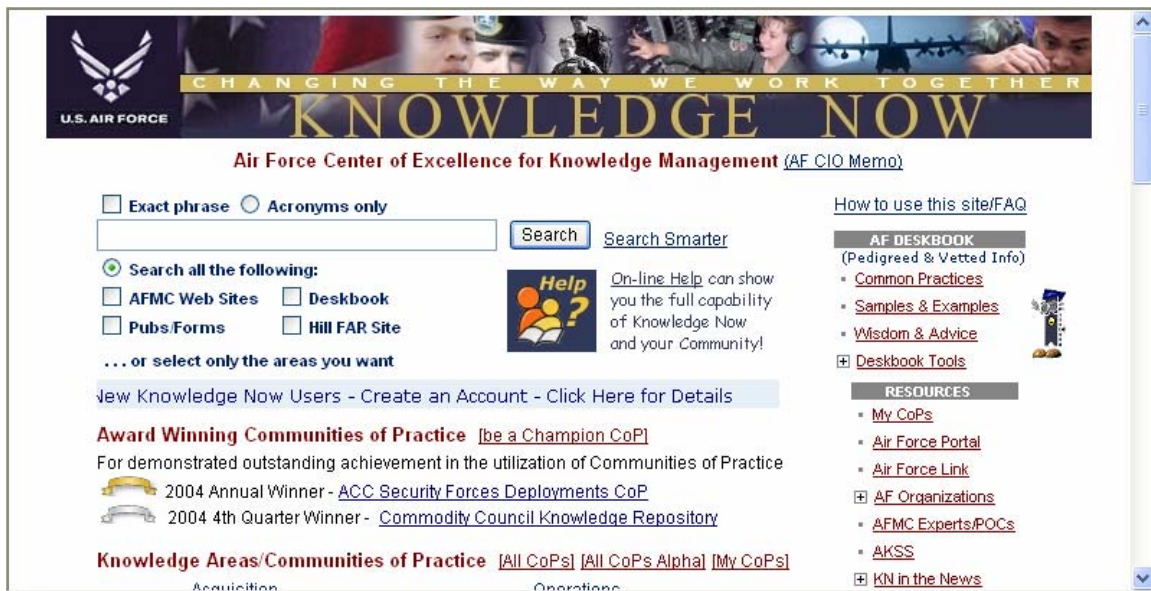


Figure 19. Knowledge Now Site (600x800)

The owl icon seen on the homepage in figure 19 above, as compared to the same icon on the Deskbook page below in figure 20, does not perform the same operation. First, the Deskbook icon does not have an alt text string attached to it explaining what the icon is for. Second, the homepage owl icon links you to a file maintenance page, while the Deskbook owl icon doesn’t link to anywhere. If you click on the help link along side

of the Deskbook owl icon it takes you to a screen to ask questions, which is inconsistent with the other icon.

The screenshot shows the AF Deskbook web page. At the top, there is a navigation bar with links for 'KN Home', 'Feedback', 'Tell a Friend', and 'Logout'. Below this is the 'AF Deskbook' logo and the tagline 'Knowledge Now | AF Deskbook'. A search bar is present with a search button and an 'Advanced Search' link. A left sidebar contains 'Resources' and 'Categories' menus. The main content area is titled 'Common Practices' and displays a table of 10 items.

	Viewed	User Rating	Rate	Updated/Reviewed	POC
1. AFMC - Conduct Integrated Logistics Support Planning	163	★★☆☆	✓OTE	3/2004	
2. AFMC - Develop SE and Manage Support Equipment Program	303	★★★★	✓OTE	10/2004	
3. AF - Air Force Guide: Award Term/Incentive Options	217	No Votes	✓OTE	6/2004	
4. AF - Air Force Guide: Contracting for Long Lead Items Initiated with Advance Procurement Funds	75	★★★☆☆	✓OTE	6/2004	
5. AF - Air Force Guide: Multiview Contracting (MYC)	176	★★★★	✓OTE	6/2004	
6. AF - Analysis Handbook for AoAs and FSAs	445	★★★☆☆	✓OTE	4/2004	
7. AF - Bid Protests at GAO: A Descriptive Guide	53	★★★☆☆	✓OTE	6/2004	
8. AF - FMS Case Line Closure for OAC 43	104	No Votes	✓OTE	5/2004	
9. AF - Interagency Acquisitions under the Economy Act	117	★★★★	✓OTE	6/2004	
10. AF - Project Managers Guide for Design and Construction	39	No Votes	✓OTE	10/2004	

Figure 20. AF Deskbook Web Page

One final recommendation offered in this study is to use a consistent color-coding scheme throughout the different pages. Some links on the homepage (see Figure 19) are red/brown and some are blue. When you go to the Deskbook page (see Figure 20) all the links are blue. There is no consistency across the system and no distinguishable meaning for the difference in colors. If color changes are used they should specifically draw attention, communicate organization, indicate status changes, and/or establish relationships.

Cookies

DOD Web Site Administration Policies & Procedures policy prohibits the use of Web technology that collects personally-identifying information such as extensive lists of previously visited sites, e-mail addresses, or other information to identify or build profiles on individual visitors (i.e., “persistent cookies”) to DOD public Web sites (AFI33-129, 2005). Although no usability questions addressed the use of cookies specifically, the researcher wanted to make note that this ultimately could be a limitation to the usability of the site studied.

Limitations of Research

The most notable limitation of this study was the application of the heuristic evaluation method by two evaluators. Nielsen (1994) states while a single evaluator can perform the evaluation, he/she will find less than 35 percent of the usability problems in an interface, and that heuristic evaluations are most effective when conducted by three to five evaluators. While this study uses two evaluators, which should increase the validity, it still could have been more effective with three to five evaluators. However, it should be noted that the overall compliance ratings for both the usability and accessibility studies would have identified more problems with an increase in the number of evaluators and strengthened the results of this research.

A disputed limitation along the same line is with the experience level of the evaluators. Nielsen and Molich (1990) report on the use of heuristic evaluation by computer scientists or other evaluators not trained in human factors. These authors reserve the term heuristic evaluation for a process in which an existing user interface is

compared to a handful of user interface guidelines by a non-expert evaluator (i.e., one not trained in human factors). However, Desurvire, Lawrence, and Atwood (1991) expanded on this work, showing that human factors experts were better able to predict problems in the user interface than non-experts. Jeffries, Miller, Wharton, and Uyeda (1991) also made this comparison and reported that the heuristic evaluation conducted by trained usability specialists was the most effective method in that it identified the most problems, was successful in identifying serious usability problems, and was lowest in cost. While the evaluators in this study were not experts in human factors or usability, they were able to find a significant number of usability and accessibility problems with the interface being evaluated. However, this still is being considered a limitation to this study.

Even though the results of using heuristic evaluation improve with the more you know and the more carefully you apply the method, one of its virtues is that the “intimidation barrier” is very low, leading to immediate gratification (Nielsen, 1994). Even with the possibility of immediate gratification this will still be considered a limitation for a lack of evaluator practical experience in using the heuristic evaluation method.

Clarify the bias the researcher brings to the study. This self-reflection creates an open and honest narrative that will resonate well with readers (Creswell 2003). In this study both evaluators had previously used the web site being evaluated and could have formed a bias before they conducted their evaluations.

Concurrent Studies

It is important to note that there has been concurrent research performed for the sponsor of this research. Lt John Tate performed a case study analysis of AFKN CoP as a form of technology that acts as a knowledge management support system; Davis' (1989) technology acceptance model was used as the basis for this study. This thesis research is to be completed and published in March 2005.

Lt. George Mendoza performed a content analysis of written material pertaining to the application of knowledge management (KM) in education searching for what issues are considered key (most important). The results of this research will form the foundation for the construction of a KM model, which can be used in an actual academic setting. This thesis research is to be completed and published in March 2005.

It is also important to note that there has been concurrent research performed for the Air Force and another sponsor. Captain Gunther Kastenholz performed a similar case study on web usability utilizing the Automated Civil Engineer System Personnel Readiness module (ACES PR). This thesis research is to be completed and published in March 2005.

Suggested Future Research

Future study in this area could include using three to five evaluators. This would eliminate the limitation stated above and add more validity to this studies findings. A new set of usability/accessibility experts could be chosen to duplicate the current study. The results obtained could be used to validate the studies findings and recommendations.

A study could also be done to determine the overall usability and accessibility status of Air Force web sites. High use sites, to include the Air Force Portal and

subsidiary sites linked from the portal could be selected for this study. This would provide a snapshot of how the Air Force is doing to provide usable and accessible sites for its work force.

This study could be reaccomplished using Web Content Accessibility Guidelines (WCAG) version 2.0 once they are released. There currently is a Working Draft for version 2.0 that builds on WCAG 1.0. It has the same aim: to explain how to make Web content accessible to people with disabilities and to define target levels of accessibility. Incorporating feedback on WCAG 1.0, this Working Draft of version 2.0 focuses on guidelines. It attempts to apply guidelines to a wider range of technologies and to use wording that may be understood by a more varied audience (Caldwell, Chisholm, Vanderheiden and White, 2004). This would help to validate the results and provide the evaluators with a set of guidelines that are up to date with the current technology in use today.

Chapter Overview

In this chapter, recommendations from the analysis and results of Chapter 4 were presented. Starting with the accessibility issues and following up with usability was the suggested approach for a redesign effort. It is important to remember that both are important to providing a good web site for the AFKN users.

Appendix A: Heuristic Evaluation Checklist

1. Visibility of System Status

The system should always keep user informed about what is going on, through appropriate feedback within reasonable time.

#	Review Checklist	Yes No N/A
1.1	Does every display begin with a title or header that describes screen contents?	O O O
1.2	Is there a consistent icon design scheme and stylistic treatment across the system?	O O O
1.3	Is a single, selected icon clearly visible when surrounded by unselected icons?	O O O
1.4	Do menu instructions, prompts, and error messages appear in the same place(s) on each menu?	O O O
1.5	In multipage data entry screens, is each page labeled to show its relation to others?	O O O
1.6	If overwrite and insert mode are both available, is there a visible indication of which one the user is in?	O O O
1.7	If pop-up windows are used to display error messages, do they allow the user to see the field in error?	O O O
1.8	Is there some form of system feedback for every operator action?	O O O
1.9	After the user completes an action (or group of actions), does the feedback indicate that the next group of actions can be started?	O O O
1.10	Is there visual feedback in menus or dialog boxes about which choices are selectable?	O O O
1.11	Is there visual feedback in menus or dialog boxes about which choice the cursor is on now?	O O O
1.12	If multiple options can be selected in a menu or dialog box, is there visual feedback about which options are already selected?	O O O

1.13	Is there visual feedback when objects are selected or moved?	0 0 0
1.14	Is the current status of an icon clearly indicated?	0 0 0
1.15	Is there feedback when function keys are pressed?	0 0 0
1.16	If there are observable delays (greater than fifteen seconds) in the system's response time, is the user kept informed of the system's progress?	0 0 0
1.17	Are response times appropriate to the task?	0 0 0
1.18	Typing, cursor motion, mouse selection: 50-1 50 milliseconds	0 0 0
1.19	Simple, frequent tasks: less than 1 second	0 0 0
1.20	Common tasks: 2-4 seconds	0 0 0
1.21	Complex tasks: 8-12 seconds	0 0 0
1.22	Are response times appropriate to the user's cognitive processing?	0 0 0
1.23	Continuity of thinking is required and information must be remembered throughout several responses: less than two seconds.	0 0 0
1.24	High levels of concentration aren't necessary and remembering information is not required: two to fifteen seconds.	0 0 0
1.25	Is the menu-naming terminology consistent with the user's task domain?	0 0 0
1.26	Does the system provide <i>visibility</i> : that is, by looking, can the user tell the state of the system and the alternatives for action?	0 0 0
1.27	Do GUI menus make obvious which item has been selected?	0 0 0
1.28	Do GUI menus make obvious whether deselection is possible?	0 0 0
1.29	If users must navigate between multiple screens, does the system use context labels, menu maps, and place markers as navigational aids?	0 0 0

2. Match Between System and the Real World

The system should speak the user's language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.

#	Review Checklist	Yes No N/A
2.1	Are icons concrete and familiar?	O O O
2.2	Are menu choices ordered in the most logical way, given the user, the item names, and the task variables?	O O O
2.3	If there is a natural sequence to menu choices, has it been used?	O O O
2.4	Do related and interdependent fields appear on the same screen?	O O O
2.5	If shape is used as a visual cue, does it match cultural conventions?	O O O
2.6	Do the selected colors correspond to common expectations about color codes?	O O O
2.7	When prompts imply a necessary action, are the words in the message consistent with that action?	O O O
2.8	Do keystroke references in prompts match actual key names?	O O O
2.9	On data entry screens, are tasks described in terminology familiar to users?	O O O
2.10	Are field-level prompts provided for data entry screens?	O O O
2.11	For question and answer interfaces, are questions stated in clear, simple language?	O O O
2.12	Do menu choices fit logically into categories that have readily understood meanings?	O O O
2.13	Are menu titles parallel grammatically?	O O O
2.14	Does the command language employ user jargon and avoid	O O O

	computer jargon?	
2.15	Are command names specific rather than general?	0 0 0
2.16	Does the command language allow both full names and abbreviations?	0 0 0
2.17	Are input data codes meaningful?	0 0 0
2.18	Have uncommon letter sequences been avoided whenever possible?	0 0 0
2.19	Does the system automatically enter leading or trailing spaces to align decimal points?	0 0 0
2.20	Does the system automatically enter a dollar sign and decimal for monetary entries?	0 0 0
2.21	Does the system automatically enter commas in numeric values greater than 9999?	0 0 0
2.22	Do GUI menus offer activation: that is, make obvious how to say " <i>now do it</i> "?	0 0 0
2.23	Has the system been designed so that keys with similar names do not perform opposite (and potentially dangerous) actions?	0 0 0
2.24	Are function keys labeled clearly and distinctively, even if this means breaking consistency rules?	0 0 0

3. User Control and Freedom

Users should be free to select and sequence tasks (when appropriate), rather than having the system do this for them. Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Users should make their own decisions (with clear information) regarding the costs of exiting current work. The system should support undo and redo.

#	Review Checklist	Yes No N/A
---	------------------	------------

3.1	If setting up windows is a low-frequency task, is it particularly easy to remember?	0 0 0
3.2	In systems that use overlapping windows, is it easy for users to rearrange windows on the screen?	0 0 0
3.3	In systems that use overlapping windows, is it easy for users to switch between windows?	0 0 0
3.4	When a user's task is complete, does the system wait for a signal from the user before processing?	0 0 0
3.5	Can users type-ahead in a system with many nested menus?	0 0 0
3.6	Are users prompted to confirm commands that have drastic, destructive consequences?	0 0 0
3.7	Is there an "undo" function at the level of a single action, a data entry, and a complete group of actions?	0 0 0
3.8	Can users cancel out of operations in progress?	0 0 0
3.9	Are character edits allowed in commands?	0 0 0
3.10	Can users reduce data entry time by copying and modifying existing data?	0 0 0
3.11	Are character edits allowed in data entry fields?	0 0 0
3.12	If menu lists are long (more than seven items), can users select an item either by moving the cursor or by typing a mnemonic code?	0 0 0
3.13	If the system uses a pointing device, do users have the option of either clicking on menu items or using a keyboard shortcut?	0 0 0
3.14	Are menus broad (many items on a menu) rather than deep (many menu levels)?	0 0 0
3.15	If the system has multiple menu levels, is there a mechanism that allows users to go back to previous menus?	0 0 0
3.16	If users can go back to a previous menu, can they change their earlier menu choice?	0 0 0
3.17	Can users move forward and backward between fields or dialog	0 0 0

	box options?	
3.18	If the system has multipage data entry screens, can users move backward and forward among all the pages in the set?	O O O
3.19	If the system uses a question and answer interface, can users go back to previous questions or skip forward to later questions?	O O O
3.20	Do function keys that can cause serious consequences have an undo feature?	O O O
3.21	Can users easily reverse their actions?	O O O
3.22	If the system allows users to reverse their actions, is there a retracing mechanism to allow for multiple undos?	O O O
3.23	Can users set their own system, session, file, and screen defaults?	O O O

4. Consistency and Standards

Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.

#	Review Checklist	Yes No N/A
4.1	Have industry or company formatting standards been followed consistently in all screens within a system?	O O O
4.2	Has a heavy use of all uppercase letters on a screen been avoided?	O O O
4.3	Do abbreviations not include punctuation?	O O O
4.4	Are integers right justified and real numbers decimal-aligned?	O O O
4.5	Are icons labeled?	O O O
4.6	Are there no more than twelve to twenty icon types?	O O O
4.7	Are there salient visual cues to identify the active window?	O O O
4.8	Does each window have a title?	O O O

4.9	Are vertical and horizontal scrolling possible in each window?	0 0 0
4.10	Does the menu structure match the task structure?	0 0 0
4.11	Have industry or company standards been established for menu design, and are they applied consistently on all menu screens in the system?	0 0 0
4.12	Are menu choice lists presented vertically?	0 0 0
4.13	If "exit" is a menu choice, does it always appear at the bottom of the list?	0 0 0
4.14	Are menu titles either centered or left justified?	0 0 0
4.15	Are menu items left-justified, with the item number or mnemonic preceding the name?	0 0 0
4.16	Do embedded field-level prompts appear to the right of the field label?	0 0 0
4.17	Do on-line instructions appear in a consistent location across screens?	0 0 0
4.18	Are field labels and fields distinguished typographically?	0 0 0
4.19	Are field labels consistent from one data entry screen to another?	0 0 0
4.20	Are fields and labels left justified for alpha lists and right-justified for numeric lists?	0 0 0
4.21	Do field labels appear to the left of single fields and above list fields?	0 0 0
4.22	Are attention-getting techniques used with care?	0 0 0
4.23	Intensity: two levels only	0 0 0
4.24	Size: up to four sizes	0 0 0
4.25	Font: up to three	0 0 0
4.26	Blink: two to four hertz	0 0 0
4.27	Color: up to four (additional colors for occasional use only)	0 0 0
4.28	Sound: soft tones for regular positive feedback, harsh for rare	0 0 0

	critical conditions	
4.29	Are attention-getting techniques used only for exceptional conditions or for time-dependent information?	0 0 0
4.30	Are there no more than four to seven colors, and are they far apart along the visible spectrum?	0 0 0
4.31	Is a legend provided if color codes are numerous or not obvious in meaning?	0 0 0
4.32	Have pairings of high-chroma, spectrally extreme colors been avoided?	0 0 0
4.33	Are saturated blues avoided for text or other small, thin line symbols?	0 0 0
4.34	Is the most important information placed at the beginning of the prompt?	0 0 0
4.35	Are user actions named consistently across all prompts in the system?	0 0 0
4.36	Are system objects named consistently across all prompts in the system?	0 0 0
4.37	Do field-level prompts provide more information than a restatement of the field name?	0 0 0
4.38	For question and answer interfaces, are the valid inputs for a question listed?	0 0 0
4.39	Are menu choice names consistent, both within each menu and across the system, in grammatical style and terminology?	0 0 0
4.40	Does the structure of menu choice names match their corresponding menu titles?	0 0 0
4.41	Are commands used the same way, and do they mean the same thing, in all parts of the system?	0 0 0
4.42	Does the command language have a consistent, natural, and mnemonic syntax?	0 0 0
4.43	Do abbreviations follow a simple primary rule and, if necessary, a simple secondary rule for abbreviations that otherwise would	0 0 0

	be duplicates?	
4.44	Is the secondary rule used only when necessary?	0 0 0
4.45	Are abbreviated words all the same length?	0 0 0
4.46	Is the structure of a data entry value consistent from screen to screen?	0 0 0
4.47	Is the method for moving the cursor to the next or previous field consistent throughout the system?	0 0 0
4.48	If the system has multipage data entry screens, do all pages have the same title?	0 0 0
4.49	If the system has multipage data entry screens, does each page have a sequential page number?	0 0 0
4.50	Does the system follow industry or company standards for function key assignments?	0 0 0
4.51	Are high-value, high-chroma colors used to attract attention?	0 0 0

5. Help Users Recognize, Diagnose, and Recover From Errors

Error messages should be expressed in plain language (NO CODES).

#	Review Checklist	Yes No N/A
5.1	Is sound used to signal an error?	0 0 0
5.2	Are prompts stated constructively, without overt or implied criticism of the user?	0 0 0
5.3	Do prompts imply that the user is in control?	0 0 0
5.4	Are prompts brief and unambiguous?	0 0 0
5.5	Are error messages worded so that the system, not the user, takes the blame?	0 0 0
5.6	If humorous error messages are used, are they appropriate and inoffensive to the user population?	0 0 0

5.7	Are error messages grammatically correct?	0 0 0
5.8	Do error messages avoid the use of exclamation points?	0 0 0
5.9	Do error messages avoid the use of violent or hostile words?	0 0 0
5.10	Do error messages avoid an anthropomorphic tone?	0 0 0
5.11	Do all error messages in the system use consistent grammatical style, form, terminology, and abbreviations?	0 0 0
5.12	Do messages place users in control of the system?	0 0 0
5.13	Does the command language use normal action-object syntax?	0 0 0
5.14	Does the command language avoid arbitrary, non-English use of punctuation, except for symbols that users already know?	0 0 0
5.15	If an error is detected in a data entry field, does the system place the cursor in that field or highlight the error?	0 0 0
5.16	Do error messages inform the user of the error's severity?	0 0 0
5.17	Do error messages suggest the cause of the problem?	0 0 0
5.18	Do error messages provide appropriate semantic information?	0 0 0
5.19	Do error messages provide appropriate syntactic information?	0 0 0
5.20	Do error messages indicate what action the user needs to take to correct the error?	0 0 0
5.21	If the system supports both novice and expert users, are multiple levels of error-message detail available?	0 0 0

6. Error Prevention

Even better than good error messages is a careful design, which prevents a problem from occurring in the first place.

#	Review Checklist	Yes No N/A
6.1	If the database includes groups of data, can users enter more	0 0 0

	than one group on a single screen?	
6.2	Have dots or underscores been used to indicate field length?	0 0 0
6.3	Is the menu choice name on a higher-level menu used as the menu title of the lower-level menu?	0 0 0
6.4	Are menu choices logical, distinctive, and mutually exclusive?	0 0 0
6.5	Are data inputs case-blind whenever possible?	0 0 0
6.6	If the system displays multiple windows, is navigation between windows simple and visible?	0 0 0
6.7	Are the function keys that can cause the most serious consequences in hard-to-reach positions?	0 0 0
6.8	Are the function keys that can cause the most serious consequences located far away from low-consequence and high-use keys?	0 0 0
6.9	Has the use of qualifier keys been minimized?	0 0 0
6.10	If the system uses qualifier keys, are they used consistently throughout the system?	0 0 0
6.11	Does the system prevent users from making errors whenever possible?	0 0 0
6.12	Does the system warn users if they are about to make a potentially serious error?	0 0 0
6.13	Does the system intelligently interpret variations in user commands?	0 0 0
6.14	Do data entry screens and dialog boxes indicate the number of character spaces available in a field?	0 0 0
6.15	Do fields in data entry screens and dialog boxes contain default values when appropriate?	0 0 0

7. Recognition Rather Than Recall

Make objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.

#	Review Checklist	Yes No N/A
7.1	For question and answer interfaces, are visual cues and white space used to distinguish questions, prompts, instructions, and user input?	O O O
7.2	Does the data display start in the upper-left corner of the screen?	O O O
7.3	Are multiword field labels placed horizontally (not stacked vertically)?	O O O
7.4	Are all data a user needs on display at each step in a transaction sequence?	O O O
7.5	Are prompts, cues, and messages placed where the eye is likely to be looking on the screen?	O O O
7.6	Have prompts been formatted using white space, justification, and visual cues for easy scanning?	O O O
7.7	Do text areas have "breathing space" around them?	O O O
7.8	Is there an obvious visual distinction made between "choose one" menu and "choose many" menus?	O O O
7.9	Have spatial relationships between soft function keys (on-screen cues) and keyboard function keys been preserved?	O O O
7.10	Does the system gray out or delete labels of currently inactive soft function keys?	O O O
7.11	Is white space used to create symmetry and lead the eye in the appropriate direction?	O O O
7.12	Have items been grouped into logical zones, and have headings been used to distinguish between zones?	O O O
7.13	Are zones no more than twelve to fourteen characters wide and six to seven lines high?	O O O
7.14	Have zones been separated by spaces, lines, color, letters, bold titles, rules lines, or shaded areas?	O O O

7.15	Are field labels close to fields, but separated by at least one space?	0 0 0
7.16	Are long columnar fields broken up into groups of five, separated by a blank line?	0 0 0
7.17	Are optional data entry fields clearly marked?	0 0 0
7.18	Are symbols used to break long input strings into "chunks"?	0 0 0
7.19	Is reverse video or color highlighting used to get the user's attention?	0 0 0
7.20	Is reverse video used to indicate that an item has been selected?	0 0 0
7.21	Are size, boldface, underlining, color, shading, or typography used to show relative quantity or importance of different screen items?	0 0 0
7.22	Are borders used to identify meaningful groups?	0 0 0
7.23	Has the same color been used to group related elements?	0 0 0
7.24	Is color-coding consistent throughout the system?	0 0 0
7.25	Is color used in conjunction with some other redundant cue?	0 0 0
7.26	Is there good color and brightness contrast between image and background colors?	0 0 0
7.27	Have light, bright, saturated colors been used to emphasize data and have darker, duller, and desaturated colors been used to de-emphasize data?	0 0 0
7.28	Is the first word of each menu choice the most important?	0 0 0
7.29	Does the system provide <i>mapping</i> : that is, are the relationships between controls and actions apparent to the user?	0 0 0
7.30	Are input data codes distinctive?	0 0 0
7.31	Have frequently confused data pairs been eliminated whenever possible?	0 0 0
7.32	Have large strings of numbers or letters been broken into chunks?	0 0 0

7.33	Are inactive menu items grayed out or omitted?	0 0 0
7.34	Are there menu selection defaults?	0 0 0
7.35	If the system has many menu levels or complex menu levels, do users have access to an on-line spatial menu map?	0 0 0
7.36	Do GUI menus offer affordance: that is, make obvious where selection is possible?	0 0 0
7.37	Are there salient visual cues to identify the active window?	0 0 0
7.38	Are function keys arranged in logical groups?	0 0 0
7.39	Do data entry screens and dialog boxes indicate when fields are optional?	0 0 0
7.40	On data entry screens and dialog boxes, are dependent fields displayed only when necessary?	0 0 0

8. Flexibility and Minimalist Design

Accelerators-unseen by the novice user-may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions. Provide alternative means of access and operation for users who differ from the "average" user (e.g., physical or cognitive ability, culture, language, etc.)

#	Review Checklist	Yes No N/A
8.1	If the system supports both novice and expert users, are multiple levels of error message detail available?	0 0 0
8.2	Does the system allow novices to use a keyword grammar and experts to use a positional grammar?	0 0 0
8.3	Can users define their own synonyms for commands?	0 0 0
8.4	Does the system allow novice users to enter the simplest, most common form of each command, and allow expert users to add parameters?	0 0 0

8.5	Do expert users have the option of entering multiple commands in a single string?	0 0 0
8.6	Does the system provide function keys for high-frequency commands?	0 0 0
8.7	For data entry screens with many fields or in which source documents may be incomplete, can users save a partially filled screen?	0 0 0
8.8	Does the system automatically enter leading zeros?	0 0 0
8.9	If menu lists are short (seven items or fewer), can users select an item by moving the cursor?	0 0 0
8.10	If the system uses a type-ahead strategy, do the menu items have mnemonic codes?	0 0 0
8.11	If the system uses a pointing device, do users have the option of either clicking on fields or using a keyboard shortcut?	0 0 0
8.12	Does the system offer "find next" and "find previous" shortcuts for database searches?	0 0 0
8.13	On data entry screens, do users have the option of either clicking directly on a field or using a keyboard shortcut?	0 0 0
8.14	On menus, do users have the option of either clicking directly on a menu item or using a keyboard shortcut?	0 0 0
8.15	In dialog boxes, do users have the option of either clicking directly on a dialog box option or using a keyboard shortcut?	0 0 0
8.16	Can expert users bypass nested dialog boxes with either type-ahead, user-defined macros, or keyboard shortcuts?	0 0 0

9. Aesthetic and Minimalist Design

Dialogues should not contain information, which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.

#	Review Checklist	Yes No N/A
9.1	Is only (and all) information essential to decision making displayed on the screen?	O O O
9.2	Are all icons in a set visually and conceptually distinct?	O O O
9.3	Have large objects, bold lines, and simple areas been used to distinguish icons?	O O O
9.4	Does each icon stand out from its background?	O O O
9.5	If the system uses a standard GUI interface where menu sequence has already been specified, do menus adhere to the specification whenever possible?	O O O
9.6	Are meaningful groups of items separated by white space?	O O O
9.7	Does each data entry screen have a short, simple, clear, distinctive title?	O O O
9.8	Are field labels brief, familiar, and descriptive?	O O O
9.9	Are prompts expressed in the affirmative, and do they use the active voice?	O O O
9.10	Is each lower-level menu choice associated with only one higher-level menu?	O O O
9.11	Are menu titles brief, yet long enough to communicate?	O O O
9.12	Are there pop-up or pull-down menus within data entry fields that have many, but well-defined, entry options?	O O O

10. Help and Documentation

Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.

#	Review Checklist	Yes No N/A
10.1	If users are working from hard copy, are the parts of the hard	O O O

	copy that go on-line marked?	
10.2	Are on-line instructions visually distinct?	0 0 0
10.3	Do the instructions follow the sequence of user actions?	0 0 0
10.4	If menu choices are ambiguous, does the system provide additional explanatory information when an item is selected?	0 0 0
10.5	Are data entry screens and dialog boxes supported by navigation and completion instructions?	0 0 0
10.6	If menu items are ambiguous, does the system provide additional explanatory information when an item is selected?	0 0 0
10.7	Are there memory aids for commands, either through on-line quick reference or prompting?	0 0 0
10.8	Is the help function visible; for example, a key labeled HELP or a special menu?	0 0 0
10.9	Is the help system interface (navigation, presentation, and conversation) consistent with the navigation, presentation, and conversation interfaces of the application it supports?	0 0 0
10.10	Navigation: Is information easy to find?	0 0 0
10.11	Presentation: Is the visual layout well designed?	0 0 0
10.12	Conversation: Is the information accurate, complete, and understandable?	0 0 0
10.13	Is the information relevant?	0 0 0
10.14	Goal-oriented (What can I do with this program?)	0 0 0
10.15	Descriptive (What is this thing for?)	0 0 0
10.16	Procedural (How do I do this task?)	0 0 0
10.17	Interpretive (Why did that happen?)	0 0 0
10.18	Navigational (Where am I?)	0 0 0
10.19	Is there context-sensitive help?	0 0 0
10.20	Can the user change the level of detail available?	0 0 0

10.21	Can users easily switch between help and their work?	O O O
10.22	Is it easy to access and return from the help system?	O O O
10.23	Can users resume work where they left off after accessing help?	O O O

11. Skills

The system should support, extend, supplement, or enhance the user's skills, background knowledge, and expertise -- not replace them.

#	Review Checklist	Yes No N/A
11.1	Can users choose between iconic and text display of information?	O O O
11.2	Are window operations easy to learn and use?	O O O
11.3	If users are experts, usage is frequent, or the system has a slow response time, are there fewer screens (more information per screen)?	O O O
11.4	If users are novices, usage is infrequent, or the system has a fast response time, are there more screens (less information per screen)?	O O O
11.5	Does the system automatically color-code items, with little or no user effort?	O O O
11.6	If the system supports both novice and expert users, are multiple levels of detail available.	O O O
11.7	Are users the initiators of actions rather than the responders?	O O O
11.8	Does the system perform data translations for users?	O O O
11.9	Do field values avoid mixing alpha and numeric characters whenever possible?	O O O
11.10	If the system has deep (multilevel) menus, do users have the option of typing ahead?	O O O

11.12	When the user enters a screen or dialog box, is the cursor already positioned in the field users are most likely to need?	O O O
11.13	Can users move forward and backward within a field?	O O O
11.14	Is the method for moving the cursor to the next or previous field both simple and visible?	O O O
11.15	Has auto-tabbing been avoided except when fields have fixed lengths or users are experienced?	O O O
11.16	Do the selected input device(s) match user capabilities?	O O O
11.17	Are cursor keys arranged in either an inverted T (best for experts) or a cross configuration (best for novices)?	O O O
11.18	Are important keys (for example, <u>ENTER</u> , <u>TAB</u>) larger than other keys?	O O O
11.19	Are there enough function keys to support functionality, but not so many that scanning and finding are difficult?	O O O
11.20	Are function keys reserved for generic, high frequency, important functions?	O O O
11.21	Are function key assignments consistent across screens, subsystems, and related products?	O O O
11.22	Does the system correctly anticipate and prompt for the user's probable next activity?	O O O

12. Pleasurable and Respectful Interaction with the User

The user's interactions with the system should enhance the quality of her or his work-life. The user should be treated with respect. The design should be aesthetically pleasing- with artistic as well as functional value.

#	Review Checklist	Yes No N/A
12.1	Is each individual icon a harmonious member of a family of icons?	O O O
12.2	Has excessive detail in icon design been avoided?	O O O

12.3	Has color been used with discretion?	0 0 0
12.4	Has the amount of required window housekeeping been kept to a minimum?	0 0 0
12.5	If users are working from hard copy, does the screen layout match the paper form?	0 0 0
12.6	Has color been used specifically to draw attention, communicate organization, indicate status changes, and establish relationships?	0 0 0
12.7	Can users turn off automatic color-coding if necessary?	0 0 0
12.8	Are typing requirements minimal for question and answer interfaces?	0 0 0
12.9	Do the selected input device(s) match environmental constraints?	0 0 0
12.13	If the system uses multiple input devices, has hand and eye movement between input devices been minimized?	0 0 0
12.14	If the system supports graphical tasks, has an alternative-pointing device been provided?	0 0 0
12.15	Is the numeric keypad located to the right of the alpha key area?	0 0 0
12.16	Are the most frequently used function keys in the most accessible positions?	0 0 0
12.17	Does the system complete unambiguous partial input on a data entry field?	0 0 0

13. Privacy

The system should help the user to protect personal or private information- belonging to the user or his/her clients.

#	Review Checklist	Yes No N/A
13.1	Are protected areas completely inaccessible?	0 0 0
13.2	Can protected or confidential areas be accessed with certain	0 0 0

	passwords?	
13.3	Is this feature effective and successful?	000

Appendix B: Accessibility Checklist

This document is an appendix to the W3C ["Web Content Accessibility Guidelines 1.0"](#). It provides a list of all checkpoints from the Web Content Accessibility Guidelines 1.0, organized by concept, as a checklist for Web content developers. This list may be used to review a page or site for accessibility. For each checkpoint, indicate whether the checkpoint has been satisfied, has not been satisfied, or is not applicable.

Priorities

Each checkpoint has a priority level assigned by the Working Group based on the checkpoint's impact on accessibility.

Some checkpoints specify a priority level that may change under certain (indicated) conditions.

Priority 1 checkpoints

A Web content developer **must** satisfy this checkpoint. Otherwise, one or more groups will find it impossible to access information in the document. Satisfying this checkpoint is a basic requirement for some groups to be able to use Web documents.

	In General (Priority 1)	Yes	No	N/A
1.1	Provide a text equivalent for every non-text element (e.g., via "alt", "longdesc", or in element content). This includes: images, graphical representations of text (including symbols), image map regions, animations (e.g., animated GIFs), applets and programmatic objects, ascii art, frames, scripts, images used as list bullets, spacers, graphical buttons, sounds (played with or without user interaction), stand-alone audio files, audio tracks of video, and video.			
2.1	Ensure that all information conveyed with color is also available without color, for example from context or markup.			
4.1	Clearly identify changes in the natural language of a document's text and any text equivalents (e.g., captions).			
6.1	Organize documents so they may be read without style sheets. For example, when an HTML document is rendered without associated style sheets, it must still be possible to read the document.			
6.2	Ensure that equivalents for dynamic content are updated when the dynamic content changes.			
7.1	Until user agents allow users to control flickering, avoid causing the screen to flicker.			
14.1	Use the clearest and simplest language appropriate for a site's content.			
	And if you use images and image maps (Priority 1)	Yes	No	N/A
1.2	Provide redundant text links for each active region of a server-side image map.			

9.1	Provide client-side image maps instead of server-side image maps except where the regions cannot be defined with an available geometric shape.			
And if you use tables (Priority 1)		Yes	No	N/A
5.1	For data tables, identify row and column headers.			
5.2	For data tables that have two or more logical levels of row or column headers, use markup to associate data cells and header cells.			
And if you use frames (Priority 1)		Yes	No	N/A
12.1	Title each frame to facilitate frame identification and navigation.			
And if you use applets and scripts (Priority 1)		Yes	No	N/A
6.3	Ensure that pages are usable when scripts, applets, or other programmatic objects are turned off or not supported. If this is not possible, provide equivalent information on an alternative accessible page.			
And if you use multimedia (Priority 1)		Yes	No	N/A
1.3	Until user agents can automatically read aloud the text equivalent of a visual track, provide an auditory description of the important information of the visual track of a multimedia presentation.			
1.4	For any time-based multimedia presentation (e.g., a movie or animation), synchronize equivalent alternatives (e.g., captions or auditory descriptions of the visual track) with the presentation.			
And if all else fails (Priority 1)		Yes	No	N/A
11.4	If, after best efforts, you cannot create an accessible page, provide a link to an alternative page that uses W3C technologies, is accessible, has equivalent information (or functionality), and is updated as often as the inaccessible (original) page.			

Priority 2 checkpoints

A Web content developer **should** satisfy this checkpoint. Otherwise, one or more groups will find it difficult to access information in the document. Satisfying this checkpoint will remove significant barriers to accessing Web documents.

In General (Priority 2)		Yes	No	N/A
2.2	Ensure that foreground and background color combinations provide sufficient contrast when viewed by someone having color deficits or when viewed on a black and white screen. [Priority 2 for images, Priority 3 for text].			
3.1	When an appropriate markup language exists, use markup rather than images to convey information.			
3.2	Create documents that validate to published formal grammars.			
3.3	Use style sheets to control layout and presentation.			
3.4	Use relative rather than absolute units in markup language attribute values and style sheet property values.			

3.5	Use header elements to convey document structure and use them according to specification.			
3.6	Mark up lists and list items properly.			
3.7	Mark up quotations. Do not use quotation markup for formatting effects such as indentation.			
6.5	Ensure that dynamic content is accessible or provide an alternative presentation or page.			
7.2	Until user agents allow users to control blinking, avoid causing content to blink (i.e., change presentation at a regular rate, such as turning on and off).			
7.4	Until user agents provide the ability to stop the refresh, do not create periodically auto-refreshing pages.			
7.5	Until user agents provide the ability to stop auto-redirect, do not use markup to redirect pages automatically. Instead, configure the server to perform redirects.			
10.1	Until user agents allow users to turn off spawned windows, do not cause pop-ups or other windows to appear and do not change the current window without informing the user.			
11.1	Use W3C technologies when they are available and appropriate for a task and use the latest versions when supported.			
11.2	Avoid deprecated features of W3C technologies.			
12.3	Divide large blocks of information into more manageable groups where natural and appropriate.			
13.1	Clearly identify the target of each link.			
13.2	Provide metadata to add semantic information to pages and sites.			
13.3	Provide information about the general layout of a site (e.g., a site map or table of contents).			
13.4	Use navigation mechanisms in a consistent manner.			
	And if you use tables (Priority 2)	Yes	No	N/A
5.3	Do not use tables for layout unless the table makes sense when linearized. Otherwise, if the table does not make sense, provide an alternative equivalent (which may be a linearized version).			
5.4	If a table is used for layout, do not use any structural markup for the purpose of visual formatting.			
	And if you use frames (Priority 2)	Yes	No	N/A
12.2	Describe the purpose of frames and how frames relate to each other if it is not obvious by frame titles alone.			
	And if you use forms (Priority 2)	Yes	No	N/A
10.2	Until user agents support explicit associations between labels and form controls, for all form controls with implicitly associated labels, ensure that the label is properly positioned.			
12.4	Associate labels explicitly with their controls.			
	And if you use applets and scripts (Priority 2)	Yes	No	N/A

6.4	For scripts and applets, ensure that event handlers are input device-independent.			
7.3	Until user agents allow users to freeze moving content, avoid movement in pages.			
8.1	Make programmatic elements such as scripts and applets directly accessible or compatible with assistive technologies [Priority 1 if functionality is important and not presented elsewhere, otherwise Priority 2.]			
9.2	Ensure that any element that has its own interface can be operated in a device-independent manner.			
9.3	For scripts, specify logical event handlers rather than device-dependent event handlers.			

Priority 3 checkpoints

A Web content developer **may** address this checkpoint. Otherwise, one or more groups will find it somewhat difficult to access information in the document. Satisfying this checkpoint will improve access to Web documents.

	In General (Priority 3)	Yes	No	N/A
4.2	Specify the expansion of each abbreviation or acronym in a document where it first occurs.			
4.3	Identify the primary natural language of a document.			
9.4	Create a logical tab order through links, form controls, and objects.			
9.5	Provide keyboard shortcuts to important links (including those in client-side image maps), form controls, and groups of form controls.			
10.5	Until user agents (including assistive technologies) render adjacent links distinctly, include non-link, printable characters (surrounded by spaces) between adjacent links.			
11.3	Provide information so that users may receive documents according to their preferences (e.g., language, content type, etc.)			
13.5	Provide navigation bars to highlight and give access to the navigation mechanism.			
13.6	Group related links, identify the group (for user agents), and, until user agents do so, provide a way to bypass the group.			
13.7	If search functions are provided, enable different types of searches for different skill levels and preferences.			
13.8	Place distinguishing information at the beginning of headings, paragraphs, lists, etc.			
13.9	Provide information about document collections (i.e., documents comprising multiple pages.).			
13.10	Provide a means to skip over multi-line ASCII art.			
14.2	Supplement text with graphic or auditory presentations where they will facilitate comprehension of the page.			

14.3	Create a style of presentation that is consistent across pages.			
	And if you use images and image maps (Priority 3)	Yes	No	N/A
1.5	Until user agents render text equivalents for client-side image map links, provide redundant text links for each active region of a client-side image map.			
	And if you use tables (Priority 3)	Yes	No	N/A
5.5	Provide summaries for tables.			
5.6	Provide abbreviations for header labels.			
10.3	Until user agents (including assistive technologies) render side-by-side text correctly, provide a linear text alternative (on the current page or some other) for all tables that lay out text in parallel, word-wrapped columns.			
	And if you use forms (Priority 3)	Yes	No	N/A
10.4	Until user agents handle empty controls correctly, include default, place-holding characters in edit boxes and text areas.			

Bibliography

- Agarwal, Ritu., and Venkatesh, Viswanath. "Assessing a Firm's Web Presence: A Heuristic Evaluation Procedure for the Measurement of Usability". *Information Systems Research*. June 2002, pages 168-186.
- Air Force Knowledge Now, Knowledge Now Homepage, n. pag. <https://afkm.wpafb.af.mil/>. 30 May 2004.
- Airman Magazine, January 2005 Web Edition, n. pag. <http://www.af.mil/news/airman/0105/person.shtml>. January 2005.
- Borenstein, Nathaniel S. *Programming as if People Mattered*. New Jersey: Princeton University Press, 1991.
- Caldwell, Ben., Chisholm, Wendy., Vanderheiden, Gregg., and White, Jason., "Web Content Accessibility Guidelines 2.0, W3C Working Draft 19 November 2004" n. pag. <http://www.w3.org/TR/WCAG20/>. 20 December 2004.
- Carignan, Joelle. "Evaluating Accessibility" n. pag. <http://www.sapdesignguild.org/editions/edition4/joelle.asp>. 20 January 2004.
- Carter, Jeff., and Markel, Mike. "Web Accessibility for People with Disabilities: An Introduction for Web Developers". *IEEE*. 2001, pages 225-233.
- Chisholm, Wendy., Vanderheiden, Gregg., Jacobs, Ian., "Checklist of Checkpoints for Web Content Accessibility Guidelines 1.0" n. pag. <http://www.w3.org/TR/1999/WAI-WEBCONTENT-19990505/full-checklist>. 1999a.
- Chisholm, Wendy., Vanderheiden, Gregg., Jacobs, Ian., "Web Content Accessibility Guidelines 1.0" n. pag. <http://www.w3.org/TR/1999/WAI-WEBCONTENT-19990505/wai-pageauth.html#tech-text-equivalent>. 5 May 1999b.
- Chisholm, Wendy., Vanderheiden, Gregg., Jacobs, Ian., "Core Techniques for Web Content Accessibility Guidelines 1.0" n. pag. <http://www.w3.org/TR/WCAG10-CORE-TECHS/#structure>. 6 November 2000a.
- Chisholm, Wendy., Vanderheiden, Gregg., Jacobs, Ian., "CSS Techniques for Web Content Accessibility Guidelines 1.0" n. pag. <http://www.w3.org/TR/WCAG10-CSS-TECHS/#style-info-not-in-color-alone>. 6 November 2000b.

- Chisholm, Wendy., Vanderheiden, Gregg., Jacobs, Ian., “HTML Techniques for Web Content Accessibility Guidelines 1.0” n. pag. <http://www.w3.org/TR/WCAG10-HTML-TECHS/#identifying-table-rows-columns>. 6 November 2000c.
- Creswell, John. W. “Research Design: Qualitative, Quantitative, and Mixed Methods Approaches”. Thousand Oaks, CA, Sage Publications, Inc. 2003.
- Dasgupta, Subhasish., Granger, Mary., and McGarry, Nina., “User Acceptance of E-Collaboration Technology: An Extension of the Technology Acceptance Model”. *Group Decision and Negotiation*. 2002, pages 87-100.
- Davis, Fred D., Bagozzi, Richard P., and Warshaw, Paul R., “User Acceptance of Computer Technology: A Comparison of Two Theoretical Models”. *The Institute of Management Sciences*. 1989, pages 982-1003.
- Davis, Judith., Kendall, Tyler., and Meeks, Hal. “The Message is the Message: Designing Information Technology for Inclusiveness and Accessibility”. *IEEE*. 2002, pages 283-289.
- Department of the Air Force. *Transmission of Information via the Internet*. AFI 33-129. Washington: HQ USAF, 4 April 2001.
- Department of the Air Force. *Web Management and Internet Use*. AFI 33-129. Washington: HQ USAF, 3 February 2005.
- Department of Justice, Section 508 Home Page, n. pag. <http://www.usdoj.gov/crt/508/508home.html>. 30 May 2004.
- Desurvire, H., Lawrence, D., and Atwood, M. “Empiricism versus judgement: Comparing user interface evaluation methods on a new telephone-based interface”. *SIGCHI Bulletin*, 23. 1991, pages 58-59.
- Dillon, Andrew., Morris, Michael G., “User Acceptance of Information Technology: Theories and Models”. *Annual Review of Information Science and Technology*. 1996, pages 3-32.
- Fitzgerald, David C., “An Exploratory Analysis of Factors Affecting Participation in Air Force Knowledge Now Communities of Practice”. Air Force Institute of Technology, Wright-Patterson Air Force Base, OH. March 2004.
- "Fourteen Heuristics [OCLC Heuristic Evaluation]" www.oclc.org. ©2004 OCLC Online Computer Library Center. <http://www.oclc.org/policies/usability/heuristic/set.htm>. 30 May 2004.

- Gilligan, John M., Air Force Chief Information Officer. Memorandum for See Distribution. Pentagon, Washington D.C.. 18 February 2004.
- Gilroy, Andrew T., "A Plan for Air Force Use of the World Wide Web". Air Force Institute of Technology, Wright-Patterson Air Force Base, OH. 1995.
- Head, Alison J., "Design Wise: A Guide for Evaluating the Interface Design of Information Resources", Cyberage Books, Inc., 1 June 1999.
- Hewett, T., Ronald Baecker, Stuart Card, Tom Carey, Jean Gasen, Marilyn Mantei, Gary Perlman, Gary Strong, and William Verplank. "ACM SIGCHI Curricula for Human-Computer Interaction". Chapter 2, Section 2.2.1. (1996).
http://sigchi.org/cdg/cdg2.html#2_2_1. 12 November 2003
- Human Factors International. "A Bit of History – How the Problem of Accessibility Arose". n. pag. <http://www.humanfactors.com/downloads/accessibility.asp>. 30 May 2004
- Jacobs, Ian., Gunderson, Jon., Hansen, Eric., *Table of Checkpoints for User Agent Accessibility Guideline 1.0*. n. pag. 17 December 2002.
<http://www.w3.org/TR/UAAG10/uaag10-chktable.html>
- Jeffries, Robin., Miller, James R., Wharton, Cathleen., and Uyeda, Kathy M. "User Interface Evaluation in the Real world: A Comparison of Four Techniques". *ACM*. 1991, pages 119-124.
- Kurosu, Masaaki, Matsuura, Sachiyo, and Sugizaki, Masamori. "Categorical Inspection Method-Structured Heuristic Evaluation (sHEM)". *IEEE*. 1977, pages 2613-2618.
- Leedy, Paul D. and Ormrod, Jeanne E. "Practical Research: Planning and Design". Upper Saddle River, NJ, Prentice-Hall, Inc. 2001.
- Mack, Robert L. and Nielsen, Jakob. "Executive Summary", in *Usability Inspection Methods*. John Wiley and Sons, Inc. 1994.
- Manning, Harley., Dalton, John., Dorsey, Moira., and Belanger, Nicole. "Accessibility Tops the list of Site Failures". n. pag.
<http://www.forrester.com/find?No=25&Ntt=manning&Ntk=MainSearch&Ntx=mode+matchallany&N=0>. 19 December 2003.
- Nielsen, Jakob. "Heuristic Evaluation", in *Usability Inspection Methods*. Ed. by J. Nielsen and R. Mack. John Wiley and Sons, Inc. 1994, pages 25-62.

- Nielsen, Jakob and Molich, Rolf. "Heuristic Evaluation of User Interfaces", in *Proceedings of ACM CHI'90 Conference of Human Factors in Computing Systems*. ACM, New York. 1990, pages 249-256.
- Nielsen, Jakob and Tahir, Marie. "Homepage Usability 50 Websites Deconstructed". New Riders Publishing 2002.
- Pack, Thomas. "Use it or lose it: Jakob Nielsen champions content usability". EContent. Wilton. 2001.
- Palmer, Jonathan. "Web Site Usability, Design, and Performance Metrics". *Information Systems Research*. June 2002, pages 151-167.
- Patton, Michael. "Qualitative Research & Evaluation Methods" Ed. by Sage Publications, Inc. 2002, pages 56,447.
- Pierotti, Deniese. "Heuristic Evaluation – A System Checklist". n. pag. <http://www.stcsig.org/usability/topics/articles/he-checklist.html>. 15 December 2002.
- Stake, Robert E. "The Art of Case Study Research." Thousand Oaks, CA: Sage Publications, Inc. 5 April 1995
- Stenbit, John P., Department of Defense Chief Information Officer. Memorandum for See Distribution. Pentagon, Washington D.C.. 9 May 2003
- Useit.com. "Heuristic Evaluation". n. pag. <http://www.useit.com/papers/heuristic>. 30 December 2004.
- Useit.com. "Accessible Design for Users with Disabilities". n. pag. <http://www.useit.com/alertbox/9610.html>. October 1996.
- Venkatesh, Viswanath., Morris, Michael G., Davis, Gordon B., and Davis, Fred D. "User Acceptance of Information Technology: Toward a Unified View". *MIS Quarterly*. 2003, pages 425-478.
- Venkatesh, Viswanath., Speier, Cheri., and Morris, Michael G. "User Acceptance Enablers in Individual Decision Making About Technology: Toward an Integrated Model". *Decision Sciences*. 2002, pages 297-316.
- Virzi, Robert A., Sorce, James F., and Herbert, Leslie B. "A Comparison of Three Usability Evaluation Methods: Heuristic, Think-Aloud, and Performance Testing". *Proceedings of the Human Factors and Ergonomics Society 37th Annual Meeting*. 1993, pages 309-313.

Yin, Robert K. "Case Study Research: Design and Methods". Thousand Oaks: Sage Publications, Inc. 2003.

Vita

Captain Gary A. Felax graduated from Rogers City High School in Rogers City, Michigan. He entered undergraduate studies at Park University where he graduated with a Bachelors of Science degree in Management/Computer Information Systems in December 1997. He entered the Air Force as a Missile Systems Maintenance Specialist in January 1986 and was later commissioned through the Officer Training School at Maxwell AFB, Alabama in November 1998.

His first assignment, October 1986, was as a Missile Systems Maintenance Specialist at Mather AFB, California. In 1988 he was reassigned as a Missile Electronic Equipment Specialist to the 379th Munitions Maintenance Squadron, Wurtsmith AFB, Michigan. Following this assignment, in 1992 he was reassigned as a Verification and Checkout Equipment Technician at the 410th Maintenance Squadron, K.I. Sawyer AFB, Michigan. In 1995 he was reassigned as an Electronics Laboratory Technician to the 321st Maintenance Squadron, Grand Forks AFB, North Dakota. In 1998 he was reassigned as a Communications and Information Officer at the 1st Communications Squadron, Langley AFB, Virginia. Following this assignment, in 2000 he was reassigned as a Computer System Development Project Officer, National Air Intelligence Center, Wright-Patterson AFB, Ohio. In 2003, he was selected to enter the Graduate School of Engineering and Management, Air Force Institute of Technology to pursue a Master of Science degree in Information Resource Management. Upon graduation, he will be assigned to the Air Force Communications Agency, Scott AFB, Illinois.

REPORT DOCUMENTATION PAGE				<i>Form Approved OMB No. 074-0188</i>	
<p>The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of the collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.</p> <p>PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.</p>					
1. REPORT DATE (DD-MM-YYYY) 03-21-2005		2. REPORT TYPE Master's Thesis		3. DATES COVERED (From - To) August 2003 - March 2005	
4. TITLE AND SUBTITLE Web Usability Guidelines for Air Force Knowledge Now Web Site				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Felax, Gary A., Captain, USAF				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAMES(S) AND ADDRESS(S) Air Force Institute of Technology Graduate School of Engineering and Management (AFIT/EN) 2950 Hobson Way WPAFB OH 45433-7765				8. PERFORMING ORGANIZATION REPORT NUMBER AFIT/GIR/ENV/05M-04	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Air Force Knowledge Now Attn: Mr. Randy Adkins HQ AFMC/TRCI 4375 Chidlaw Rd. WPAFB OH 45433-7765 DSN: 986-0822				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT <p>The Department of Defense Net-Centric Data Strategies number one key attribute is to ensure data is visible, available, and usable when and where needed to accelerate decision-making. The Internet provides opportunities for quick and efficient disseminating of information to the public, distributing information throughout the Air Force, and accessing information from a variety of sources.</p> <p>In 2002, the Air Force CIO designated the Air Force Knowledge Now (AFKN) as the center of excellence for Knowledge Management. The site is a one-stop resource, providing access to a great depth and breadth of information. This study seeks to determine how usable and accessible the web interface is to its customers.</p> <p>A literature review determined the usability inspection method called Heuristic Evaluation to be most favorable for this type of evaluation. The researcher conducted a case study using heuristic evaluation to determine the site usability compliance rate. A second case study using web content accessibility guidelines was then performed to determine the sites accessibility compliance rate. The study finally presented a comparative analysis of the usability and accessibility checklists to determine if any overlap occurred between the two or if one is a subset of the other.</p> <p>This exploratory research finds more emphasis on web usability and accessibility should be explored in the future for AFKN.</p>					
15. SUBJECT TERMS Technology Acceptance, Heuristic Evaluation, Web Usability, Web Accessibility, Case Study, Air Force Knowledge Now					
16. SECURITY CLASSIFICATION OF: Unclassified			17. LIMITATION OF ABSTRACT UU	18. NUMBER OF PAGES 143	19a. NAME OF RESPONSIBLE PERSON Kevin L. Elder, Ph.D., USAF (AFIT/ENV)
REPORT U	ABSTRACT U	c. THIS PAGE U			19b. TELEPHONE NUMBER (Include area code) (937) 255-3636, ext 4600; e-mail: Kevin.Elder@afit.edu