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World Wide Web Administration and distribution of the Maintenance Climate Assessment Survey (MCAS)

Fenton, Jeff W.

Monterey, California ; Naval Postgraduate School

NAVAL POSTGRADUATE SCHOOL

Monterey, California

THESIS

WORLD WIDE WEB ADMINISTRATION AND DISTRIBUTION OF THE MAINTENANCE CLIMATE ASSESSMENT SURVEY (MCAS)

by

Jeff W. Fenton

September 1999

Thesis Advisor:	John K. Schmidt
Co-Advisor:	Douglas E. Brinkley
Second Reader:	Robert R. Read

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Naval Aviation has been tasked to reduce it's 1996 human factors related Class A flight mishap rate in half by the year 2000. The Human Factors Quality Management Board (HFQMB) was established in 1996 to help Naval Aviation achieve its mishap reduction goals. Previous HFQMB mishap reduction initiatives focused on flight mishaps and aircrew related issues, however a recent shift to broaden the scope now puts attention on aircraft maintenance and consequently maintainers. Baker (1998) developed from a Maintainer's perspective a Climate Assessment Survey (MCAS). The purpose of the MCAS was to provide a diagnostic tool to identify potential intervention areas from the perspective of maintenance-related mishaps. This thesis seeks to provide a vehicle fostering the proliferation of the MCAS throughout the fleet by adapting it for the World Wide Web (WWW), and developing a prototype Web site. A usability analysis was conducted to form a basis for future modification to the online version of the MCAS, with the ultimate goal being an effective tool to promote the reduction of human factors related mishaps in Naval Aviation maintenance.

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WORLD WIDE WEB ADMINISTRATION AND DISTRIBUTION OF THE MAINTENANCE CLIMATE ASSESSMENT SURVEY (MCAS)

Jeff W. Fenton
Lieutenant Commander, United States Navy
B.S., Indiana University, 1983

Submitted in partial fulfillment of the
requirements for the degree of

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ABSTRACT

Naval Aviation has been tasked to reduce its 1996 human factors related Class A flight mishap rate in half by the year 2000. The Human Factors Quality Management Board (HFQMB) was established in 1996 to help Naval Aviation achieve its mishap reduction goals. Previous HFQMB mishap reduction initiatives focused on flight mishaps and aircrew related issues, however a recent shift to broaden the scope now puts attention on aircraft maintenance and consequently maintainers. Baker (1998) developed, from a Maintainer's perspective a Climate Assessment Survey (MCAS). The purpose of the MCAS was to provide a diagnostic tool to identify potential intervention areas from the perspective of maintenance-related mishaps. This thesis seeks to provide a vehicle fostering the proliferation of the MCAS throughout the fleet by adapting it for the World Wide Web (WWW), and developing a prototype Web site. A usability analysis was conducted to form a basis for future modification to the online version of the MCAS, with the ultimate goal being an effective tool to promote the reduction of human factors related mishaps in Naval Aviation maintenance.

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A. HUMAN FACTORS QUALITY MANAGEMENT BOARD

1. Overview

Following the tragic January 1996 Nashville, Tennessee Navy F-14 mishap that killed the aircrew and several local residents, Vice Admiral Bennitt, the then Commander of the Naval Air Force, U. S. Pacific Fleet, created a Human Factors Quality Management Board (HFQMB) to improve aviation safety through identifying strategies to prevent human error. The purpose of the HFQMB simply stated in its charter (1996) is:

> To significantly reduce the rate of occurrence of naval aviation mishaps caused by aircrew/operator error by identifying systemic improvements in the processes and systems that affect human performance and guard against human error. Further, to institutionalize continual improvement in these areas.

Senior Naval Aviation leaders recognized a need to form a coalition between them as policy makers and individuals who work directly in the Naval Aviation community. Consequently, the HFQMB is composed of a Flag Officer and senior operational Officers from both the Navy and Marine Corps including a cross section of all communities and ranks from Squadron Commanding Officers to Fleet Lieutenants. The implementation of the HFQMB findings was intended to foster a reduction in the 1996 Naval Aviation class "A" flight mishap rate by 50 percent within three years and by 75 percent within 10 years (HFQMB Charter, 1996).

2. Human Factors Quality Management Board Efforts

The HFQMB's strategy of taking an across the board approach to improve its processes and systems encompassed a three-prong approach, including: (1) Mishap Data analysis, (2) Benchmarking Best Procedures, (3) Climate Safety Assessment (See Figure 1). Mishap Data Analysis included the practice of observing patterns that may have formed in past mishaps, and trends that may been have established in relation to human factors. Bench Marking involved observing the practices used in other organizations to combat human factor related error. The Climate Safety Assessment was designed to qualify issues that might impact these human factor errors.

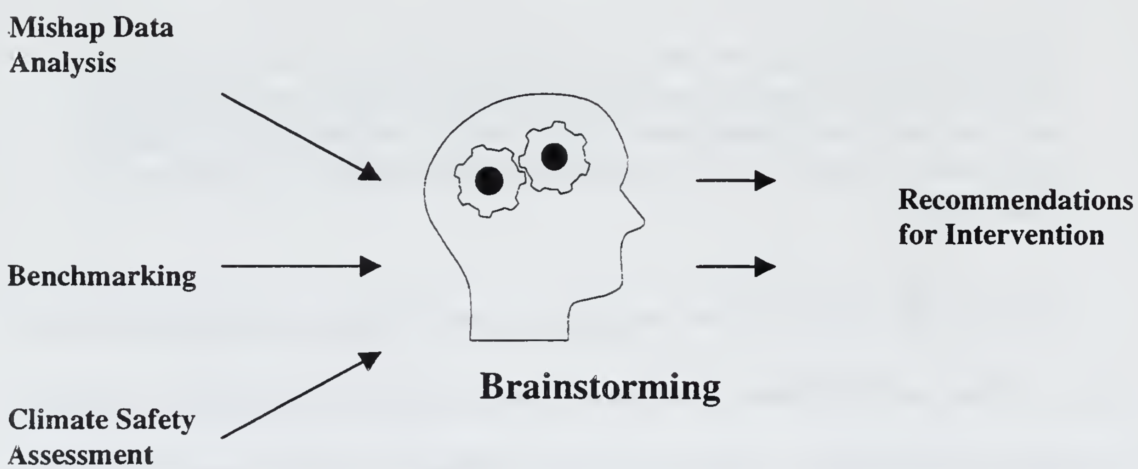


Figure 1. HFQMB Methodology
From "AIRPAC Brief," by CDR J. Schmidt, March 1998.

The first area of interest to the HFQMB, analysis of mishap data, represents research conducted without the need for external data collection. The Naval Safety

Center (NSC) maintains a database of mishaps dating back 20 years; this historical data is categorized by 1050 characteristics (NSC, 1999). Taking the NSC data and classifying the cause and type of mishaps enabled aggregate analysis by the HFQMB. The NSC's mishap database also allowed the HFQMB to analyze the mishaps with enough specificity that when coupled with the appropriate modeling techniques, enabled meaningful action development.

Benchmarking processes/practices was the second area of endeavor by the HFQMB for mishap reduction. Benchmarking is the process through which internal or external organizations' performance levels are compared, and its processes/practices are observed. The organizational benchmarks can be utilized to establish guidelines and ultimately lead to "Best Practice" decisions (Chapman, 1997). In this instance, the HFQMB observed processes from organizations that seek the same safety goals as Naval Aviation such as, the U.S. Air Force, and the commercial airlines, etc. (HFQMB, 1996).

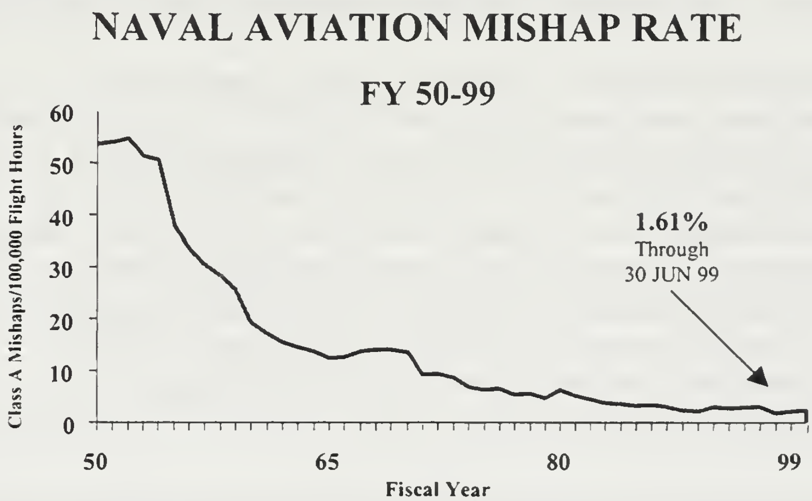
The third area of focus by the HFQMB is addressed by the Command Safety Assessment (CSA), a tool designed by Ciavarelli and Figlock (1997) at the Naval Postgraduate School to measure safety climate in a squadron from the aircrew perspective. The CSA (Discussed in subsequent chapters) enabled the HFQMB to measure the climate and process effectiveness within an organizations' flight operations. Recommendations were deemed a critical part of the overall success of the HFQMB's actions. Using the information acquired through the means of observation and collection, the HFQMB prioritized the recommendations in terms of their potential to achieve the mishap reduction goals and forwarded them to the appropriate authority for coordination and implementation at the organizational level of Naval Aviation (HFQMB, 1996).

3. Human Factors Quality Management Board Results

Historically, the mishap rates of the last two decades have been low by past standards (See Figure 2). However, despite a low mishap rate, it is important to realize that Naval Aviation strikes several aircraft per year. An example of the effect lost aircraft have on the fleet is illustrated by the data taken from fiscal year 1997 through 1998. In FY '97, a total of 65 aircraft were accepted into the Naval Aviation inventory (Naval Aviation News, 1998). During FY '98, 36 aircraft were removed from the inventory as a result of mishaps, (NSC, 1999). The aircraft lost in 1998 represent 55 percent of those purchased in the previous year. The class "A" mishap rate has been essentially on a plateau since 1988. Without a change in leadership action or the conduct of Naval Aviation, the mishap rate would not be expected to deviate from its current level.

Contributing to mishap data analysis, Shappell and Weigmann (1995) adapted Reason's (1990) Human Error Model to re-classify the divisions of Naval Aircrew Flight mishaps. This classification model took the larger category of human error and expanded it to three sub-areas of responsibility (Nutwell & Sherman, 1997). The new divisions of human error consisted of: unsafe aircrew conditions, unsafe supervisory conditions, and unsafe aircrew acts. The redesigned model gave a better understanding of the human cause factors than previous classifications in the traditional model; more accurate reporting resulted in improved understanding, and clearly indicated the appropriate intervention areas to achieve the goals sought by the HFQMB. Notably, in a report issued in 1997 by the Department of the Navy, 40 percent of the procedure violations committed by aircrew were conscious breeches, and 50 percent of the supervisory failures were labeled unsafe supervisory conditions. Both aircrew and supervisory conditions are an indication of climate within the organization. Relatively little work has been completed on organizational factors when considering the effectiveness of a squadrons performance and safety (Ciavarelli & Figlock, 1997). Program and policy of the squadron are a part the safety climate and culture maintained within the organization.

Figure 2. FY 50-99 Flight Mishap Rates.



From: Naval Safety Center 1999. (Through 30 JUN 99)

The efforts of the HFQMB were expected to bring about fundamental changes in the way business was conducted in Naval Aviation, with these changes, the established mindset regarding attainable mishap reduction would have to change. (HFQMB Charter, 1996). The recommendations of the HFQMB resulted in a record mishap rate for the U.S. Navy in 1997, with a mishap rate of 1.29 %, the lowest level of class A mishaps ever (NSC, 1999). The U. S. Marine Corps reached a comparable milestone in 1998 with the organizations lowest mishap rate of 2.52 % (NSC, 1999). The past actions taken by the HFQMB have had the desired effect of reducing the human factor related mishap rate. To continue to reduce the human factors related mishaps, refinements in the process evaluation would need to take place. Nutwell and Sherman (1997) state human error represents a large portion of the causal factors that contribute to Class "A" mishaps and propose additional reductions in the mishap rate could be attained with refinements in this area. Traditional approaches targeting aircrew human factors should be expanded to include the maintainer with potential gains in mishap reduction. If further improvements in mishap reduction were to occur continued exploration of all facets of prevention needed to be studied and understood. Efforts in mishap reduction were concentrated in the aircrew side of human factors caused mishaps, expanding the focus to include the maintenance caused human factors mishaps could enhance the overall reduction of the mishap rate. The desire to measure the climate of safety from a maintainer's viewpoint was a topic that necessitated the development of a tool for this purpose.

B. AVIATION SAFETY CLIMATE ASSESSMENT

1. Command Safety Assessment

The Command Safety Assessment (CSA) was developed by Ciavarelli and Figlock (1997) of the Naval Postgraduate School; its goal was to estimate the effectiveness of organizational safety programs. To assess the effectiveness of safety programs and processes, it is necessary to understand the climate that is maintained within the organization. Organizational culture is defined by Merritt and Helmreich (1996) in the following manner.

> Culture can be defined as the values, beliefs, rituals, symbols and behaviors that we share with others that help define us as a group, especially in relation to other groups. Culture gives us cues and clues on how to behave in normal and novel situations, thereby making the world less uncertain and more predictable for us. There are two important and distinct components of culture. The surface structure, or outer layer of culture consists of observable behaviors and recognizable physical manifestations such as member's uniforms, signs and logos, and documents. The deep structure, or inner layer of culture, consists of the values, beliefs and assumptions which underlie the surface structure and provide the logic which guides the members' behaviors.

Measuring culture and looking at the safety climate an organization fosters is part of understanding the organization and the people that make up the group. Each person brings their history and multi-cultural memberships with them to an organization (Merritt & Helmriech, 1996). If organizational culture has an impact on the safety of the group, it would be desirable for the group to have a unified, integrated organizational culture, rather than one made up of diverse values. Much attention has been focused on human error in complex systems, but relatively little has been accomplished on the potential contribution that organizational factors have on crew performance and safety (Ciavarelli & Figlock, 1997).

Work in the area of climate measurement within Naval Aviation squadrons is built on research conducted by Roberts (1990). Roberts discussed the attributes in organizations that were successful in reducing risks associated with hazardous operations. Her label for this type of organization was "high-reliability" and described an organization that worked in a hazardous environment, yet produced very low rates of accidents. The CSA study was based on a model of high reliability organizations, and produced a questionnaire that would provide feedback to the HFQMB concerning the issues of command climate, morale of Naval personnel, workload, resource availability, and estimated success in safety intervention programs. This newly developed tool, the CSA, could be used by the Aviation Safety Officer (ASO) to assess the organizations' effectiveness regarding their commands safe operation (Nutwell & Sherman, 1997).

3. Maintenance Climate Assessment Survey

Safety culture within an organization effects the entire output of the group. Naval Aviation is recognized as a high-risk organization, devastating consequences occur if something goes wrong within any aspect of the organizations operation. Just as the concept of the CSA was created as an extension of the principles guiding the study of high reliability organizations (Ciavarelli & Figlock, 1997), the Maintenance Climate Assessment Survey (MCAS) became the maintenance focused extension of the CSA (Baker, 1998). The MCAS was developed with the notion that operational climate and maintenance climate hold the same importance within the unit, therefore, both contribute to safe completion of the organizations mission. With maintenance actions contributing to the mishap rate, the need to modify a survey tool to address the issues pertaining to maintenance became relevant (Baker, 1998).

The MCAS has a focus on safety climate from the aviation maintainer's viewpoint. Baker's (1998) goal was to develop, administer, and validate a questionnaire to assess the effectiveness of Naval Aviation maintenance operations in the management of risk. Baker concludes that the developed prototype MCAS with a few noted exceptions conformed to the existing Model of Organizational Safety Effectiveness (MOSE) quite readily, he successfully adapted the model to make it maintenance specific. Statistical analysis allowed the original 67 question MCAS to be reduced to a more practical length of 35 questions. Refinement and consideration for distribution of the

MCAS offer areas of further development.

C. RESEARCH OBJECTIVE

The objective of this study is to further enhance the effectiveness of the MCAS developed by Baker at the Naval Postgraduate School (Baker, 1998). This study creates an online version of the MCAS, and incorporates this version of the MCAS within an electronic distribution system and tests the usability of the online system. The intent is to increase the availability of the MCAS, enhancing present efforts to reduce maintenance related mishaps and the overall mishap rate.

D. STATEMENT OF PROBLEM

Utilizing the distribution capability that is created by the World Wide Web, an online version of the MCAS can be distributed to an ever-increasing audience with virtually no increase in distribution expense (Lewis, 1998). To further reduce the maintenance attributed aviation mishaps, safety process and programs that contribute to safe operation will need to improve. Not simply seeking improvements in process and programs, the aviation community sought the invention of new processes to enable the desired improvements in mishap reduction (Nutwell & Sherman, 1997).

Distribution of information on the World Wide Web offers the opportunity for the Naval Aviation community to "invent" the new process that it desires, bringing about changes in safety and ultimately reducing the mishap rate. As Lewis (1997) states, the World Wide Web offers increased exposure to an audience without increases in distribution costs, and as a distribution medium, the World Wide Web can disseminate information that was originally designed for distribution in other forms. Specifically, the

MCAS was created to be distributed in paper form, with modification to format, the MCAS can be reconfigured to World Wide Web specifications. Distribution of the developed MCAS by an effective Web based method will enable more organizations to use this tool for self-evaluation.

The main thrust of this study focuses on the effective reconfiguration and distribution of the existing MCAS through the World Wide Web. Usability of the online version of the MCAS was the measurement of effectiveness. Understanding and measuring the effectiveness of the safety program is vital to the reduction of human factor caused mishaps. It is essential to provide tools to the aviation organization for self-assessment of the effectiveness of their processes and programs. Four issues are relevant in the discussion of an electronic distribution of the MCAS, specifically, this thesis explores the following questions:

1. Is there a need to disseminate and administer Web based materials to aviation units?

2. Do U.S. Navy and Marine Corps squadrons have the necessary software/hardware capabilities to utilize the World Wide Web?

3. Can the MCAS be effectively distributed and administered using the World Wide Web?

4. Once distributed, do personnel have the necessary ability to utilize the electronic version of the MCAS?

E. SCOPE AND LIMITATIONS

The intent of this study is to gain a better understanding of the distribution capability the World Wide Web offers organizations with the proper hardware and software in place. It is essential to determine the usability of an online version of the MCAS for use by Naval Aviation squadrons. Subjects from the Naval Aviation School of Safety will be used due to their close proximity, this effort represents a preliminary effort to measure the usability of the online version of the MCAS. An exit survey will allow the users to rate their impression of this method of MCAS distribution.

II. LITERATURE REVIEW

A. OVERVIEW

The review of the literature considers three areas pertinent to the effective online delivery of an organizational climate assessment tool. Areas covered include: 1) Organizational climate and its assessment to provide background on the traditional process; 2) High Reliability Organizations (HRO) as a model for effective organizational climate is considered and its application to the military; 3) Development of the Command Safety Assessment (CSA) and the Maintenance Climate Assessment Survey (MCAS) for Naval Aviation based on the HRO model; 4) The software development process entailed for organizational assessment tool delivery; and 5) The Human computer interface concept, functionality and usability. The information is summarized and considered in context of the research questions.

B. ORGANIZATIONAL CLIMATE AND ASSESSMENT

Daft (1989) defines organizational climate as:

> ...the set of key values, guiding beliefs, and understandings that are shared by members of an organization. It defines basic organizational values, and communicates to new members the correct way to think and act, and how things ought to be done. It represents the unwritten, feeling part of the organization. (p. 503)

Climate is the unseen part of an organization that helps members make sense of organizational events and activities (Daft, 1989). When an organization enjoys widespread agreement, climate within the organization is strong, conversely, if little agreement exists within the organization, climate is weak. Daft (1989) also notes that leadership plays a large role in the organizational climate. He states that simple mandates of policy do not form an organizations cultural climate, values and beliefs come from observing leaders within the organization. Climate is an important feature of the organization, and if a change in organizational climate is desired, leadership must implement more than simple policy to effect the needed changes (Schein, 1992).

To understand more fully the process of change, it is helpful to study the needed elements that will successfully facilitate it. Burke (1994) looks at organizational development as it relates to change. Much work in this area is built on a model developed by Lewin (1958) called the three-step procedure of change. The first step of this model is unfreezing the present level of behavior, which is no more than reducing prejudice and clarifying the area that requires change. The second step is movement, take action that will change the social system from its original state of behavior. The final and third step is refreeze, or establish processes that will secure the new behavior from change.

Schein (1992) elaborates on Lewin's model, enlarging and defining the scope of each step. He further sets forth useful assumptions when studying an organization and attempting to measure culture. Schein notes, it is important to keep in mind that the contextual meaning of cultural assumptions can only be fully understood by the members of that culture, so creating a vehicle that helps the members of the group understand their own culture is actually more important than the researcher gaining this perspective. Since culture is a shared set of assumptions, obtaining initial data in a group setting is appropriate.

C. HIGH RELIABILITY ORGANIZATION (HRO)

In research conducted by Roberts (1990), and extended by Libuser (1994), an HRO is defined as an organization that operates in a hazardous environment, yet produces very low rates of accidents and incidents. HROs seem to have less than their "fair share" of failures despite operating in a complex, demanding environment involving significant risks and hazards. Roberts and Libuser note that these HROs had certain characteristics that made them organizationally effective managers of risk. Libuser (1994) went on to develop a Model of Organizational Safety Effectiveness (MOSE) that categorized five traits that were common among this type of organization, these traits include: process auditing, reward systems, quality of operations, risk perception and command control.

HROs are found in many areas of manufacturing and everyday life (Perrow, 1984). The operation of power plants, oil refineries and transportation represent a few industries where accidents are rare but if they occur have catastrophic and far reaching effects (Reason, 1998). The operating concepts of HROs can apply to many other industries where accidents can not be tolerated, the food industry, drug manufacturers, financial institutions are just a few of the organizations that characterize groups that depend on high reliability. Finally, the HRO concept can also be extended to military applications (Roberts, 1988).

Reason (1998) describes a theory of active and latent causes of accidents and applies these causal factors to HROs. An active failure is one that is directly attributable to an action or violation by an individual directly influencing a system. Latent conditions may exist for years within a system and not cause an accident until the proper sequence of events come together simultaneously. He contends the perception of individuals within an HRO is that iron clad defenses are in place preventing accidents, however in practice, organizational defenses are not iron clad, and may have certain weaknesses. When the weaknesses in separate defenses occur together in the proper sequence, failure may result (See Figure 3). Meeting peak requirements or time pressures may cause individuals within the HRO to neglect the ongoing process of finding holes in the accident prevention strategy; infrequent mishap occurrence contributes to this mindset (Reason, 1998).

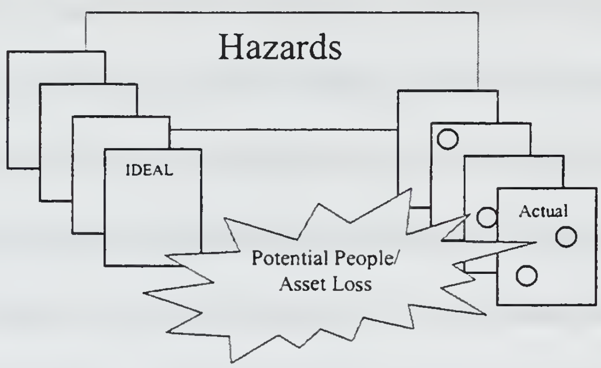


Figure 3. Perceived and Actual Defenses from Risk

Research conducted by Roberts (1990) and Libuser (1994) indicate that the complexities of systems today necessitate new strategies for prevention, the simple direct causation of an accident by one individual does not fit a HRO. HROs must continually seek new methods of process improvement and not become complacent despite the fact they suffer from few accidents (Perrow, 1984). The perception that these organizations maintain "iron clad" defenses against hazards it can not hamper continual process improvement (Reason, 1998). Strategies to achieve a HRO would include a strong hazard reporting system with no fear of retribution by the members, as well as maintaining a flexible, learning culture within the organization.

Bierly and Spender (1995) adapt the HRO model concept for military application and claim that a nuclear powered submarine fits many of its assumptions. They observe culture interacts with the formal organization, and that the strong organizational culture within the nuclear submarine supports the formal structure. Roberts (1988) finds an increasing number of organizations in modern society fit the HRO model, observing the size and complexity of the aircraft carrier organization coupled with a seemingly low incidence history in dealing with high risk evolutions qualified it as a HRO. Baker (1998) states, "In high-risk endeavors such as aircraft operations, it is essential that such support be flawless, as the price of deviations is high." Naval Aviation as a whole with its complexity, high risk, and low tolerance for error fits the criteria to be a HRO.

Building on the work of Roberts and Libuser, Ciavarelli and Figlock (1997) tailored the MOSE to fit the conditions found in Naval Aviation. They created the CSA, a tool designed to assess the safety climate within a Naval Aviation squadron from an aircrew perspective. The goal of this research was to develop and apply a methodology that enabled a command to assess it performance on key safety issues, providing a feedback tool as part of the mishap prevention process. Planned follow on efforts include cross-comparing squadrons, aircraft type and demographic variables in an attempt to construct an empirical foundation for assessing hazards and risk.

Baker (1998) furthered the efforts of the CSA by designing and validating the MCAS that would accomplish the same objectives as the CSA, but from the perspective of the aviation maintainer. With the help of maintenance experts, he took a list of maintenance topics and created 67 questions specifically tailored to aviation maintenance. Baker's initial 67 question survey through factor analysis was further refined and reduced to a 35 question instrument. The MCAS was successfully proven to support each of the MOSE components.

Currently, Naval Postgraduate School Operations Research Department students are engaged in taking the MCAS and validating it by analyzing the results within an aircraft community, and across aircraft communities (B. Goodrum, Personal Communication, 1999; T. Oneto, Personal Communication, 1999). To further enhance the effectiveness of the MCAS, this study seeks to provide a wide reaching delivery system on the World Wide Web. Effective distribution will involve the creation of an electronic delivery system, and the usability testing of that system.

D. SOFTWARE TOOLS

The software necessary to carry out the successful development and administration of the online MCAS includes two categories: developmental software, and user software (Alexander & Tate, 1999). The developmental software in this research created both the Web site, and also the online version of the MCAS. The user software is the tool each user must employ to utilize the online MCAS once developed; this software is determined by the end user and is a World Wide Web browser. Both categories of software and its employment are discussed below.

1. Developmental Software

Perseus Survey Solutions for the Web is the software that was used for the transformation of the MCAS to an online version of the same. The Perseus Corporation makes this software product Microsoft Office compatible (Strebe & Perkins, 1998). Compatibility with Microsoft products allows for future expansion of the online MCAS to include functions contained in Microsoft Access and Microsoft Excel.

The most common application of this development software is construction and distribution of surveys, but its other functionality includes the development of inquiry forms, feedback questionnaires and order forms (Perseus Survey Solutions User Guide, 1998). Functioning as a word processor, Survey Solutions for the Web acts as an interface between the plain language text formulation and translation to Hypertext Markup Language (HTML). Once textual data is converted to HTML, it may be posted on a server and users may access the stored data through their computer and an Internet browser. The storage and availability of these files is further described in the discussion of the World Wide Web.

Data collection is the final function that the Perseus software package carries out as part of the design of the online MCAS. Once collected through the user response to questions within the online MCAS, data is packaged in a standard tab separated form (ASCII TSV) which may be further stored, or interpreted using Microsoft Access or any program that allows the ASCII TSV data entry (Perseus Survey Solutions User Guide, 1998).

The second software development tool used was Netscape Navigator Gold Version 4.5. This software package was used in the development of the Web site that presented the online MCAS to the user. Netscape Navigator Gold utilizes a powerful What-You-See-Is-What-You-Get (WYSIWYG) HTML generator that uses many of the same functions found in word processors (Authoring Guide, Netscape Navigator Gold, 1995). Maintenance Aviation Safety material was gathered from existing sources and combined with original material to form a distribution vehicle for the MCAS.

2. User Software

The final piece of software used in this project is the Internet Browser (browser). A browser is defined as "a computer program that enables the user to read HYPER-TEXT from disk files or on the World Wide Web" (Downing, Covington & Covington, 1996). A browser is the software each end user must utilize to access the online MCAS, and becomes the most dynamic portion of the all the software packages used. The dynamic nature of Internet Browsers is discussed more fully in subsequent sections and will be an ongoing concern in a Web based project.

E. WORLD WIDE WEB

1. Overview of the World Wide Web

The World Wide Web is a unified, interconnected interface to the vast amount of information stored on the computers around the world (Sobell, 1995). Information can be displayed on the World Wide Web using a combination of text, graphics, animations and audio to form dynamic documents. Once created, these documents are displayed on a user computer by an Internet browser. A browser provides easy access to Web sites that are posted on many servers connected to the World Wide Web. A series of Clients, computers that receive information from other computers, and Servers, a computer that provides services to another computer, make up the Internet.

Composed of HTML code, a Web site is made up of one or more pages to create an organized presentation of material through the use of Hyperlinks. The Authoring Guide, Netscape Navigator Gold (1995) defines the Web site as a package that contains; topics that can be linked to from other Web sites, may require the use to scroll the browse window to see the entire page, can contain links to graphic files and other pages, and finally can be located on a server so that other users may access the page. Below, Figure 2 illustrates the composition of a Web site that is made up of several Web pages, connected by use of Hyperlinks.

Hyperlinks are the mechanism that allow an entire Web site composed of many Web pages to be connected in a logical sequence. The use of Hyperlinks to tie together multiple Web pages of the same theme allow a user to navigate a rather complex Web site with ease and little confusion. The World Wide Web offers and opportunity to distribute information to a vast audience at very little cost (Lewis, 1998).

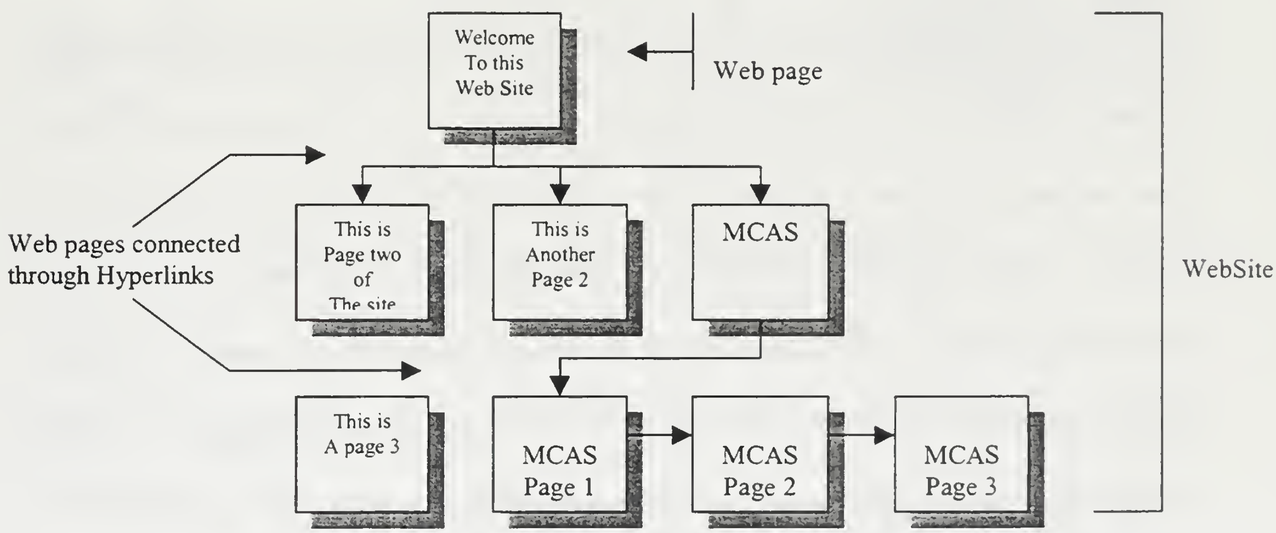


Figure 4. Overview of a Web site

2. The Internet Browser

The browser is an integral part of using any online software applications, including the online MCAS. Each browser interprets HTML code by applying a set of defaults established by the individual user. A default is a set of assumptions that a browser makes unless it is given instructions to the contrary (Downing, Covington & Covington, 1996). These defaults within the browser determine how the browser interprets the HTML code and displays the information on the users monitor. Different interpretations of HTML code result in different views of the same information. For this reason, two browsers may interpret the same HTML code differently. In the design of Web sites, it becomes necessary to consider the different default settings users will utilize and anticipate the effects this may have on data within a Web site application (Randall, 1999).

3. The Client/Server Model

The Client/Server model is the basic model that enables individual users to access a Web site at any given time (Sobell, 1995). The Server is a program that runs all the time waiting to receive a request for the information it contains in its data stores or memory. World Wide Web clients are the computer users who access a server through the use of a browser. The Client/Server interaction occurs using a computer language known as Hypertext Transfer Protocol (HTTP). HTTP is a computer language that works across all platforms; consequently, whether the Client and Server are the same type of computer does not inhibit the ability for the two computers to communicate (Downing, Covington & Covington, 1996). When the Client requests information from the Server via HTTP, the request is acknowledged and data is sent back to the Client. (See Figure 5)

The Client/Server Model is responsible for enabling the efficiencies in distribution of online material throughout the World Wide Web (Tanenbaum, 1992). Once posted on a Server, the Online MCAS will incur the same distribution cost as it reaches an ever-increasing audience. The efficiency in online distribution is analogous to the infinite shelf space retailer of the frictionless economy (Lewis, 1997). The ability to distribute training materials at a small, fixed cost, to an audience that is potentially infinite represents a method of improvement for training that may facilitate reaching mishap reduction goals set within the organization of Naval Aviation.

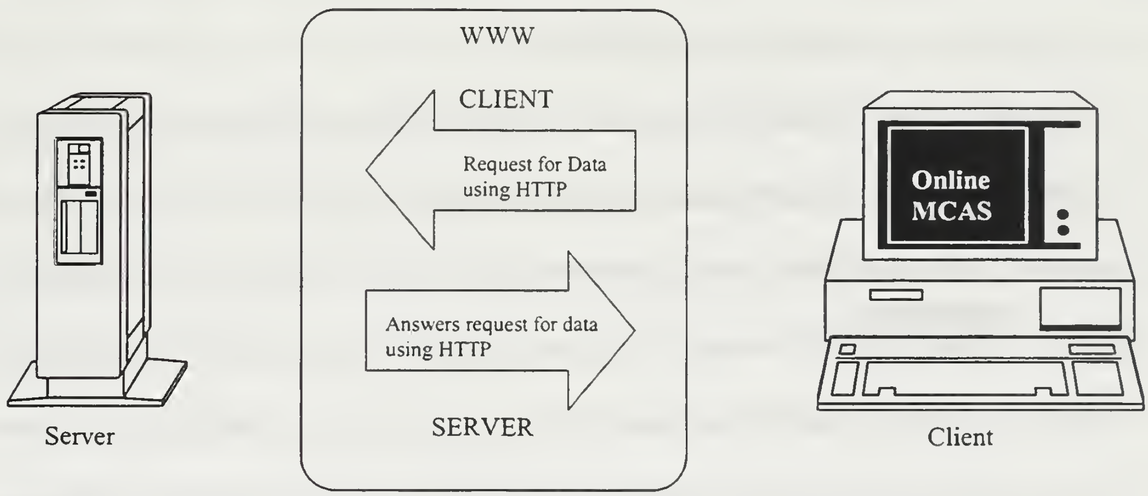


Figure 5. Illustration of the Client/Server Model

F. HUMAN USABILITY ISSUES

Hawkins (1998) observes that "Human factors is about people…It is about their relationship with machines and equipment, with procedures and with the environment about them." He illustrates this relationship through the SHEL model, where the elements of Software (e.g., training, procedures, etc.), Hardware (e.g., controls, displays, etc.), Environment (e.g., temperature, lighting, etc.), and Liveware (e.g., operator, systems, etc.), pair to form a human system interface. Liveware is considered the hub of the model and all remaining components must be effectively matched to this central component.

Human factors principles have traditionally been applied to hardware devices such as monitors, keyboards, etc. as well as workstation design to optimize their fit with human needs and capabilities (Grandjean, 1987). The proliferation of hardware and software technology necessitated the same intensive application of human factors technology to enhance software Human Computer Interface (HCI) design (Brown, 1989). Today, most software and design applications integrate HCI design concepts including: fonts, color, etc., as well as screen layout and functionality.

The "browsers" that the World Wide Web is accessed through have gone passed many HCI design iterations to maximize their efficiency and ease of use (Frederickson-Mele, Levi, & Conrad, 1999). Web software and that used in Web site development have also been crafted using HCI concepts with similar objectives as in software development. Using the Internet as a distribution method raises unique design issues that are dependent on user terminals and pre-selected defaults, consequently, World Wide Web applications benefit from the HCI research in the browser they are viewed through. This unique set of user circumstances requires that Web sites be tested for usability by their intended audience.

1. Usability Testing

Software and its design presents many challenges to the user in trying to accomplish a given task. A reasonable goal of any software project should be the ease of use of the final product (Jordan, 1998). Usability issues are not only important within the realm of consumer products, but also those products used within a commercial or professional context (Jordan, 1998). Past studies indicate, with the exception of safety testing, usability testing takes place in the worst possible arena, the marketplace (Randall, 1999). In other words, Randall (1998), states whether a product was usable or not was left up to the end user, after the purchase or attempted use of the final product. Formal usability testing became recognized about a dozen years ago in the computer software industry. Usability testing does not speed the design process up, but if user satisfaction is the goal, the increased development time is well spent. Constructing a site to meet the needs of your intended audience increases the impact the overall presentation has upon the user (Frederickson-Mele, Levi, & Conrad, 1999).

Delivering a prototype of the product to a test group followed by a questionnaire is a method Jordan (1998) found beneficial in determining the attitudes and expectations of potential product users. Jordan specifies that data obtained from usability studies should answer the following questions:

- Are there usability faults in the product? If so, what are these faults?
- How can these usability faults be solved?
- What are user attitudes towards the use of this product?
- What design changes are required to make the users' attitudes more positive?

Open ended questions, allow the respondent to write their own answers to questions and prove particularly useful in determining what the important issues were to the users. A usability study enhances the effectiveness of modification to a prototype, ultimately; the final product will have more utility to the end user (Jordan, 1998).

2. Writing For the Web

When writing for Web sites, studies have shown that users do not actually read: instead, they scan the text (Nielsen, 1994). This finding suggests a style of writing that can be absorbed through scanning rather than through in-depth study. During Nielsen's four years of usability testing, he considered site architecture, navigation, search, page design, and style yielding surprising results. When asked to comment on the Web site, users critiqued content quality and relevance to a much greater extent than navigational issues or page elements (Nielsen & Sano 1994; Nielsen, 1997). This suggested content would play a very large part in the users perception of the Web site. Morkes and Nielsen (1997) suggest three main content oriented conclusions be drawn from their study.

1. Users do not read on the Web; instead they scan the pages, trying to pick out a few sentences or even parts of sentences to get the information they want.
2. Users do not like long, scrolling pages: they prefer the text to be short and to the point.
3. Users detest anything that seems like marketing fluff or overly hyped language and prefer factual information.

It is clear that users require concise presentations of content when on the Web, and have very low tolerance for superfluous words or ideas in the material.

Morkes and Nielsen (1997) state that writing effectively for the Web is a function of sensitivity to the users needs balanced with the message you wish to covey to the user. Writing in a concise, scannable style would seem to fit the users need for quick fact finding, while ensuring content was available to the user. It was noted that when a page comes up, the readers attention shifts to center screen and the body of the text was read before they looked over headers or other navigational elements that made up the page (Morkes & Nielsen, 1997). Similar findings on the importance of content resulted from the work of other similar studies of online materials (Spool, Scanlon, Schroeder, Snyder, & DeAngelo, 1997). This indicates the need to maintain a concise writing style on the

Web page, paying particular attention to the relevance of the material presented to the intended user.

G. SUMMARY

An understanding of organizational climate leads research in the direction of categorizing Naval Aviation as a HRO. As a HRO, Naval Aviation safety programs and processes can be analyzed and improved using the CSA and MCAS. Working within the confines of current distribution methods, the WWW offers unique opportunities for widespread, inexpensive distribution of safety material. Special consideration must be given to design issues regarding usability of software applications. A vehicle to distribute the online version of the MCAS will further the need to assess safety program effectiveness in Naval Aviation.

III. METHODS

A. RESEARCH APPROACH

Naval Aviation seeks methods to improve its process and programs regarding safety in an effort to reduce mishap rates. The MCAS developed by Baker (1998) was designed to be utilized by squadrons to assess the effectiveness of their safety programs from a maintainers perspective, making it possible to measure the safety climate within an aviation command. Making the MCAS available to more aviation units through effective distribution on the World Wide Web is the goal of this study.

To measure the effectiveness of the online MCAS, a prototype Web site was developed and distributed to a sample user group. Each subject tested the Naval Aviation Maintenance Safety Web site with a prepared task list that required them to navigate through the pages of the Web site. At the completion of the task list, the subject would have viewed all the pages of the Web site, and presumably formed an opinion on its effectiveness. Subjects upon completing the task list filled out an exit survey composed of demographic questions of their computer background and perusal of the prototype Web site.

B. DATA COLLECTION

1. Subjects

Students attending the Aviation Safety Officer Course (ASO) at the School of Aviation Safety served as subjects in the study. Selection to the ASO course is made by individual Aviation Commands and yields a cross section of the Naval Aviators and Naval Flight Officers from all aircraft communities within the U.S. Navy and Marine Corps. Squadron ASOs are responsible for the safety programs in all squadrons and will likely be one of the primary users. Each subject from this test group will have a direct influence on the safety climate within their squadrons.

2. Apparatus

The Naval Postgraduate School's School of Aviation Safety provides a computer lab for the ASO students during their training. Each Officer is issued a password that allows computer usage through a group account. The computers in the lab each had a full functioning prototype of the Aviation Maintenance Safety Web Site. After a subject gained access to the computer through use of the group account, the icon "Aviation Maintenance Safety Web site" resided on the computer desktop. Once the Web site was opened, it appeared as any World Wide Web site, although this prototype was installed on the hard drive of the computer rather than on a server on the Internet. The prototype was kept locally on the lab computers to facilitate changes that would occur in its development. Microsoft Internet Explorer was the user software provided to the subjects. All of the functions within Internet Explorer operated in the same manner as if the application was taken from the World Wide Web.

3. Instrument

The exit survey consisted of three parts: 1) Demographic items or computer experience, 2) Likert type questions assessing feeling towards the Web site, and 3) Open-ended items to elicit subjective opinions. The first part, collecting demographic information, allowed the subject to choose from a list of descriptors (e.g. Squadron level, Intermediate level, etc.). The second and third part of the survey was a combination of Likert style questions and open-ended questions that allowed the subjects to interject comments they felt were relevant. The Likert questions were constructed using a five point rating scale with verbal anchors, as follows: Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree. The open-ended questions were included in the questionnaire to elicit respondent viewpoints regarding such factors as the overall impression of the Web based distribution, and comments regarding improving the usability of the Web site. The open-ended questions provided subjects an opportunity to comment on aspects of the prototype Web site they felt were not adequately covered in the previous portions of the survey (See Appendix D for survey).

4. Procedure

The subjects were divided into two groups of 26 and presented with an overview presentation of the study. The overview consisted of a projected computer demonstration of the Aviation Maintenance Safety Web site, and distribution of the materials necessary to carry out the user test. The materials used to direct the subjects exposure to the Web site included: Instructions for viewing the Aviation Maintenance Web site (Appendix B); Aviation Maintenance Safety Web Site Task List (Appendix C); and User's Impression of the Maintenance Safety Web Site and MCAS (Appendix D). The Instructions for viewing the Aviation Maintenance Web Site was a guide for the subject to follow enabling him/her to log on to the group account provided in the computer lab and access the Web site installed on the computer. As a portion of the group overview, specific questions subjects expressed on using the computers in the lab were addressed. The Task list was designed to take the subject through a series of planned navigation routes within the Web site. By completing the task list, the subject would have navigated through the entire prototype of the Aviation Maintenance Safety Web site.

C. DATA TABULATION

The data was transcribed from the exit survey into the software program SPSS (SPSS v. 9.0). Multiple choice responses were each assigned a value from one through four. The Likert style questions were based on a five point scale, these questions were coded into the SPSS software using five (5) through one (1) corresponding to the respective anchors (Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree). Once the data was transcribed, the analysis tools in the software SPSS were used to generate descriptive statistics including the mean, standard deviation, range, and frequency distribution. Content analysis was conducted on the responses provided from the open-ended survey questions.

D. DATA ANALYSIS

1. Analysis Strategy

The data from the surveys was transferred to the statistical analysis program SPSS (SPSS v.9.0) for analysis and interpretation. One-way Analysis of Variance (ANOVA) testing matched the level of user experience, Independent Variable (IV), with selected Dependent Variables (DV) gathered in the survey. The one-way ANOVA was used to assist in answering the difference (group comparison) issues raised from the study.

IV. RESULTS

A. FREQUENCY AND CONTENT ANALYSIS

The 21 item exit survey was administered to 52 subjects with a response rate of 88% (n = 46). The test users represented a cross section of the aviation commands that make up the squadrons of the Fleet. Each aviation command is required to have an officer trained by the School of Aviation Safety; as a result, the entire fleet is represented in this school at any given time. The sample included flight qualified Officers from Naval and Marine Corps Aviation and did not include Non-Commissioned Officers or Enlisted personnel.

1. Demographic Information

The material collected in Part I, the demographic portion of the exit survey determined the experience level each subject had with computers, as well as, the Internet and Internet browsers. This information is later used to determine if experience level with Internet browsers affected a subject's level of satisfaction, and impacted the usability of the Web site. Question one on the survey revealed that all participants were members of aviation units that performed maintenance at the squadron level (n = 46, 100%). Question two asked, "How long have you been using an Internet browser?" Table 1 shows the breakdown regarding experience each subject had with Internet browsers. A total of 82 percent (n = 38) of the subjects had at least one year of experience using the Internet.

"How long have you been using an Internet browser?"		
Experience	Number of Respondents	Percentage
Less than one month	4	9%
One month to < One year	4	9%
One year to < two years	9	19%
Two years or more	29	63%
Total	46	100%

Table 1. User Experience With a Computer Browser

2. User Satisfaction With the Web Site

Part II of the exit survey examined the subject's impressions of the layout and content of the Web site. Questions 6 through 9 specifically targeted the subjects' overall impression of the Web site. Question 6 asked, "My tour of the Web site was very interesting." and the mean was 3.87 (SD=.686). The range for question 6 was 4, and the histogram of the frequency distribution is presented in Figure 6. Clearly many respondents (74%) agreed that the tour of the Web site was interesting, with only one person disagreeing with this statement.

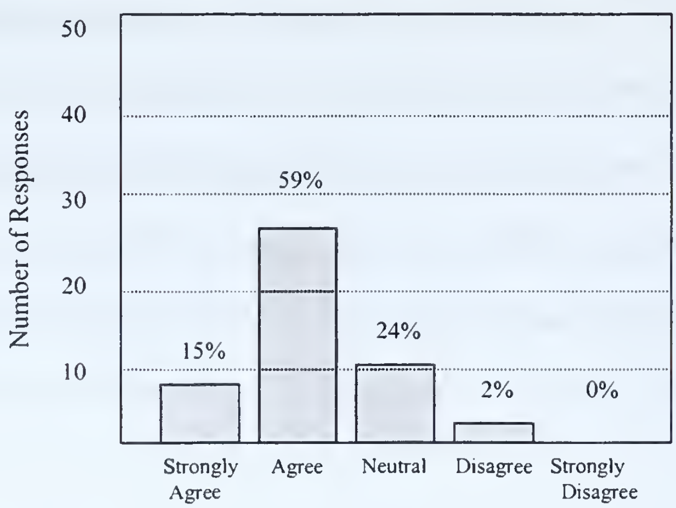


Figure 6. "Interesting"

Question 7 stated, “I found the Web site easy to navigate” and the mean was 4.35, (SD = .822). The range for question 7 was 4, and the histogram of the frequency distribution is presented in Figure 7. The vast majority (91%) agreed with this statement, while three persons disagreed.

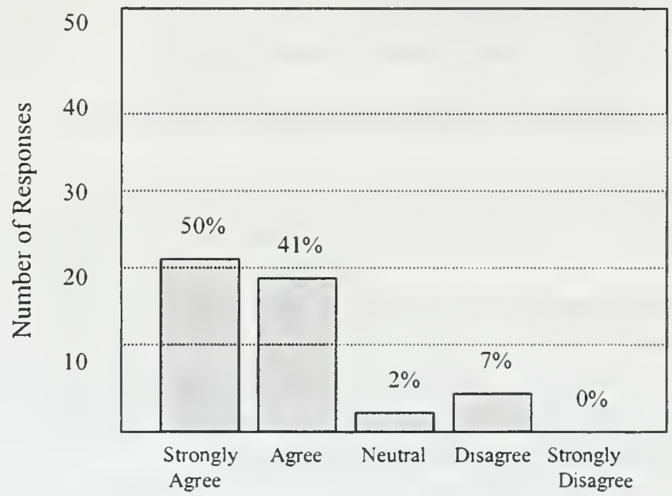


Figure 7. “Easy to Navigate”

Question 8 asked, “I feel the information on this Web site was in a logical form.” and the mean was 4.16, (SD = .556). The range for question 8 was 3, and the histogram of the frequency distribution is presented in Figure 8. Most respondents (91%) agreed that information was logically represented, with only four persons neutral on this topic.

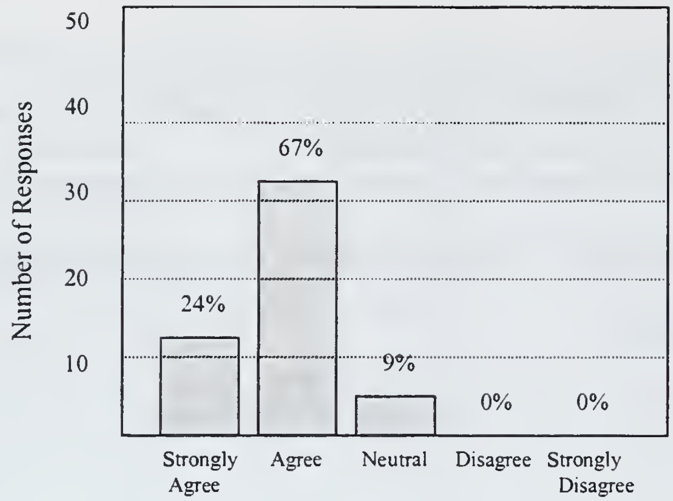


Figure 8. "Web Site in Logical Form"

Question 9 asked, "The information presented in the Web site is relevant to maintenance safety" and the mean was 4.37 (SD = .488). The range for question 9 was 2, and the histogram of the frequency distribution is presented in Figure 9. All subjects (100%) either strongly agreed or agreed with this statement.

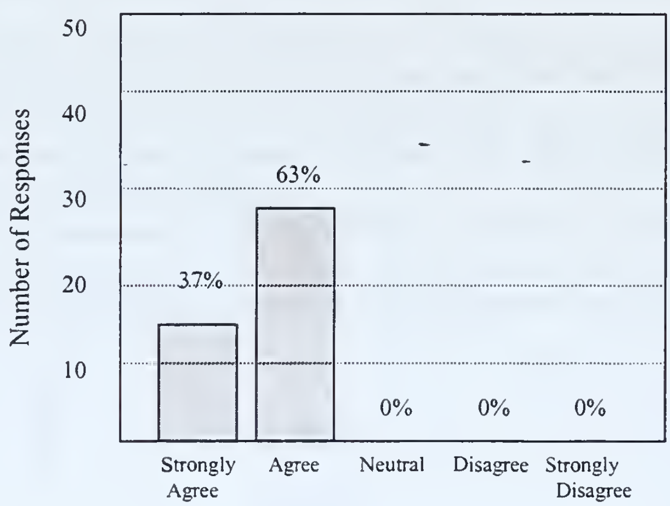


Figure 9. "Information Relevant"

After completing the Likert style questions in the first section of Part II, the respondent was asked to comment on his/her impression of the site through the open ended question, “My overall impression of the Web site is:” Below are listed some of comments that typified the response to this question.

“Looks like it’ll be useful. Especially the MCAS and MCAS analysis tools.”

“Simple, straight forward and should have useful information for safety issues.”

“Very user friendly Web site which contained both interesting and useful information.”

“Should be a good tool for promoting safety and existing tools.”

Subjects expressed general enthusiasm for the Web site and thought it would be useful in the distribution of safety related material.

The next four questions (10-13) of the exit survey looked at consistency issues. Consistency is important in both term usage and implicit instructions, this makes navigation through the Web site possible with minimum confusion. Whether consistency is achieved was determined by the impression of the respondent. These four Likert style questions were posed to allow each user of the prototype to comment on their perceived consistency throughout the exercise.

Question 10 asked, “During my tour of the Web site, I found the use of terms consistent” and the mean was 4.05 (SD = .630). The range to question 10 was 4, and the histogram of the frequency distribution is presented in Figure 10. The majority of users (74%) agreed with this statement, with only two users neutral and two disagreeing.

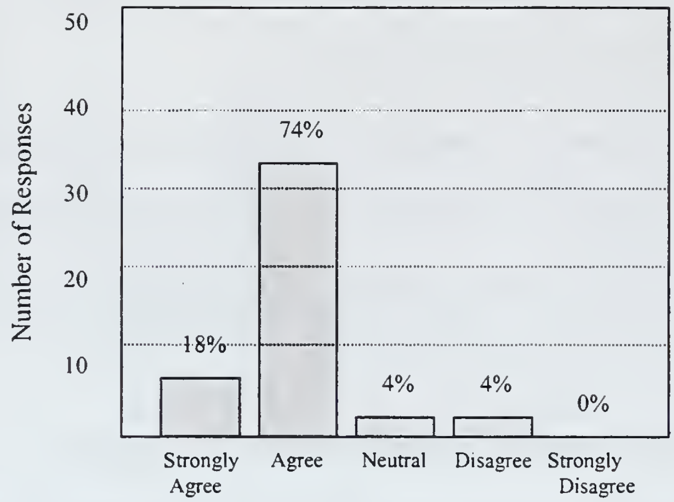


Figure 10. "Use of Terms Consistent"

Question 11 continued with consistency by asking, "During my tour of the Web site, I found The position of screen instructions were consistent" and the mean of this question was 4.31 (SD = .510). The range to question 11 was 3, and the histogram of the frequency distribution is presented in Figure 11. The majority (98%) agreed with this statement, and only one user was neutral.

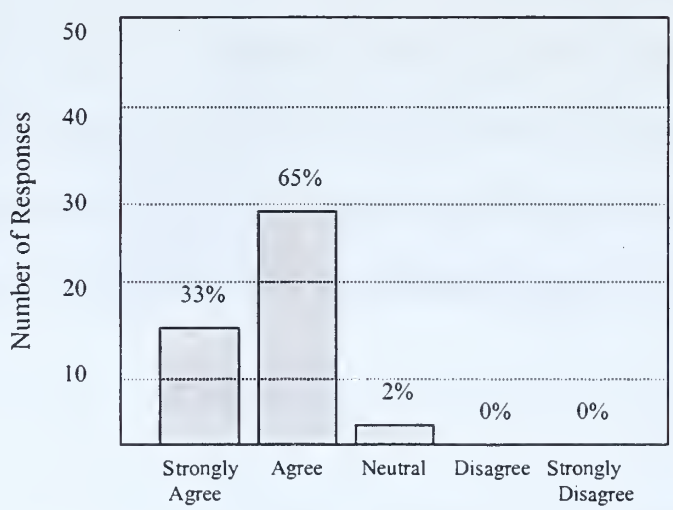


Figure 11. "Screen Instructions Consistent"

Question 12 asked, "I found the results obtained from the Web site were predictable" and the mean was 3.94 (SD = .611). The range of question 12 was 3, and the histogram of the frequency distribution is presented in Figure 12. A majority of the users (78%) found that they received consistent results from the Web site, although, nearly on quarter of the respondents (22%) were neutral on this aspect.

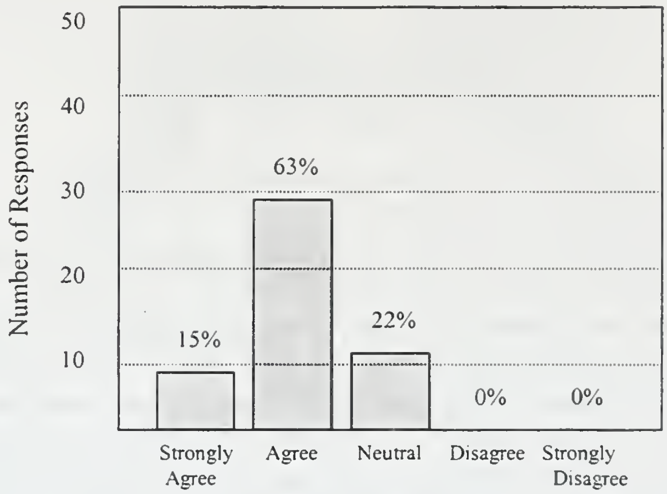


Figure 12. "Results Predictable"

Question 13 asked, "During my tour of the Web site, I found adequate instructions were provided to navigate" and the mean was 4.22 (SD = .757). The range for question 13 was 4, and the histogram of the frequency distribution is presented in Figure 13. Most users (89%) aggreed adequate instructions were provided, while three persons were neutral and two persons disagreed.

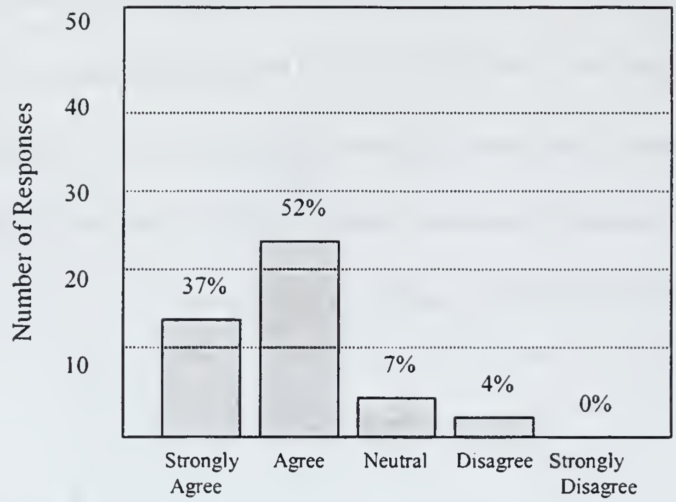


Figure 13. "Adequate Navigation Instructions"

The next five questions on the survey (14-18) addressed the organization and clarity of the information presented in the prototype Web site. These questions concentrate on the experience of the user while learning the methods employed to navigate the site. An open-ended question at the end of this section provided the subject an opportunity to voice opinions not covered in the Likert scale questions.

Question 14 asked, "I feel that the information on the Web site is easy to understand" and the mean was 4.16 (SD = .868). The range for question 14 was 4, and the histogram of the frequency distribution is presented in Figure 14. While a majority agreed (87%) the information was easy to understand, two subjects were neutral, with two disagreeing.

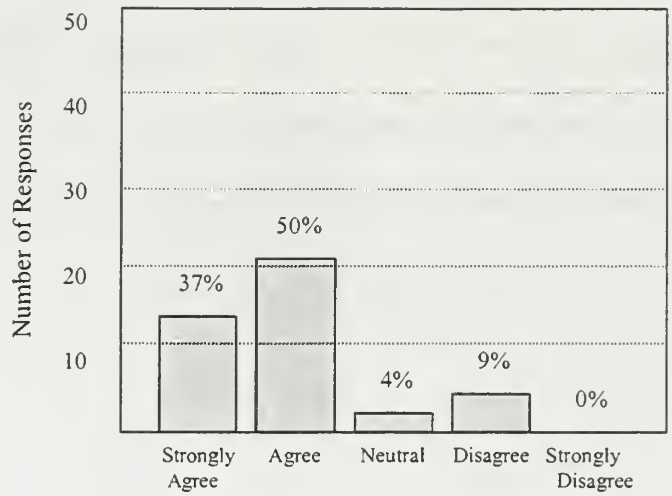


Figure 14. "Information Easy to Understand"

Question 15 stated, "I feel that it was easy to learn to use this Web site" and the mean was 4.42 (SD = .652). The range for question 15 was 3, and the histogram of the frequency distribution is presented in Figure 15. A large majority (91%) agreed with this statement, while half (50 %) strongly agreed with the ease of learning the Web site.

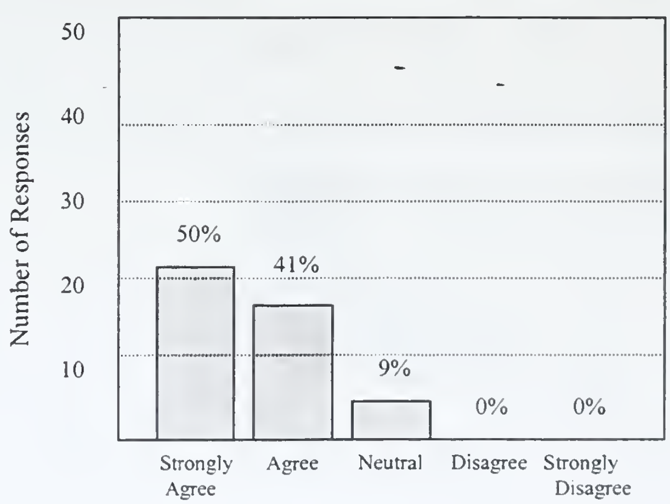


Figure 15. "Ease of Learning the Web Site"

Question 16 stated, "I feel that the organization of material on this Web site is clear" and the mean was 4.05 (SD = .815). The range for question 16 was 4, and the histogram of the frequency distribution is presented in Figure 16. Most users (82%) the organization was clear, while five users were neutral and three users disagreed.

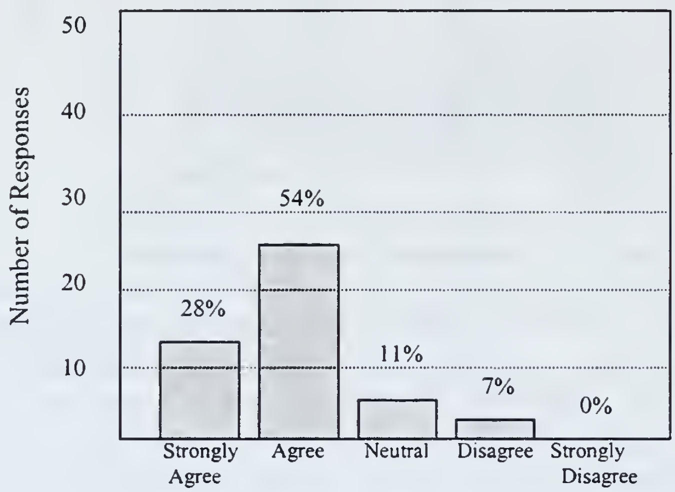


Figure 16. "Organization of Material"

Question 17 stated, "I feel that I could effectively use the information on this Web site" and the mean was 4.35 (SD = .566). The range for question 17 was 3, and the histogram of the frequency distribution is presented in Figure 17. The majority of respondents (96%) agreed, with two persons being neutral.

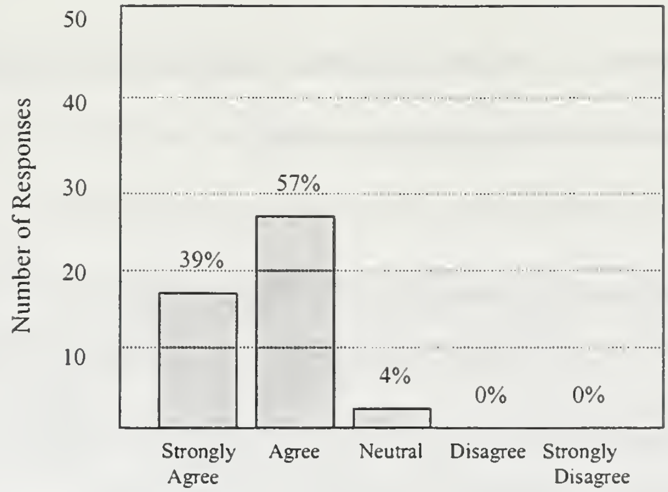


Figure 17. "Effectively Use the Information"

Question 18 stated, "I feel that when fully implemented, this Web site will have all the functions and capabilities I would expect it to have" and the mean was 4 (SD = .760). The range for question 18 was 4, and the histogram of the frequency distribution is presented in Figure 19. Most users (81%) agreed, whereas nine users disagreed.

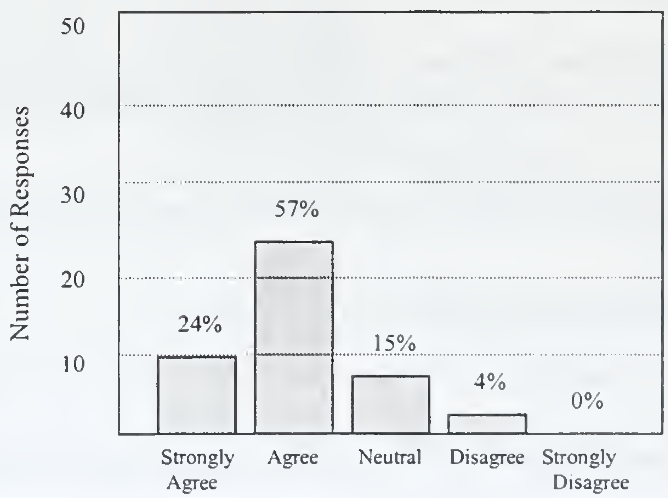


Figure 18. "Web Site has all Functions I Expect"

The open ended question in the final section of Part II of the Exit Survey asked, "To improve the usability of this Web site, I would." The purpose of this question was twofold; first, allow the respondent to voice any usability concerns that were not covered in the Likert style questions, and second, highlight any issues the study may have omitted. The responses to this question are summarized in Table 2.

"To improve the usability of this Web site, I would"		
Type of Response	Number of Responses	Percent of Total
No Response	16	35%
Written Response	30	65%

Table 2. Comments on Usability Improvements

Of the 30 responses, most commented that the Web site was user friendly and did not offer suggestions for improvement to the prototype. The responses that suggested changes to the prototype were typified by the comments below.

> "Provide more links on the first page to make it more efficient and easier to the final page I am after. Index or reference at the start or bottom of the page would work."
>
> "Perhaps on the opening slide there could be something like a table of contents. It would be useful to know everything that is contained on the Web site."
>
> "... Also, home page is confusing, I would title the button START HERE instead of ENTER."
>
> "Add a link to the NASA safety site."
>
> "Use Frames."

A common theme of these answers was one of mild navigational preferences, some relating to verbage and others related to the physical layout of the Web site.

3. User Satisfaction With the Online MCAS

Part III of the Exit Survey contained questions pertaining to the online version of the MCAS. To effectively use the online MCAS, the user needed to be capable of finding the MCAS in the Web site, and he/she also needed to comprehend the method of completing the questionnaire and submitting it. Questions 19 through 21 deal with the feelings about the clarity of instructions and ease of completing the online MCAS.

Question 19 asks, "Finding the online MCAS in the Aviation Maintenance Safety Web site was straight forward" and the mean was 4.44 (SD = .655). The range for question 19 was 4, and the histogram of the frequency distribution is presented in Figure 19. The vast majority of users (96%) either strongly agreed or agreed with this statement, and two were neutral or disagreed.

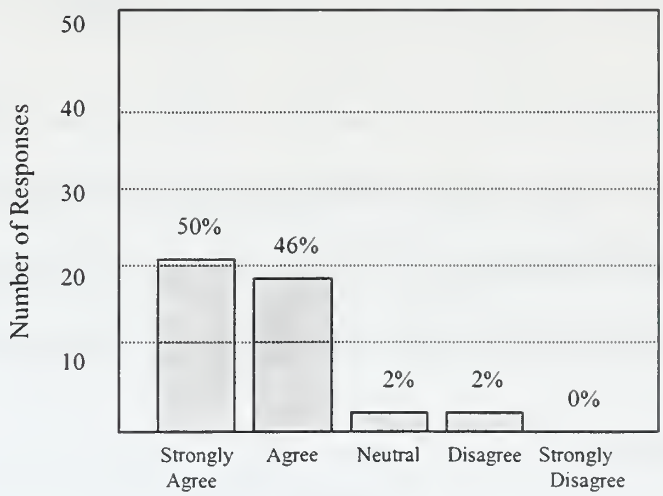


Figure 19. "Finding the MCAS"

Question 20 asked, "The instructions for completing the MCAS are easily understood" and the mean was 4.64 (SD = .488). The range for question 20 was 2, and the histogram of the frequency distribution is presented in Figure 20. All respondents (100%) either strongly agreed or agreed to this question.

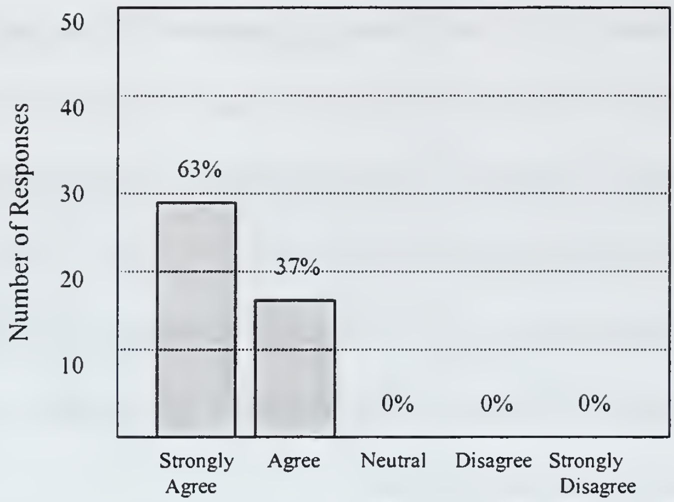


Figure 20 "Instructions for MCAS Understood"

Question 21 asked, "The task of putting answers in the MCAS was easily completed" and the mean was 4.55 (SD = .585). The range for question 21 was 3, and the histogram of the frequency distribution is presented in Figure 21. Mainly users (96%) strongly agreed or agreed with this question, with the exception of two persons who were neutral.

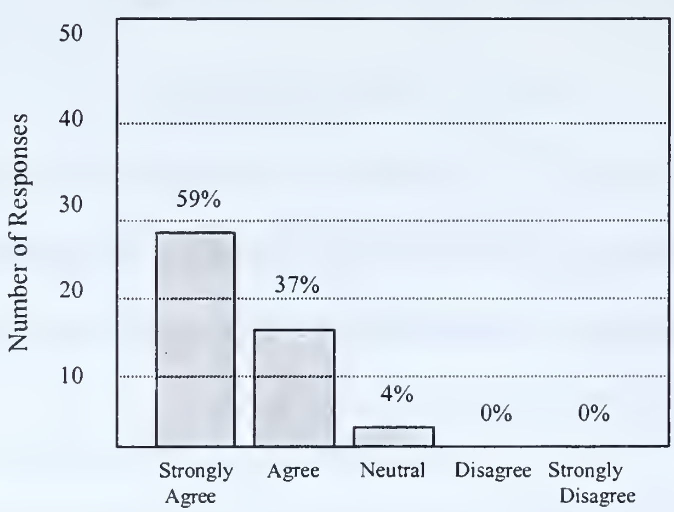


Figure 21. "Submitting Answers to the MCAS was Easy"

The final question in Part III of the Exit Survey was the open ended question "I would make these changes (if any) to the administration of the online MCAS." The response rate to this question is summarized in Table 3 below.

"I would make these changes (if any) to the administration of the online MCAS."		
Type of Response	Number of Responses	Percent of Total
No Response	12	26%
Written Response	34	74%

Table 3. Comments on MCAS

Content analysis of the open-ended responses yielded a grouping of similar themes. Users commented on the content of the survey as well as the administration, below are typical responses to the online MCAS.

> "The survey is too long…Your average trooper will not willingly (hence honestly) fill out such an in-depth survey."
>
> "I am a Marine 53-E Pilot and many of the questions did not pertain to me. Some of those did not have N/A as a selection."
>
> "E-6 Community- Where would it fall?"
>
> Administrative Comments:
>
> "Have an option of no graphics/cookies. Units at sea have minimal bandwidth and download time is terrible."
>
> "I tried to tab thru [sic] the questions (instead of mouse). I thought hitting ENTER would record an answer, but instead… it submitted the survey before I was complete."

"… having to manually scroll down continually to answer more questions was annoying."

"Have more questions on one page"

Comments in this area ranged from a concern that the length of the survey might inhibit the validity of some respondent's answers (attention span) to physical limitations of the movement through the Web site (utilizing back button of browser, etc.).

The final area of the Exit Survey was labeled "Comments" and posed two the open ended questions "The most negative aspects of this Web site were" and "The most positive aspects of this Web site were". The response rate to each of these questions is summarized in Table 4 and Table 5.

"The most negative aspects of this Web site were."		
Type of Response	Number of Responses	Percent of Total
No Response	5	11%
Written Response	41	89%

Table 4. Comments on Negative and Positive Aspects of online prototype

"The most positive aspects of this Web site were."		
Type of Response	Number of Responses	Percent of Total
No Response	3	7%
Written Response	43	93%

Table 5. Comments on Negative and Positive Aspects of online prototype

The Comments on both negative and positive aspects of the prototype Web site were analyzed and the most representative comments are listed below.

Negative Aspects:

"Having to back out after completing the survey"

"Marine billets not included"

"Lack of visual stimulation for the Gen X/ Mountain Dew crowd."

"Too much wasted space on the main pages"

"Survey might be too long, you'll surpass the attention span of your target audience."

"Survey on the long side"

Positive Aspects:

"Ease of use, simplicity"

"Power point Lectures"

"A great information hwy for maintenance. Nothing but positive results can come from this site."

"Generally easy to use"

"Easy access, easy to navigate, accessible to everybody"

"Should provide good background data"

The negative comments centered on a concern that young sailors would not take the time to complete the survey because of it's length. The positive comments characterized a Web site that was easy to use and contained useful information for safety programs.

B. ANOVA TESTING

1. One Way ANOVA

SPSS software provides a metric called the significance level, also known as p value, which allows the researcher to interpret a calculated statistic in the generated output without using a critical value table. The symbol p equates to the probability of a Type I error. A Type I error is the likelihood of rejecting the null hypothesis when it is actually true. If the reported p is less than .05, the finding is statistically significant and the null Hypothesis (no difference) is rejected (Morgan & Griego, 1998).

A one-way ANOVA was used to compare the means of different respondent experience levels to test for significant differences in levels of usability. ANOVA assumes the Dependant Variable (DV) is interval scale, normally distributed, and the variance of the groups are equal. If the assumptions of ANOVA are violated, an alternative nonparametric test called the Kruskal-Wallis (K-W) test should be used to compare the differences. It was not necessary to use the Kruskal-Wallis test with the data from this study, since it met all the parameters necessary to for ANOVA analysis. The Independent Variable (IV) in this study was represented as ordinal data while the DVs were measured on an interval scale. The distributions of each of the DVs were compared to a normal distribution curve to ensure they approximated the normal distribution.

The equality of variances was tested using the Levene Test (Kotz, Johnson, & Read, 1988). Since the Levene statistic was not significant ($p > .05$), the assumption of equal variances was not violated and the K-W test was not needed. (Morgan & Griego, 1998). The ANOVA statistic compares means between groups and is used to identify a statistically significant difference between means. If the p value calculated by an ANOVA test is significant ($p < .05$) then there is a significant difference between groups with respect to the DV. In order to answer the difference between the IV and the individual DVs, hypotheses were developed and tested.

2. Formulation of The Null Hypothesis

The null hypothesis is used for testing; it is a statement that no difference exists between the parameter and the statistic being compared to it (Cooper & Emory, 1995). The Alternative hypothesis is the logical opposite of the null hypothesis. If statistically significant, the null hypothesis can be rejected, and the alternative hypothesis is accepted. The following hypotheses formed and tested to compare how the IV (User experience level) impacted the DV (User impressions).

1) IV: How long have you been using an Internet Browser?

DV: I found the Web site easy to Navigate.

NULL HYPOTHESIS: there is no difference in how experience level impacted the ease of navigation of the Web site.

The F statistic with 3, and 42 degrees of freedom was 1.494. This resulted in a p value of .234, which did not allow rejection of the null hypothesis.

2) IV: How long have you been using an Internet Browser?

DV: I feel the information on the Web site was in a logical form.

NULL HYPOTHESIS: There is no difference in how experience level impacted perception of whether the information was presented in a logical form.

The F statistic with 3, and 42 degrees of freedom was .799. This resulted in a p value of .503, which did not allow rejection of the null hypothesis.

3) IV: How long have you been using an Internet Browser?

DV: I found that adequate instructions were provided to navigate the Web site.

NULL HYPOTHESIS: There was no difference in how experience level impacted whether respondent felt enough instructions were provided.

The F statistic with 3, and 42 degrees of freedom was 1.494. This resulted in a p value of .234, which did not allow rejection of the null hypothesis.

4) IV: How long have you been using an Internet Browser?

DV: It was easy to learn to use this Web site.

NULL HYPOTHESIS: There is no difference in how experience level impacted the ease of learning to use the Web site.

The F statistic with 3, and 42 degrees of freedom was 2.287. This resulted in a p value of .097, which did not allow rejection of the null hypothesis.

With each case, the null hypothesis could not be rejected. The comparison of the subject's experience level with Internet browsers to usability concerns, does not impact the impression the subject had on the Web site's usability.

V. CONCLUSION

A. SUMMARY

Naval Aviation is posed with the challenge of reducing its mishap rate, making it essential to pursue programs and processes to achieve this. Organizational climate has been linked to risk management and, consequently, experienced mishaps. Understanding the climate that pervades an organization is essential if changes are to be made to ultimately effect the mishap rate.

Many theoretical frameworks have been developed to understand organizational climate; one that fits the characteristics of Naval Aviation is the High Reliability Organization model (HRO). Working within the HRO framework, the Command Safety Assessment (CSA) survey evaluated the safety climate within Naval Aviation Squadrons from aircrew perspective. The Maintenance Climate Assessment Survey (MCAS) was designed to measure HRO characteristics, but from a perspective of the aviation maintainer.

In order to provide for an effective vehicle to distribute the MCAS, the World Wide Web (WWW) was explored. The WWW offers an opportunity to obtain a wide distribution of material at a very small, fixed cost. Shrinking budgets within the military necessitates finding new methods of mission accomplishment, therefore making the efficiency of the WWW a method of allowing process improvement within the confines of shrinking budgets.

B. CONCLUSIONS

This research, based on the initial research questions, has given the following:

1) Is there a need to disseminate and administer Web based materials to aviation units? Naval Aviation is challenged to meet aggressive reductions in its mishap rate by the year 2000. Even with the record low mishap rates that have been achieved in recent years, continued improvement is necessary. The HFQMB is seeking the “invention” of new processes and procedures to help meet the goals set forth in mishap reduction. A Web based MCAS will further facilitate climate assessment and evaluation throughout the Naval Aviation Fleet, improved methods of assessment will lead to process improvements for Naval Aviation.

2) Do the U.S. Navy and Marine Corps squadrons have the necessary software/hardware capabilities to utilize the WWW? As technology permeates the fleet, it is clear that the ability to utilize the WWW at the squadron level exists. A total of 97 percent of the subjects in this study had access to the WWW (n = 46). The remaining 3 percent involved in this study were not familiar with the computing capability at their future squadron assignment.

3) Can the MCAS be effectively distributed and administered using the WWW? Development software available enables the design and implementation of surveys for applications on the WWW. The HTML editors that are commonly available facilitate the design of a Web site for distribution of the MCAS. The current level of technology can easily support the dissemination and collection of data from the MCAS.

4) Once distributed, do personnel have the necessary ability to utilize the electronic version of the MCAS? The subjects in this study were representative of ASOs throughout the fleet, 82 percent ($n = 46$) had over one year experience using the Internet. Successfully navigating the prototype of the Naval Aviation Maintenance Safety Web Site, subjects not only demonstrated the requisite knowledge for using the online tool, they demonstrated an acceptance and enthusiasm for the project.

Adequate knowledge exists within the ASO community to make effective use of the WWW as a distribution method for the MCAS. Using the efficiency obtained through the WWW allows increased distribution of the MCAS with minimal cost. Taking advantage of the software and hardware that is currently in place within aviation squadrons is an additional step to achieving the improvements that Naval Aviation must accomplish to meet its goals of mishap reduction.

C. RECOMMENDATIONS

Many areas remain open for further development and testing of the Naval Aviation Maintenance Safety Web Site. It is suggested that further research efforts include the following areas: 1) Inclusion of survey feedback into the layout and design of the Web site, 2) Populating the pages that were data space holders, (e.g., summaries of mishaps, etc.), and 3) Further development of data capture methods.

APPENDIX A. AVIATION MAINTENANCE SAFETY WEB SITE

This appendix consists of three parts: (1) A verbal description of the pages that make up the Aviation Maintenance Safety Web site, (2) A symbolic depiction of the logical layout of the Web site, (3) Screen captures of the pages that make up the complete prototype Aviation Maintenance Web site.

Part 1. Verbal Description of Web Pages

Page 1: Title page for the Web site.

Page 2: Welcome/Purpose page. Branches to page: 2.1

Page 2.1: Safety Survey Page. Branches to pages: 2.1.1, 2.1.2, and 2.1.3

Page 2.1.1: MCAS

Page 2.1.2: Fleet Statistics on Excel

Page 2.1.3: Interpretation Materials

Page 2.2: Related Web sites.

Page 3: Aviation Maintenance Training Page. Branches to pages: 3.1, 3.2

Page 3.1: Groundcrew Coordination Training. Branches to pages: 3.1.1, 3.1.2, and 3.1.3

Page 3.1.1: Workshop Materials.

Page 3.1.2: Student Guide.

Page 3.1.3: Case Studies.

Page 3.2: FAA Document.

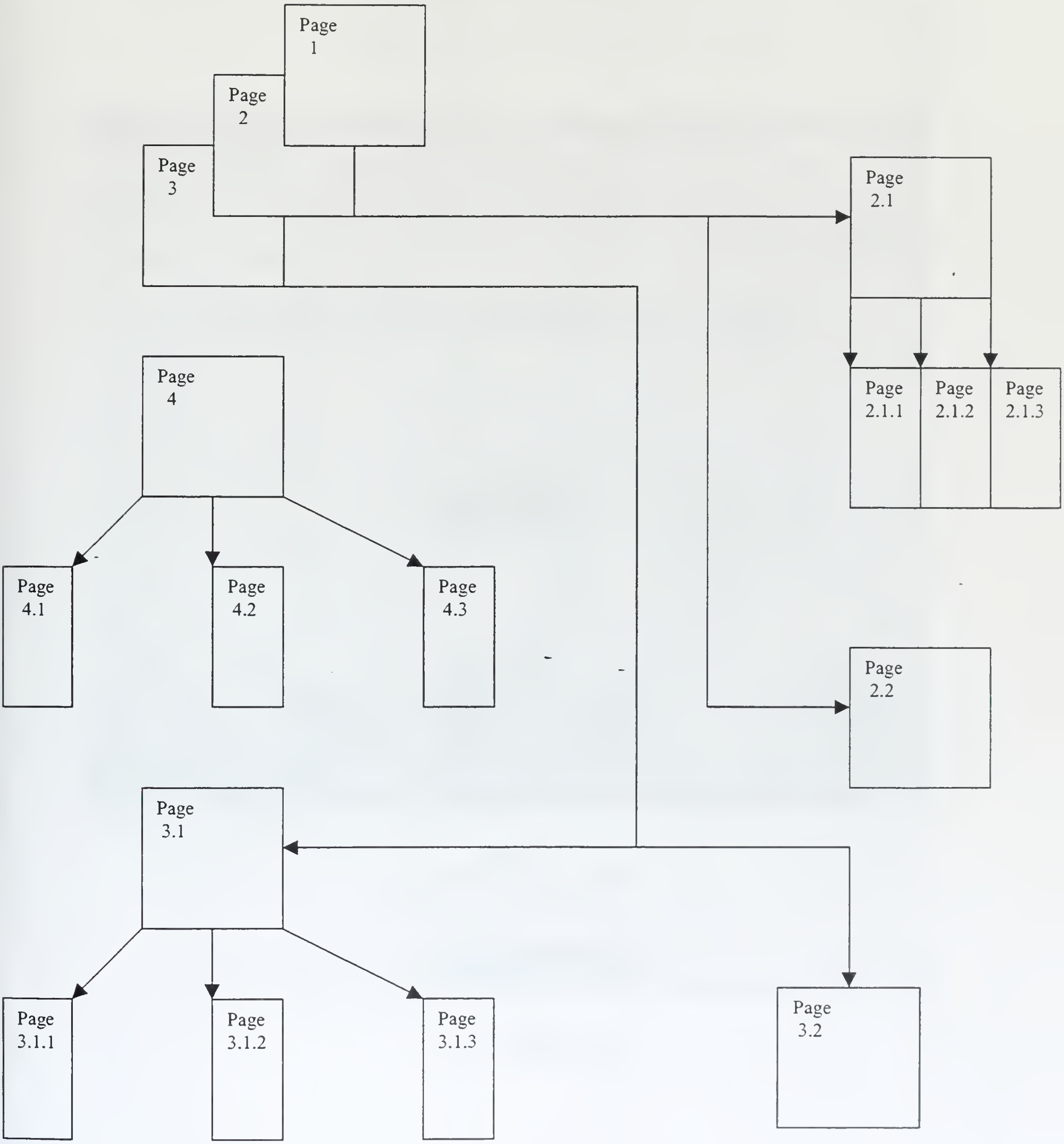
Page 4: Community Maintenance Human Factors Briefs.

Page 4.1: Community Human Factors Briefs for Jets.

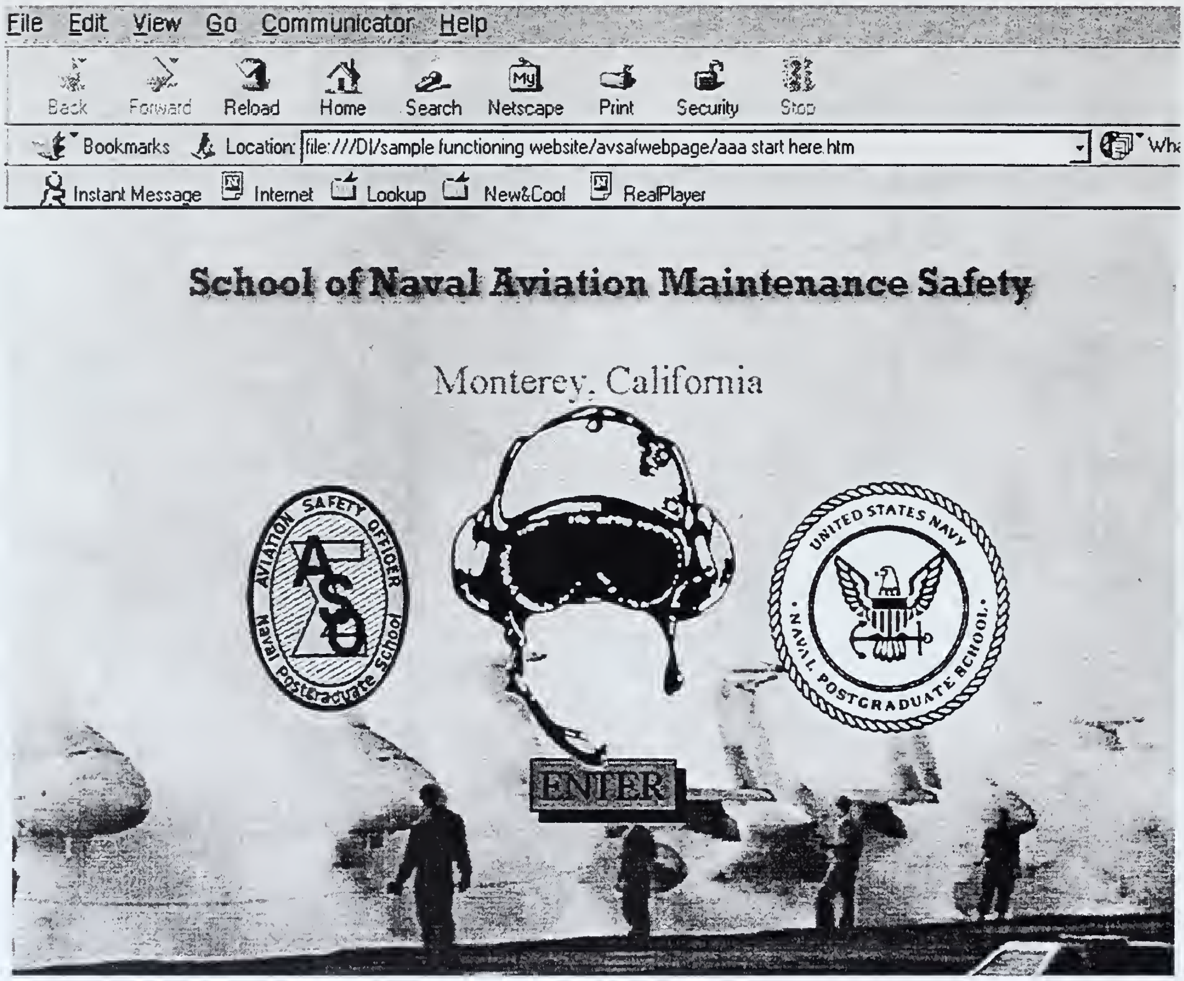
Page 4.2: Community Human Factors Briefs for Props.

Page 4.3: Community Human Factors Briefs for Helos.

Part 2. Symbolic Depiction of the Logical Layout of the Web Site

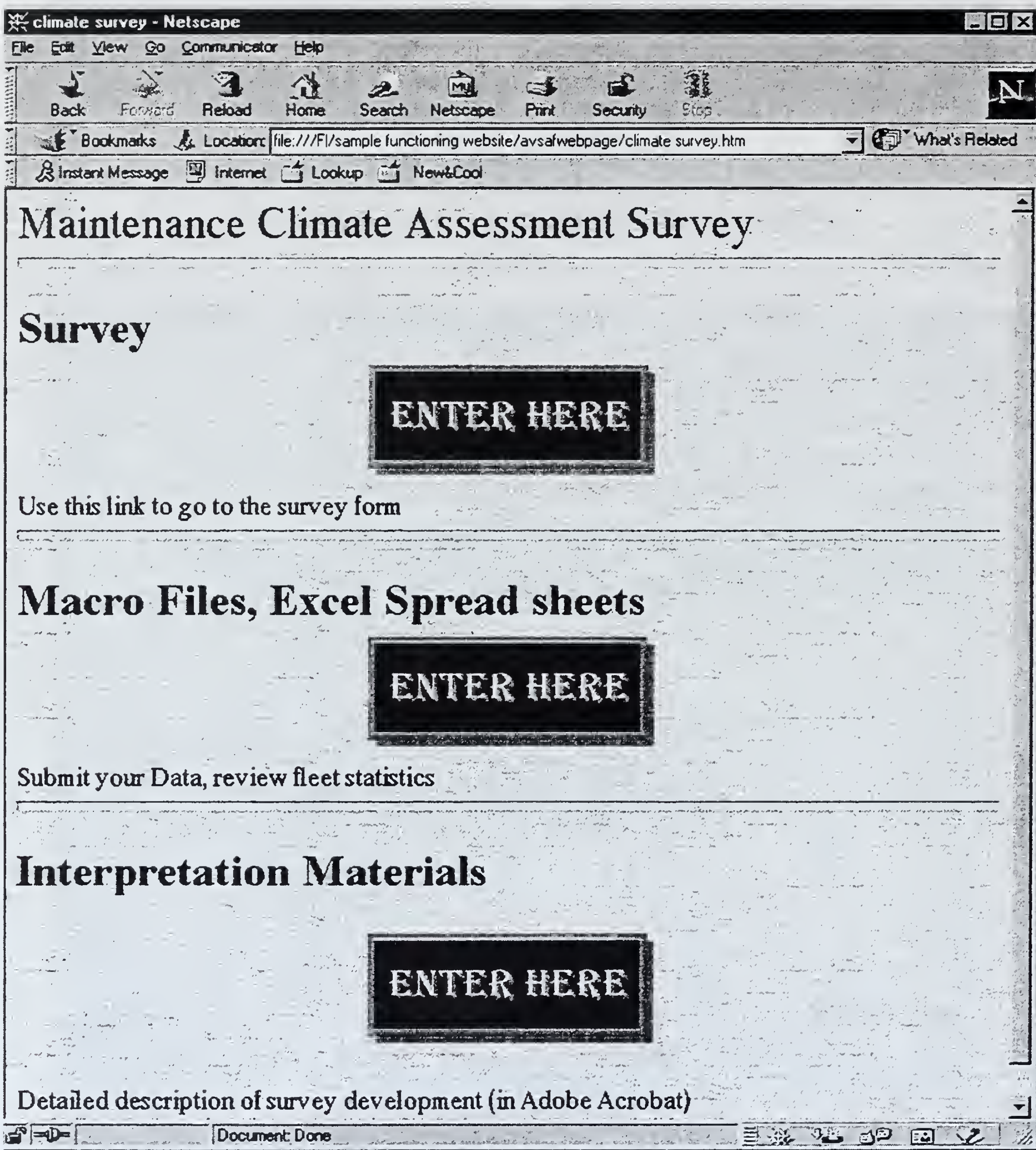


Part 3. Screen Captures of the Aviation Maintenance Safety Web Site

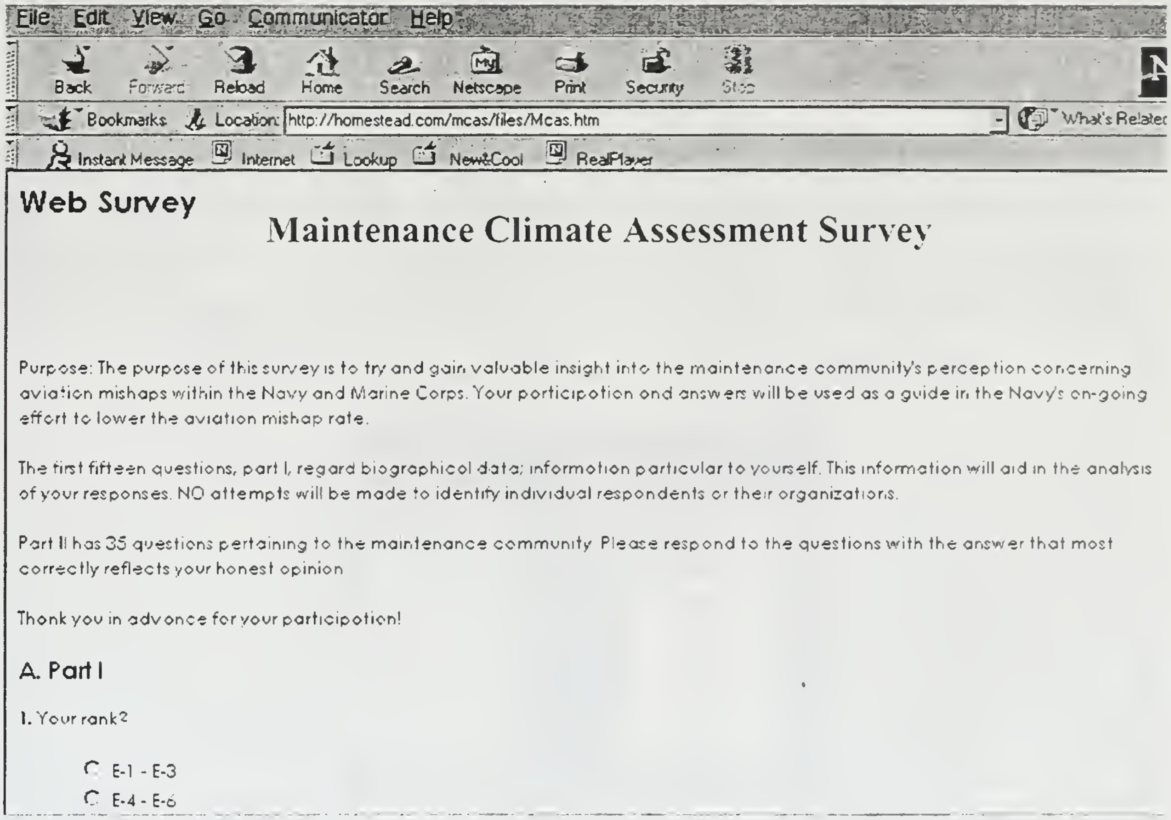


Page 1
Title page for the Web site

Page 2
Welcome/Purpose page



Page 2.1
Safety Survey Page



Web Survey

Maintenance Climate Assessment Survey

Purpose: The purpose of this survey is to try and gain valuable insight into the maintenance community's perception concerning aviation mishaps within the Navy and Marine Corps. Your porticipotion ond answers will be used as a guide in the Navy's on-going effort to lower the aviation mishap rate.

The first fifteen questions, part I, regard biographicol data; informotion particular to yourself. This information will aid in the analysis of your responses. NO attempts will be made to identify individual respondents or their organizations.

Part II has 35 questions pertaining to the maintenance community. Please respond to the questions with the answer that most correctly reflects your honest opinion

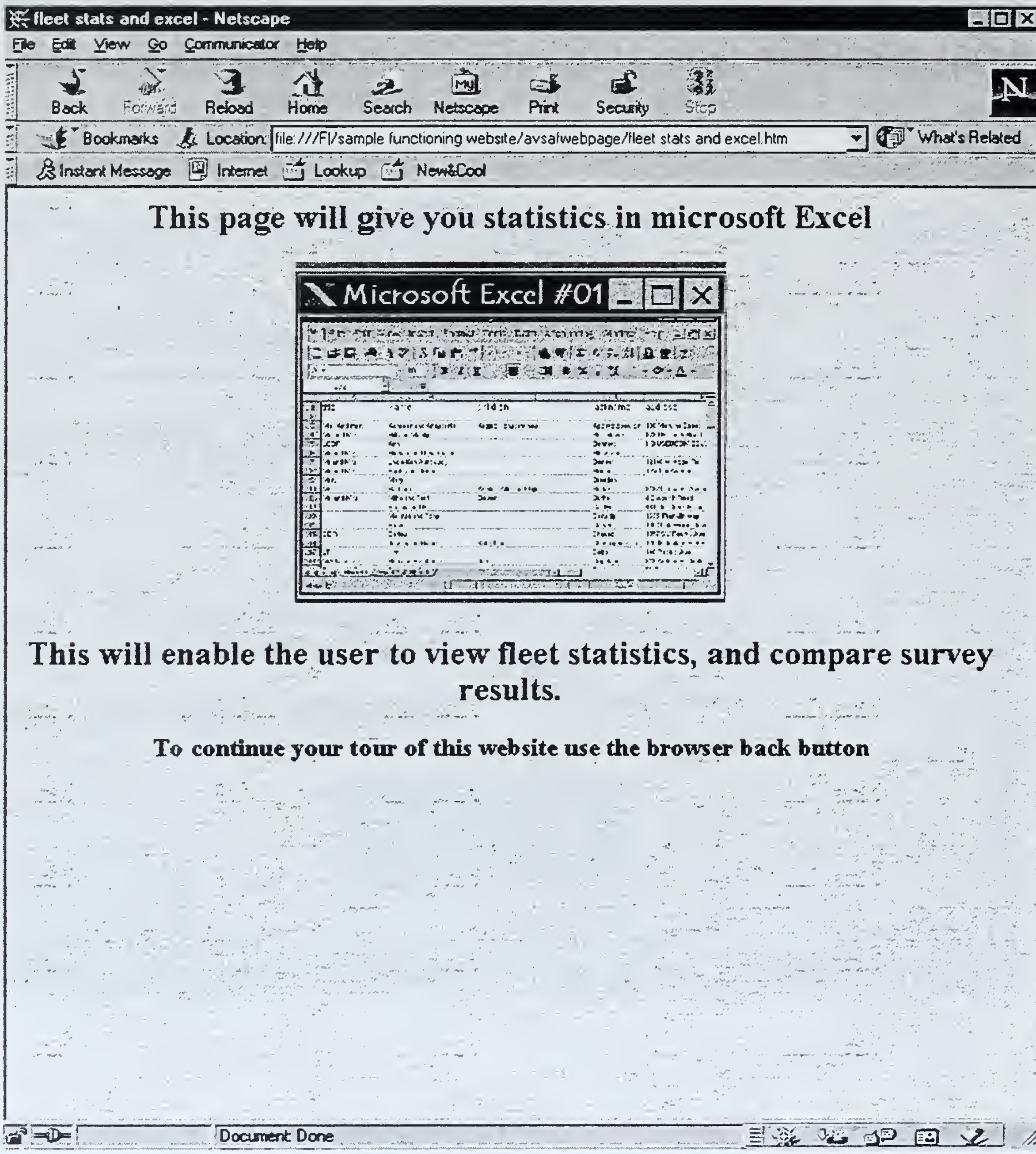
Thonk you in advonce for your participotion!

A. Part I

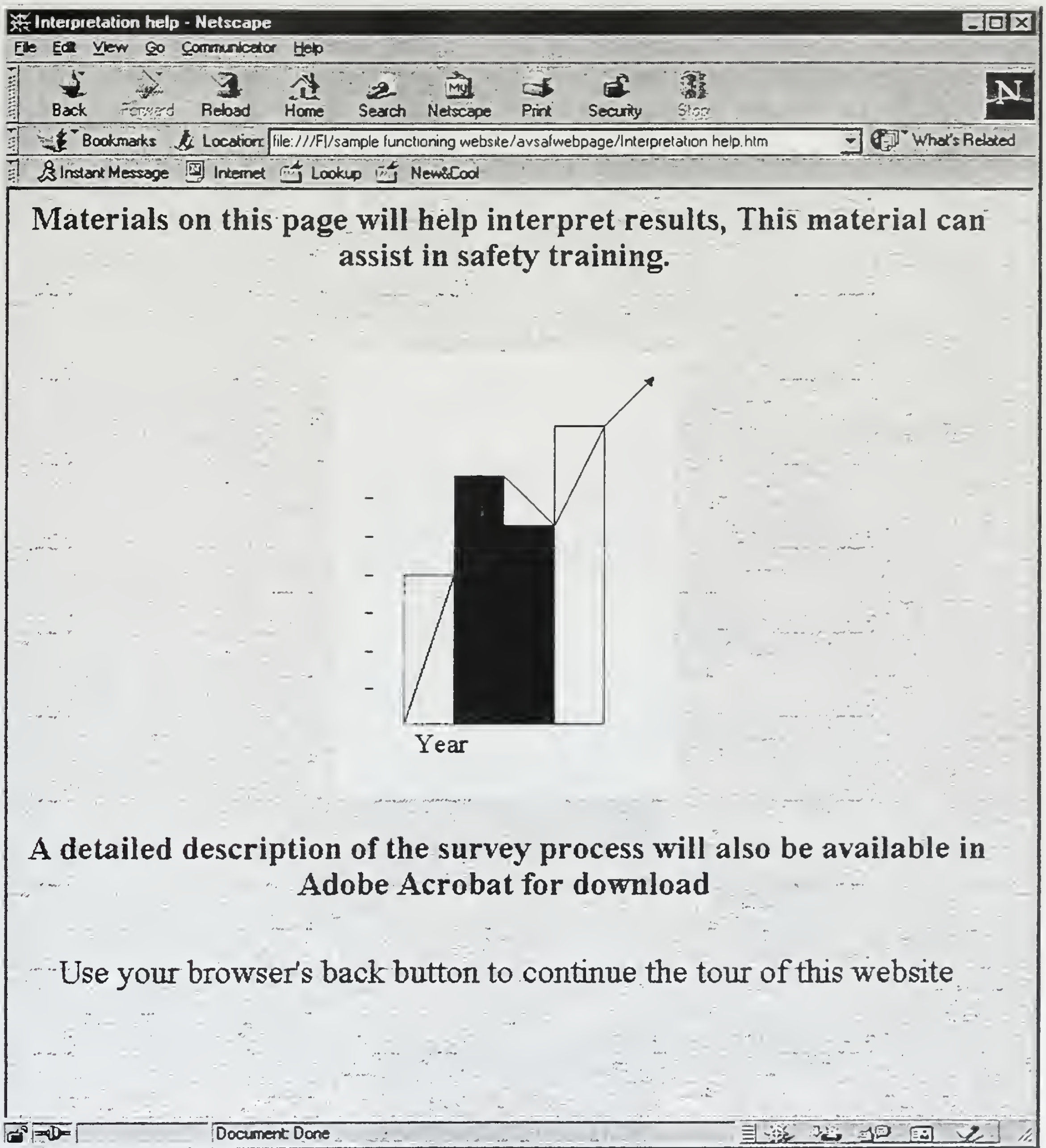
1. Your rank?

- E-1 - E-3
- E-4 - E-6

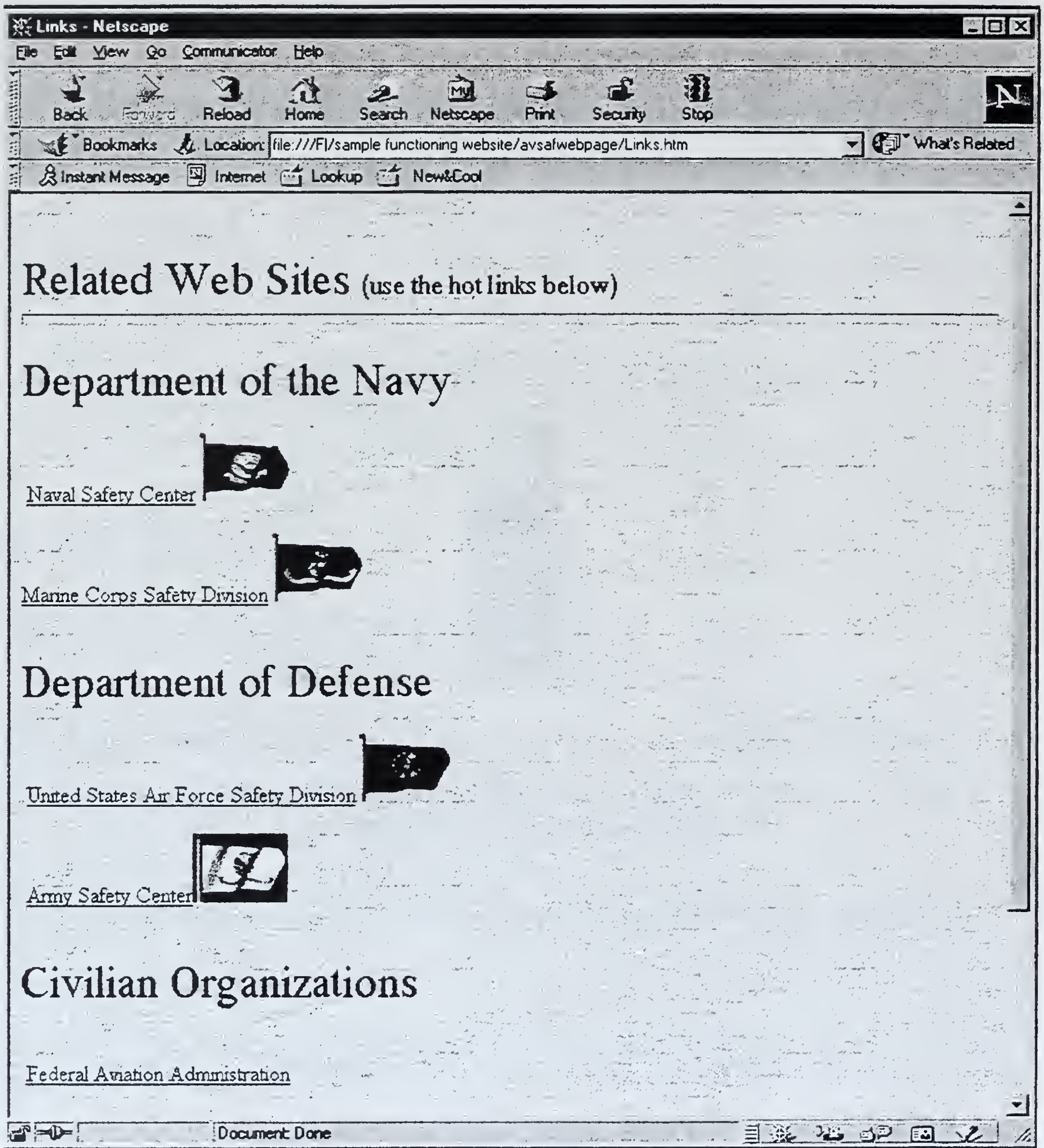
Page 2.1.1
Maintenance Climate Assessment Survey



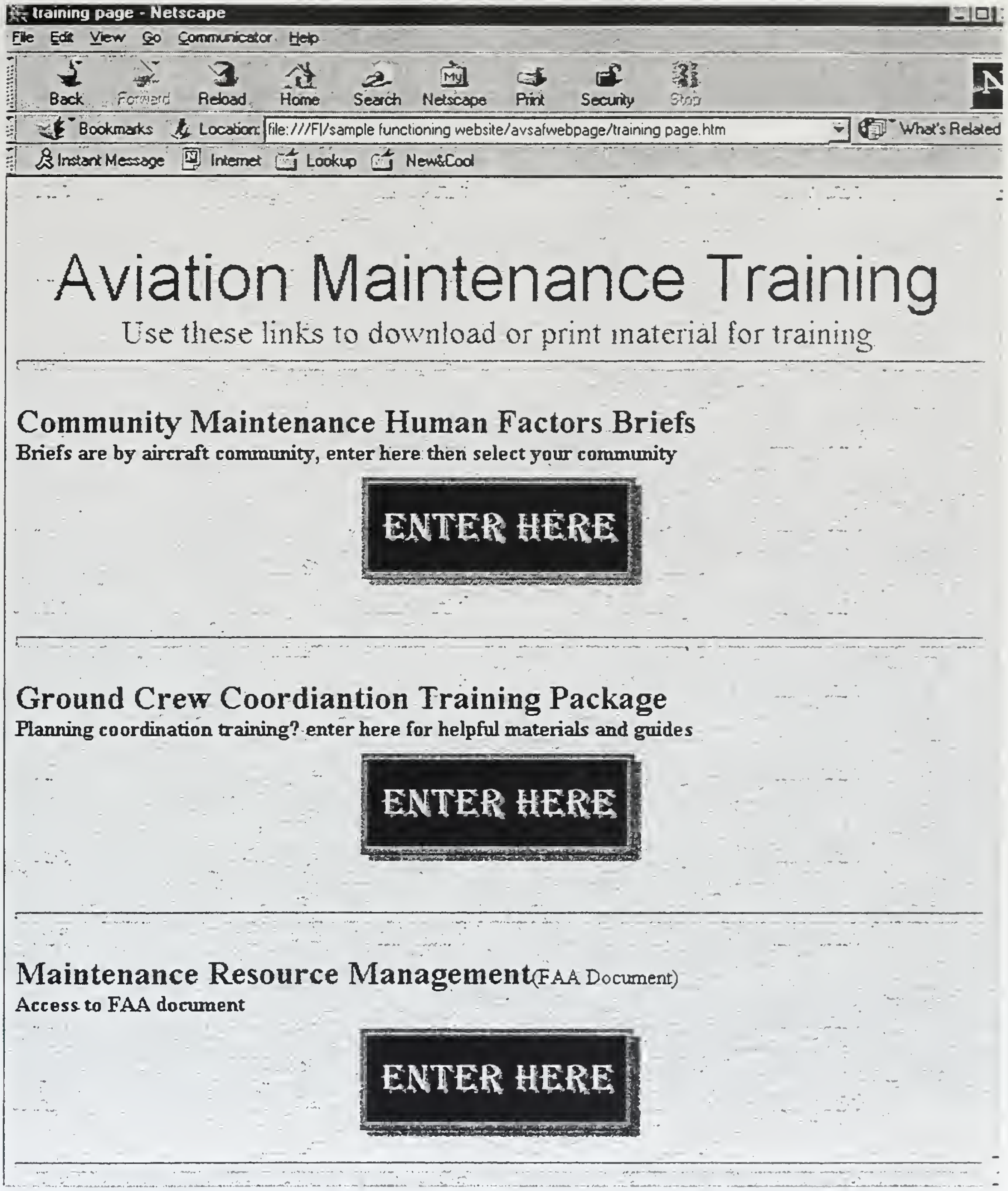
Page 2.1.2
Fleet Statistics on Excel



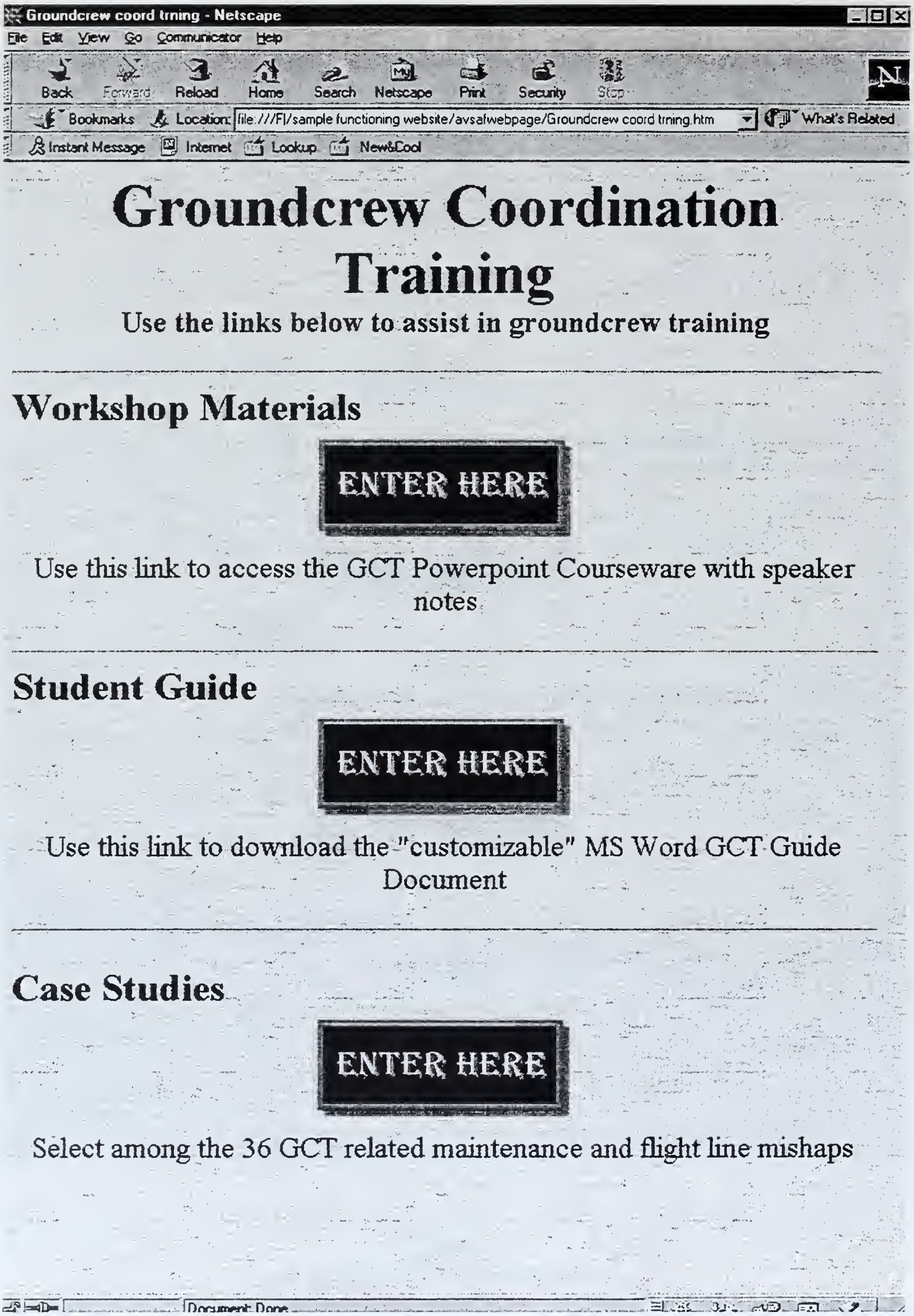
Page 2.1.3
Interpretation Materials



Page 2.2
Related Web sites



Page 3
Aviation Maintenance Training Page



Groundcrew Coordination Training

Use the links below to assist in groundcrew training

Workshop Materials

ENTER HERE

Use this link to access the GCT Powerpoint Courseware with speaker notes

---

Student Guide

ENTER HERE

Use this link to download the "customizable" MS Word GCT Guide Document

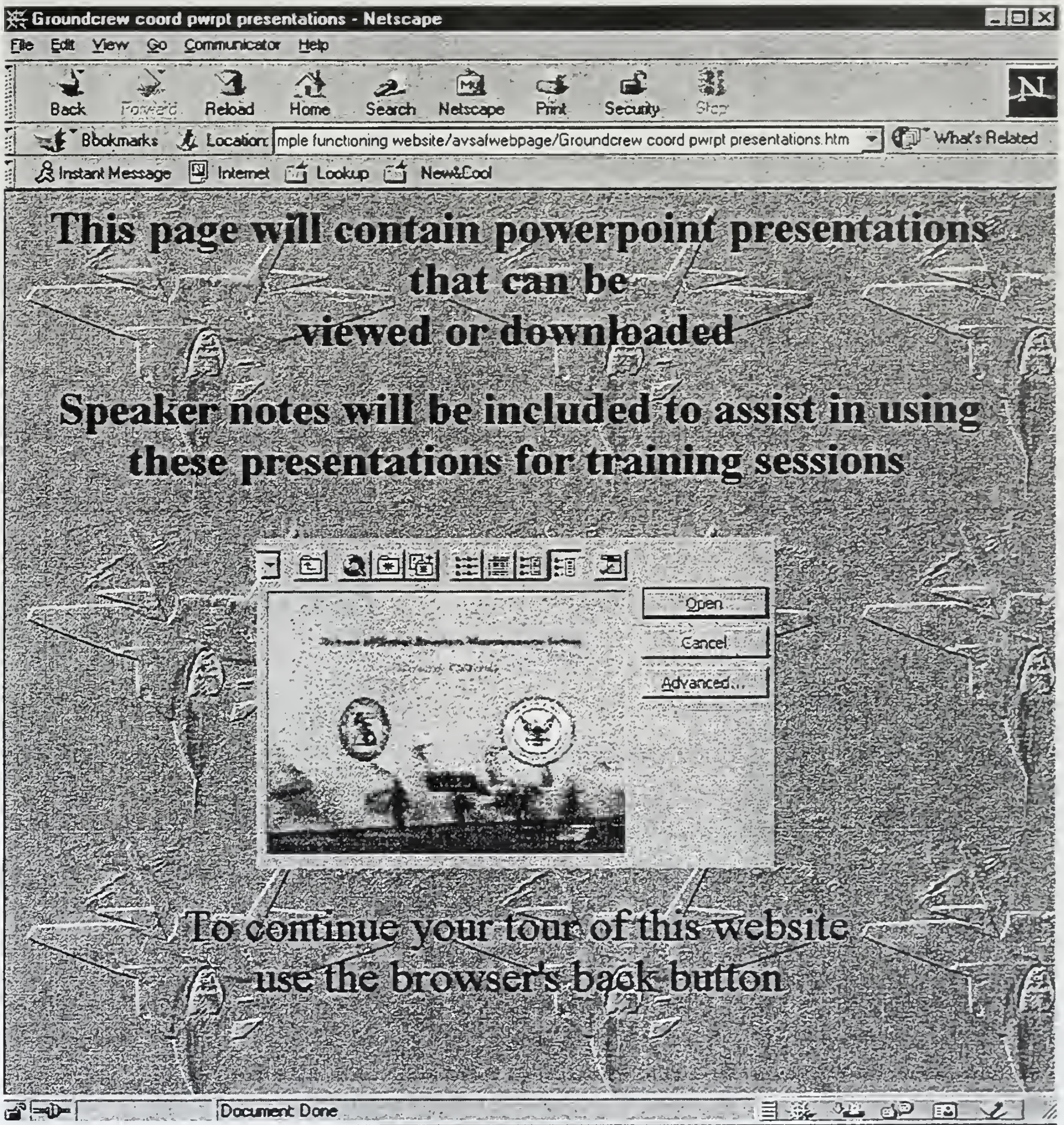
---

Case Studies

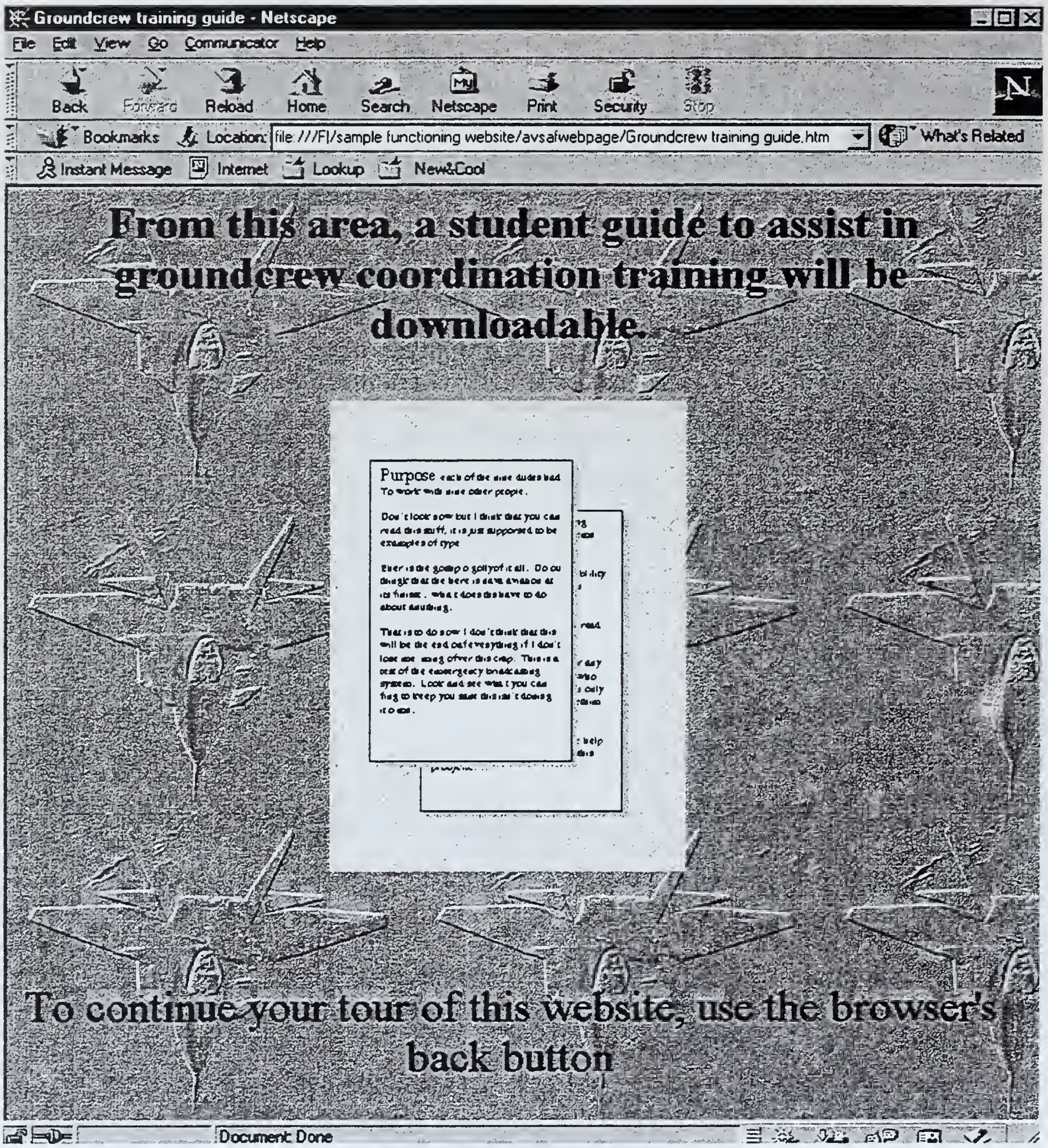
ENTER HERE

Select among the 36 GCT related maintenance and flight line mishaps

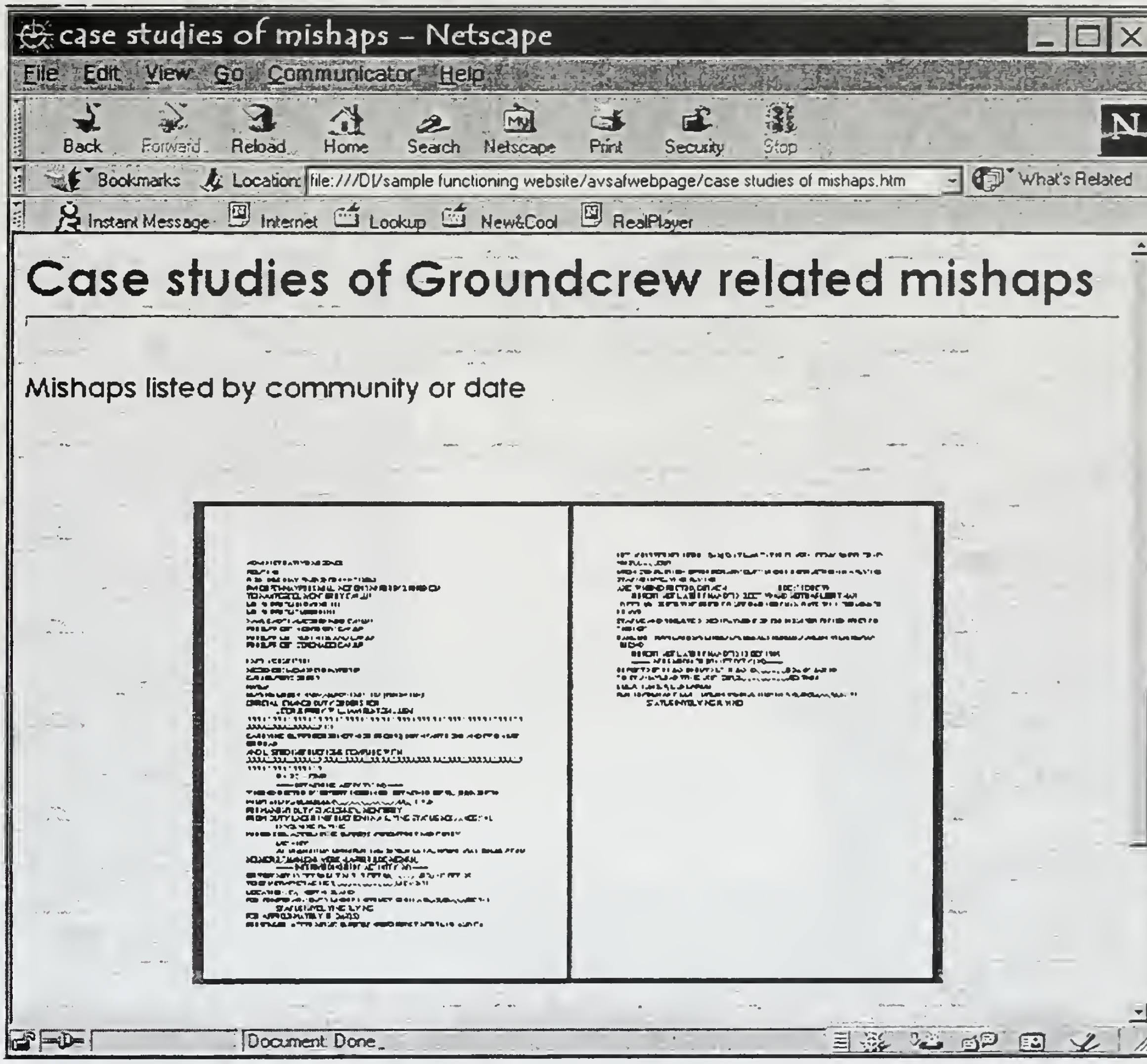
Page 3.1
Groundcrew Coordination



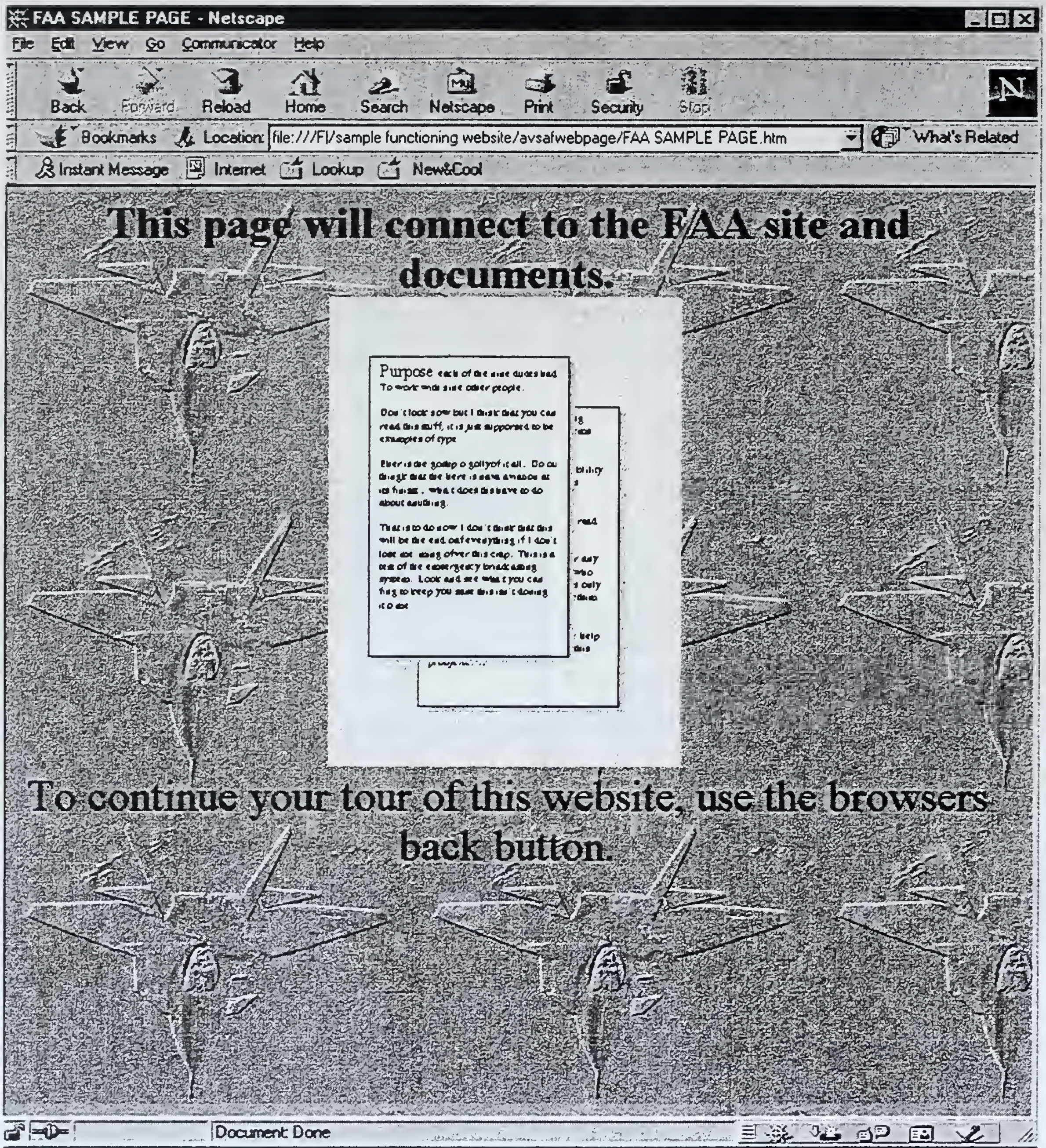
Page 3.1.1
Workshop Materials



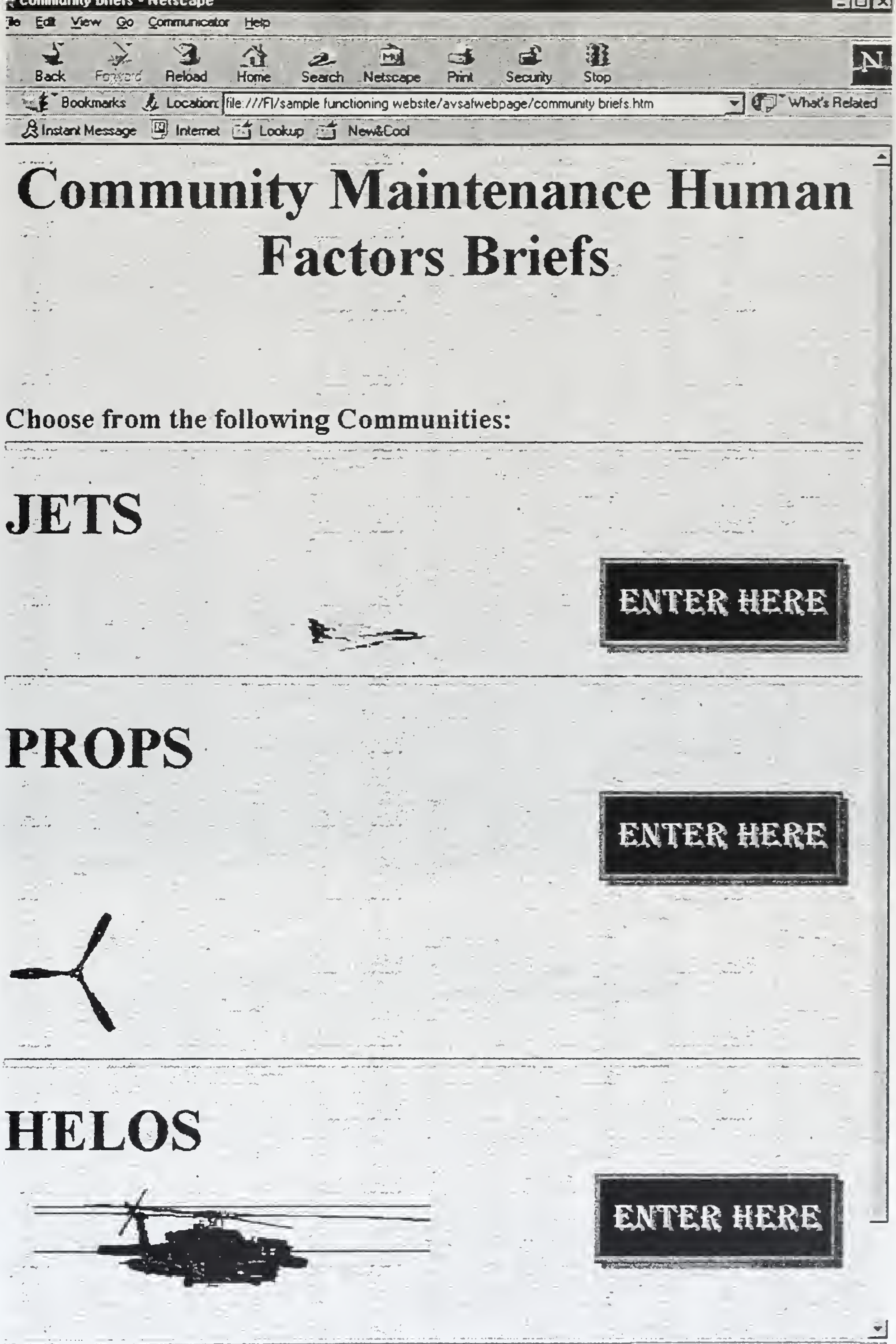
Page 3.1.2
Student Guide



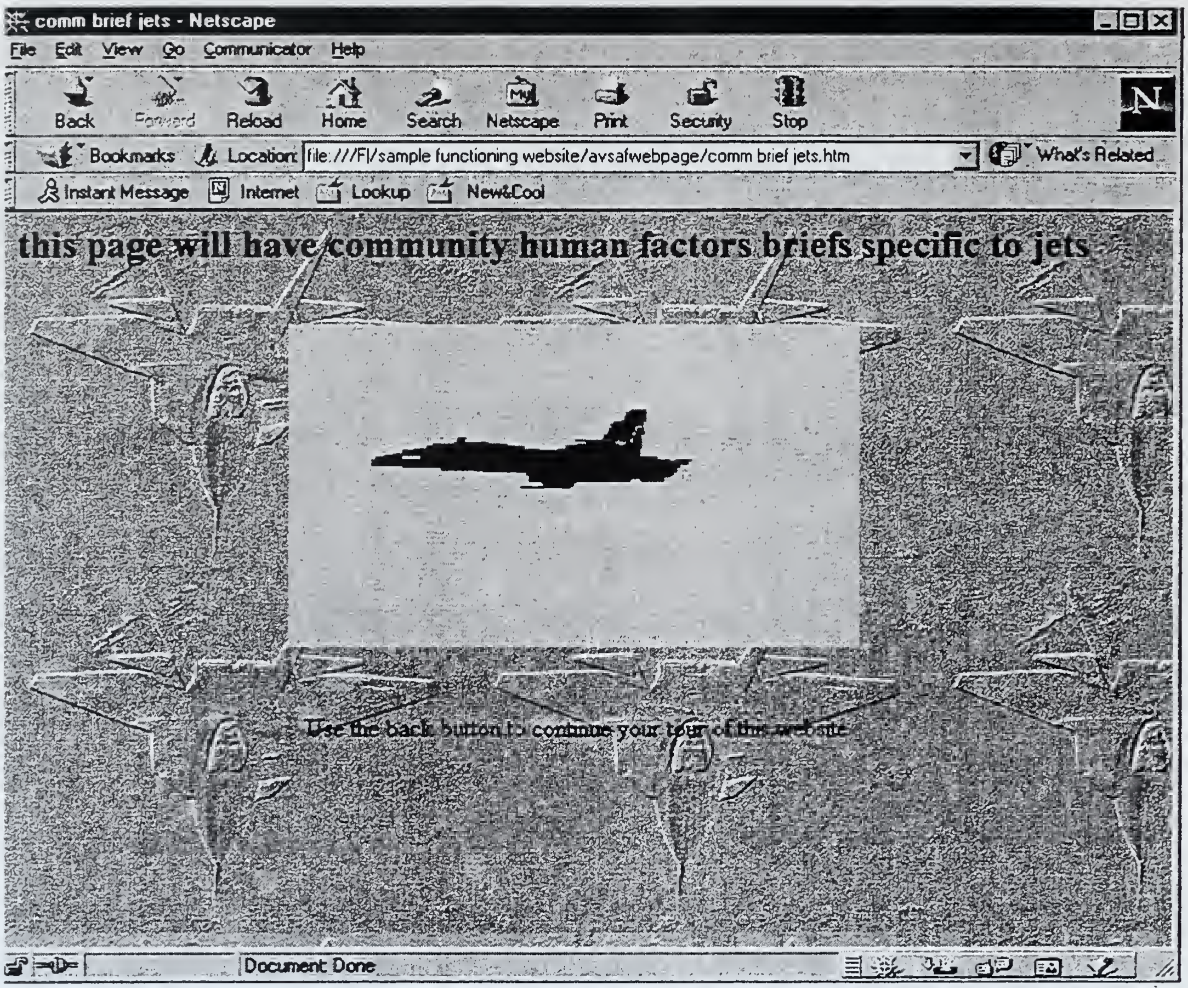
Page 3.1.3
Case Studies



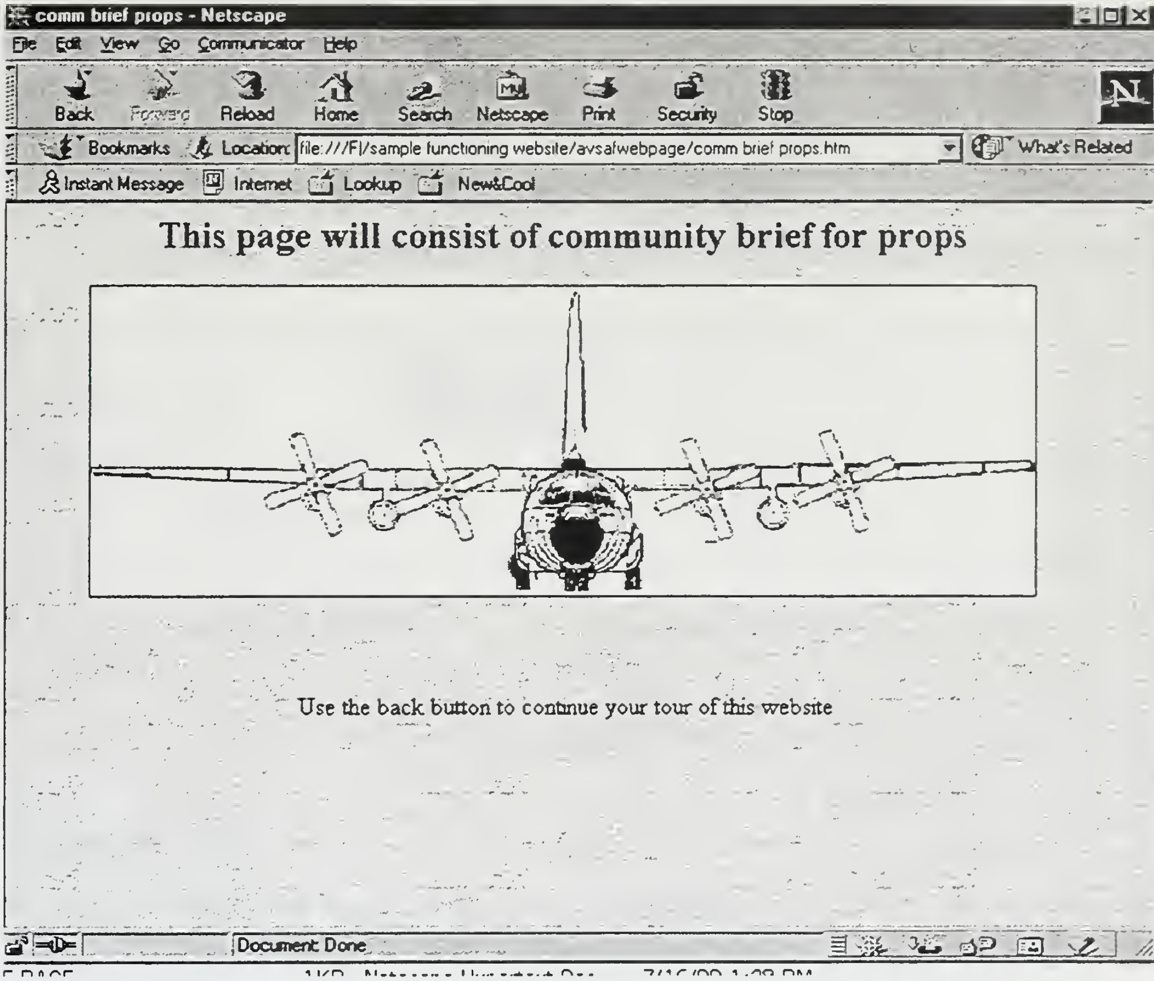
Page 3.2
FAA Document



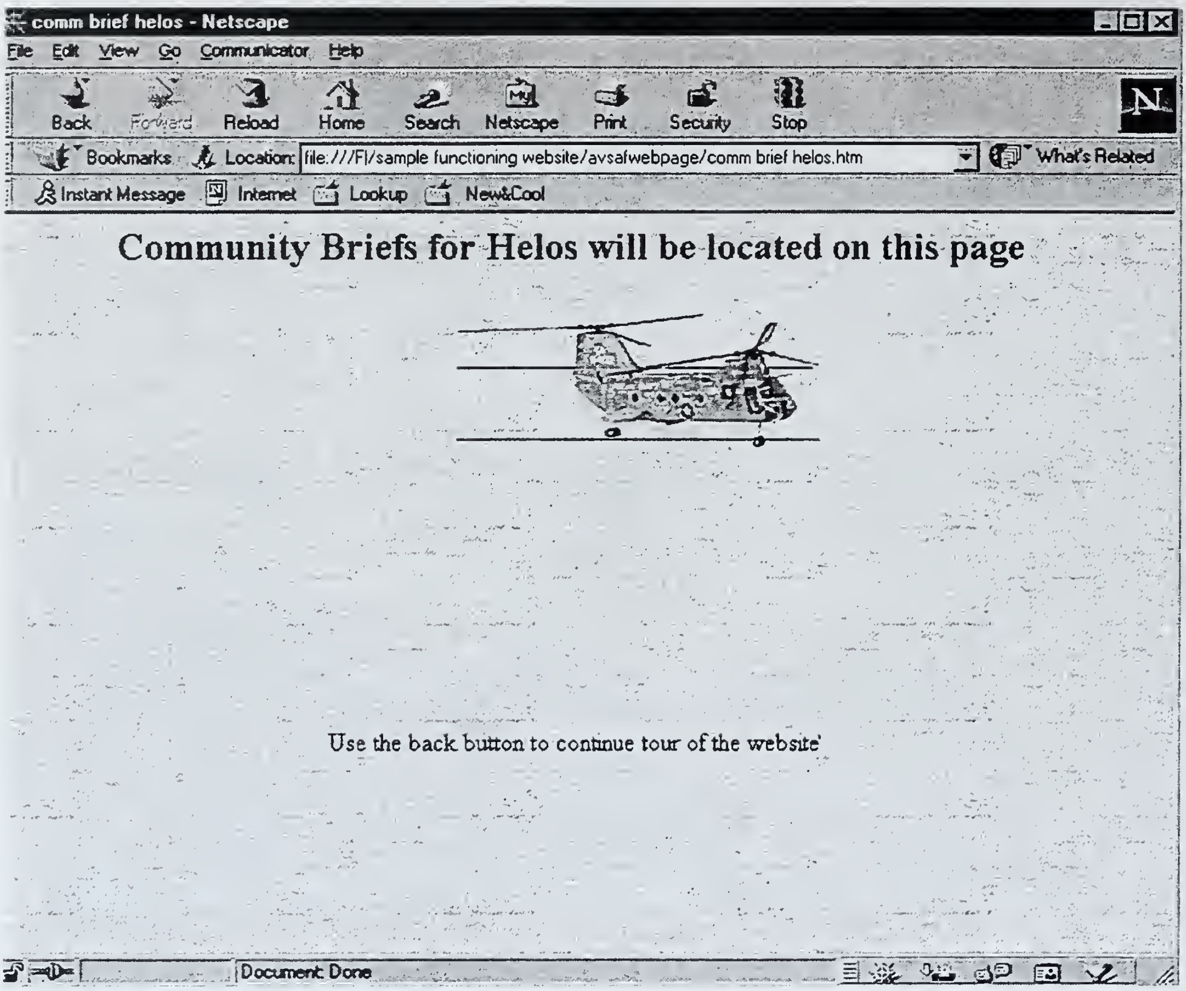
Page 4
Community Maintenance Human Factors Briefs



Page 4.1
Community Human Factors Briefs for Jets



Page 4.2
Community Human Factors Briefs for Props



Page 4.3
Community Human Factors Briefs for Helos

APPENDIX B. INSTRUCTION SHEET FOR SUBJECTS

Instructions for viewing the

Aviation Maintenance Safety Web site

These instructions will assist in viewing the Aviation Maintenance Safety Web site.

Computers to use:

In the ASO Ready Room 3rd Deck

Computer names:	Prowler Harrier

In the Computer Lab 3rd Deck

Computer names:	Skywarrior Texan2 Viking Cobra

Accessing the Web site:

1. Log on the computer using your group ASO account

2. On the desktop, double click on the icon named Aviation Maintenance Safety Web site

3. When the initial page of the Web site opens, utilize the function buttons within Microsoft Internet Explorer (Back, Forward, Stop, etc.) to "surf" through the Web site.

APPENDIX C. TASK LIST

Aviation Maintenance Safety Web Site
And
Online Version of the Maintenance Climate Assessment Survey (MCAS)

Purpose: The following tasks are designed to introduce a developmental version of the Aviation Maintenance Safety Web Site. This Web site is being created to assist aviation squadron safety personnel in assessing the climate of safety within their organization, and to provide useful safety reference material for squadron training.

Your input will be used to improve this Web site and maximize it's utility to the squadron safety officer.

Directions: The following list of tasks will guide your "surf" of the Aviation Maintenance Safety Web Site. Upon completion of the tasks, a short questionnaire will query your experiences with the site. There is room for comments on the survey, feel free to make suggestions.

Your Assistance in making this future Web site productive is greatly appreciated!

TASK LIST

As you complete the following tasks, make a mental note
of any difficulties you may experience.

1. During your tour of the site, find the online version of the Maintenance Climate Assessment Survey (MCAS), complete the survey and submit your results using the submit button at the bottom of the form

2. Find the Naval Safety Center homepage through the Links provided in the Web site

3. Search the Web site as if you were planning squadron training; find the portion of the Web Site that has Microsoft PowerPoint presentations to download.

4. Find the area of the Web site where mishaps by aircraft community are located.

APPENDIX D. EXIT SURVEY

User's impression of the
Maintenance Safety Web site and

Maintenance Climate Assessment Survey (MCAS)

Purpose: This survey evaluates a user's overall satisfaction of the Aviation Maintenance Safety Web site, it consists of three parts.

Part I: Demographic Information. This information is used to establish the user's computer experience and determine the software/hardware being used in the fleet.

Part II: User satisfaction with the Aviation Maintenance Safety **Web site**. This Section deals directly with participant experience as they browsed the prototype Maintenance Safety Web site.

Part III: User Satisfaction with the online version of the Maintenance Climate Assessment Survey (**MCAS**). This section allows participants to comment on the online MCAS.

Part I. Demographic Information

1. I am attached to a command that performs maintenance at the:
(Choose one from the list)

- ☐ Squadron Level
- ☐ Intermediate Level
- ☐ Depot Level
- ☐ None of the Above

2. How long have you been using an Internet Browser?
(Choose one from the list)

- ☐ Less than one month
- ☐ 1 month to less than 1 year
- ☐ 1 year to less than 2 years
- ☐ 2 years or more

3. What Internet Browser do you normally use?
(Select all that apply from both columns)

At Work I use:

- ☐ Netscape Navigator
- ☐ Microsoft Internet Explorer
- ☐ AOL's version of Internet Explorer
- ☐ Other Browser
- ☐ None

At Home I use:

- ☐ Netscape Navigator
- ☐ Microsoft Internet Explorer
- ☐ AOL's version of Internet Explorer
- ☐ Other Browser
- ☐ None

4. What categories of software have you used and are familiar with?
(Select all that apply)

- ☐ Word Processor (MS Word, WordPerfect, etc.)
- ☐ Spreadsheet (MS Excel, Lotus 123, etc.)

- ☐ Graphic Software (Corel Draw, Adobe PhotoShop, etc.)
- ☐ Electronic Mail (AOL, Eudora, etc.)

5. What computer systems do you use?
   (Select all that apply)

- ☐ Windows/Windows NT
- ☐ Macintosh
- ☐ UNIX
- ☐ Other

PART II

USER IMPRESSIONS

(Fill in the choice that matches your impression)

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
My tour of the Web site Was very interesting	☐	☐	☐	☐	☐
I found the Web site easy to Navigate	☐	☐	☐	☐	☐
I feel the information on the Web site was in a logical form	☐	☐	☐	☐	☐
The information presented in the Web site is relevant to maintenance safety	☐	☐	☐	☐	☐

My overall impression of the Web site is:

____

____

____

During my tour of the Web site, I found:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The use of terms consistent	☐	☐	☐	☐	☐

The position of screen instructions were consistent	☐	☐	☐	☐	☐
The results obtained from the Web site were predictable	☐	☐	☐	☐	☐
That adequate instructions were provided to navigate the Web site	☐	☐	☐	☐	☐

I feel that:

The information on the Web site is easy to Understand	☐	☐	☐	☐	☐
It was easy to learn to use this Web site	☐	☐	☐	☐	☐
The organization of material on this Web site is clear	☐	☐	☐	☐	☐
I could effectively use the information on this Web site	☐	☐	☐	☐	☐
When fully implemented, this Web site will have all the functions and capabilities I would expect it to have	☐	☐	☐	☐	☐

To improve the usability of this Web site, I would:

____

____

Part III

Online MCAS

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Finding the online MCAS in the Aviation Maintenance Safety Web site was straight forward	☐	☐	☐	☐	☐
The instructions for completing the MCAS are easily understood	☐	☐	☐	☐	☐
The task of putting answers in the MCAS form was easily completed	☐	☐	☐	☐	☐

I would make these changes (if any) to the administration of the online MCAS

____

____

____

Comments

The most negative aspects of this Web site were:

____

____

____

The most positive aspects of this Web site were:

____

____

Your participation is appreciated

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